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[Intervention Review]

Surgical interventions for treating extracapsular hip fractures in older adults: a network meta-analysis

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ABSTRACT

Background

Hip fractures are a major healthcare problem, presenting a challenge and burden to individuals and healthcare systems. The number of hip fractures globally is rising. The majority of extracapsular hip fractures are treated surgically.

Objectives

To assess the relative effects (benefits and harms) of all surgical treatments used in the management of extracapsular hip fractures in older adults, using a network meta-analysis of randomised trials, and to generate a hierarchy of interventions according to their outcomes.

Search methods

We searched CENTRAL, MEDLINE, Embase, Web of Science and five other databases in July 2020.

Selection criteria

We included randomised controlled trials (RCTs) and quasi-RCTs comparing different treatments for fragility extracapsular hip fractures in older adults. We included internal and external fixation, arthroplasties and non-operative treatment. We excluded studies of hip fractures with specific pathologies other than osteoporosis or resulting from high-energy trauma.

Data collection and analysis

Two review authors independently assessed studies for inclusion. One review author completed data extraction which was checked by a second review author. We collected data for three outcomes at different time points: mortality and health-related quality of life (HRQoL) - both reported within 4 months, at 12 months and after 24 months of surgery, and unplanned return to theatre (at end of study follow-up).

We performed a network meta-analysis (NMA) with Stata software, using frequentist methods, and calculated the differences between treatments using risk ratios (RRs) and standardised mean differences (SMDs) and their corresponding 95% confidence intervals (CIs). We also performed direct comparisons using the same codes.

Main results

We included 184 studies (160 RCTs and 24 quasi-RCTs) with 26,073 participants with 26,086 extracapsular hip fractures in the review. The mean age in most studies ranged from 60 to 93 years, and 69% were women.

After discussion with clinical experts, we selected nine nodes that represented the best balance between clinical plausibility and efficiency of the networks: fixed angle plate (dynamic and static), cephalomedullary nail (short and long), condylocephalic nail, external fixation, hemiarthroplasty, total hip arthroplasty (THA) and non-operative treatment. Seventy-three studies (with 11,126 participants) with data for at least two of these treatments contributed to the NMA.

We selected the dynamic fixed angle plate as a reference treatment against which other treatments were compared. This was a common treatment in the networks, providing a clinically appropriate comparison.

We downgraded the certainty of the evidence for serious and very serious risks of bias, and because some of the estimates included the possibility of transitivity owing to the proportion of stable and unstable fractures between treatment comparisons. We also downgraded if we noted evidence of inconsistency in direct or indirect estimates from which the network estimate was derived. Most estimates included the possibility of benefits and harms, and we downgraded the evidence for these treatments for imprecision.

Overall, 20.2% of participants who received the reference treatment had died by 12 months after surgery. We noted no evidence of any differences in mortality at this time point between the treatments compared. Effect estimates of all treatments included plausible benefits as well as harms. Short cephalomedullary nails had the narrowest confidence interval (CI), with 7 fewer deaths (26 fewer to 15 more) per 1000 participants, compared to the reference treatment (risk ratio (RR) 0.97, 95% CI 0.87 to 1.07). THA had the widest CI, with 62 fewer deaths (177 fewer to 610 more) per 1000 participants, compared to the reference treatment (RR 0.69, 95% CI 0.12 to 4.03). The certainty of the evidence for all treatments was low to very low. Although we ranked the treatments, this ranking should be interpreted cautiously because of the imprecision in all the network estimates for these treatments.

Overall, 4.3% of participants who received the reference treatment had unplanned return to theatre. Compared to this treatment, we found very low-certainty evidence that 58 more participants (14 to 137 more) per 1000 participants returned to theatre if they were treated with a static fixed angle plate (RR 2.48, 95% CI 1.36 to 4.50), and 91 more participants (37 to 182 more) per 1000 participants returned to theatre if treated with a condylocephalic nail (RR 3.33, 95% CI 1.95 to 5.68). We also found that these treatments were ranked as having the highest probability of unplanned return to theatre. In the remaining treatments, we noted no evidence of any differences in unplanned return to theatre, with effect estimates including benefits as well as harms. The certainty of the evidence for these other treatments ranged from low to very low.

We did not use GRADE to assess the certainty of the evidence for early mortality, but our findings were similar to those for 12-month mortality, with no evidence of any differences in treatments when compared to dynamic fixed angle plate. Very few studies reported HRQoL and we were unable to build networks from these studies and perform network meta-analysis.

Authors' conclusions

Across the networks, we found that there was considerable variability in the ranking of each treatment such that there was no one outstanding, or subset of outstanding, superior treatments. However, static implants such as condylocephalic nails and static fixed angle plates did yield a higher risk of unplanned return to theatre. We had insufficient evidence to determine the effects of any treatments on HRQoL, and this review includes data for only two outcomes. More detailed pairwise comparisons of some of the included treatments are reported in other Cochrane Reviews in this series. Short cephalomedullary nails versus dynamic fixed angle plates contributed the most evidence to each network, and our findings indicate that there may be no difference between these treatments. These data included people with both stable and unstable extracapsular fractures. At this time, there are too few studies to draw any conclusions regarding the benefits or harms of arthroplasty or external fixation for extracapsular fracture in older adults.

Future research could focus on the benefits and harms of arthroplasty interventions compared with internal fixation using a dynamic implant.

PLAIN LANGUAGE SUMMARY

Which are the best treatments for hip fractures in older adults?

Key messages

- There is no 'best treatment' for this type of broken hip.

- More people needed additional surgery on their broken hip after treatment with condylocephalic nails (where a nail is inserted upwards from the knee towards the hip joint) or static fixed angle plates (where pins or screws attach a plate to the broken bone).

- There may be no difference between a short cephalomedullary nail (where a nail is inserted downwards from the hip joint towards the knee) and a dynamic fixed angle plate (where the pins or screws attaching a plate to the broken bone are able to slide in a sleeve).

- We found too few studies to know whether any of these treatments were better at improving people's quality of life after surgery.

Hip fractures in older people

A hip fractures is a break at the top of the leg bone. There are two types of hip fractures; in this review, we included people with a break just outside the hip joint. The other type of hip fracture is a break just below the ball and socket joint - we reviewed these fractures in another review. Both types of broken hip are common in older adults whose bones may be fragile because of a condition called osteoporosis.

What are the treatments?

- Using metal implants to fix the broken parts of the bone. A nail is inserted inside the thigh bone. These long or short nails may be inserted downwards from the hip joint towards the knee (cephalomedullary nails). Some nails may be inserted upwards from the knee towards the hip joint (condylocephalic nail). Alternatively, the surgeon may use a 'fixed angle plate' which sits on the outer edge of the broken bone and is attached to the bone with screws or pins. Often the screws for these plates slide in a sleeve and the plate is called a dynamic fixed angle plate. Without this, it is a static fixed angle plate.

- Replacing the broken hip with an artificial one. This can be done using a hemiarthroplasty (HA), which replaces only the ball part of the joint, or with a total hip arthroplasty (THA) which replaces all of the hip joint including the socket.

- Using external fixation. Pins or screws are placed into the bones around the fracture and a metal frame holds these nails in place. The frame sits outside the body, around the broken hip.

- Treatment without an operation, usually requiring a period of rest in bed whilst the leg is held in position using traction with weights.

What did we do?

We searched for studies that compared one or more of these treatments. We wanted to find out the benefits and harms of these different treatments. We combined the findings from studies, and created a 'network' (which is used when researchers compare all available treatments in a single analysis called a 'network meta-analysis') to see if we could find out if some treatments were better than others.

What did we find?

We found 184 studies with 26,073 people who had this type of hip fracture. Most people were aged between 60 and 93 years, and 69% were women, which is usual for people with this type of broken bone. We included 73 of these studies in our 'network'.

We found little or no difference in how many people died with each treatment. We were not sure whether any of the treatments were better than another at reducing deaths within 12 months of surgery.

For most treatments, we also found little or no difference in whether people needed to have additional surgery on their broken hip. However, for the condylocephalic nail and the static fixed angle plate, more people needed additional surgery compared to people treated with a dynamic fixed angle plate. It seemed that these treatments increased the chance of needing additional surgery.

Very few studies reported whether or not people had better health-related quality of life after their treatment.

Are we confident in what we found?

We are not very confident in these findings because:

- most of the studies were not well reported. It is possible that their study methods could introduce errors in their results;

- we found some differences between some of the study results which we could not explain;

- we found some differences in the types of fractures in some studies;

- most treatments included the possibility of a benefit (for example, fewer deaths) as well as the possibility of a harm (for example, more deaths). This made the result very uncertain.

The true effects of these treatments might be very different to what we have found in this review.

How up to date is this review?

The evidence is up to date to July 2020.

Summary of findings 1. Certainty of the effects and network estimates for treating extracapsular hip fractures in older adults: mortality at 12 months

Certainty of the effects and network estimates for treating extracapsular hip fractures in older adults: mortality at 12 months

Patient or population: older adults (> 60 years of age) with extracapsular hip fractures

Intervention: static fixed angle plate, long cephalomedullary nail, short cephalomedullary nail, condylocephalic nail, external fixation, hemiarthroplasty, non-operative treatment, total hip arthroplasty

Comparison: dynamic fixed angle plate

Outcome: mortality at 12 months; range of follow-up time points from 5 months up to 24 months (in most studies, data were reported at 12 months)

Setting: in hospital

Total studies: 56 **Total participants: 8407**	**Relative effect (95% CI)**	**Anticipated absolute effect* (95% CI)**			**Certainty of the evidence**
		With comparison	**With intervention**	**Difference**	
Static fixed angle plate (5 studies; 847 participants)[a]	**RR** 1.02 (0.77 to 1.36)	201 per 1000	205 per 1000	4 per 1000 more (46 fewer to 72 more)	**Very low** Downgraded for risk of bias,[b,c] and imprecision[d]
Long cephalomedullary nail (2 studies; 400 participants)[a]	**RR** 1.27 (0.89 to 1.81)	201 per 1000	255 per 1000	54 per 1000 more (22 fewer to 162 more)	**Very low** Downgraded for risk of bias,[b,c] imprecision[d] and intransitivity[e]
Short cephalomedullary nail (33 studies; 5380 participants)[a]	**RR** 0.97 (0.87 to 1.07)	201 per 1000	194 per 1000	7 per 1000 fewer (26 fewer to 15 more)	**Very low** Downgraded for risk of bias[b,c] and imprecision[d]
Condylocephalic nail (6 studies; 847 participants)[a]	**RR** 0.93 (0.74 to 1.16)	201 per 1000	186 per 1000	15 per 1000 fewer (52 fewer to 32 more)	**Very low** Downgraded for risk of bias[b,c] and imprecision[d]
External fixation (1 study; 100 participants)[a]	**RR** 0.75 (0.36 to 1.57)	201 per 1000	150 per 1000	51 per 1000 fewer (130 fewer to 115 more)	**Low**

					Downgraded for risk of bias,[b] and imprecision[d]
Hemiarthroplasty (No direct evidence, indirect evidence only)	**RR** 1.36 (0.73 to 2.54)	201 per 1000	274 per 1000	73 per 1000 more (54 fewer to 309 more)	**Very low** Downgraded for risk of bias,[b,c] imprecision[d] andintransitivity[e]
Non-operative treatment (1 study; 106 participants)[a]	**RR** 1.00 (0.53 to 1.87)	201 per 1000	201 per 1000	0 per 1000 fewer (94 fewer to 175 more)	**Low** Downgraded for risk of bias[b] and imprecision[e]
Total hip arthroplasty (1 study; 156 participants)[a]	**RR** 0.69 (0.12 to 4.03)	201 per 1000	139 per 1000	62 per 1000 fewer (177 fewer to 610 more)	**Low** Downgraded for risk of bias[b] and imprecision[e]
Dynamic fixed angle plate	Reference comparator	-	-	-	Reference comparator

*Anticipated absolute effects compare two risks by calculating the difference between the risk with the intervention group and the risk with the comparison/control group (reference comparator).
CI: confidence interval; **NMA:** network meta-analysis; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: we are confident that the true estimate lies close to the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate. The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited. The true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate. The true effect is likely to be substantially different from the estimate of the effect.

[a]Network estimate derived from direct evidence and indirect evidence (number of studies and participants is for direct evidence contributing to the network estimate)
[b]Risk of bias: all studies in direct and indirect estimates had high risks of detection bias, as well as unclear risks of bias in at least one other domain (downgraded by one level)
[c]Risk of bias: studies in direct or indirect estimates (or both) had high risks of selection bias or 'other bias' (downgraded by one level)
[e]Imprecision: confidence interval in the network estimate included benefits as well as harms (downgraded by one level)
[e]Intransitivity: indirect estimates included variation in proportion of stable/unstable fractures and intransitivity may be evident (downgraded by one level)

Summary of findings 2. Certainty of the effects and network estimates for treating extracapsular hip fractures in older adults: unplanned return to theatre

Certainty of the effects and network estimates for treating extracapsular hip fractures in older adults: unplanned return to theatre

Patient or population: older adults (> 60 years of age) with extracapsular hip fractures

Intervention: static fixed angle plate, long cephalomedullary nail, short cephalomedullary nail, condylocephalic nail, external fixation, hemiarthroplasty

Comparison: dynamic fixed angle plate

Outcome: unplanned return to theatre: range of follow-up time points from 6 weeks up to 5 years (in most studies, data were reported at 12 months; with only one study at 5 years)

Setting: in hospital

Total studies: 55 **Total participants: 9296**	**Relative effect (95% CI)**	**Anticipated absolute effect* (95% CI)**			**Certainty of the evidence**
		With comparison	**With intervention**	**Difference**	
Static fixed angle plate (4 studies; 622 participants)[a]	**RR** 2.48 (1.36 to 4.50)	39 per 1000	97 per 1000	58 per 1000 more (14 more to 137 more)	**Very low** Downgraded for risk of bias[b,c] and inconsistency[d]
Long cephalomedullary nail (2 studies; 400 participants)[a]	**RR** 1.58 (0.55 to 4.56)	39 per 1000	62 per 1000	23 per 1000 more (18 fewer to 139 more)	**Very low** Downgraded for risk of bias,[b,c] inconsistency[d] and imprecision[e]
Short cephalomedullary nail (34 studies; 6437 participants)[a]	**RR** 1.12 (0.80 to 1.56)	39 per 1000	43 per 1000	4 per 1000 more (8 fewer to 22 more)	**Very low** Downgraded for risk of bias,[b,c] inconsistency[d] and imprecision[e]
Condylocephalic nail (7 studies; 996 participants)[a]	**RR** 3.33 (1.95 to 5.68)	39 per 1000	130 per 1000	91 per 1000 more (37 more to 182 more)	**Very low** Downgraded for risk of bias[b,c] and inconsistency[d]
External fixation (1 studies; 100 participants)[a]	**RR** 0.09 (0.00 to 1.87)	39 per 1000	4 per 1000	35 per 1000 fewer (39 fewer to 34 more)	**Low** Downgraded for risk of bias[b] and imprecision[e]
Hemiarthroplasty (No direct evidence, indirect evidence only)	**RR** 0.37 (0.01 to 10.26)	39 per 1000	14 per 1000	25 per 1000 fewer (38 fewer to 361 more)	**Very low** Downgraded for risk of bias,[b,c] inconsistency,[d] imprecision[e] and intransitivity[f]

Dynamic fixed angle plate	Reference comparator	-	-	-	Reference comparator

*Anticipated absolute effects compare two risks by calculating the difference between the risk with the intervention group and the risk with the comparison/control group (reference comparator).
CI: confidence interval; **NMA:** network meta-analysis; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: we are confident that the true estimate lies close to the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate. The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited. The true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate. The true effect is likely to be substantially different from the estimate of the effect.

[a]Network estimate derived from direct evidence and indirect evidence (number of studies and participants is for direct evidence contributing to the network estimate)
[b]Risk of bias: all studies in direct and indirect estimates had high risks of detection bias, as well as unclear risks of bias in at least one other domain (downgraded by one level)
[c]Risk of bias: studies in direct or indirect estimates (or both) had high risks of selection bias or 'other bias' (downgraded by one level)
[d]Inconsistency: evidence of statistical inconsistency in direct or indirect estimates, or both (downgraded by one level)
[e]Imprecision: confidence interval in the network estimate included benefits as well as harms (downgraded by one level)
[f]Intransitivity: indirect estimates included variation in proportion of stable/unstable fractures and intransitivity may be evident (downgraded by one level)

BACKGROUND

This review has been written in accordance with guidance for authors on preparing a protocol for a systematic review with multiple interventions (Chaimani 2017; CMIMG 2014).

Description of the condition

Epidemiology

A hip fracture, or proximal femoral fracture, is a break in the upper region of the femur (thigh bone) between the subcapital region (the area just under the femoral head) and 5 cm below the lesser trochanter (a bony projection of the upper femur). The incidence of hip fractures rises with age; they are most common in the older adult population (Court-Brown 2017; Kanis 2001). Those seen in younger adults are usually associated with poor bone health (Karantana 2011; Rogmark 2018). A very small proportion of fractures in younger people are caused by high-energy trauma such as road traffic collisions, industrial injuries and sports injuries. The overwhelming majority of hip fractures are fragility fractures associated with osteoporosis; such fractures are caused by mechanical forces that would not ordinarily result in fracture. The World Health Organization (WHO) has defined fragility fractures as those sustained from injuries equivalent to a fall from a standing height or less (Kanis 2001). In the UK, the mean age of a person with hip fracture is 83 years, and approximately two-thirds occur in women (NHFD 2017).

Hip fractures are a major healthcare problem at the individual and population level. They present a huge challenge and burden to individuals, healthcare systems and society. The increased proportion of older adults in the world population means that the absolute number of hip fractures is rising rapidly across the globe. For example, in 2016 there were 65,645 new presentations of hip fracture to 177 trauma units in England, Wales and Northern Ireland (NHFD 2017). Based on population estimates for these regions for mid-2016, this equates to an incidence rate of 109 cases per 100,000 population (ONS 2016). By 2050, it is estimated that the annual worldwide incidence of hip fracture will be 6 million (Cooper 2011; Johnell 2004). Incident hip fracture rates are higher in industrialised countries than in developing countries. Northern Europe and the USA have the highest rates of hip fracture, whereas Latin America and Africa have the lowest (Dhanwal 2011). European studies show that there are more hip fractures in the north of the region than in the south, and there is also a similar north-south gradient in the USA (Dhanwal 2011). Factors thought to be responsible for this variation are population demographics (with older populations in countries with higher incidence rates) and the influence of ethnicity, latitude and environmental factors such as socioeconomic deprivation (Bardsley 2013; Cooper 2011; Dhanwal 2011; Kanis 2012).

Burden of disease

Hip fractures are associated with a high risk of death. For example, in England, Wales and Northern Ireland, the 30-day mortality rate in 2016 remained high at 6.7%, despite a decline from 8.5% in 2011 and 7.1% in 2015 (NHFD 2017). The mortality rate one year after a hip fracture is approximately 30%; however, fewer than half of deaths are attributable to the fracture itself, which reflects the frailty of the patients and associated high prevalence of comorbidities and complications (Parker 1991; SIGN 2009). The impact of morbidity associated with hip fractures is similar to that of stroke, and entails a substantial loss of healthy life-years in older people (Griffin 2015). Hip fractures commonly result in reduced mobility and greater dependency, with many people failing to return to their pre-injury residence. In addition, the public health impact of hip fractures is significant: data from large prospective cohorts show the burden of disease due to hip fracture is 27 disability-adjusted life years (DALYs) per 1000 individuals, which equates to an average loss of 2.7% of the healthy life expectancy in the population at risk of fragility hip fracture (Papadimitriou 2017). The direct economic burden of hip fractures is also substantial. Hip fractures are amongst the most expensive conditions seen in hospitals; the aggregated cost for 316,000 inpatient episodes in the USA in 2011 was nearly USD 4.9 billion (USD 4900 million; Torio 2011). In England, Wales and Northern Ireland, people with hip fractures occupy 1.5 million hospital bed days each year, and cost the National Health Service and social care GBP 1 billion (GBP 1000 million; NHFD 2017). Combined health and social care costs incurred during the first year following a hip fracture have been estimated at USD 43,669, which is greater than the cost for non-communicable diseases such as acute coronary syndrome (USD 32,345) and ischaemic stroke (USD 34,772) (Williamson 2017). In established market economies, hip fractures represent 1.4% of the total healthcare burden (Johnell 2004).

Extracapsular hip fracture

Hip fractures either involve the region of the bone which is enveloped by the ligamentous hip joint capsule (intracapsular), or that outside the capsule (extracapsular). Extracapsular fractures traverse the femur within the area of bone bounded by the intertrochanteric line proximally, up to a distance of 5 cm from the distal part of the lesser trochanter. Several classification methods have been proposed to define different types of extracapsular fractures (AO Foundation 2018; Evans 1949; Jensen 1980). They are generally subdivided depending on their relationship to the greater and lesser trochanters (the two bony projections present at the upper end of the femur) and the complexity of the fracture configuration. It is increasingly clear that each of these classifications is limited in its generalisability since inter- and intra-observer agreement is poor. Table 1 provides a description of the most recent classification of trochanteric fractures (AO Foundation 2018). For this review, we use a pragmatic simplification of these classifications, as follows.

- Trochanteric fractures: those which lie mostly between the intertrochanteric line and a transverse line at the level of the lesser trochanter. These can be further divided into simple two-part stable fractures, and comminuted or reverse obliquity unstable fractures.
- Subtrochanteric fractures: those which mostly lie in the region bordered by the lesser trochanter and 5 cm distal to the lesser trochanter.

Approximately 40% of hip fractures are extracapsular, of which 90% are trochanteric and 10% are subtrochanteric (NHFD 2017).

Description of the intervention

Internationally, many guidelines exist concerning the management of hip fracture (e.g. AAOS 2014; Mak 2010; NICE 2011; SIGN 2009). Each recommend that early surgical management, generally within 24 to 48 hours, is the mainstay of care for the majority of hip fractures. The overall goal of surgery in the older population is

to facilitate early rehabilitation, which enables early mobilisation and the return to premorbid function while minimising the complication risk. This approach has been associated with reductions in mortality in many worldwide registries (Neufeld 2016; Sayers 2017).

Osteosynthesis

The most common surgical treatment for extracapsular fractures is osteosynthesis. A variety of internal fixation implants exist, including both extramedullary and intramedullary types. External fixation, where external bars traverse the fracture and are attached to the bones by threaded pins, has also been applied. A description and proposed grouping of interventions is given in Table 2. Although less common, arthroplasty is an option in the management of these fractures. Descriptions and a proposed grouping of arthroplasty interventions is provided in Table 3.

In general, the majority of fractures must be reduced prior to fixation. Typically, fragility fractures are reduced closed, under X-ray control using an image intensifier. However, if a fracture is irreducible using closed means, the fracture may be reduced open (exposed surgically to aid reduction). The reduced fracture is held by an implant passed across the fracture, or is bridged by an external fixator.

Extramedullary implants are those where a side plate is screwed to the lateral edge of the femur. They are grouped into static and dynamic designs. In static designs, the part of the implant that crosses the fracture is fixed in relation to the side plate; in dynamic designs, this can slide within the side plate, allowing collapse of the fracture along the axis of the femoral neck until the fracture is stable. There are also variable angles between the plate and the interfragmentary components of the system. In general, there are those which approximate a right angle, such as condylar screws and blade plates, and those which approximate the native angle of the femoral neck (approximately 130 degrees), such as the sliding hip screw.

Intramedullary implants are those which run along the internal course of the femur. They are grouped into cephalocondylic nails, which are advanced in an antegrade fashion into the femur, and condylocephalic nails, which are advanced retrograde. Retrograde nails, such as Ender nails, are passed from distal to proximal and a single implant traverses both the femoral canal and the fracture. Cephalomedullary nails, such as the Gamma or Proximal Femoral Nail (PFN), are passed from the tip of the greater trochanter or piriformis fossa into the medullary canal and subsequently an interfragmentary component is passed separately from the lateral femur through the centre of the nail and across the fracture. Cephalomedullary implants are grouped into short nails (where the tip of the nail ends in the region of the mid femur) and long nails (where the tip ends in the region of the distal metaphysis).

Arthroplasty

Arthroplasty entails replacing part or all of the hip joint with an endoprosthesis, an implant constructed of non-biological materials such as metal, ceramic or polyethylene. Arthroplasties can be grouped into two main categories: hemiarthroplasty (where only the femoral head and neck are replaced) and total hip arthroplasty (THA, also known as 'total hip replacement') (where both the femoral head and the acetabulum or socket are replaced).

Hemiarthroplasty

Hemiarthroplasty involves replacing the femoral head with a prosthesis whilst retaining the natural acetabulum and acetabular cartilage. Hemiarthroplasties can be broadly divided into two groups: unipolar and bipolar. In unipolar hemiarthroplasties, the femoral head is a solid block of metal. Bipolar femoral heads include a single articulation which allows movement to occur, not only between the acetabulum and the prosthesis, but also at this joint within the prosthesis itself.

The best-known of the early hemiarthroplasty designs are the Moore prosthesis (1952) and the FR Thompson Hip Prosthesis (1954). These are both monoblock implants and were designed before the development of poly(methyl methacrylate) bone cement; they were therefore originally inserted as a 'press fit'. The Moore prosthesis has a femoral stem, which is fenestrated (i.e. has holes or openings) and also has a square stem with a shoulder to enable stabilisation within the femur; this resists rotation within the femoral canal. This prosthesis is generally used without cement and, in the long term, bone in-growth into the fenestrations can occur. The Thompson prosthesis has a smaller stem without fenestrations and is now often used in conjunction with cement. Numerous other designs of unipolar hemiarthroplasties exist, based on stems that have been used for THAs.

In bipolar prostheses, there is an articulation within the femoral head component itself. In this type of prosthesis, there is a spherical inner metal head which measures between 22 and 36 millimetres in diameter. This fits into a polyethylene shell, which in turn is enclosed by a metal cap. The objective of the second joint is to reduce acetabular wear by promoting movement at the interprosthetic articulation rather than with the native acetabulum. There are a number of different types of prostheses with different stem designs. Examples of bipolar prostheses are the Charnley-Hastings, Bateman, Giliberty and the Monk prostheses, but many other types with different stem designs exist.

Total hip arthroplasty

THA involves the replacement of the acetabulum in addition to the femoral head. The first successful THA was developed by John Charnley, using metal alloy femoral heads articulating with polyethylene acetabular components. Subsequently, the articulating materials have diversified; designs using metal alloys, ceramics and various polyethylenes in various combinations have all been used.

Component fixation

Irrespective of the nature of the articulating surfaces, the components must be fixed to the bone to ensure longevity of the arthroplasty. The two approaches used to achieve this fixation are cemented and uncemented designs.

Cemented systems

In this approach, poly(methyl methacrylate) bone cement may be inserted at the time of surgery. It sets hard and acts as grout between the prosthesis and the implant at the time of surgery. Potential advantages of cement are a reduced risk of intraoperative fracture and later periprosthetic fracture, and that it does not rely on integration of the prosthesis with osteoporotic bone. Major side effects of cement are cardiac arrhythmias and cardiorespiratory collapse, which occasionally occur following its insertion. These

complications may be fatal, and are caused by either embolism from marrow contents forced into the circulation (Christie 1994), or a direct toxic effect of the cement.

Uncemented systems

Uncemented systems rely on osseous integration forming a direct mechanical linkage between the bone and the implant. A prosthesis may be coated with a substance such as hydroxyapatite, which promotes bone growth into the prosthesis. Alternatively, the surface of the prosthesis may be macroscopically and microscopically roughened so that bone grows onto the surface of the implant.

The complications of arthroplasty are those general to surgical management of hip fracture - for example, pneumonia, venous thromboembolism, infection, acute coronary syndrome and cerebrovascular accident - and those specific to arthroplasty, including dislocation of the prosthesis, loosening of the components, acetabular wear and periprosthetic fracture.

Non-operative management

Although the majority of extracapsular fractures are treated surgically, some people have non-operative or conservative treatment. In 2016, 0.6% of people with an extracapsular fracture in England and Wales did not receive surgical management (NHFD 2017). Conservative or non-operative management can consist of traction and may be of two types: skeletal traction (where traction is applied to the injured limb either via a pin inserted into the proximal tibia or distal femur) or skin traction (where adhesive tape or bandages are applied to the injured leg). Traction is then maintained, for a period of two to four months, by using 4 kg to 9 kg of weight. This ensures that the injured leg is immobilised whilst the fracture heals. Non-operative treatment may be acceptable where modern surgical facilities are unavailable, where low income or different systems of care preclude an individual's access to surgery, or in medically unfit people with an unacceptably high risk of perioperative death.

Why it is important to do this review

Currently, there are six independent Cochrane Reviews that have focused on specific interventions for extracapsular fracture (Parker 2000; Parker 2006; Parker 2009; Lewis 2022a; Parker 2013; Queally 2014). The findings of the reviews varied. Although the sliding hip screw (SHS) is widely used in practice, there is uncertainty about the beneficial effects of intramedullary implants or the most appropriate implant for the specific type of extracapsular fracture (Mak 2010). Moreover, the implant design of the intramedullary nail is evolving substantially and a body of evidence supporting its use in certain situations is building.

It is difficult to determine the most effective treatment option for extracapsular fractures from the results of conventional pairwise meta-analyses of direct evidence for three reasons:

- some pairs of treatments have not been directly compared in a randomised controlled trial;
- sometimes the direct evidence does not provide sufficient data and we need to support it with indirect evidence;
- there are frequently multiple overlapping comparisons that potentially give inconsistent estimates of effect.

A network meta-analysis (NMA) overcomes these problems by simultaneously synthesising direct and indirect evidence (comparisons of treatments that have not been tested in a randomised controlled trial). For each outcome, an NMA provides estimates of effect for all possible pairwise comparisons. This allows the ranking of the different interventions in order of effectiveness, and assessment of their relative effectiveness.

This Cochrane NMA has been developed in parallel with a sister NMA on surgical interventions for treating intracapsular hip fractures in older adults (Lewis 2022b).

OBJECTIVES

To assess the relative effects (benefits and harms) of all surgical treatments used in the management of extracapsular hip fractures in older adults, using a network meta-analysis of randomised trials, and to generate a hierarchy of interventions according to their outcomes.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) and quasi-RCTs assessing surgical interventions for the management of people with extracapsular hip fracture. Quasi-RCTs are defined as trials in which the methods of allocating people to a trial are not random, but are intended to produce similar groups when used to allocate participants (Cochrane 2018). Studies published as conference abstracts were eligible for inclusion in the review, provided sufficient data relating to the methods and outcomes of interest were reported. We also considered unpublished data for inclusion.

Types of participants

Population

The fundamental assumption underpinning a network meta-analysis is that of transitivity (Caldwell 2005; Cipriani 2013). This implies that the distribution of potential treatment effect modifiers is balanced across the available direct comparisons. Therefore, we assume that any individual who meets the inclusion criteria below is, in principle, equally able to have been randomised to any of the eligible interventions examined in this review; that is, they are 'jointly randomisable' (Salanti 2012).

We included older adults (at least 60 years of age) undergoing surgery in a hospital setting for a fragility extracapsular hip fracture. We included stable and unstable trochanteric fractures, and subtrochanteric fractures, which we expected to be caused by low-energy trauma.

As a benchmark, representative of the general hip fracture population, we expected trial populations to have a mean age of between 80 and 85 years and include 70% women, 30% with chronic cognitive impairment, and 50% with an American Society of Anesthesiologists (ASA) score greater than two (NHFD 2017; NICE 2011).

We excluded studies that focused exclusively on the treatment of participants younger than 16 years of age, participants with

fractures caused by specific pathologies other than osteoporosis, and participants with high-energy fractures. However, we took a pragmatic approach to study inclusion criteria and included studies with mixed populations (fragility and other mechanisms, ages or pathologies). We expected that the proportion of participants with standard fragility fractures was most likely to outnumber those with high-energy or local pathological fractures; therefore, the results will be generalisable to the fragility fracture population. If data were reported separately for standard fragility fractures, we planned to use this subgroup data in our main analysis. However, we excluded studies if we noted baseline characteristics indicated that participants were not representative of the general hip fracture population. We considered it unlikely that participants under 60 years of age would have experienced a fragility intracapsular hip fracture caused by low-energy trauma.

Types of interventions

We included trials comparing at least two of the competing interventions in the synthesis set. All the eligible interventions are assumed to be legitimate treatment alternatives for people with extracapsular fractures and therefore 'jointly randomisable'. We expected randomised groups to be similar with respect to co-interventions; for example, perioperative care, the use of intraoperative antibiotics or postoperative rehabilitation.

We included the following interventions.

- Any implant used for fixation of an extracapsular hip fracture.
- All hip endoprostheses: unipolar hemiarthroplasty (HA), bipolar HA, or total hip arthroplasty (THA) (small and large head) — applied with or without cement.
- Non-operative treatment, including treatment with or without traction.

Grouping interventions

We spoke to our clinical authors and the International Fragility Fracture Network in preparation for this review, to group possible interventions into homogenous therapeutic categories. We present these categories in Table 2 and Table 3. We updated these tables to include all interventions included within studies in this review. These interventions, or sufficiently similar variations of these interventions, are all potentially still in clinical use worldwide.

These categories formed the main nodes of the network. With our clinical authors, we explored differences within these nodes and made decisions on whether to group or split the nodes. This was guided by the data as well as considering the underlying assumptions (such as whether merging insufficiently similar interventions might violate transitivity).

We did not identify any unexpected interventions while searching for eligible studies. In this event, we had planned to consider these based on the context and whether they provided information to the network via a closed loop of treatment effects.

Types of outcome measures

We extracted data on the following critical outcomes.

- Mortality.
- Health-related quality of life (HRQoL): measured using recognised scores such as the Short Form 36 questionnaire (SF-36; Ware 1992) or EuroQol-5D (EQ-5D; Dolan 1997; EQ-5D).
- Unplanned return to theatre: secondary procedure required for a complication resulting directly or indirectly from the index operation/primary procedure.

We chose these outcomes by considering all relevant outcomes of benefit and harm, and also taking into account input from our stakeholder workshop (Sreekanta 2018).

Depending on the length of follow-up reported, we categorised the endpoints for mortality and HRQoL into early (up to and including four months), 12 months (prioritising 12-month data, but in its absence including data after four months and up to 24 months), and late (after 24 months) time points. We reported data at each of these time points for these two outcomes. For unplanned return to theatre, we extracted data at the end of study follow-up.

Search methods for identification of studies

As well as developing a strategy for this review, we developed general search strategies for the large bibliographic databases to find records to feed into a number of Cochrane Reviews and review updates on hip fracture surgery (Lewis 2021; Lewis 2022a; Lewis 2022b; Lewis 2022c). We searched the main databases up to July 2020.

Electronic searches

We identified RCTs and quasi-RCTs through literature searching with systematic and sensitive search strategies, as outlined in Chapter 4 of the *Cochrane Handbook of Systematic Reviews of Interventions* (Lefebvre 2019, hereafter referred to as the *Cochrane Handbook*). We applied no restrictions on language, date or publication status. We searched these databases for relevant trials:

- Cochrane Central Register of Controlled Trials (CENTRAL; CRS Web; 8 July 2020);
- MEDLINE (Ovid; 1946 to 6 July 2020);
- Embase (Ovid; 1980 to 7 July 2020);
- Web of Science (SCI EXPANDED; 1900 to 8 July 2020);
- Cochrane Database of Systematic Reviews (CDSR; Cochrane Library; 7 July 2020);
- Database of Abstracts of Reviews of Effects (DARE; www.crd.york.ac.uk/CRDWeb/; 17 December 2018);
- Health Technology Assessment (HTA) database (www.crd.york.ac.uk/CRDWeb/; 17 December 2018);
- Epistemonikos (www.epistemonikos.org/; 9 July 2020);
- ProQuest Dissertations and Theses (www.proquest.com/; 1743 to 8 July 2020);
- National Technical Information Service (NTIS, for technical reports; www.ntis.gov/; 10 July 2020).

We developed a subject-specific search strategy in MEDLINE and other listed databases. We adapted strategies with consideration of database interface differences as well as different indexing languages. In MEDLINE, we used the sensitivity-maximising version of the Cochrane Highly Sensitive Search Strategy for identifying randomised trials (Lefebvre 2019). In Embase, we used the Cochrane Embase filter (www.cochranelibrary.com/central/central-creation) to focus on RCTs. The initial search was run in

November 2018 and December 2018, and a top-up search was run in July 2020 in all databases except for DARE and HTA, in which no new records have been added since the initial search. At the time of the search, CENTRAL was fully up-to-date with all records from the Cochrane Bone, Joint, and Muscle Trauma (BJMT) Group's Specialised Register, and so it was unnecessary to search this register separately. We developed the search strategy in consultation with Information Specialists (see Acknowledgements) and the Information Specialist for the BJMT Group. Search strategies can be found in Appendix 1.

We scanned ClinicalTrials.gov (www.clinicaltrials.gov/) for ongoing and unpublished trials on 10 July 2020.

Searching other resources

We handsearched abstracts from the following conferences from 2016 to November 2018.

- Fragility Fractures Network Congress.
- British Orthopaedic Association Congress.
- Orthopaedic World Congress (SICOT).
- Orthopaedic Trauma Association Annual Meeting.
- Bone and Joint Journal Orthopaedic Proceedings.
- American Academy of Orthopaedic Surgeons Annual Meeting.

Data collection and analysis

In order to reduce bias, we ensured that any review author who is also a co-applicant on the Cochrane Programme Grant on the management of hip fracture, a study author, or who has or has had an advisory role on any potentially relevant study, remained independent of study selection decisions, risk of bias assessment and data extraction for their study.

Selection of studies

Two review authors screened titles and abstracts of all the retrieved bibliographic records in a web-based systematic reviewing platform, Rayyan (Ouzzani 2016), and in the top-up search using Covidence. We retrieved the full texts of all potentially eligible records passing the title and abstract screening. Two review authors independently examined the full texts, using the eligibility criteria mentioned in Criteria for considering studies for this review. Full-text screening was conducted using Covidence. We resolved disagreements through discussion or adjudication by a third review author. We excluded duplicates and we collated multiple reports of the same study so that each study, rather than each report, was the unit of interest in the review. We prepared a PRISMA flow-diagram to outline the study selection process, numbers of records at each stage of selection, and reasons for exclusions of full-text articles (Moher 2009). In the review, we reported details of key excluded studies, rather than all studies that were excluded from consideration of full-text articles.

Data extraction and management

All review authors conferred on the essential data for extraction, and we structured a form to align with default headings in the Characteristics of included studies (see Appendix 2). Two review authors piloted the form on five studies and compared results. We then made changes to the template following additional discussion with the author team. For the remaining data extraction, one review author independently extracted data and a second review author checked all the data for accuracy. We extracted the following data.

- Study methodology: publication type; sponsorship/funding/notable conflicts of interest of trial authors; study design; number of centres and locations; size and type of setting; study inclusion and exclusion criteria; randomisation method; number of randomised participants, losses (and reasons for losses), and number analysed for each outcome. (Collecting information relating to the participant flow helped the assessment of risk of attrition bias.)
- Population: baseline characteristics of the participants, by group and overall (age, gender, smoking history, medication, body mass index (BMI), comorbidities, functional status such as previous mobility, place of residence before fracture, cognitive status, American Society of Anesthesiologists (ASA) status, fracture type and stability). This included data on the clinical and methodological variables that can act as effect modifiers across treatment comparisons. For intracapsular hip fractures, these have been identified as age, gender, baseline comorbidity, fracture displacement and cognitive status.
- Interventions: details of each intervention (number and type, manufacturer details); general surgical details (number of clinicians and their skills and experience, perioperative care such as use of prophylactic antibiotics or antithromboembolics, mobilisation or weight-bearing protocols).
- Outcomes: all outcomes measured or reported by study authors; outcomes relevant to the review (to include measurement tools and time points of measure); extraction of outcome data into data and analysis tables in Review Manager 2014.

We extracted this data in accordance with recommendations in the DECiMAL (Data Extraction for Complex Meta-Analysis) guide developed by Pedder and colleagues, which optimises data extraction for NMAs (Pedder 2016).

Assessment of risk of bias in included studies

One review author independently assessed risk of bias in the included studies using the Cochrane risk of bias tool (Higgins 2011a). A second author checked these decisions and a final judgement was made through discussion, if required. We assessed the following domains.

- Sequence generation (selection bias).
- Allocation concealment (selection bias).
- Blinding of participants, personnel (performance bias).
- Blinding of outcome assessors (detection bias).
- Incomplete outcome data (attrition bias).
- Selective reporting (reporting bias).
- Other risks of bias.

In addition, we also considered performance bias related to the experience of the clinicians (whether clinicians were equally experienced with the implants used in the study). We considered risk of detection bias separately for: subjective outcomes measured by clinicians, objective outcomes measured by clinicians, and participant-reported outcomes (e.g. pain and HRQoL). For each domain, two review authors judged whether study authors made sufficient attempts to minimise bias in their design. For each domain, we made judgements using three measures - high, low or

unclear risk of bias - and we recorded these judgements in risk of bias tables.

Measures of treatment effect

Summary measures

At each data point, we extracted either:

- mean or mean change from the baseline and standard deviations (SDs) per arm, or the information from which SDs could be derived, such as standard error or confidence interval (CI) for continuous outcomes;
- number of events per arm.

If a trial presented outcomes at more than one time point, we extracted data for all relevant time points. We included three time points in the review for mortality and HRQoL: 'early' (up to and including four months), 12 months (prioritising 12-month data, but in its absence including data after four months and up to 24 months), and 'late' (after 24 months).

Relative treatment effects

Studies reported HRQoL using different measurement tools and we therefore pooled data using standardised mean difference (SMD) (Hedges' adjusted g). We entered data presented as a scale with a consistent direction of effect across studies. For interpretation, we re-expressed the SMD in the measurement scale most commonly used in the estimate and used a minimal clinically important difference (MCID) for the selected measurement scale (Schünemann 2019).

For dichotomous outcomes, we reported the risk ratio (RR) and 95% CI. Results from NMA are presented as summary relative effect sizes - SMDs and risk ratio (RR) - for each possible pair of treatments.

Relative treatment ranking

We obtained a treatment hierarchy using the surface under the cumulative ranking curve (SUCRA), which is used to evaluate superiority of different treatments (Konig 2013; Mavridis 2015; Rucker 2015; Salanti 2008b; Salanti 2011; Salanti 2012). We prepared these for outcomes with sufficient data to form a network (early mortality, 12-month mortality, and unplanned return to theatre). Generally, a larger SUCRA means a more effective intervention. We expressed SUCRA as a proportion (0 to 1.0). The higher the SUCRA value, the more likely the outcome of the respective treatment would be ranked first, or at least near the top of the rankings. Computations for SUCRA values were implemented in Stata (Stata) using the command 'sucra' (Chaimani 2013; Rucker 2015; Salanti 2011). We also calculated the estimated proportion of times each intervention would be ranked in each order position (from best to worst treatment) and from this, we presented an estimated mean rank for each intervention for each outcome in a network.

Unit of analysis issues

Alternative trial designs

We did not encounter any within-person randomised trials or cluster-randomised trials.

Reports of outcomes at different time points

When preparing the review, we found that outcomes were reported at a wider range of 'late' time points than we had anticipated. Following discussion with our clinical authors, we grouped these into three time points; we maintained an early time point (up to four months after surgery) and adopted two later time points - one that prioritised data at 12 months (between four months and 24 months), and a final time point later than 24 months after surgery (which included final study follow-up) (see Differences between protocol and review).

Studies with multiple treatment groups

We included multi-armed trials and accounted for the correlation between the effect sizes in the network meta-analysis. We followed guidance provided in the *Cochrane Handbook* on dealing with multiple groups from one study (Higgins 2011b), and NMA (Higgins 2011c).

We assumed that studies of different comparisons were similar in all ways apart from the interventions being compared.

Dealing with missing data

For each included study, we recorded the number of participant losses for each outcome. Unless reported otherwise, we assumed complete case data for mortality and unplanned return to theatre. For outcomes that required participant assessment at end of follow-up (i.e. HRQoL), we prioritised intention-to-treat (ITT) data where these data were available. If ITT data were unavailable for these outcomes, and if study authors did not clearly report denominator figures for each group for the outcome, we reduced the denominator figure in each group to account for reported mortality. We did not impute missing data. We used the risk of bias tool to judge attrition bias. We judged studies to be at high risk of attrition bias if we noted large amounts of unexplained missing data, loss that could not be easily justified in the study population, or losses that were not sufficiently balanced between intervention groups.

Assessment of heterogeneity

Assessment of clinical and methodological heterogeneity within treatment comparisons

We assessed clinical and methodological diversity in terms of participants, interventions, outcomes and study characteristics for the included studies to determine whether a meta-analysis was appropriate. We conducted this assessment by generating the descriptive statistics for trial and study population characteristics across all eligible trials that compared each pair of interventions, and observing these data from the data extraction tables.

Assumptions when estimating the heterogeneity

The network model allows for heterogeneity between studies within trial design by incorporating a study-specific random effect. Standard pairwise meta-analyses estimate different heterogeneity variances for each pairwise comparison. In NMAs, we assumed a common estimate for the heterogeneity variance across the different comparisons.

Measures and tests for heterogeneity

Pairwise comparisons

We assessed statistical heterogeneity within each pairwise comparison by visual inspection of the forest plots to detect any large differences of intervention effects across included studies. If the studies are estimating the same intervention effect, there should be overlap between the CIs for each effect estimate on the forest plot. However, if overlap is poor, or there are outliers, then statistical heterogeneity may be likely.

We used Stata to perform pairwise meta-analysis (Stata). We produced the Chi^2 statistic, which is the test for heterogeneity, and the I^2 statistic, which is the test used to quantify heterogeneity and which calculates the proportion of variation due to heterogeneity rather than due to chance. A P value less than 0.10 was considered to be indicative of statistical heterogeneity; in the review, we refer to this as statistical inconsistency.

The I^2 value ranges from 0% to 100%, with higher values indicating greater heterogeneity. As recommended in the *Cochrane Handbook*, an I^2 value of 0% to 40% may be interpreted as "might not be important"; 30% to 60% as "may represent moderate heterogeneity"; 50% to 90% as "may represent substantial heterogeneity"; and 75% to 100% as "considerable heterogeneity" (Deeks 2019).

Entire network

The assessment of statistical heterogeneity in the entire network was based on the magnitude of the heterogeneity variance parameter ($\tau 2$) estimated from the NMA models (Jackson 2014). For dichotomous outcomes, the magnitude of the heterogeneity variance was compared with the empirical distribution, as derived by Turner (Turner 2012). For continuous outcomes where an SMD was used to summarise effect, we planned to use the same approach using the empirical distribution produced by Rhodes (Rhodes 2015). However, because no corresponding NMA models were carried out, this could not be done.

Assessment of statistical incoherence

We evaluated the statistical incoherence — which is the statistical disagreement between direct estimates (from direct comparisons of treatment) and indirect estimates (derived from the network comparisons) — by both local and global approaches, as follows (Chaimani 2017; Donegan 2013).

Global approaches for evaluating incoherence

To check the assumption of coherence in the entire network, we used the 'design-by-treatment interaction' model (Higgins 2012; White 2012). This method accounts for different sources of incoherence that can occur when studies with different designs (two-armed trials versus three-armed trials) give different results, as well as disagreement between direct and indirect evidence. Using this approach, we inferred the presence of incoherence from any source in the entire network based on a Chi^2 test. The design-by-treatment model was performed in Stata, using the network command (Stata). We presented the results of this overall approach graphically in a forest plot using the network forest command in Stata (Stata).

Local approaches for evaluating incoherence

We evaluated the incoherence between direct and indirect comparisons using a statistical approach referred to as 'node splitting', conducted with the 'sidesplit' command in Stata, when a closed triangle or quadratic loop connecting no less than three arms existed (Dias 2010).

Investigation of heterogeneity

If we found important heterogeneity (inconsistency or incoherence, or both) across treatment comparisons, we planned to explore the possible sources. For extracapsular hip fractures, the effect modifiers have been identified as:

- age;
- gender;
- baseline comorbidity index;
- baseline functional status;
- cognitive status;
- fracture type; and
- fracture stability.

However, there was insufficient variation between studies and a lack of reporting by subgroups for many of these effect modifiers within studies. When data were sufficient (such as for gender or fracture stability), we had insufficient studies within nodes to explore these effects practically.

Assessment of transitivity across treatment comparisons

We assessed the assumption of transitivity by comparing the distribution of the potential effect modifiers (such as stable and unstable fractures) across the different pairwise comparisons to ensure that they were, on average, balanced. We assessed control groups for their similarity across treatment comparisons.

Geometry of the network

Different eligibility criteria for interventions will result in different collections of evidence in the synthesis, and because of the inter-relationships across direct and indirect evidence, this can lead to different effect estimates and relative rankings. We provided a qualitative description of network geometry accompanied by a network diagram of all competing interventions. The diagram gives a comprehensive definition of the nodes in the network and gives an indication of the volume of evidence within each comparison. It also gives a visual representation of the possible comparisons where any two modalities are compared.

We evaluated the quantitative metrics by assessing features of network geometry: the size of the nodes reflects the amount of evidence accumulated for each treatment (total number of participants) and the breadth of each edge is proportional to the inverse of the variance of the summary effect of each direct treatment comparison (Salanti 2008a). To understand which are the most influential comparisons in the network, and how direct and indirect evidence influences the final summary data, we used a contribution matrix that describes the percentage contribution of each direct meta-analysis to the entire body of evidence (Chaimani 2015).

Presentation of results

We presented the following in our review, based on Salanti 2011.

- A network diagram.
- Direct pairwise results and assessment of between-study heterogeneity.
- Direct (the observed data), indirect and combined network estimates - each reported in a single triangle table.
- Treatment rankings.
- Summary of findings tables for the primary networks accompanied by a forest plot of treatment effects.

Assessment of reporting biases

Standard systematic reviews consider the impact of possible reporting biases and small-study effects (e.g. funnel plots and Egger's test). These approaches have been extended for NMAs and we explored possible reporting biases when more than 10 relevant studies were available (early mortality, 12-month mortality, and unplanned return to theatre). We produced comparison-adjusted plots using the 'netfunnel' command in Stata to investigate any relationship between effect estimates and study size or precision (Chaimani 2012; Chaimani 2013). For the comparison-adjusted funnel plot, we ordered interventions from the oldest to newest treatments in the entire evidence base, using date of publication as a proxy for old to new. We anticipated that published small trials may tend to be biased in the direction of new treatments.

Data synthesis

Methods for direct treatment comparisons

Initially, for every treatment comparison with at least two studies, we planned to perform standard pairwise meta-analyses using a random-effects model in Stata (Stata; White 2015); we considered this for all outcomes at each available time point. If any problems were evident with convergence, we planned to re-analyse the data using a fixed-effect model (White 2015). See Assessment of heterogeneity.

Methods for indirect and mixed comparisons

For each pairwise comparison, we synthesised data to obtain summary SMDs for continuous outcomes or risk ratios for dichotomous outcomes. Because the collected studies appeared to be sufficiently similar with respect to the distribution of effect modifiers, we conducted a random-effects NMA to synthesise all evidence for each outcome and obtain a comprehensive ranking of all treatments. We performed our NMA with contrast-level data by running the consistency and inconsistency (design-by-treatment interaction) models, using multivariate meta-analysis approaches within the frequentist framework (White 2015). We used the network suite of Stata commands (Stata).

Subgroup analysis and investigation of heterogeneity

Although we planned to subgroup the data according to fracture type, we found limited variation in trochanteric and subtrochanteric fractures across most studies and therefore did not conduct subgroup analysis.

Sensitivity analysis

We did not conduct sensitivity analysis on the network estimates. See Differences between protocol and review.

Summary of findings and assessment of the certainty of the evidence

Credibility of the evidence

We used the GRADE approach to assess the certainty of the evidence for each outcome of interest in each paired comparison for which there is direct evidence (i.e. where two interventions have been compared in randomised trials). The GRADE system classifies evidence as 'high', 'moderate', 'low', or 'very low' certainty. The starting point for certainty in estimates for randomised trials is high, but for direct comparisons may be rated down based on limitations concerning risk of bias, imprecision, inconsistency, indirectness and publication bias (Guyatt 2008). We presented our GRADE assessments in a summary of findings table.

We also used the GRADE approach to assess the certainty in indirect and network (mixed) effect estimates (Brignardello-Petersen 2018a; Puhan 2014). Using the 'node splitting' method, we calculated indirect effect estimates from the available 'loops' of evidence, including loops with a single common comparator (first order) or more than one intervening treatment (higher order) connecting the two interventions of the comparison of interest. To assess the certainty in evidence for each indirect comparison, we focused on the dominant first-order loop (i.e. the first-order loop that contributes most to the indirect estimate). The certainty-of-evidence rating for indirect comparisons was the lower of the ratings of certainty for the two direct estimates contributing to the dominant first-order loop. For instance, if one of the direct comparisons was rated as low-certainty evidence and the other was rated as moderate-certainty evidence, we rated the certainty of indirect evidence as low.

For ratings of certainty for indirect comparisons, we also considered downgrading the certainty for intransitivity (Brignardello-Petersen 2018a; Puhan 2014). The transitivity assumption implies similarity of the bodies of evidence (for instance, the trials assessing A versus C and B versus C informing a comparison of A versus B) informing indirect comparisons in terms of population, intervention, outcomes, settings and trial methodology (Salanti 2008b).

If both direct and indirect evidence are available and yield similar results, the NMA mixed-estimate certainty rating comes from the higher certainty of the two that contribute substantially to the pooled estimate. If the direct and indirect estimates show important differences (incoherence) — addressed by the difference in point estimates, the extent of overlap of CIs, and a statistical test of incoherence — we considered further downgrading the certainty assessment of the mixed NMA effect (Brignardello-Petersen 2018b).

Summary of findings tables

Typically, a summary of findings table presents the GRADE ratings, along with the intervention effects for the most important outcomes of the systematic review. In NMA, the comparison of multiple interventions is the main feature of the network and is likely to drive the structure of the tables. We followed the guidance for producing summary of findings tables for NMAs as outlined in Chapter 11 of the *Cochrane Handbook* (Chaimani 2018). Choosing the outcomes that yielded the most data, we produced a separate table for two outcomes in the review:

- mortality at 12 months; and

- unplanned return to the theatre at end of follow-up.

All interventions were of direct interest to our main conclusions and were included in the summary of findings tables. We selected a reference comparator against which all other treatments were compared, and we reported relative effect estimates, baseline risk information, certainty of the evidence for the NMA, judgements for downgrading the body of the evidence, and text with definitions of NMA aspects (e.g. absolute effects) (Yepes-Nuñez 2019).

RESULTS

Description of studies

See Characteristics of included studies, Characteristics of excluded studies, Characteristics of studies awaiting classification and Characteristics of ongoing studies.

Results of the search

After removal of duplicates from the search results, we screened 28,510 titles and abstracts, which included backward-citation searches and searches of clinical trials registers. We reviewed the full texts of 1028 reports and selected 184 studies (with 269 records) for inclusion in this review. We excluded 725 records, and report the details of 21 key studies from these excluded records. Twelve studies are awaiting classification and we identified 20 ongoing studies. See Figure 1.

Figure 1. Study flow diagram

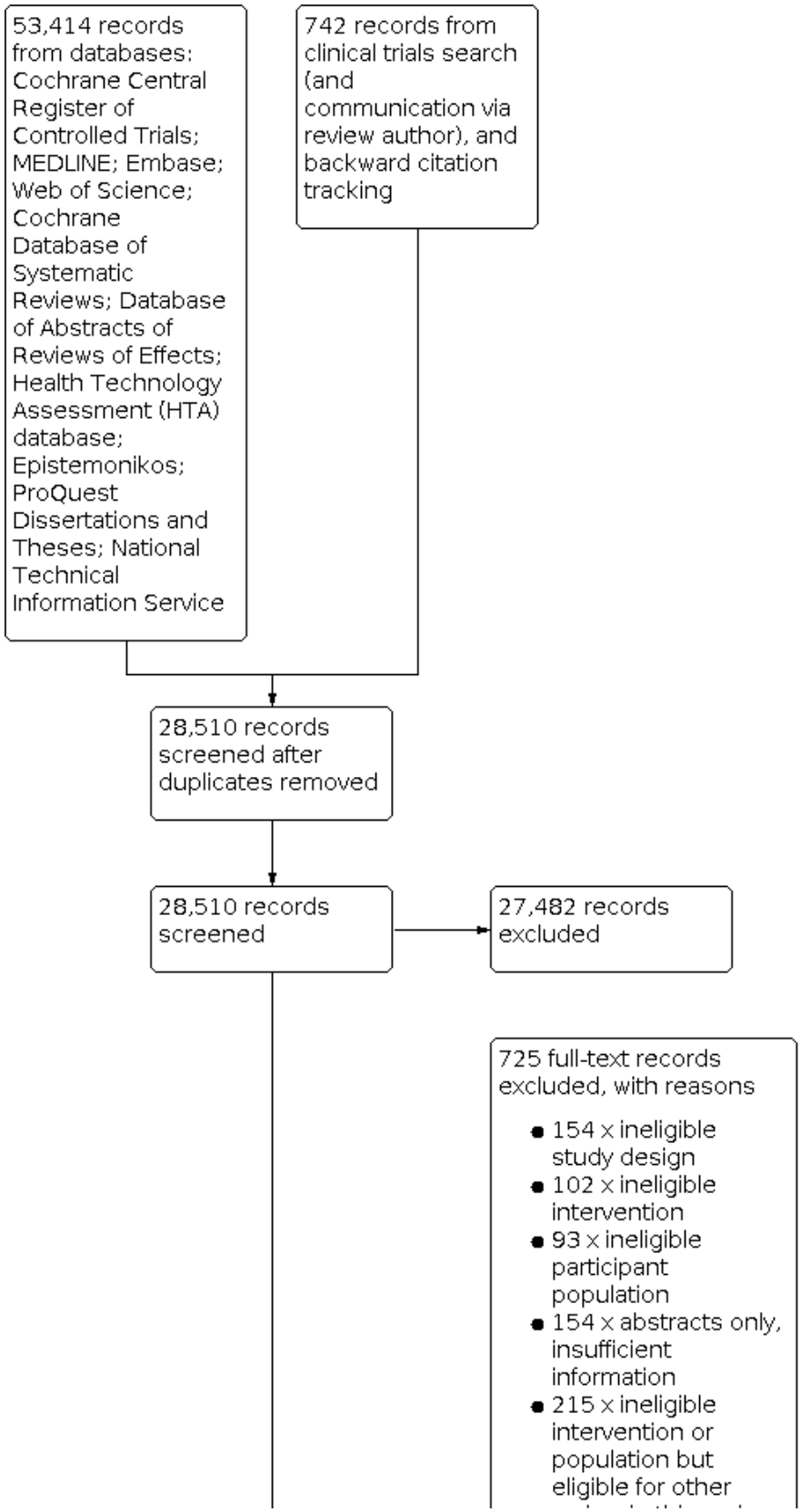
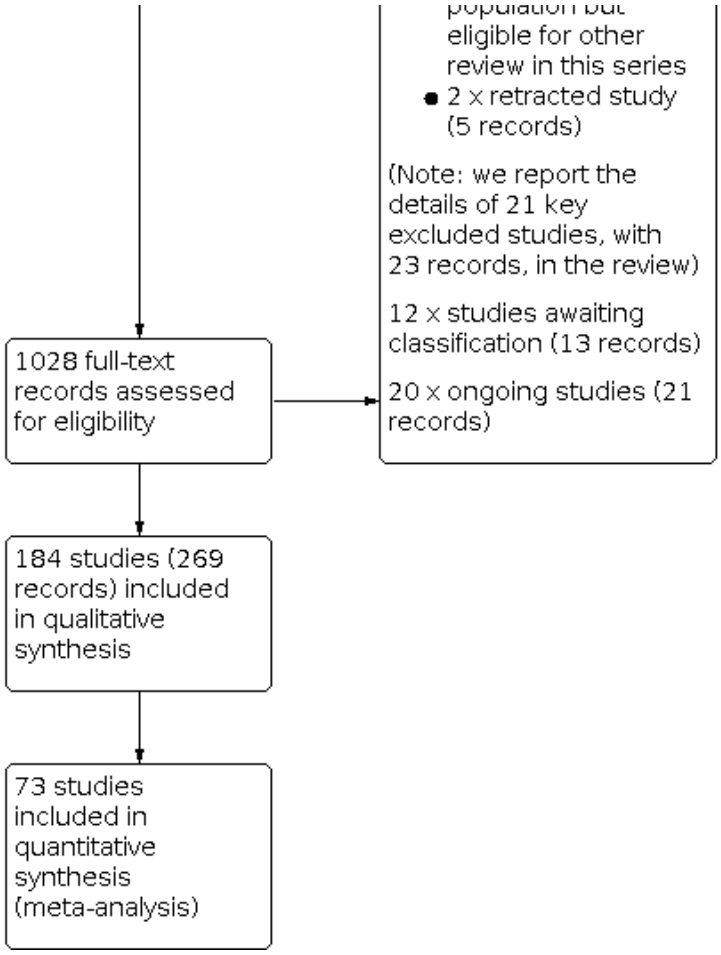


Figure 1. (Continued)



Included studies

See Characteristics of included studies. Ten studies were reported only as abstracts with limited study characteristics (Acharya 2003; Benum 1994; Irvine 2014; Mehdi 2000; Merenyi 1995; Michos 2001; Mott 1993; Raimondo 2012; Trafton 1984; Weisbrot 2005).

Types of studies and settings

We included 184 studies (see Included studies). Twenty-four studies allocated participants to interventions using methods that we have described as quasi-randomised (Agrawal 2017; Bajpai 2015; Butt 1995; Dhamangaonkar 2013; Galanopoulos 2018; Guyer 1991; Hardy 1998; Kammerlander 2018; Lopez 2002; Lopez-Vega 2015; Marques 2005; Park 1998; Park 2010; Schipper 2004; Sharma 2018; Verettas 2010; Watson 1998; Yamauchi 2014). Although we expected most other studies were randomised controlled trials, methods of randomisation were not always clearly reported.

Twenty-two studies were conducted across multiple centres (Ahrengart 1994; Andalib 2020; Baumgaertner 1998; Benum 1994; Caiaffa 2016; Ciaffa 2018; Davis 1988; Ekstrom 2007; Fitzpatrick 2011; Griffin 2021; Kammerlander 2018; Lunsjo 2001; Matre 2013; McCormack 2013; Mott 1993; Okcu 2013; Rahme 2007; Reindl 2015; Sanders 2017; Schipper 2004; Vaquero 2012; Wu 2020), and the remainder were completed at a single centre.

Studies were conducted in:

- China (Cao 2017; Chen 2018; Cheng 2014; Dong 2018; Gou 2013; Guo 2015; Han 2012; Huang 2006; Li 2010; Li 2015b; Li 2018; Pan 2009; Shi 2018; Song 2011 Su 2016; Tao 2013; Wang 2011; Wang 2019; Xu 2010b; Xu 2010a; Xu 2018; Yang 2011a; Yaozeng 2010; Yu 2015; Zhang 2013; Zhang 2018; Zhou 2012; Zou 2009);
- UK (Adams 2001; Bannister 1990; Barton 2010; Bridle 1991; Butt 1995; Davis 1988; Esser 1986; Griffin 2016; Griffin 2021; Harrington 2002; Haynes 1996; Hornby 1989; Kosygan 2002; Little 2008; McLaren 1991; Mehdi 2000; Parker 2012; Parker 2017; Parker 2020; Radford 1993);
- Sweden (Brostrom 1992; Dalen 1988; Ekstrom 2007; Lunsjo 2001; Mattsson 2004; Mattsson 2005; Miedel 2005; Nungu 1991; Olsson 2001; Sernbo 1988; Sernbo 1994; Stark 1992);
- India (Agrawal 2017; Bajpai 2015; Barwar 2014; Dhamangaonkar 2013; Haq 2014; Jolly 2019; Kumar 2019; Singh 2017; Singh 2019; Vidyadhara 2007);
- Italy (Andreani 2015; Caiaffa 2016; Carulli 2017; Catania 2019; Ciaffa 2018; Dall'Oca 2010; Moroni 2004; Moroni 2005; Pesce 2014; Raimondo 2012);
- Greece (Aktselis 2014; Efstathopoulos 2007; Galanopoulos 2018; Kouvidis 2012; Makridis 2010; Michos 2001; Papasimos 2005; Verettas 2010; Vossinakis 2002);
- Spain (Barrios 1993; Herrera 2002; Lopez 2002; Lopez-Vega 2015; Marques 2005; Utrilla 1998; Utrilla 2005; Vaquero 2012; Varela-Egocheaga 2009);

- USA (Baumgaertner 1998; Chapman 1981; Fitzpatrick 2011; Goldhagen 1994; Shannon 2019; Trafton 1984; Watson 1998; Yang 2011b);
- Turkey (Akinci 2010; Desteli 2015; Eceviz 2020; Okcu 2013; Ozkayin 2015; Seyhan 2015; Zehir 2015);
- Germany (Berger-Groch 2016; Fritz 1999; Hoffmann 1999; Hopp 2016; Stappaerts 1995; Wild 2010);
- South Korea (Hong 2011; Kim 2005; Park 1998; Park 2010; Shin 2017);
- Switzerland (Guyer 1991; Pelet 2001; Sadowski 2002; Saudan 2002; Stern 2011);
- Belgium (De Grave 2012; Hardy 1998; Hardy 2003; Janzing 2002);
- Canada (McCormack 2013; O'Brien 1995; Reindl 2015; Sanders 2017);
- Norway (Benum 1994; Buciuto 1998; Haddon 2019; Matre 2013);
- France (Dujardin 2001; Giraud 2005; Pitsaer 1993);
- Iran (Andalib 2020; Kazemian 2014; Kazemian 2016);
- Israel (Chechik 2014; Juhn 1988; Peyser 2007);
- Mexico (Calderon 2013; Delgado 1990; Romero 2008);
- Netherlands (Liem 1993; Pahlpatz 1993; Schipper 2004);
- Two studies each in: Austria (Irvine 2014; Kukla 1997), Brazil (Guerra 2014; Sharma 2018), Denmark (Dalsgaard 1986; Hogh 1981), Finland (Pajarinen 2005; Teerenhovi 1984), Japan (Kuwabara 1998; Yamauchi 2014), and Pakistan (Adeel 2020; Akhtar 2016);
- One study each in: Egypt (Selim 2020), Hong Kong (Leung 1992), Hungary (Merenyi 1995), Nepal (Karn 2006), and New Zealand (Hoffman 1996).

Three studies were conducted in more than one country: Australia and UK (Rahme 2007); Sweden and Finland (Ahrengart 1994); and Austria, Belgium, Germany, Israel, Norway and Switzerland (Kammerlander 2018). In two studies, there was insufficient information in the study report for us to determine the country (Acharya 2003; Weisbrot 2005).

Studies were published between 1980 and 2020. We noted that 25% of studies were published before 2000, and 52% were published since 2010.

Types of participants

In total, 26,073 participants with 26,086 extracapsular hip fractures were recruited across the 184 studies. Whilst most studies included a mix of stable and unstable fractures, almost a third of studies included only participants with unstable fractures and two studies included only participants with stable fractures (Eceviz 2020; Sharma 2018). Most studies included a mix of fracture instability. One study included only subtrochanteric fractures (Rahme 2007), and whilst some studies also included subtrochanteric fractures, these were generally a much smaller proportion of the overall fracture type in these studies.

Most participants were randomised within three days of injury, but 13 studies included participants at later time points after injury: up to four days (Pelet 2001), five days (Sernbo 1994), seven days (Akhtar 2016; Eceviz 2020; Karn 2006; O'Brien 1995; Vossinakis 2002), two weeks (Hong 2011; Reindl 2015), 15 days (Caiaffa 2016; Ciaffa 2018), or three weeks (Haq 2014; Zhou 2012).

Although some studies recruited participants from a younger starting age (e.g. at least 50 years or 55 years of age), we found that the mean age of participants in most studies (where reported) ranged from 60 to 93 years of age. In only five studies, we noted a mean age slightly younger than 60 years (Adeel 2020; Agrawal 2017; Akhtar 2016; Haq 2014; Singh 2017). Three studies recruited only female participants (Esser 1986; Moroni 2004; Moroni 2005). In the remaining studies that reported gender distribution, there were 15,944 females, which represents 69% of the participants included in these studies. We expected that female representation was higher than this in most studies because we noted that in 15 of these studies, there were more male participants than female participants, and we expected that these studies affected this percentage (Adeel 2020; Agrawal 2017; Akhtar 2016; Akinci 2010; Chapman 1981; Ciaffa 2018; Desteli 2015; Dhamangaonkar 2013; Dong 2018; Hong 2011; Huang 2006; Radford 1993; Romero 2008; Wang 2011; Zhang 2018).

Types of interventions

Only two studies included three comparison arms (Ciaffa 2018; Papasimos 2005). The remaining studies were two-arm studies comparing only one type of intervention with another. Studies included the following interventions (see Table 2 and Table 3 for approaches to classification of interventions).

- Cephalomedullary nails: Gamma nail, Gamma 3, Endovis nail, Holland nail, Trigen Intertan nail, Kűntscher-Y nail, Zimmer nail, Uni-nail, Elos Intramedullary nail, ACE Trochanteric nail, Gliding nail, Proximal Femoral Nail (PFN), expandable PFN, PFN-antirotation (PFNA), Targon PFN, Fixion PFN, Intramedullary Hip Screw, Affixus Hip Fracture Nail System and unspecified cephalomedullary nails. Where reported, studies included nails that were short (or likely to be short) and long. Although less frequently reported, we noted other intervention characteristics such as whether the lag screw was dynamic or static, single or double, etc.
- Condylocephalic nails: Ender nails and Harris nails.
- Fixed angle plates: sliding hip screw, dynamic hip screw, compression hip screw, dynamic condylar screw, Medoff sliding plate, AMBI hip screw, percutaneous compression plate, X-bolt Dynamic Hip Plating System, Contralateral reverse Distal Femoral Locking Compression Plate (DFLCP), Less Invasive Stabilisation System (LISS), locking compression plate, McLaughlin nail plate, Richards sliding hip screw, Pugh nail plate, Jewett nail plate, AO angle plate, proximal femoral locking plate, locking plate, blade plate, angle plate. Where reported, or when the implant was specified, we noted whether the capital screw or blade was dynamic or static within the barrel.
- Arthroplasties, including all types of hemiarthroplasty and total hip arthroplasty.
- External fixation.
- Non-operative treatment, including skin or skeletal traction.

Types of outcome measures

Forty nine studies did not report review outcomes (Acharya 2003; Adeel 2020; Akhtar 2016; Bajpai 2015; Bannister 1990; Barrios 1993; Barwar 2014; Calderon 2013; Cao 2017; Chen 2017; Chen 2018; Cheng 2014; Delgado 1990; Desteli 2015; Dhamangaonkar 2013; Dong 2018; Fitzpatrick 2011; Galanopoulos 2018; Guo 2015; Han 2012; Hong 2011; Juhn 1988; Karn 2006; Kuwabara 1998; Li 2010; Li

2018; Mehdi 2000; Moroni 2004; Moroni 2005; Pan 2009; Park 1998; Park 2010; Pesce 2014; Romero 2008; Selim 2020; Sernbo 1994; Shi 2018; Stappaerts 1995; Vidyadhara 2007; Wang 2011; Wang 2019; Watson 1998; Weisbrot 2005; Xin 2014; Xu 2010a; Xu 2018; Yamauchi 2014; Yu 2015; Zhang 2018). The remaining studies reported data for at least one of the review outcomes.

Sources of funding and declarations of interest

Approximately 40% of the studies declared that they had no conflicts of interest. However, we note that sources of funding were not always clearly reported, such that we could not determine how some of these studies were funded.

We judged that the funding was from independent sources (such as universities, hospitals or foundation trusts) in 11 studies (Cai 2016; Davis 1988; Esser 1986; Haddon 2019; Hornby 1989; Lunsjo 2001; Olsson 2001; Parker 2012; Parker 2017; Reindl 2015; Xu 2018). In 14 studies, all or part of the funding was received from a manufacturer of study implants (Ahrengart 1994; Griffin 2016; Griffin 2021; Hardy 1998; Haynes 1996; Kammerlander 2018; Matre 2013; Mattsson 2004; Mattsson 2005; Miedel 2005; Parker 2020; Sanders 2017; Schipper 2004; Vaquero 2012); this represented only 7.5% of all studies. However, we note that overall, two-thirds of studies did not report whether they received funding for their research.

Excluded studies

Because the searches in this review were designed to feed into a series of related Cochrane Reviews about the surgical management of hip fracture, we have not included a bibliographic list of all excluded studies. We excluded most studies because they were study designs that were ineligible for inclusion in this review, or were not treating participants with the type of fracture or with the types of interventions that were eligible for this review. Some of the excluded studies were eligible for inclusion in the related Cochrane Reviews.

Here, we report the details of 21 key excluded studies (see Characteristics of excluded studies). We excluded three studies because studies recruited younger participants than the expected population for the type of fracture, or included mainly fractures from high-energy trauma, or both (El-Desouky 2016; Emami 2013; Lee 2007b). The decision to exclude younger participants was a change from our protocol (see Differences between protocol and review). Five studies were abstracts with insufficient detail on the number of participants in each group, meaning extraction of data was not feasible (Ahmad 2011; Gupta 2012; Kumar 2006; Savadhkoohi 2016; Sher 1985). We excluded six studies that investigated the surgical approach or a supplement to treatment rather than the interventions of interest for this review (Alobaid 2004; Bong 1981; Kumar 1996; Lee 2007a; Li 2015a; Wong 2009). We excluded seven clinical trials reports. Two of these were terminated early and have not published findings (ACTRN12608000162314; NCT03065101). Five of these were completed in 2011/2012, according to the clinical trials register; we excluded these because we expect publication of findings is now unlikely (NCT00323232; NCT00686023; NCT00736684; NCT01173744; NCT01238068). See Characteristics of excluded studies.

Ongoing studies

We identified 20 studies from clinical trials register searches. These studies evaluate: two different models of cephalomedullary nail (NCT01437176; NCT01509859; NCT01797237; NCT02627040; NTR1133); cephalomedullary nails that are locked or unlocked (ACTRN12618001431213), with or without a lateral plate (ChiCTR1900025588), with a static or dynamic lag screw (NCT04441723), and single lag screw nailing and helical blade nailing (CTRI/2019/02/017733; NCT04306198); cephalomedullary nail versus fixed angle plate (ACTRN12610000992000; IRCT20141209020258N80; NCT03906032); two different models of fixed angle plate (ChiCTR-TRC-11001642; CTRI/2019/11/022097); fixed angle plate with or without a static screw (IRCT20170621034689N2); fixed angle plate and external fixator (IRCT20181015041344N1); internal fixation versus hemiarthroplasty (JPRN-UMIN000019523; NCT03407131); and hemiarthroplasty and total hip arthroplasty (ChiCTR-INR-17011841). The estimated enrolment is more than 2400 participants; this number does not include seven ongoing studies for which we did not have estimated numbers (ChiCTR1900025588; ChiCTR-INR-17011841; ChiCTR-TRC-11001642; CTRI/2019/02/017733; CTRI/2019/11/022097; IRCT20170621034689N2; IRCT20181015041344N1). See Characteristics of ongoing studies.

Awaiting classification

We found twelve studies that are awaiting classification. These studies are described as completed in a clinical trials register, or we expected they were completed, but do not yet have published results. The studies evaluate: two different models of cephalomedullary nails (ISRCTN48618754; JPRN-UMIN000018307; NCT03635320); cephalomedullary nail with or without cement augmentation (NCT03000972); cephalomedullary nail and fixed angle plate (NCT01380444; NCT02788994; NCT03849014; NCT04240743; REGAIN 2008); two different models of fixed angle plate (ISRCTN32393360); fixed angle plate with or without trochanteric support plate (NCT02294747); and internal fixation and total hip arthroplasty (NCT02171897). Recruited participants are likely to number more than 1500; this number does not include two studies for which we did not have estimated participant numbers (ISRCTN32393360;ISRCTN48618754). See Studies awaiting classification.

Risk of bias in included studies

See Figure 2. We only conducted risk of bias assessment for studies with outcome data included in the networks, and we conducted risk of detection bias separately for each outcome. Blank spaces in the risk of bias figure indicate that assessments were not completed for these studies or domains.

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study. Blank spaces indicate that risk of bias was not conducted because: (1) the study reported no review-relevant

outcomes; (2) no outcome data were included in analyses; (3) the study was not included in any networks; or (4) study authors did not report outcomes relevant to these domains.

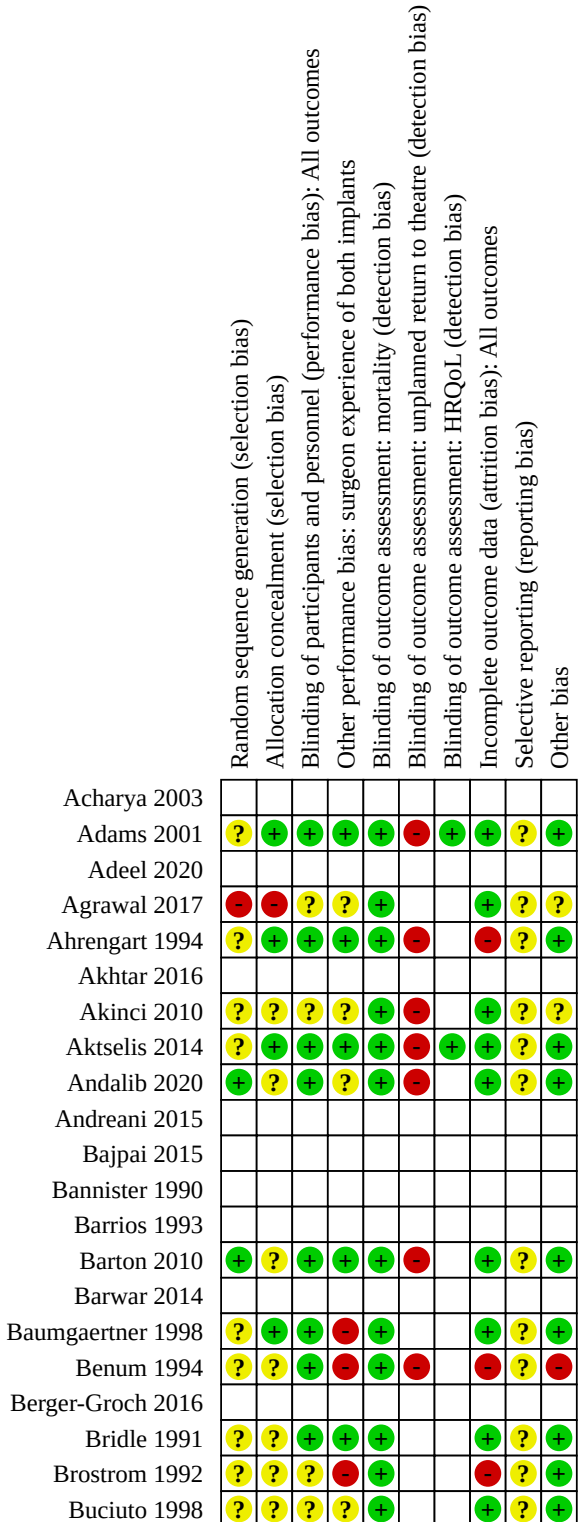
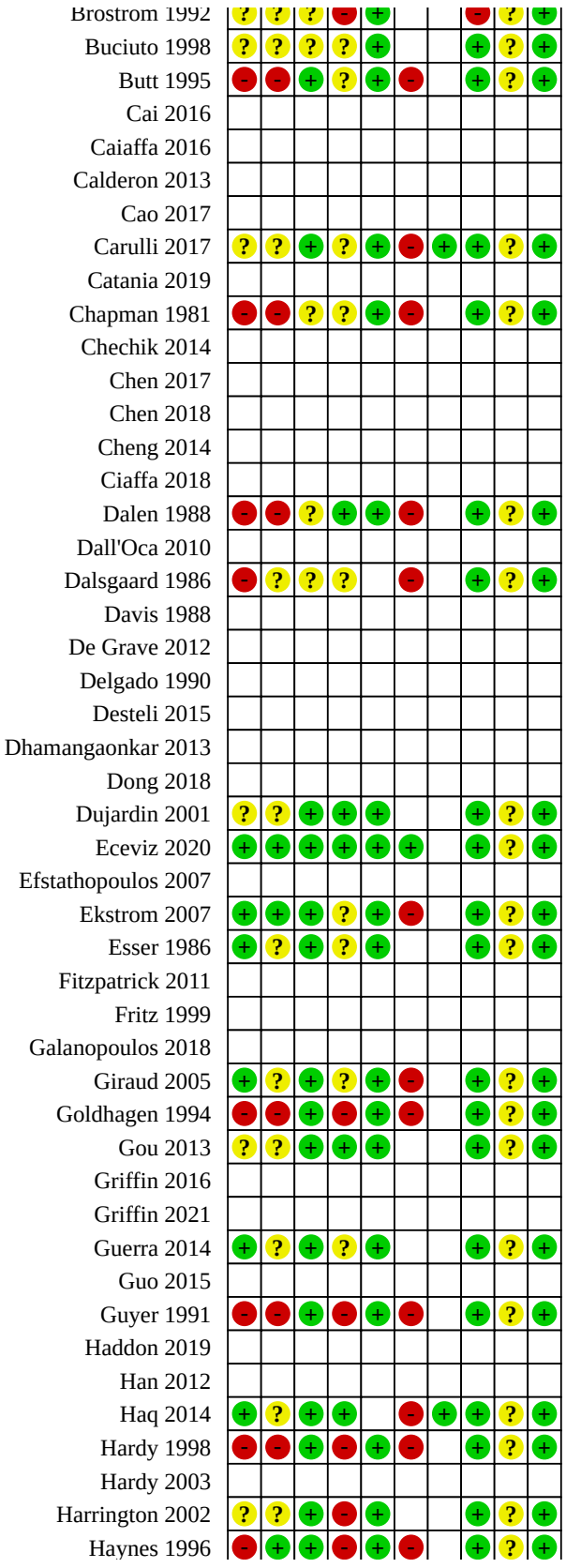


Figure 2. (Continued)



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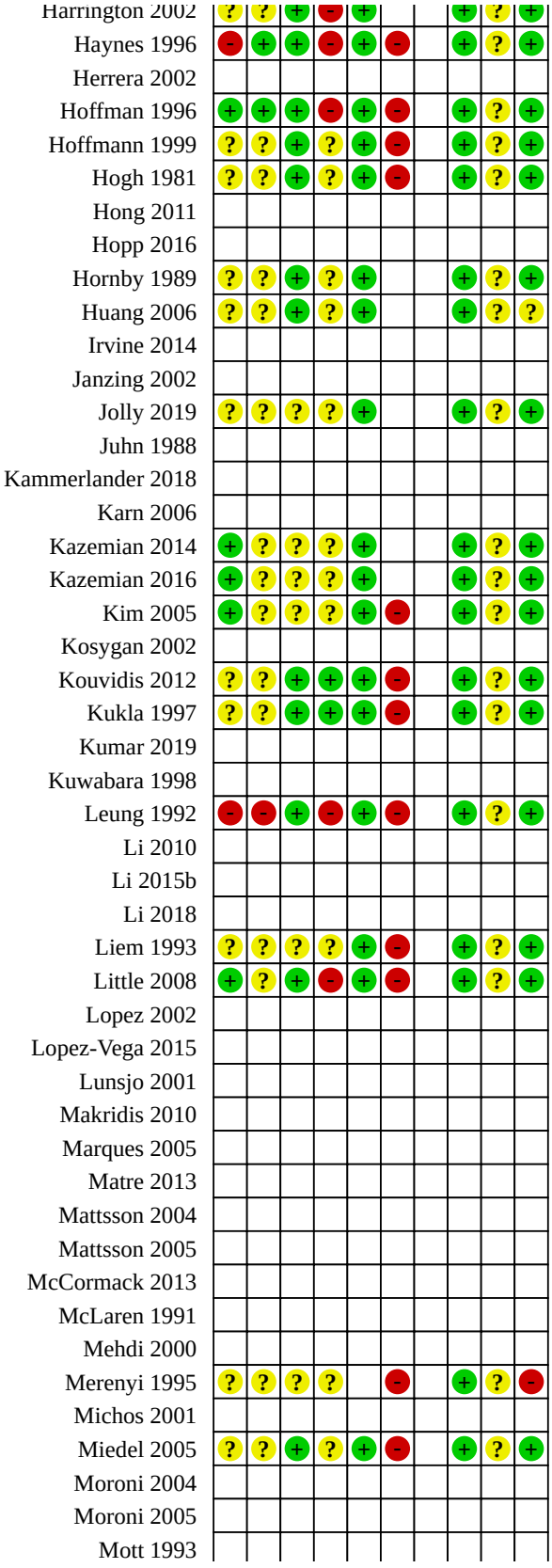

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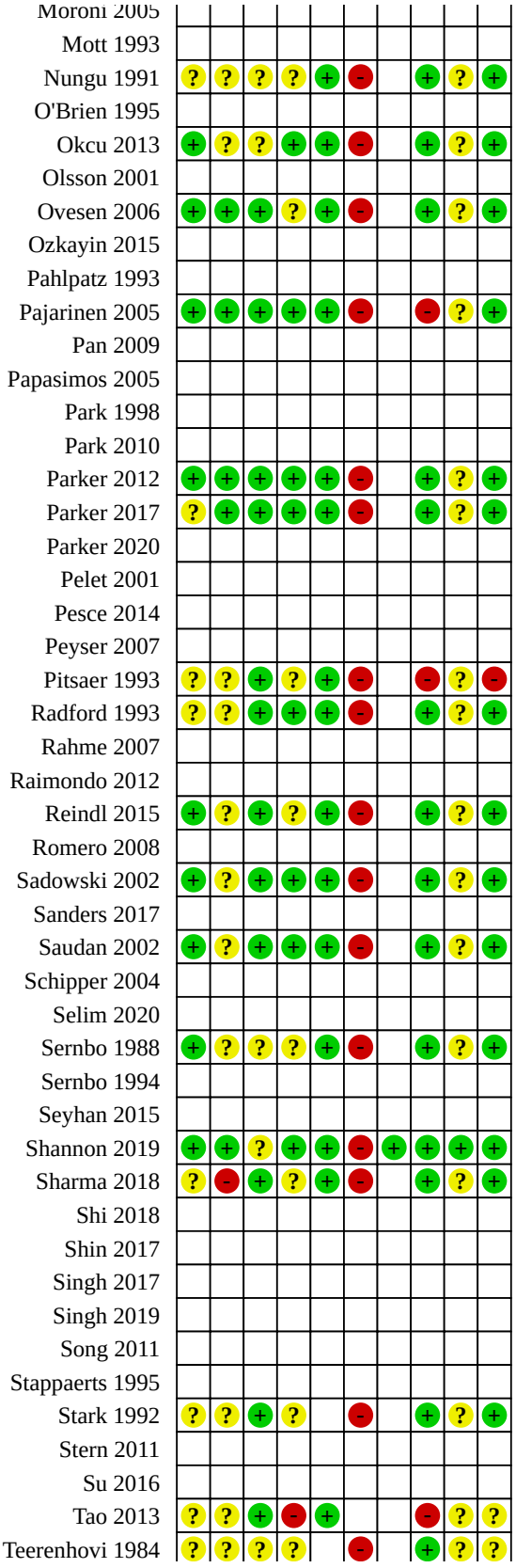

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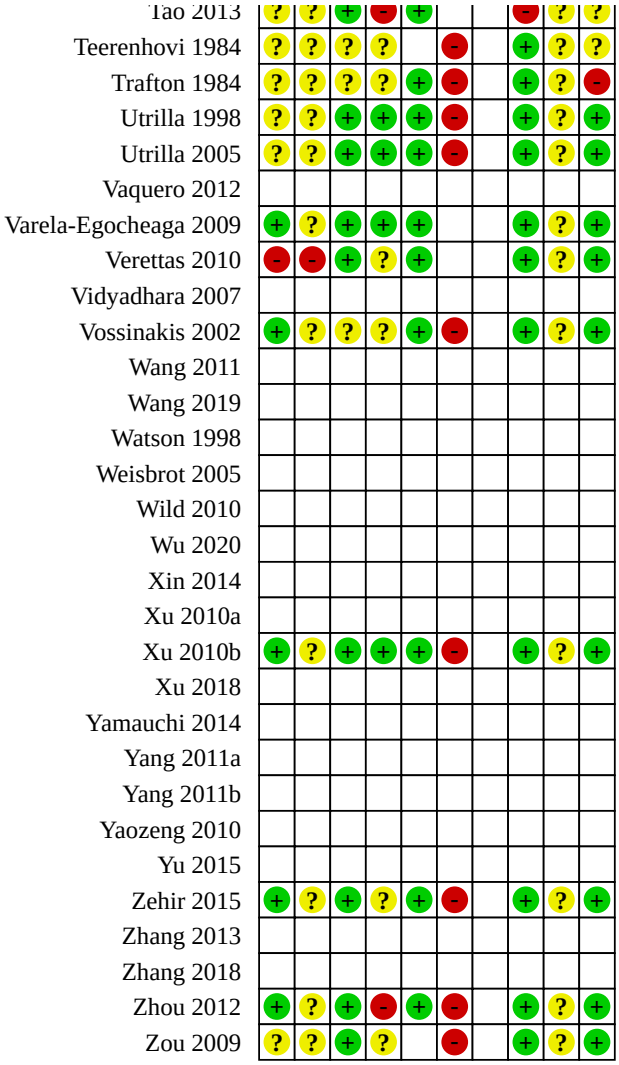


Allocation

Twenty-six studies described adequate methods to randomise participants to treatment groups, and we judged these studies to be at low risk of selection bias for sequence generation (Andalib 2020; Barton 2010; Eceviz 2020; Ekstrom 2007; Esser 1986; Giraud 2005; Guerra 2014; Haq 2014; Hoffman 1996; Kazemian 2014; Kazemian 2016; Kim 2005; Little 2008; Ovesen 2006; Pajarinen 2005; Parker 2012; Reindl 2015; Sadowski 2002; Saudan 2002; Sernbo 1988; Shannon 2019; Varela-Egocheaga 2009; Vossinakis 2002; Xu 2010b; Zehir 2015; Zhou 2012). We judged 11 studies to be at high risk of selection bias for sequence generation because these were quasi-randomised studies (Agrawal 2017; Butt 1995; Chapman 1981; Dalen 1988; Dalsgaard 1986; Goldhagen 1994; Guyer 1991; Hardy 2003; Haynes 1996; Leung 1992; Verettas 2010). The remaining studies reported insufficient information for us to judge risk of selection bias for sequence generation.

Thirteen studies described adequate methods to conceal allocation during the selection process and were at low risk of bias (Adams 2001; Ahrengart 1994; Aktselis 2014; Baumgaertner 1998; Eceviz 2020; Ekstrom 2007; Haynes 1996; Hoffman 1996; Ovesen 2006; Pajarinen 2005; Parker 2012; Parker 2017; Shannon 2019). We judged all the quasi-randomised studies to be at high risk of bias for allocation concealment, and the remaining studies reported insufficient information for us to judge risk of bias for this domain.

Blinding

It is not possible to blind surgeons to the different study implants, but we did not expect that this lack of blinding would introduce bias and we judged all studies to be at low risk of performance bias for blinding of personnel. However, we believed that the experience with the interventions may affect performance. We judged 23 studies to be at low risk of other performance bias because surgeons were experienced, or likely to be experienced, with both types of implants (Adams 2001; Ahrengart 1994; Aktselis 2014; Barton 2010; Bridle 1991; Dalen 1988; Dujardin 2001; Eceviz 2020; Gou 2013; Haq 2014; Kouvidis 2012; Kukla 1997; Okcu 2013; Pajarinen 2005; Parker 2012; Parker 2017; Radford 1993; Sadowski

2002; Saudan 2002; Shannon 2019; Utrilla 1998; Utrilla 2005; Varela-Egocheaga 2009). Thirteen studies were at high risk of bias because surgeons were more experienced using one of the study implants (Baumgaertner 1998; Benum 1994; Brostrom 1992; Goldhagen 1994; Guyer 1991; Hardy 1998; Harrington 2002; Haynes 1996; Hoffman 1996; Leung 1992; Little 2008; Tao 2013; Zhou 2012). There was insufficient detail about surgeon experience in the remaining studies.

We judged detection bias according to the type of outcome being measured. We expected that assessment of mortality was at low risk of detection bias in all studies. Although participants were not always blinded when providing assessment information for health-related quality of life, we also expected that detection bias for this outcome was low in all relevant studies. However, we believed that decisions on return to theatre were subjective, were likely to be made by unblinded surgeons, and we judged all studies reporting this outcome to be at high risk of detection bias. Only one study reported methods used to conceal identity on radiographs to ensure blinded outcome assessment for unplanned return to theatre, and we judged risk of detection bias for this outcome to be low (Eceviz 2020).

Incomplete outcome data

We judged six studies to be at high risk of attrition bias because of unexplained losses affecting some or all of the outcomes or because we could not determine whether data were complete for all participants (Ahrengart 1994; Benum 1994; Brostrom 1992; Pajarinen 2005; Pitsaer 1993; Tao 2013). We judged the remaining studies to be at low risk of attrition bias.

Selective reporting

We judged only one study to be at low risk of selective reporting bias (Shannon 2019). This study was prospectively registered with a clinical trials register and reported outcomes in this study were consistent with those in the trials register documents. Four studies were retrospectively registered with a clinical trials register (Barton 2010; Eceviz 2020: Parker 2017; Reindl 2015). It was not feasible to use these registration documents to assess risk of selective reporting bias. The remaining studies did not report pre-published protocols or clinical trials registration and we were unable to assess reporting bias.

Other potential sources of bias

We judged five studies to be at high risk of other bias because they were reported only in brief abstracts or reports which we expected were not peer-reviewed (Benum 1994; Merenyi 1995; Pitsaer 1993; Trafton 1984). We noted a difference in clinical management between participant groups in three studies (Agrawal 2017; Akinci 2010;Tao 2013); we judged risk of other bias to be unclear because we could not be certain whether this could influence participant outcomes. We had only limited translation for Teerenhovi 1984, and risk of other bias was therefore unclear. We identified no other sources of bias in the remaining studies.

Effects of interventions

See: **Summary of findings 1** Certainty of the effects and network estimates for treating extracapsular hip fractures in older adults: mortality at 12 months; **Summary of findings 2** Certainty of the effects and network estimates for treating extracapsular hip fractures in older adults: unplanned return to theatre

Where data were available, we produced networks for each of our specified outcomes and time points, as described in Types of outcome measures, yielding three different networks. The overall approach to development of these networks was driven principally by consideration of the clinical appropriateness of lumping/splitting the nodes, carried out in a series of meetings between the author group and representatives from the Fragility Fracture Network. We refined the networks such that a balance was achieved between efficiency, where consideration was taken for how many studies could be included, and the best possible representation of the interventions and their component subtypes.

Although not all the networks included all nodes, we defined nine separate nodes across this review:

- dynamic fixed angle plates;
- static fixed angle plates;
- long cephalomedullary nails;
- short cephalomedullary nails;
- condylocephalic nails;
- external fixation;
- hemiarthroplasty;
- total hip arthroplasty; and
- non-operative treatment.

We had insufficient studies in this review to enable networks for late mortality and for HRQoL at any time point. Therefore, the networks of interest in this review are for:

- early mortality (participant numbers in nodes ranged from 79 to 2050; studies ranged from 1 to 21 per comparison);
- mortality at 12 months (participant numbers in nodes ranged from 76 to 2861; studies ranged from 1 to 33 per comparison);
- unplanned return to theatre (participant numbers in nodes ranged from 29 to 4228; studies ranged from 1 to 34 per comparison).

The treatments in these networks were all connected (see Figure 3; Figure 4; Figure 5).

Figure 3. Network geometry for early mortality. The size of the nodes is proportional to the number of trials investigating each treatment, whilst the thickness of the edges is proportional to the number of direct comparisons. Treatment nodes - A: dynamic fixed angle plate;B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail;F: external fixation; G: hemiarthroplasty

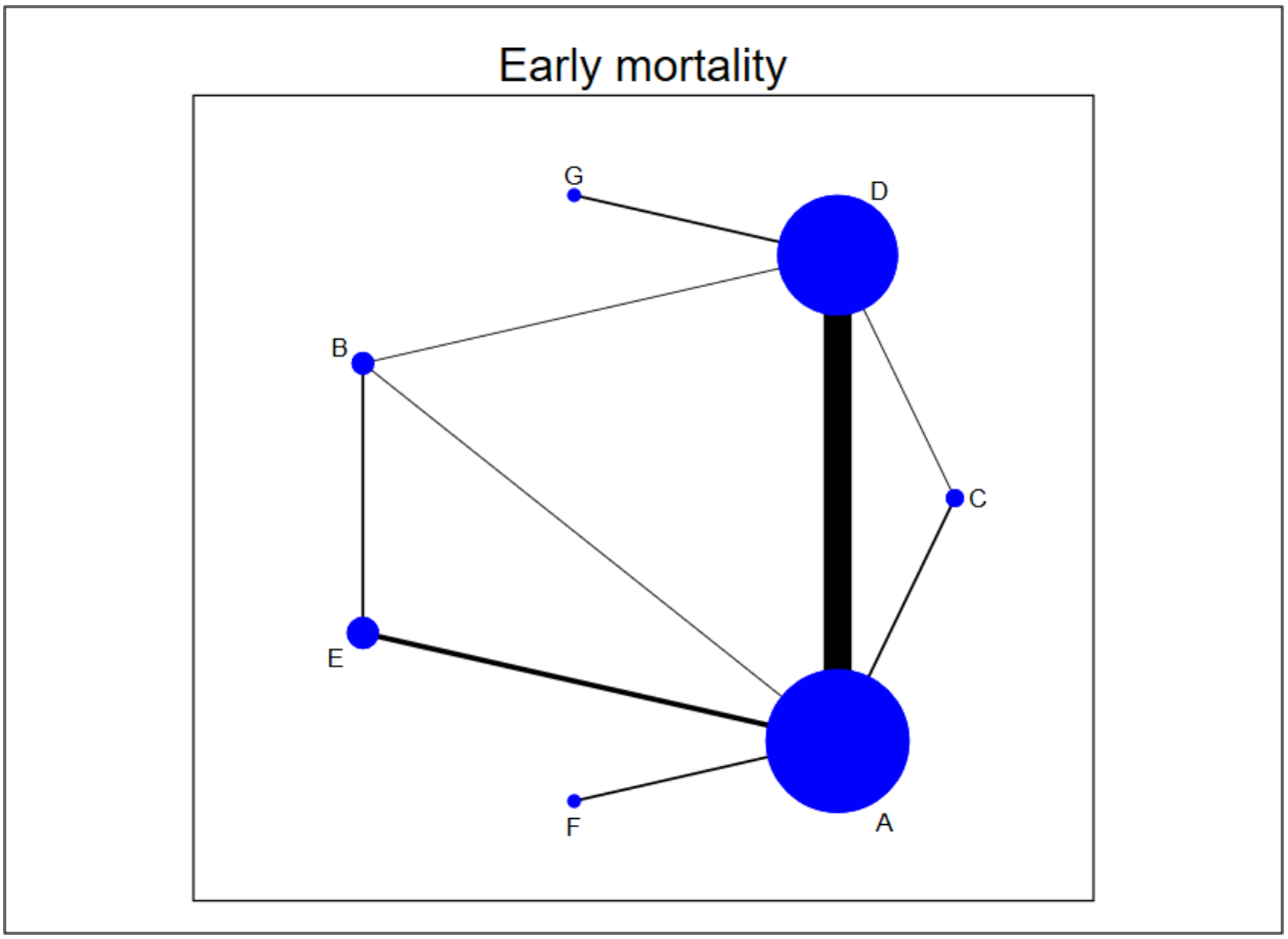


Figure 4. Network geometry for mortality at 12 months. The size of the nodes is proportional to the number of trials investigating each treatment, whilst the thickness of the edges is proportional to the number of direct comparisons. Treatment nodes - A: dynamic fixed angle plate;B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail; F: external fixation; G: hemiarthroplasty; H: non-operative treatment; I: total hip arthroplasty

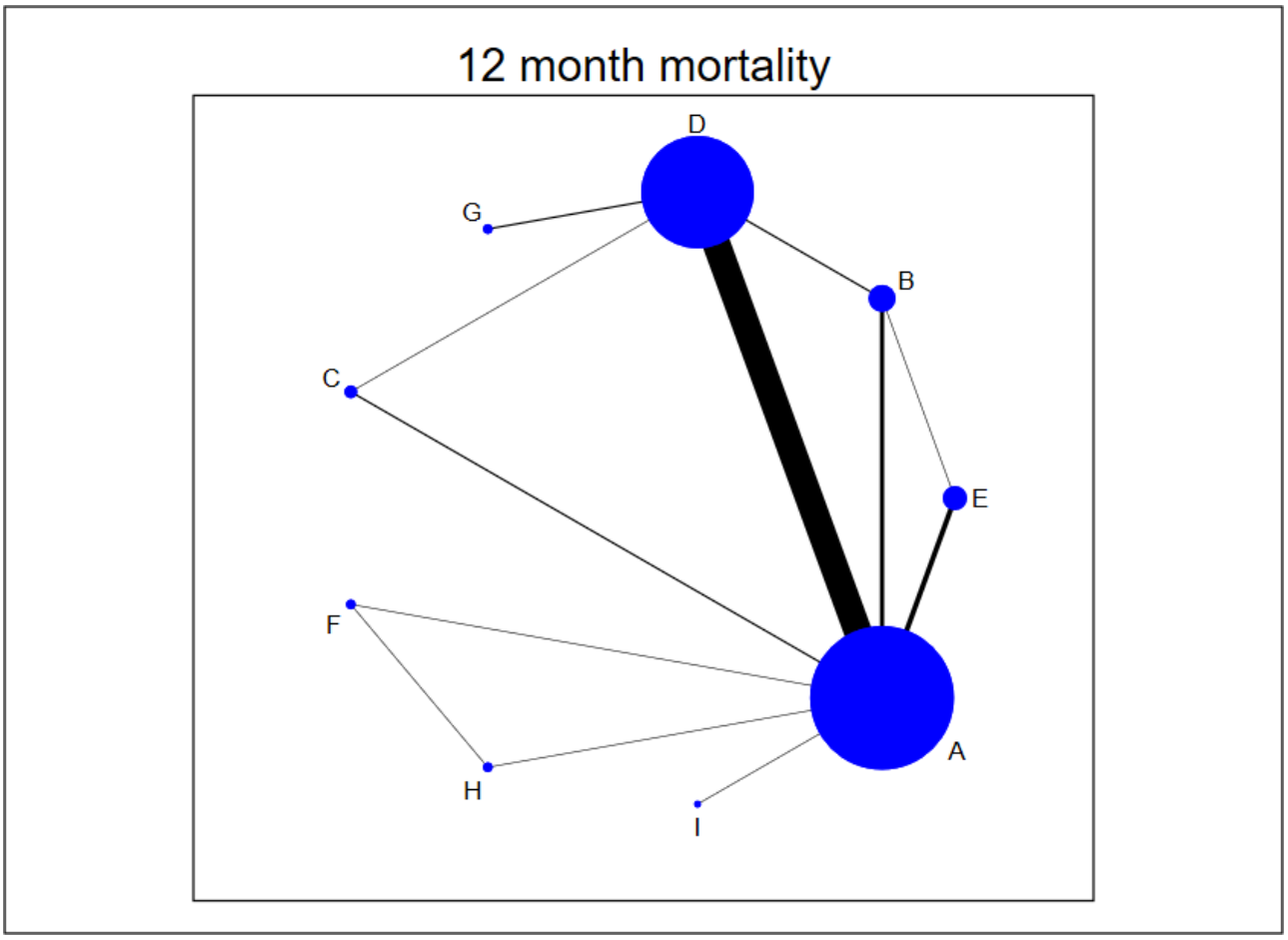
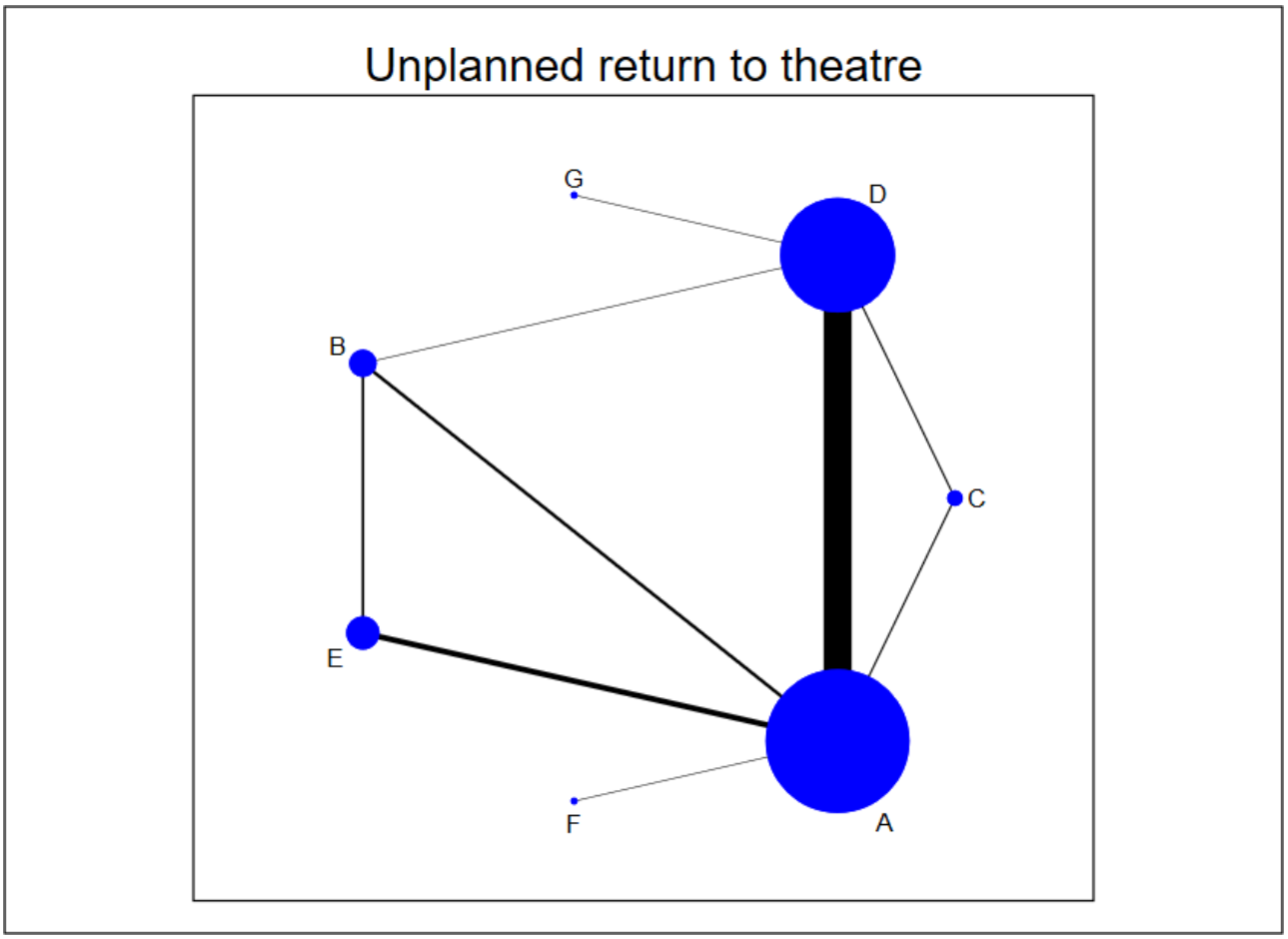


Figure 5. Network geometry for unplanned return to theatre. The size of the nodes is proportional to the number of trials investigating each treatment, whilst the thickness of the edges is proportional to the number of direct comparisons. Treatment nodes - A: dynamic fixed angle plate; B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail; F: external fixation; G: hemiarthroplasty



We prepared summary of findings tables for two of these networks, and we selected dynamic fixed angle plates as our reference comparator against which we reported network effect estimates and assessed the certainty of the evidence. This treatment was included in all networks and was deemed clinically to be a reasonable candidate as a 'default' treatment that would likely be appropriate for the vast majority of people with an extracapsular fracture.

For each treatment in all of the networks, we calculated probabilities for each treatment for every possible rank between best and worst treatment, along with the mean rank and surface under the cumulative ranking (SUCRA) values. The magnitude of the estimated between-study standard deviations for each of the networks conducted was in keeping with published estimates of non-pharmacological interventions.

1. Early mortality

We included 36 studies (4822 randomised participants and 4791 analysed participants) in the network for mortality within four months of surgery (Barton 2010; Bridle 1991; Brostrom 1992; Chapman 1981; Dalen 1988; Dalsgaard 1986; Dujardin 2001; Giraud 2005; Guyer 1991; Hardy 1998; Harrington 2002; Hoffman 1996; Hoffmann 1999; Hogh 1981; Jolly 2019; Kazemian 2014; Kim 2005; Kukla 1997; Liem 1993; Little 2008; Miedel 2005; Ovesen 2006; Pajarinen 2005; Parker 2017; Radford 1993; Sadowski 2002; Saudan 2002; Shannon 2019; Utrilla 1998; Utrilla 2005; Varela-Egocheaga 2009; Verettas 2010; Vossinakis 2002; Xu 2010b; Zehir 2015; Zhou 2012). The maximum number of randomised participants was 400 and the minimum number was 39.

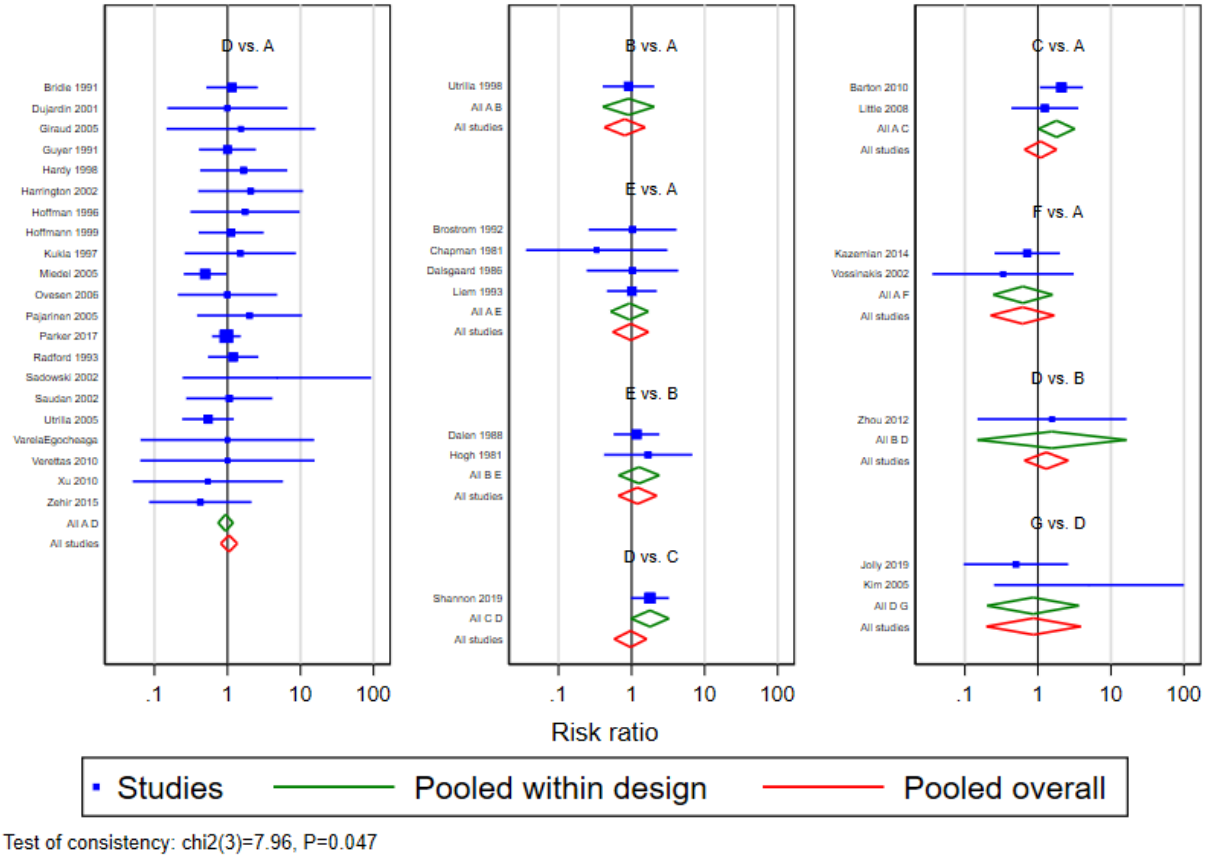
Twenty additional studies reported early mortality which we did not include in the network. We dropped seven of these from the analysis because at least one of the treatments in the study did not correspond with our node definitions (e.g. mixed group of cephalomedullary nail lengths, or we could not determine the length of nail) (Chechik 2014; Matre 2013; Michos 2001; O'Brien 1995; Pahlpatz 1993; Sanders 2017; Wild 2010). We dropped the remaining 13 studies from the analysis because they compared treatments within a node (e.g. a short cephalomedullary nail with another short cephalomedullary nail) (Caiaffa 2016; Efstathopoulos 2007; Fritz 1999; Hardy 2003; Kosygan 2002; Makridis 2010; Olsson 2001; Papasimos 2005; Parker 2020; Peyser 2007; Schipper 2004; Vaquero 2012; Wu 2020). The network included no data for non-operative treatment or total hip arthroplasty.

Direct comparisons

In the direct comparisons, we found evidence of a difference in early mortality between dynamic fixed angle plate versus long cephalomedullary nail (RR 1.80, 95% CI 1.02 to 3.18, favours fixed angle plate; 2 studies, 400 participants).

However, we found no evidence of a difference between any of the other treatments for this outcome (Table 4; Figure 6). On inspection of Table 4, we noted that CIs for each estimate overlapped and there was little evidence to suggest that any one of the treatments was either substantially better or worse than the other. However, the CIs were wide for most of these estimates, indicating substantial imprecision.

Figure 6. Network forest plot for early mortality. Treatment nodes - A: dynamic fixed angle plate;B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail;F: external fixation; G: hemiarthroplasty



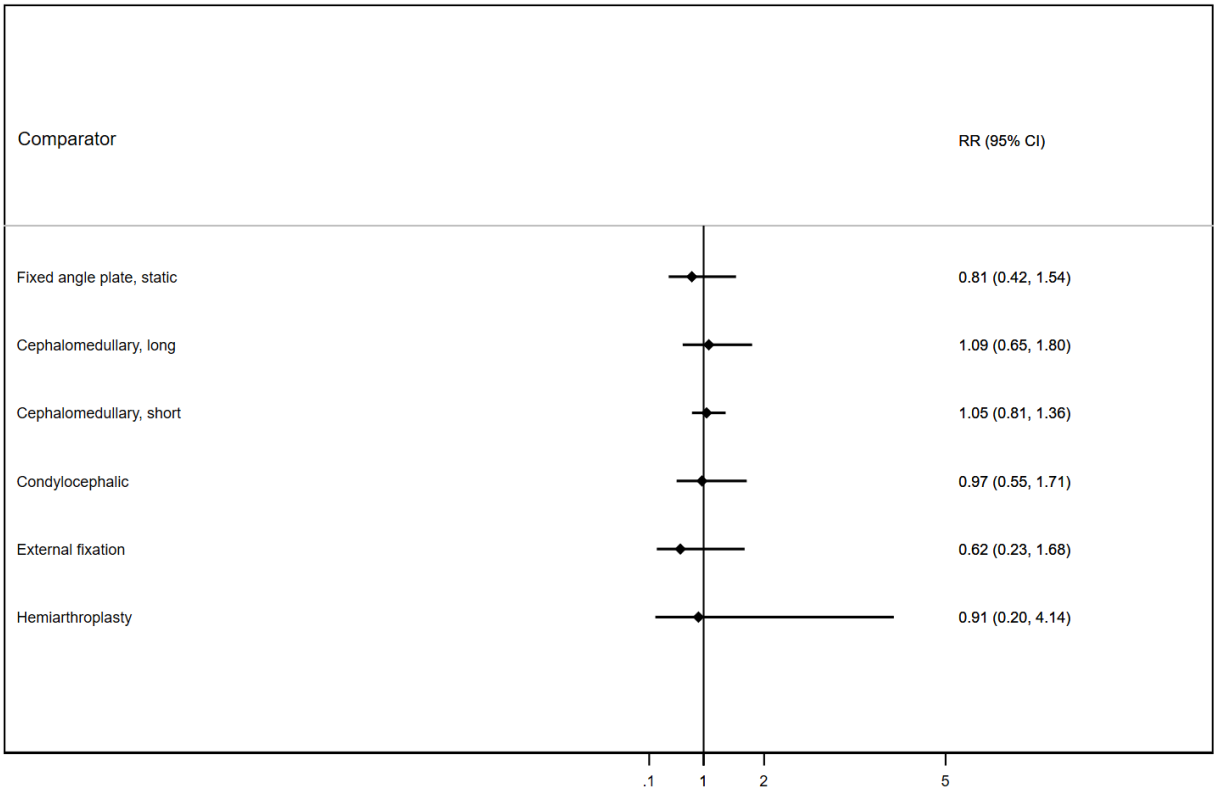
Test of consistency: chi2(3)=7.96, P=0.047

Network meta-analysis

The global test for incoherence was significant (P = 0.047); this appeared to be driven by comparisons of long versus short cephalomedullary nails, and dynamic fixed plates versus both long and short cephalomedullary nails. We could not determine any methodological or clinical reasons for this incoherence.

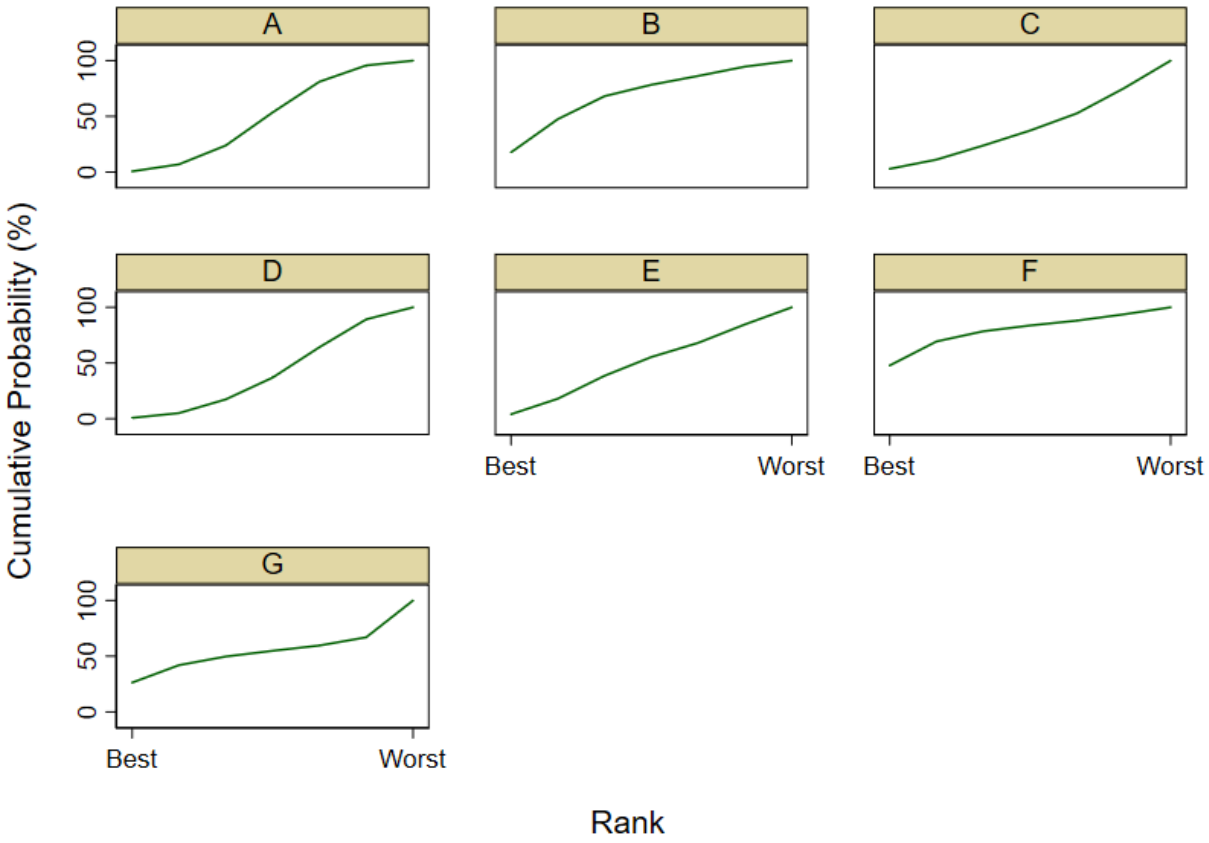
There was no evidence of any difference between any of the treatments in the network meta-analysis (Table 4). We present the network estimates compared to dynamic fixed angle plates in Figure 7. There was no evidence of statistical inconsistency in any of the direct estimates, and no evidence of publication bias or small study effects. We noted variation between all treatments in the proportion of stable and unstable fractures, and other variables (age and gender) were reasonably balanced between treatment comparisons; we therefore did not consider intransitivity to be of concern in this network. However, we found evidence of incoherence in network estimates for long and short cephalomedullary nails, and all effect estimates included plausible benefits as well as harms. For this outcome, we could not rule out the possibility of selection bias because studies published only as abstracts did not adequately report data for this outcome.

Figure 7. Network estimates of treatments compared to dynamic fixed angle plate for early mortality, as risk ratios with 95% confidence intervals (CI)



We found that external fixation and static fixed-angle plate seemed to have the greatest likelihood of being ranked highly (mean ranks 2.4, 3.1; SUCRA values 0.8, 0.7 respectively) (Table 5; Figure 8). External fixation was ranked the highest, but we note that this was derived from two small studies (Kazemian 2014; Vossinakis 2002). Long and short cephalomedullary nails had the worst mean ranks (5 and 4.9) and the lowest SUCRA values (0.3 and 0.4) which would indicate that these treatments have the lowest probability of reducing early death. However, on inspection of the CIs in Table 4, we noted no evidence of a difference between the treatments in any of the network estimates for this outcome and we are cautious in drawing meaningful interpretations from the ranking of treatments in this network.

Figure 8. Cumulative ranking probability curves for each treatment in the early mortality network. Each curve corresponds to the cumulative probability for all treatment ranks. From left to right along the x-axis are the possible rankings for each treatment (12 in total; only best (1st) and worst (12th) shown in figure). Probabilities of each ranking are cumulatively summed from best to worst along the x-axis for each treatment. Treatment nodes - A: dynamic fixed angle plate;B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail;F: external fixation; G: hemiarthroplasty



The direct evidence from the dynamic fixed angle plate comparison with short cephalomedullary nails was the most informative for this network, contributing 22.7% to the network estimates. This was a notably higher contribution than the other direct comparisons, with the comparison between dynamic fixed angle plates and condylocephalic nails giving the next most informative contribution to the network estimates with 14.0%. This variation reflects the uneven nature of the available data when viewed as a network, with no direct evidence available for a number of the comparisons. Where direct evidence is present, the quantity of evidence varies substantially between comparisons. However, none of the direction comparisons appear to dominate the network estimates unduly.

2. Mortality at 12 months

We included 56 studies (8407 randomised participants; 8203 analysed participants) in the network for 12 months mortality (Adams 2001; Agrawal 2017; Ahrengart 1994; Akinci 2010; Aktselis 2014; Andalib 2020; Barton 2010; Baumgaertner 1998; Bridle 1991; Buciuto 1998; Butt 1995; Carulli 2017; Chapman 1981; Dalsgaard 1986; Dujardin 2001; Eceviz 2020; Ekstrom 2007; Esser 1986; Goldhagen 1994; Gou 2013; Guerra 2014; Hardy 1998; Harrington 2002; Haynes 1996; Hoffman 1996; Hogh 1981; Hornby 1989; Huang 2006; Jolly 2019; Kazemian 2016; Kim 2005; Kouvidis 2012; Kukla 1997; Leung 1992; Liem 1993; Little 2008; Miedel 2005; Nungu 1991; Okcu 2013; Ovesen 2006; Parker 2012; Parker 2017; Reindl 2015; Sadowski 2002; Saudan 2002; Sernbo 1988; Sharma 2018; Tao 2013; Trafton 1984; Utrilla 1998; Utrilla 2005; Varela-Egocheaga 2009; Vossinakis 2002; Xu 2010b; Zehir 2015; Zhou 2012). The maximum number of randomised participants was 598 and the minimum number was 31.

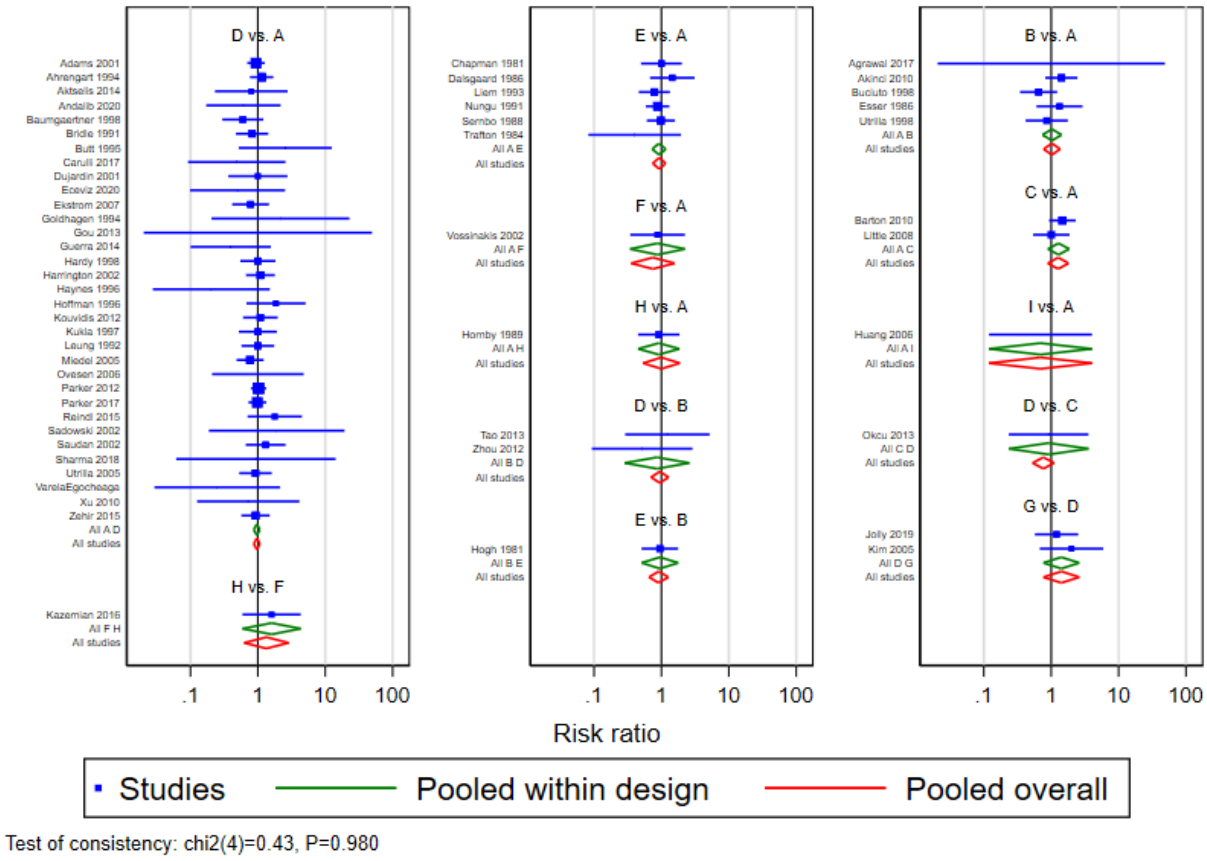
Forty-eight additional studies reported mortality at 12 months which we did not include in the network. We dropped thirteen studies from the analysis because at least one of the study treatments did not correspond with our node definitions (e.g. mixed group of cephalomedullary nail lengths, or we could not determine the length of nail) (Cai 2016; Chechik 2014; Davis 1988; Kammerlander 2018; Lopez 2002; Matre 2013; Pahlpatz 1993; Pelet 2001; Rahme 2007; Raimondo 2012; Sanders 2017; Singh 2019; Yang 2011a). We dropped the 34 other studies from the

analysis because they compared treatments within a node (e.g. a short cephalomedullary nail with another short cephalomedullary nail) (Berger-Groch 2016; Caiaffa 2016; Catania 2019; Ciaffa 2018; Dall'Oca 2010; De Grave 2012; Fritz 1999; Griffin 2016; Griffin 2021; Haddon 2019; Hardy 2003; Herrera 2002; Hopp 2016; Janzing 2002; Kosygan 2002; Kumar 2019; Li 2015b; Lopez-Vega 2015; Lunsjo 2001; Makridis 2010; Marques 2005; Mattsson 2005; McCormack 2013; McLaren 1991; Parker 2020; Peyser 2007; Schipper 2004; Stern 2011; Su 2016; Vaquero 2012; Wu 2020; Yang 2011b; Yaozeng 2010; Zhang 2013).

Direct comparisons

In the direct comparisons, we found no evidence of a difference between any of the treatments in mortality at 12 months (Table 6; Figure 9). On inspection of Table 6, we noted that all CIs for each estimate overlapped and there was little evidence to suggest that any one of the treatments was either substantially better or worse than the other. However, the CIs were wide for most of these estimates, indicating substantial imprecision.

Figure 9. Network forest plot for mortality at 12 months. Treatment nodes - A: dynamic fixed angle plate;B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail; F: external fixation; G: hemiarthroplasty; H: non-operative treatment; I: total hip arthroplasty



Test of consistency: chi2(4)=0.43, P=0.980

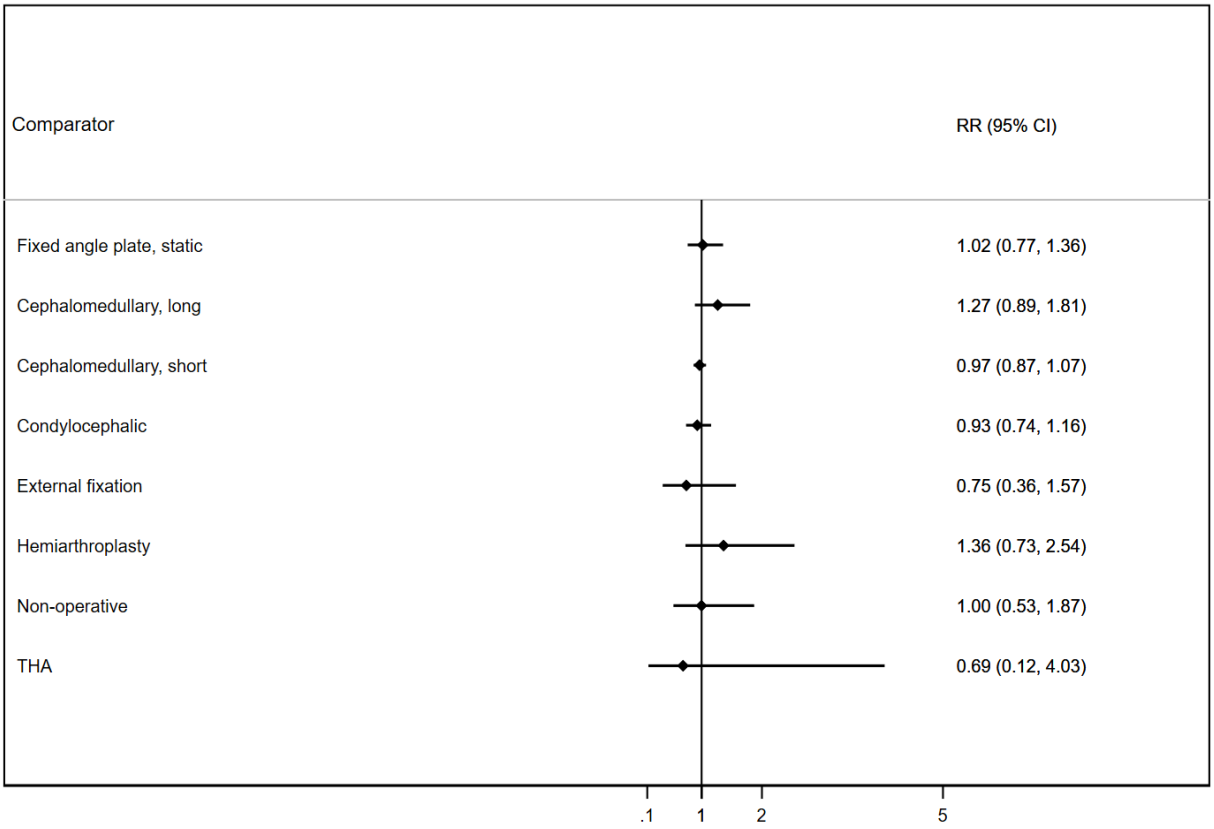
Network meta-analysis

The global test for incoherence was nonsignificant (P = 0.980). There was no evidence of any difference between any of the treatments in the network meta-analysis (Table 6).

A summary of this outcome, compared to dynamic fixed angle plate, is in Summary of findings 1, and we present the network estimates against this reference comparator in Figure 10. The certainty of the evidence ranged from low to very low. We downgraded the evidence for all treatments by one level for risk of bias because all studies in the direct or indirect estimates (or both estimates) had unclear risks of bias in at least one domain. We also downgraded for a further level for risk of bias if estimates included studies at high risk of bias. We could not rule out the possibility of selection bias because studies published only as abstracts did not adequately report data for this outcome. There was no evidence of statistical inconsistency in any of the direct or indirect estimates and no evidence of publication bias or small study effects. We noted some variation in the proportion of stable and unstable fractures in some of the indirect estimates and we downgraded the evidence for treatments that included these indirect comparisons because of possible intransitivity. We also considered variation in age and gender, but judged these to be comparable between treatment comparisons. There was no evidence of incoherence in the network estimates. However, we downgraded all estimates for imprecision

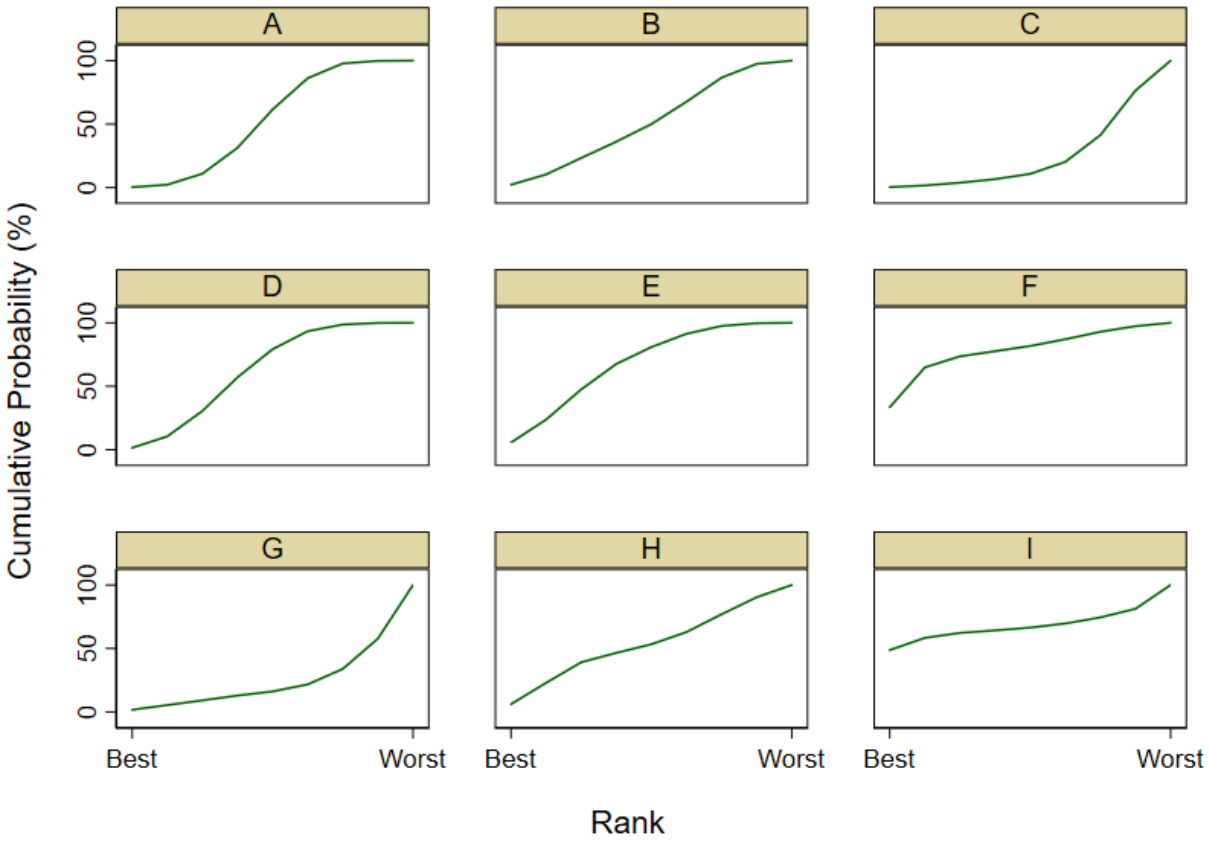
because network estimates included evidence of benefits as well as harms.

Figure 10. Network estimates of treatments compared to fixed angle plate for mortality at 12 months, as risk ratios with 95% confidence intervals (CI).



We found that external fixation and total hip arthroplasty seemed to have the greatest likelihood of being ranked highly (mean ranks 2.9, 3.7; SUCRA values 0.8, 0.7 respectively) (Table 7; Figure 11). External fixation was ranked the highest, but we note that this was derived from two small studies (Kazemian 2014; Vossinakis 2002). Long cephalomedullary nails and hemiarthroplasty had the worst mean ranks (both 7.4) and the lowest SUCRA values (both 0.2) which would indicate that these treatments have the lowest probability of reducing late mortality. However, on inspection of the CIs in Figure 10, we noted no evidence of a difference between the treatments in any of the network estimates for this outcome and are cautious in drawing meaningful interpretations from the ranking of treatments in this network.

Figure 11. Cumulative ranking probability curves for each treatment in the network for mortality at 12 months. Each curve corresponds to the cumulative probability for all treatment ranks. From left to right along the x-axis are the possible rankings for each treatment (12 in total; only best (1st) and worst (12th) shown in figure). Probabilities of each ranking are cumulatively summed from best to worst along the x-axis for each treatment. Treatment nodes - A: dynamic fixed angle plate;B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail; F: external fixation; G: hemiarthroplasty; H: non-operative treatment; I: total hip arthroplasty



The direct evidence from the dynamic fixed angle plate comparison with short cephalomedullary nails was the most informative for this network, contributing 18.8% to the network estimates. This was a notably higher contribution than the other direct comparisons, with the comparison between dynamic fixed angle plates and non-operative treatment giving the next most informative contribution to the network estimates with 11.3%. This variation reflects the uneven nature of the available data when viewed as a network, with no direct evidence available for a number of the comparisons. Where direct evidence is present, the quantity of evidence varies substantially between comparisons. However, none of the direction comparisons appear to dominate the network estimates unduly.

3. Late mortality

Only two studies reported data for mortality later than 24 months after surgery (Akinci 2010; Berger-Groch 2016). Akinci 2010 compared a dynamic fixed angle plate with a static plate, and we found no evidence of any differences in mortality between these treatments at five years (RR 0.83, 95% CI 0.57 to 1.22, favours dynamic plate; 157 participants).

Berger-Groch 2016 compared treatments within the node for short cephalomedullary nails.

4. Early health-related quality of life (HRQoL)

Only one study reported data for this outcome within four months of surgery (Griffin 2021). This study compared treatments within the dynamic fixed angle plate node.

5. HRQoL at 12 months

Three studies (260 randomised participants, 230 analysed participants) compared treatments for short cephalomedullary nails and dynamic fixed angle plates and reported HRQoL at 12 months (Aktselis 2014; Carulli 2017; Haq 2014). An additional four studies reported this outcome but compared treatments within a node (Andreani 2015; Griffin 2021; Vaquero 2012), or did not correspond to our node definitions because the study included

cephalomedullary nails of mixed lengths (Singh 2019). We therefore could not conduct a network meta-analysis.

In the direct comparison of these three studies, we found that HRQoL was improved when a dynamic fixed angle plate was used (SMD 0.35, 95% CI 0.09 to 0.61). After converting this estimate onto the Short Form 12-item questionnaire (SF-12) physical component summary score (PCS) scale (with which two studies measured this outcome), the difference between treatments was compatible with both no clinically important difference and plausible benefits (MD 3.68, 95% CI 0.94 to 6.42); this was based on a MCID for SF-12 (PCS) of 4.6 (Berliner 2016).

6. Late HRQoL

No studies reported HRQoL later than 24 months after surgery.

5. Unplanned return to theatre

We included 55 studies (9296 randomised participants; 8739 analysed participants) in the network for unplanned return to theatre (Adams 2001; Ahrengart 1994; Akinci 2010; Aktselis 2014; Andalib 2020; Barton 2010; Benum 1994; Butt 1995; Carulli 2017; Chapman 1981; Dalen 1988; Dalsgaard 1986; Eceviz 2020; Ekstrom 2007; Giraud 2005; Goldhagen 1994; Guyer 1991; Haq 2014; Hardy 1998; Haynes 1996; Hoffman 1996; Hoffmann 1999; Hogh 1981; Kim 2005; Kouvidis 2012; Kukla 1997; Leung 1992; Liem 1993; Little 2008; Merenyi 1995; Miedel 2005; Nungu 1991; Okcu 2013; Ovesen 2006; Pajarinen 2005; Parker 2012; Parker 2017; Pitsaer 1993; Radford 1993; Reindl 2015; Sadowski 2002; Saudan 2002; Sernbo 1988; Shannon 2019; Sharma 2018; Stark 1992; Teerenhovi 1984; Trafton 1984; Utrilla 1998; Utrilla 2005; Vossinakis 2002; Xu 2010b; Zehir 2015; Zhou 2012; Zou 2009).

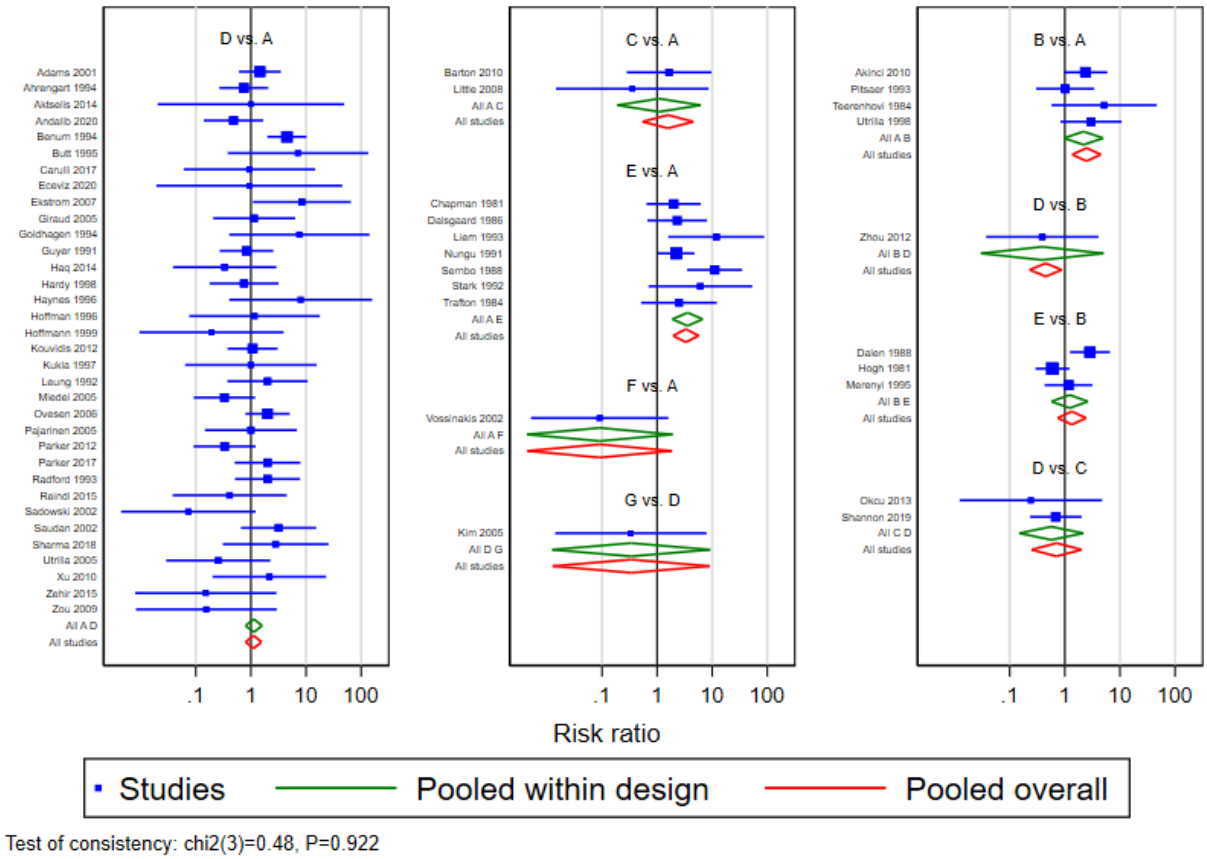
Forty-one additional studies reported unplanned return to theatre which we did not include in the network. We dropped 15 of these studies from the analysis because at least one of the treatments in the study did not correspond with our node definitions (e.g. mixed group of cephalomedullary nail lengths, or we could not determine the length of nail) (Chechik 2014; Davis 1988; Irvine 2014; Kammerlander 2018; Lopez 2002; Matre 2013; Michos 2001; Mott 1993; O'Brien 1995; Ozkayin 2015; Pelet 2001; Rahme 2007; Sanders 2017; Singh 2017; Singh 2019). We dropped the remaining 26 studies from the analysis because they compared treatments within a node (e.g. a short cephalomedullary nail with another short cephalomedullary nail) (Catania 2019; De Grave 2012; Fritz 1999; Griffin 2021; Haddon 2019; Herrera 2002; Hopp 2016; Janzing 2002; Kumar 2019; Lopez-Vega 2015; Lunsjo 2001; Marques 2005; Mattsson 2004; Mattsson 2005; McCormack 2013; Olsson 2001; Papasimos 2005; Parker 2020; Schipper 2004; Seyhan 2015; Shin 2017; Stern 2011; Su 2016; Wu 2020; Yaozeng 2010; Zhang 2013). The network included no data for non-operative treatment or total hip arthroplasty.

Direct comparisons

In the direct comparisons, we found evidence of a difference in unplanned return to theatre between dynamic fixed angle plate versus condylocephalic nail (RR 3.57, 95% CI 1.91 to 6.66, favours fixed angle plate; 7 studies, 996 participants).

However, we found no evidence of a difference between any of the other treatments for this outcome (Table 8; Figure 12). On inspection of Table 9, we noted that all CIs for each estimate overlapped and there was little evidence to suggest that any one of the treatments was either substantially better or worse than the other. However, the CIs were wide for most of these estimates, indicating substantial imprecision.

Figure 12. Network forest plot for unplanned return to theatre. Treatment nodes - A: dynamic fixed angle plate; B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail; F: external fixation; G: hemiarthroplasty



Network meta-analysis

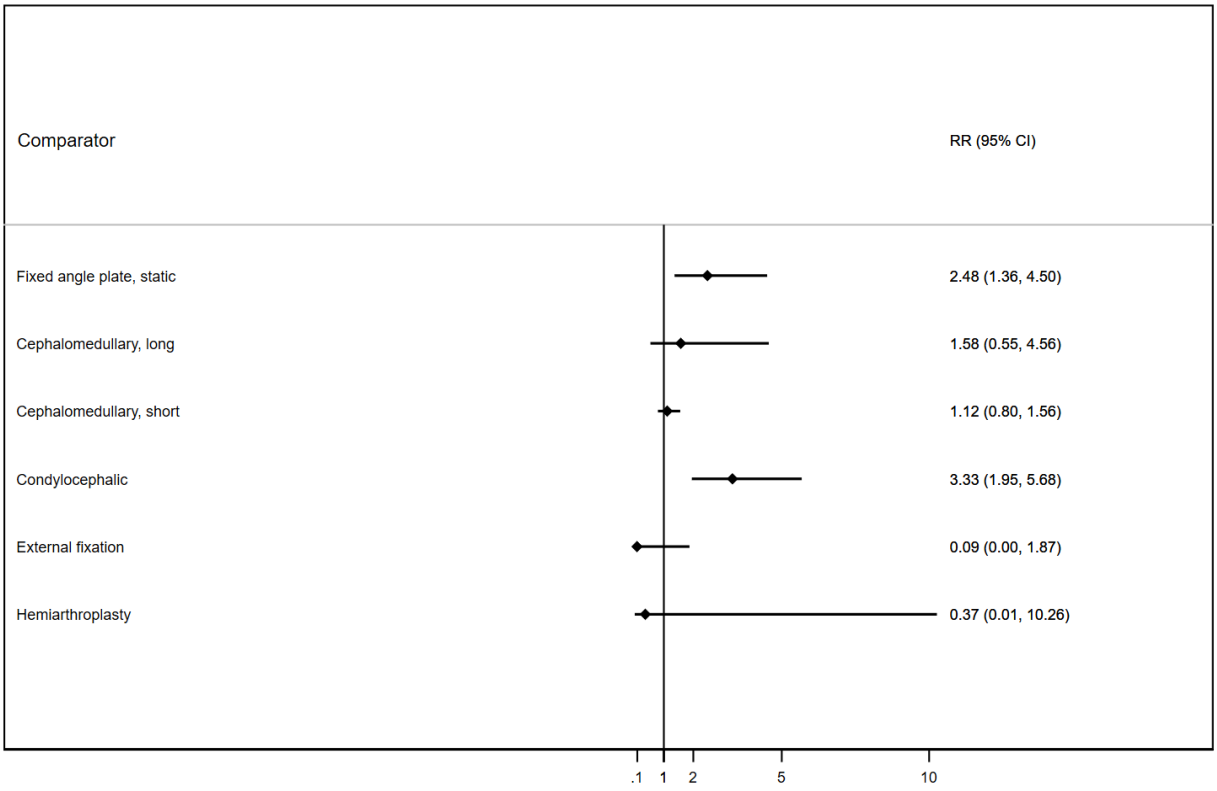
The global test for incoherence was nonsignificant (P = 0.922). Based upon the network estimates, we noted a difference in unplanned return to theatre for the following comparisons.

- Dynamic versus static fixed angle plate (RR 2.48, 95% CI 1.36 to 4.50, favours dynamic fixed angle plate); this effect was derived from direct evidence (RR 2.19, 95% CI 0.97 to 4.92; 4 studies, 622 participants), and indirect evidence (RR 2.91, 95% CI 1.17 to 7.22).
- Dynamic fixed angle plate versus condylocephalic nail (RR 3.33, 95% CI 1.95 to 5.68, favours fixed angle plate); this effect was derived from direct evidence (RR 3.57, 95% CI 1.91 to 6.66; 7 studies, 996 participants), and indirect evidence (RR 2.74, 95% CI 0.93 to 8.05).
- Static fixed angle plate versus short cephalomedullary nail (RR 0.45, 95% CI 0.23 to 0.88, favours cephalomedullary nail); this effect was derived from direct evidence (RR 0.39, 95% CI 0.03 to 4.93; 1 study, 68 participants), and indirect evidence (RR 0.45, 95% CI 0.22 to 0.92).
- Static fixed angle plate versus external fixation (RR 0.04, 95% CI 0.00 to 0.80, favours external fixation); this effect was derived only from indirect evidence.
- Short cephalomedullary nail versus condylocephalic nail (RR 2.98, 95% CI 1.59 to 5.60, favours cephalomedullary nail); this effect was derived only from indirect evidence.
- Condylocephalic nail versus external fixation (RR 0.03, 95% CI 0.00 to 0.59, favours external fixation); this effect was derived only from indirect evidence).

A summary of this outcome, compared to dynamic fixed angle plate, is in Summary of findings 2, and we present the network estimates against this reference comparator in Figure 13. The certainty of the evidence ranged from low to very low. We downgraded the evidence for all treatments by one level for risk of bias because all studies in the direct or indirect estimates (or both estimates) had high risk of detection bias and unclear risks of bias in at least one domain. We also downgraded for a further level for risk of bias if estimates included studies at high risk of selection bias or 'other bias'. We noted statistical heterogeneity in some direct or indirect estimates and downgraded for inconsistency for treatments that may be affected by this, but found no evidence of publication bias or small study effects. We downgraded for intransitivity when we noted that indirect estimates included variation in the proportion of stable and unstable fractures; however, we judged variation in age and gender to be comparable between treatment comparisons. There was no evidence of

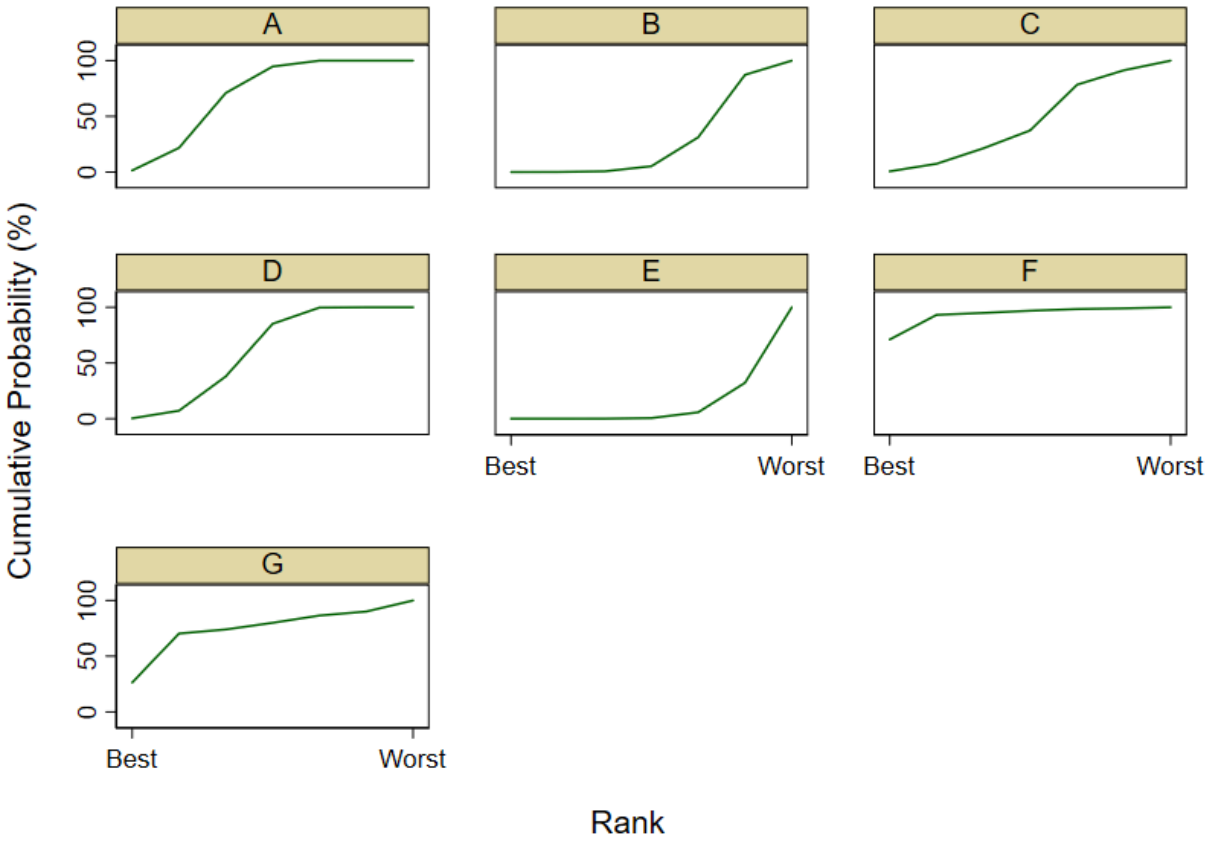
incoherence in the network estimates. However, we downgraded estimates that included evidence of benefits as wells as harms for imprecision.

Figure 13. Network estimates of treatments compared to fixed angle plate for unplanned return to theatre, as risk ratios with 95% confidence intervals (CI).



We found that external fixation and hemiarthroplasty seemed to have the greatest likelihood of being ranked highly (mean ranks 1.5, 2.7; SUCRA values 0.9, 0.7 respectively) (Table 9, Figure 14). External fixation was ranked the highest, but we note that this was derived from two small studies (Kazemian 2014; Vossinakis 2002). Condylocephalic nail and static fixed angle plate had the worst mean ranks (6.6 and 5.8) and the lowest SUCRA values (0.1 and 0.2) which would indicate that these treatments have the lowest probability of reducing unplanned return to theatre. Consistent with these low rankings, effect estimates in Figure 13 showed clinically important and statistically significant harms of both these treatments compared with the comparator intervention. The possibility of very substantial harms but also clinically important benefits was observed with long cephalomedullary nails, which ranked poorly too. It is likely that condylocephalic nails and static fixed angle plates yield worse unplanned returns to theatre and some evidence that long cephalomedullary nails may also be associated with very substantial harms.

Figure 14. Cumulative ranking probability curves for each treatment in the network for unplanned return to theatre. Each curve corresponds to the cumulative probability for all treatment ranks. From left to right along the x-axis are the possible rankings for each treatment (12 in total; only best (1st) and worst (12th) shown in figure). Probabilities of each ranking are cumulatively summed from best to worst along the x-axis for each treatment. Treatment nodes - A: dynamic fixed angle plate; B: static fixed angle plate; C: long cephalomedullary nail; D: short cephalomedullary nail; E: condylocephalic nail; F: external fixation; G: hemiarthroplasty



The direct evidence from the dynamic fixed angle plate comparison with short cephalomedullary nails was the most informative for this network, contributing 24.9% to the network estimates. This was a notably higher contribution than the other direct comparisons, with the comparisons between dynamic fixed angle plates and external fixation and short cephalomedullary nails and hemiarthroplasty giving the next most informative contributions to the network estimates, each with 13.9%. This variation reflects the uneven nature of the available data when viewed as a network, with no direct evidence available for a number of the comparisons. Where direct evidence is present, the quantify of evidence varies substantially between comparisons. However, none of the direction comparisons appear to dominate the network estimates unduly.

DISCUSSION

Summary of main results

In the review, we included 184 studies (160 RCTs, 24 quasi-RCTs) with 26,073 participants with 26,086 fractures. Most of the studies included a mixed sample of participants with stable or unstable pertrochanteric fracture patterns. We selected nine interventions as network nodes that represented the most clinically relevant distinctions between treatments and which still yielded sufficient data with which to conduct network meta-analysis. Overall, we included 73 studies with 11,126 participants in our network meta-analyses. We selected mortality at 12 months and unplanned return to theatre as the primary analyses, balancing our prespecified critical outcomes with the availability of studies and data at each time point.

Mortality within 12 months of surgery was estimated, from the included studies, to be 20.2% for treatment with dynamic fixed angle plates. Comparing all other treatments to fixed angle plates, we found no evidence of any differences in mortality at this time point; the certainty of this evidence ranged from low to very low. Total hip arthroplasty and external fixation were the two treatments ranked highest in the network, with the greatest likelihood of reducing mortality. However, because of the imprecision in the network estimates and the lack of evidence of any between-treatment differences in risk, we are cautious in drawing meaningful conclusions from this ranking.

We found very low-certainty evidence that more participants had unplanned return to theatre when treated with a static fixed angle plate or with a condylocephalic nail compared with fixed angle plates. This finding was consistent with the treatment rankings from the network; both of these treatments had the lowest probability of reducing unplanned return to theatre. The network estimates for the other treatments provided low- and very low-certainty evidence of no differences when compared with fixed angle plates.

We found insufficient data to allow us to construct a network for the health-related quality of life (HRQoL) outcome at any time point.

We did not GRADE the certainty of the evidence for early mortality (within four months of surgery); this network was constructed from fewer studies than the later time point for mortality. However, we similarly found no evidence of any differences in early mortality in the network estimates for any of the treatments.

Overall completeness and applicability of evidence

Most of the studies reported a mixed sample of participants with stable or unstable pertrochanteric fracture patterns, one third reported an exclusively unstable group, two studies only stable patterns and only one exclusively subtrochanteric fractures. However, there were insufficient studies reporting this variation fully to be able to explore it effectively through subgroup analysis. We did not include the single study of subtrochanteric fractures in the NMAs because this study compared treatments that did not correspond with our node definitions. Where relevant baseline characteristics were reported, we noted that the majority of the studies included participants aged between 60 and 93 years and that most participants were female. Therefore, we consider that the included studies are largely representative of the general hip fracture population. However, we found that few studies reported American Society of Anesthesiologists (ASA) status or presence of cognitive impairment at baseline, such that we could not confidently state that the included studies were similarly representative for these characteristics.

We noted that studies included in the network meta-analysis were published between 1981 and 2020, and 43% of these were published before 2000. Due to the limitations in the quality of the reporting in these older studies, we could not easily judge whether patient care protocols were equivalent to current standards of care. It is certainly possible that important developments have been made in co-interventions - such as the introduction of orthogeriatric care in some parts of the world - that have yielded improved outcomes for patients. We are unable to comment on whether such co-interventions may have changed the estimates of the relative benefits and harms between treatments reported here or rather changed the absolute risks following treatment for this injury.

Although we found that many of the included studies reported mortality and unplanned return to theatre, very few reported HRQoL. We were therefore unable to evaluate whether the benefits and harms of each treatment differed in terms of this crucial outcome for individuals. Few studies reported later outcomes, extending beyond 12 months, and so the late recovery profile for participants is therefore incomplete in this review.

Quality of the evidence

The overall certainty of the evidence for the outcomes in this review was low to very low. This was largely owing to risks of bias in the included studies. Many studies included in this review predate widespread uptake of current standards of reporting, such as preregistration of trial protocols and adherence to the CONSORT statement. It is therefore perhaps not surprising that this is reflected in the grade of the evidence. We judged that many studies were at unclear risk of selection bias because they did not provide information about the allocation methods. Some were at high risk of bias because they used quasi-randomised methods to allocate participants to groups or were reported only in abstracts which we expected were not peer-reviewed. We could not rule out the possibility of selection bias because outcomes were not always reported in abstract publications. We also assessed all studies to be at a high risk of detection bias for the outcome of unplanned return to theatre.

A small number of direct and indirect estimates included inconsistency and we downgraded the certainty of the evidence for this, where appropriate. We could not rule out that variation in fracture stability may have affected the transitivity assumption in the networks, and for some treatments, we downgraded the certainty of the evidence for the network estimate for intransitivity. We did not downgrade the evidence for indirectness (the studies included the relevant population, treatments and outcome measures) and we detected no evidence of publication bias from visual inspection of the comparison-adjusted funnel plots.

Overall, our network for early mortality showed evidence for global incoherence. Through the side-splitting approach, we identified that this was likely driven by studies including long cephalomedullary nails, short cephalomedullary nails and also dynamic fixed plates. However, we were unable to identify any apparent causes for the incoherences. There was no simplification of the network that would address these inconsistencies without removing most of the studies and treatments from the network. Accordingly, we reported the network estimates and note that many were imprecise, with confidence intervals that included clinical benefits as well as possible harms. This reduced our certainty in the estimates for most treatments. Findings from this network should be interpreted cautiously.

Potential biases in the review process

The review authors conducted a thorough search and independently assessed study eligibility, extracted data, and assessed risk of bias in the included studies before reaching consensus together or with one other review author.

Our decisions on lumping/splitting of nodes were necessarily subjective and meant that some studies were inevitably excluded from the networks. This often occurred either because interventions were insufficiently described in study reports, or because studies compared two treatments within a node (such as two different types of dynamic fixed angle plates). However, sometimes this was because investigators had used a pragmatic study design, which included interventions that belonged to more than one of our specified nodes.

We made a decision to include populations with mixed fracture types - for example, stable and unstable trochanteric fractures and subtrochanteric fractures. Fracture type may be an important effect modifier and it may have been distributed unevenly across the comparisons within the networks. We were able to review the distribution of the potential effect modifiers of age, sex and fracture stability as these were sufficiently well reported. Fracture stability did seem to vary across comparisons within networks, but across the entire review there was limited evidence of inconsistency within the networks, excepting that for early mortality.

We recognise that important co-interventions are likely to have been introduced into clinical practice which are not represented in the network. We did note some evidence of global inconsistency, but we did not undertake any exploratory analyses to explore how limiting the included studies may have impacted on our findings, since there seemed little clinical justification for removing specific studies.

In the conduct of this large review, we have chosen to alter or have been unable to deliver all of our planned methods. Given the complexity of the review, the sparsity of many of the networks and the often unclear and high risk of bias of included studies, we chose not to perform any sensitivity analyses. We chose to include only older participants, such that some potentially eligible studies were excluded, but this ensured less variation in age and that the evidence was representative of the target fragility fracture population. During data extraction, it became apparent that multiple time points were reported inconsistently between studies. We chose to create additional networks rather than group widely across time windows. Balancing this against the availability of data, we elected to move away from our prespecified preference for early time points to prioritise the more often reported 12 months' time point.

Agreements and disagreements with other studies or reviews

Few network meta-analyses of treatments for fragility extracapsular hip fracture have been reported. Cheng 2020 is the most comprehensive, including 36 studies and reporting blood loss, operative time and Harris Hip Score. These outcomes did not closely reflect the priorities of patients expressed in the core outcome set development (Haywood 2014). However, the data suggest that any difference in bleeding or operative time between treatments is very small, even if statistically significant, and unlikely to drive clinical decision-making. Similarly, the between-treatment differences in hip function measured using the Harris Hip Score, were very small. The Cheng 2020 review did not report mortality or HRQoL outcomes.

In the preparation of this network meta-analysis, the author team has been involved in the production and updating of a suite of reviews that are relevant to the interpretation of the findings reported here (Lewis 2022a; Lewis 2022c). These reviews also conclude that there is no evidence of any important differences in mortality and unplanned return to theatre from pairwise comparisons of cephalomedullary implants with fixed angle plates or cemented versus uncemented hemiarthroplasty for extracapsular fractures.

An older review from 2006, comparing internal fixation with arthroplasty for extracapsular fractures, was unable to reach clear conclusions regarding the majority of outcomes (Parker 2006). This finding mirrors our network meta-analysis but, importantly, we have been able to provide more precise estimates.

AUTHORS' CONCLUSIONS

Implications for practice

The review includes older adults with both stable and unstable extracapsular fractures. Across the networks, we found that there was considerable variability in the ranking of each treatment such that there was no one outstanding, or subset of outstanding, superior treatments. However, static implants, such as condylocephalic and static fixed angle plates, did yield a higher risk of unplanned return to theatre. We had insufficient evidence to determine the effects of any treatments on health-related quality of life (HRQoL), and this review only includes two outcomes. More detailed pairwise comparisons of some of the included treatments are reported in other Cochrane Reviews in this series. Cephalomedullary nails versus dynamic fixed angle plates contributed the most evidence to each network, and our findings indicate that there may be no difference between these treatments. We did not formally review cost effectiveness studies, but there was no evidence in this review to support the rising worldwide usage of the more expensive cephalomedullary nail over the dynamic fixed angle plate. At this time, there are too few studies to draw any conclusions regarding the benefits or harms of arthroplasty or external fixation for extracapsular fracture.

Implications for research

Hip fracture continues to be a dynamic area within clinical research in trauma and orthopaedic surgery. We have identified 20 ongoing studies with an estimated enrolment of more than 2400 participants. Many of these studies are testing two interventions that we have lumped together within a single node; for example, two cephalomedullary nails from different manufacturers. We consider that such studies are unlikely to generate evidence that advances care for individuals. Three studies are comparing arthroplasty with internal fixation, however the likely impact of this additional evidence may be limited by the small sample size (approximately 140 participants) in these studies (ChiCTR-INR-17011841; JPRN-UMIN000019523; NCT03407131).

However, despite this ongoing research interest, we note that many studies in this review - even those reported more recently - are at unclear or high risk of bias, and we urge authors to report studies in accordance with the CONSORT statement. We also encourage authors to review the core outcome set for hip fracture (Haywood 2014), and to ensure that, at a minimum, data are reported at four months - the time point prioritised by people with hip fracture.

We have shown that static fixed angle implants cause harm compared with dynamic implants, which reflects worldwide practice of a fall in the use of such implants. Thirty-four studies comparing dynamic fixed angle plates with short cephalomedullary nails were included in this review. It is unlikely that additional studies will yield fundamental changes in our knowledge of the outcomes from these major classes of treatments since the precision of the effect estimates in this review are approaching clinically not relevant differences. Therefore, we consider that additional studies of such comparisons are not the best use of scarce research resources.

However, future research should focus on the use of established technologies in this fracture group, particularly focusing on the benefits and harms of arthroplasty interventions compared with internal fixation with a dynamic implant, to properly assess their efficacy prior to any widespread adoption. Based upon our findings, we propose that such a study should be highly pragmatic, allowing surgeons to choose the type of dynamic implant. The evidence from this review suggests that any true difference between fixation implants is very likely to be small. We await the findings of the three such ongoing studies, which together will likely provide sufficient information to plan a definitive, multicentre randomised trial.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Acharya 2003

Study characteristics

Acharya 2003 *(Continued)*

Methods	RCT; parallel design **Review comparison group**: fixed angle plate versus fixed angle plate: keyed (locked) or unkeyed (unlocked)
Participants	**Total number of randomised participants:** 40 **Inclusion criteria:** people who have a proximal femoral fracture **Exclusion criteria:** not reported **Setting:** not reported **Baseline characteristics** **Intervention group 1** (locked) • Age, mean (range): 74.05 (55 to 90) years **Intervention group 2** (unlocked) • Age, mean (range): 78.0 (65 to 97) years **Note:** • study authors did not report baseline characteristics for gender, smoking history, medication, BMI, place of residence, preoperative waiting time, fracture classification
Interventions	**General details:** participants assessed clinically and radiologically postoperatively at 3 months following discharge from hospital **Intervention group 1** • Sliding hip screw in locked (keyed allows sliding but not rotation) mode • Number randomised = 20 **Intervention group 2** • Sliding hip screw in unlocked (unkeyed allows sliding and rotation) mode • Number randomised = 20 **Notes:** • study authors do not report the number of clinicians or their skills and experience, the type of anaesthesia used or the participants pre-/postoperative care • abstract does not report the manufactured of the implants
Outcomes	**Outcomes measured/reported by study authors:** screw slide; fixation failure; VAS **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Notes:** • study is published only as an abstract • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Adams 2001

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma nail versus SHS
Participants	**Total number of randomised participants:** 400 **Inclusion criteria:** diagnosis of intertrochanteric fractured femur **Exclusion criteria:** inability to give informed consent, too frail for any operative intervention, and residence outside the region of the hospital because of the difficulty of follow-up **Setting:** single centre; orthopaedic hospital, UK **Intervention group 1** (Gamma nail) • Age, mean (range): 81.2 (48 to 99) years • Gender, M/F: 39/164 • Mobility assessment, independent/1 stick/2 sticks/walking frame/wheelchair and transfer, n: 88/53/2/32/28 • Place of residence, own home/part IV or relative or home for elderly/acute hospital/nursing home or long stay, n: 104/27/5/67 • Preoperative waiting time, mean (range): 1.7 (1.5 to 1.9) days • Fracture classification, AO/OTA A1.1/A1.2/A1.3/A2.1/A2.2/A2.3/A3.1/A3.2/A3.3/B2.1, n: 41/38/0/27/40/33/2/2/2/18 **Intervention group 2** (DHS) • Age, mean (range): 80.7 (32 to 102) years • Gender, M/F: 49/148 • Mobility assessment, independent/1 stick/2 sticks/walking frame/ wheelchair and transfer, n: 88/48/6/29/26 • Place of residence, own home/part IV or relative or home for elderly/acute hospital/nursing home or long stay, n: 115/27/12/43 • Preoperative waiting time, mean (range): 1.8 (1.6 to 2.1) days • Fracture classification, AO/OTA A1.1/A1.2/A1.3/A2.1/A2.2/A2.3/A3.1/A3.2/A3.3/B2.1, n: 43/29/1/22/50/27/1/4/5/15 **Note:** • study authors do not report baseline characteristics for: smoking history, medications, BMI, comorbidities, cognitive status/dementia or ASA status
Interventions	**General details:** study authors report that surgeons were experienced with both implants; both groups received standard 3-dose IV cefuroxime and routine antithrombotic prophylaxis; clinical follow-up for 1 year or until death (3 months, 6 months, 12 months) **Intervention group 1** • Gamma intramedullary nail (Stryker-Howmedica Ltd, London, UK); short type. Study authors did not report if the lag screw was static or locked; most common implant was the 130-degree by 11 mm nail; distal locking screws were used at the preference of the surgeon • Number randomised = 203; losses = unknown (study authors report one loss but do not report from which study group so we have used all participants in analysis for both groups); analysed = 203 **Intervention group 2** • CHS (Smith & Nephew, UK). The most common implant was the 135-degree, 3-hole plate

Adams 2001 *(Continued)*

- Number randomised = 197; losses = unknown (study authors report one loss but do not report from which study group so we have used all participants in analysis for both groups), analysed = 197

Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; postoperative haemoglobin; tip-apex distance; number of participants transfused; operative fracture of the femur; later fracture of the femur; cut-out of implant; detachment of the plate from the femur; re-operation; deep wound infection; superficial wound infection; DVT; mortality; use of walking aids; place of residence at follow-up; HHS (available at 3, 6, 12 months) **Outcomes relevant to the review:** mortality (12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** quote: "Although none of the authors has received or will receive benefits for personal or professional use from a commercial party related directly or indirectly to the subject of this article, benefits have been or will be received but are directed solely to a research fund, the Scottish Orthopaedic Research Trust into Trauma, a non-profit organisation with which one or more of the authors is associated." **Study dates:** February 1994 to June 1995

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Low risk	Quotes: "At admission, patients were randomized by a closed, opaque envelope method and were assigned to receive either..." Confirmed by Adams in 2001 that "the opaque envelopes were sequentially numbered" - and that there was concealment of allocation.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Quote (from draft report): "The surgeons were experienced in the insertion of both implants".
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Blinding of outcome assessment: HRQoL (detection bias)	Low risk	Quote: "Observed-blinded functional assessments were carried out by the unit research physiotherapist, by use of the Harris hip score."
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most losses were explained by death, which is expected in this population, and losses were reasonably balanced between groups.

Adams 2001 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	Study authors do not report details of pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Adeel 2020

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus DHS
Participants	**Total number of randomised participants:** 68 **Inclusion criteria:** 40 to 75 years of age; presenting with AO type A2 and A3 pertrochanteric fracture of femur diagnosed on history, clinical examination and radiograph **Exclusion criteria:** people with anaesthesia risk; pathological fracture; previous surgical intervention on the affected hip; metabolic bone disease diagnosed on history, clinical examination, baseline investigations, ECG, and radiograph **Setting:** single centre; hospital; Pakistan **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 59.32 (± 2.39) years • Gender, M/F: 25/9 • Fracture classification, A2/A3, n: 17/19 (we noted a discrepancy - reported numbers do not add up to 34) **Intervention group 2** (DHS) • Age, mean (SD): 60.88 (± 12.49) years • Gender, M/F: 22/12 • Fracture classification, A2/A3, n: 15/17 (we noted a discrepancy - reported numbers do not add up to 34) **Note:** • study authors do not report baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status, or preoperative waiting times
Interventions	**General details:** single surgical team; ceftriaxone 1 g given half an hour before surgery, and continued 2 g per day for 3 postoperative days; general or spinal anaesthesia; encouraged to take up ankle and calf exercises from POD1, mobilised non-weight bearing from POD2 depending on physical condition of participant **Intervention group 1:** • PFN; study authors did not report the nail manufacturer, type of lag screw, whether the lag screw was locked or dynamic or the length of the nails • number randomised to group = 34 **Intervention group 2:**

Adeel 2020 *(Continued)*

- CHS; study authors did not report the manufacturer of the extramedullary device
- number randomised to group = 34

Note:

- study authors do not report the skills or experience of surgical team

Outcomes	**Outcomes measured/reported by study authors:** union, operation time, volume of blood loss, complications (infection, non-union, mal-union, and implant failure); functional outcome (using HHS with grades of excellent, good, fair, and poor; and mean scores) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** no funding; study authors declare no conflicts of interest **Study dates:** September 2015 to September 2017 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Agrawal 2017

Study characteristics

Methods	Quasi-randomised; parallel design **Review comparison group**: fixed angle plate versus PFLCP
Participants	**Total number of randomised participants:** 52 **Inclusion criteria:** people who gave consent for inclusion into the study; > 18 years of age; and closed intertrochanteric fractures **Exclusion criteria:** people refusing to give consent; AO type 31A3 fractures; neurovascular injury; open fractures; associated ipsilateral or contralateral major limb injury (including fractures) affecting the treatment or rehabilitation protocol; associated upper limb fractures requiring surgery; major systemic illness (malignancy, chronic kidney, liver disease, etc.) **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (DHS) • Age, mean (range): 55.23 (24 to 76) years • Gender, M/F: 17/9 • Fracture classification, AO classification, 31A1.1/31A1.2/31A1.3 (stable)/31A2.1 (unstable)/31A2.2 (unstable)/31A2.3 (unstable), n: 3/6/4/7/2/4 **Intervention group 2** (PFLCP) • Age, mean (range): 56.46 (23 to 78) years • Gender, M/F: 15/11 • Fracture classification, AO classification, 31A1.1/31A1.2/31A1.3 (stable)/31A2.1 (unstable)/31A2.2 (unstable)/31A2.3 (unstable), n: 4/5/3/7/4/3 **Note:**

Agrawal 2017 *(Continued)*

- study authors reported no baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status/dementia, ASA status, preoperative waiting time

Interventions	**General details:** all surgeries performed on traction table; all surgeries performed by single surgeon; prophylactic antibiotics given preoperatively; mobilisation from POD1, toe-touch weight bearing in DHS group at 7 days and in PFLCP group at least 6 weeks; follow-up at 6, 12, 16, and 24 weeks, and at 3-monthly intervals until radiological union **Intervention group 1:** • Dynamic hip screw (manufacturer details not reported) • Number randomised = 26; no losses; analysed = 26 **Intervention group 2:** • Proximal femur locking compression plate (PFLCP) (manufacturer details not reported but it is highly likely that it is made by Synthes) fixed angle locking plate that allows up to three screws to be inserted into the femoral neck, • Number randomised = 26; no losses; analysed = 26 **Note:** • study authors did not report type of anaesthesia or skills and experience of surgeons
Outcomes	**Outcomes measured/reported by study authors:** duration of surgery; blood loss; need for postoperative blood transfusion; duration of hospital stay; time to radiological union; functional status; significant limb shortening; medialisation of shaft; mortality; complications (septicaemia, DVT, pulmonary embolism, stroke, MI); non-specific hip pain; varus deformity; superficial wound infection; non-union **Outcomes relevant to the review:** mortality **Note:** • time point for mortality is not clearly reported. Study authors report a minimum follow-up of 12 months and we have included this data at 12 months.
Notes	**Funding/sponsor/declarations of interest:** study authors declare no external financial aid was provided with no conflict of interest **Study dates:** June 2011 to June 2013

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Participants selected on odd/even numbers
Allocation concealment (selection bias)	High risk	It is not possible to conceal allocation because of the quasi-randomised methods.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. All surgeries were performed by a single surgeon with no experience reported. We could not be certain whether the surgeon was equally experienced in using both implants.
Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeon is not reported and we could not be certain whether experience comparable for both implants

Agrawal 2017 *(Continued)*

Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Study authors reported that no participants were lost to follow-up.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It was not feasible to effectively assess risk of selective bias without these documents.
Other bias	Unclear risk	We noted differences in the time to weight bearing between the two groups. This could influence outcomes.

Ahrengart 1994

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** intramedullary nail versus SHS
Participants	**Total number of randomised participants:** 492 **Inclusion criteria:** intertrochanteric (stable and unstable) **Exclusion criteria:** subtrochanteric and pathologic fractures, earlier fractures or operations on the same hip, or if the surgeon was unfamiliar with the Gamma nail technique **Setting:** multicentre; 5 hospitals; Sweden and Finland **Baseline characteristics:** only reported for the 426 participants that completed the study (according to linked study report Ahrengart 2002) **Intervention group 1** (Gamma nail) (n = 210) • Age, median (range): females 82 (48 to 96), males 77 (44 to 90) • Gender, M/F: 61/149 • Need for walking aid/wheelchair dependent/bedridden, n: 78/15/3 • Place of residence, live at home: 72% • ASA status, I/II/III/IV: 16/42/34/8% • Fracture classification (Evans as modified by Jensen and Michaelsen), I/II/III/IV/V, %: 16/35/15/16/18 **Intervention group 2** (SHS) (n = 216) • Age, median (range): females 81 (54 to 99) years, males 74 (32 to 98) years • Gender, M/F: 60/156 • Need for walking aid/wheelchair dependent/bedridden: 78/13/7 • Place of residence, live at home: 66% • ASA status, I/II/III/IV: 20/39/36/6% • Fracture classification (Evans as modified by Jensen and Michaelsen), I/II/III/IV/V, %: 18/35/18/19/10 **Notes:** • study authors do not report baseline characteristics for: smoking history, medications, BMI, comorbidities, cognitive status/dementia

Ahrengart 1994 *(Continued)*

- 85% were operated on the day of admittance or the following day; 96% were treated within 2 days

Interventions	**General details:** operations were carried out by surgeons of varying grades from junior resident to staff surgeons, and surgeons were excluded from the trial if not adequately experienced with the Gamma nail; 90% received spinal anaesthesia and 81% received antibiotic prophylaxis, 75% received anticoagulants, 56% received dextran and 18% received heparin or warfarin; compression stockings or other physical preventive measures occasionally used; open reduction in some cases; full weight bearing immediately in 88% of cases **Intervention group 1** • Gamma intramedullary nail; short nails were used for all participants; 12 mm nail used in 73% of participants; 14 mm nail used in 20% of participants; 16 mm nail used in 7%; distal locking in 68% of stable fractures participants and 74% of unstable fractures participants • Randomised = unknown; losses unknown; analysed for mortality = 210; analysed for unplanned return to theatre = 105 **Intervention group 2** • Sliding hip screw (either Richard's Classic, Smith and Nephew or Dynamic Hip Screw, Synthes), 2-hole plates were used in 5%, 4-hole plates were used in 67%, 5-hole plates were used in 20%, 6-hole plates were used in 7%, and 8- or 10- hole plates were used in 2% • Randomised = unknown; losses unknown; analysed for mortality = 216; analysed for unplanned return to theatre = 104 **Note:** • study authors did not report: type of anaesthesia, pre- and postoperative use of prophylactic antibiotics and antithromboembolics, time to mobilisation or weight bearing • 66 participants were lost to follow-up because of advanced age, other physical illness or dementia. These participants were excluded from analysis. It is not clear how many were initially randomised to each group, and to which group these lost participants belonged.
Outcomes	**Outcomes measured/reported by study authors:** LOS, residence at 6 months, lag screw position, length of skin incisions, operative time, blood loss, transfusion, superficial wound infection, deep wound infection, operative fracture of femur, fracture reduction, screw cut out, mortality, femoral medialisation (sliding of lag screw), lateral pain over the femoral head screw, pain at the top of the greater trochanter, thromboembolic complication (DVT, PE); clinical complications (pneumonia); shortening of leg; return to pre-fracture residential status; use of walking aids; length of skin incision; all 6 months **Outcomes relevant to the review:** mortality (6 months); unplanned return to theatre (reported as revision, 6 months)
Notes	**Funding/sponsor/declarations of interest:** supported by grants from the Karolinska Institute Foundation, Lund University, Skane County Council and Stryker-Howmedica **Study dates:** not reported **Note:** • there are multiple publications for this study. The 2002 paper by Ahrengart et al has data from all 5 centres, but has less detail than some earlier reports. Given the absence of information on 66 participants lost to follow-up in this report and some lack of clarity or potential inconsistencies with the 2-centre study regarding surgical experience, trial inclusion criteria, outcome definitions and some results, we have mostly used data from the Fornander 1994 publication. We have reported the baseline data from Ahrengart 2002 as well as outcome data for mortality and mobility.

Risk of bias

Bias	Authors' judgement	Support for judgement

Ahrengart 1994 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Randomised by consecutively opened sealed envelopes; no additional details
Allocation concealment (selection bias)	Low risk	Quote: "Randomization was achieved using sealed envelopes in numerical order before the patient was taken to the operating room."
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Surgery was done by various orthopaedic surgeons from junior residents to staff surgeons, and surgeons were excluded from trial participation if unfamiliar with the Gamma nail technique.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	Surgery was done by various orthopaedic surgeons from junior residents to staff surgeons, and surgeons were excluded from trial participation if unfamiliar with the Gamma nail technique.
Incomplete outcome data (attrition bias) All outcomes	High risk	We could not adequately assess risk of attrition bias because findings were reported by different trial centres at different points in time, and we noted variation in numbers of lost participants which were not sufficiently explained.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trial register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Akhtar 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA vs DCS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** people with unstable proximal femur fracture of 31A2 and 31A3 within 7 days of fracture; 40 to 70 years of age; either gender **Exclusion criteria:** people with 31A1 type fracture, pathological fractures, presence of neurovascular injury, inability to walk before injury, significant medical comorbidity such as diabetes mellitus; not fit for anaesthesia **Setting:** hospital; single centre; Pakistan **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD): 55.4 (± 7.89) years

Akhtar 2016 *(Continued)*

	• Gender, M/F: 17/13 • Fracture classification, 31A2/31A3, n: 21 (70%)/ 9 (30%) **Intervention group 2** (DCS) • Age, mean (SD): 55.53 (± 7.7) years • Gender, M/F: 18/12 • Fracture classification, 31A2/31A3, n: 22 (73.33%)/ 8 (26.67%) **Note:** • study authors did not report baseline characteristics for smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status, preoperative waiting times
Interventions	**General details:** study authors reported no treatment details **Intervention group 1** • PFNA; study authors do not report the length or diameter of cephomedullary nails used • Number randomised = 30 **Intervention group 2** • DCS • Number randomised = 30
Outcomes	**Outcomes measured/reported by study authors:** union time **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** September 2015 to March 2016 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Akinci 2010

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus AP
Participants	**Total number of randomised participants:** 262 **Inclusion criteria:** people with trochanteric fractures of the femur and underwent surgical treatment **Exclusion criteria:** not reported **Setting:** single site; hospital; Turkey **Baseline characteristics** **Intervention group 1** (DHS) • Age, mean: 65.6 years • Gender, M/F: 49/33

Akinci 2010 *(Continued)*

- Preoperative waiting time, mean (range): 5.2 (2 to 12) days
- Fracture classification, Boyd and Griffin, Type I (stable)/Type II (stable)/Type II (unstable)/Type III (unstable)/Type IV (unstable), n: 12/25/2/34/9

Intervention group 2 (AP)

- Age, mean: 67.2 years
- Gender, M/F: 44/31
- Preoperative waiting time, mean (range): 5 (2 to 9) days
- Fracture classification, Boyd and Griffin, Type I (stable)/Type II (stable)/Type II (unstable)/Type III (unstable)/Type IV (unstable), n: 29/13/7/18/8

Note:

- study authors did not report baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status

Interventions	**General details:** traction applied to 53.5% participants. Participants in DHS group allowed to sit after 24 hours postoperatively, walk with crutches without weight bearing on POD 6 to 10, partial weight bearing weeks 4 to 6, full weight bearing weeks 8 to 12. Participants in AP group allowed to sit at 48 hours, walk on crutches without weight bearing on POD 10, partial weight bearing weeks 8 to 12, full weight bearing weeks 12 to 16 **Intervention group 1:** • 135° dynamic hip screw (manufacturer not reported) • Number randomised = unknown; losses = 17 (death); analysed = 82 **Intervention group 2:** • 130° angled blade plate (manufacturer not reported) • Number randomised = unknown; losses = 22 (death), analysed = 75 **Note:** • study authors did not report the number of clinicians (and their skills and experience); type of anaesthesia; pre- and postoperative care (e.g. use of prophylactic antibiotics or antithromboembolics); rehabilitation (e.g. time to mobilisation or weight bearing) • number of losses is unknown. Study reported data for only 157 participants who could be reached and followed-up over a long period of time
Outcomes	**Outcomes measured/reported by study authors:** length of hospital stay; mortality (available at 12 months and 5 years); infection necessitating removal of implant; infection responding to medical treatment; DVT; severe pulmonary embolism; additional fixation; other organ injuries (multiple rib fractures, ischium-pubis fracture, ipsilateral femoral shaft fracture, colles fracture, radius and ulna forearm fracture, tibial condyle fracture and vertebral body fracture); complications (shortening, varus deformity, femoral head perforation, acetabular protrusion, device breakage, pseudoarthrosis, avascular necrosis, malunion, rotational deformity, re-operation (follow-up time unknown), partial prosthesis, total prothesis, hip movement restriction); position of screws; Foster's anatomical ranking (excellent, good, moderate and bad); Clawson functional classification (excellent, good, moderate and bad) **Outcomes relevant to the review:** mortality (reported at 12 months and 5 years); re-operation (follow-up time unknown)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** September 1988 to June 2002

Risk of bias

Bias	Authors' judgement	Support for judgement

Akinci 2010 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Although interventions are described as being randomly assigned, method of randomisation is not reported.
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors did not report skills and experience of surgeons and we could not be certain that experience was comparable for both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	We assumed that there were no additional losses other than for death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It was not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Unclear risk	We noted differences in criteria for postoperative mobilisation and weight bearing between the groups, and we could not be certain whether these differences could influence outcomes.

Aktselis 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** short intramedullary Gamma nail versus SHS (AMBI)
Participants	**Total number of randomised participants:** 80 **Inclusion criteria:** an unstable 31.A2.2 or 31.A2.3 (but not 31.A2.1) fracture type according to the AO/OTA classification, > 65 years old **Exclusion criteria:** bilateral fractures, pathologic fractures, previous chemotherapy or radiotherapy, or both, rheumatic diseases, polytrauma, a previous operation in the same hip/femur and an ASA score of IV or V **Setting:** single centre; hospital; Greece **Baseline characteristics** (only for analysed participants) **Intervention group 1** (Gamma nail)

Aktselis 2014 *(Continued)*

- Age, mean (SD): 82.9 (± 5.8) years
- Gender, M/F: 8/28
- ASA status, I/II/III/IV: 2/20/14/0

Intervention group 2 (SHS)

- Age, mean (SD): 83.1 (± 6.5) years
- Gender, M/F: 7/28
- ASA status, I/II/III/IV: 2/27/6/0

Note:

- study authors did not report smoking history, medication, BMI, preoperative waiting time, comorbidities, mobility, place of residence

Interventions	**General details:** fracture table; spinal anaesthesia; single dose antibiotics preoperatively continued 48 hours; no suction drain; mobilisation with a walker and weight bearing as tolerated and assessment of postoperative X-rays; all operations supervised by consultant orthopaedic surgeons familiar with both procedures; clinical follow-up at 1, 3, 6 and 12 months **Intervention group 1** • Short intramedullary Gamma nail (Stryker, Schönkirchen, Germany); 125 degree nail (except for 3 cases with 130 degree); study authors did not comment on whether the lag screw was static or dynamic or on the configuration of distal locking • Randomised = 40; losses = 4 (death); analysed at 12 months = 36 **Intervention group 2** • SHS (AMBI, Smith & Nephew, Memphis, USA); 3- or 4-hole plates • Randomised = 40; losses = 5 (death); analysed at 12 months = 35 **Note:** • study authors did not report details of preoperative procedure
Outcomes	**Outcomes measured/reported by study authors:** mobility (available at 1, 3, 6 and 12 months); daily function - Barthel Index (available at 1, 3, 6 and 12 months); EQ-5D - HRQoL (available at 1, 3, 6 and 12 months); mortality; duration of surgery; radiation time; LOS; hip pain; mechanical failure; cut-out; non-union; fracture (intraoperative and late); fixation failure; infection; re-operation **Outcomes relevant to the review:** HRQoL (EQ-5D, 3 & 12 months); unplanned return to theatre (described as cut outs necessitating re-operation; 12 months); mortality (12 months) **Note:** • study authors reported data for HRQoL at 3 months without denominators and we did not include these data in meta-analysis.
Notes	**Funding/sponsor/declarations of interest:** funding not reported. Study authors declare no conflicts of interest **Study dates:** October 2008 until January 2011

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Envelopes were picked from a box, however method of sequence generation is not described

Aktselis 2014 *(Continued)*

Allocation concealment (selection bias)	Low risk	Quote: "Sealed, opaque envelopes picked from a box in the presence of 3 surgeons"
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Operations supervised by 4 consultant surgeons with experience in both techniques
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Blinding of outcome assessment: HRQoL (detection bias)	Low risk	We did not expect lack of blinding to influence participant-reported outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few losses, which were balanced between groups and explained by death, which is expected in this population
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trial register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Andalib 2020

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: cephalomedullary nail vs DHS and DCS
Participants	**Total number of randomised participants:** 113 **Inclusion criteria:** unstable intertrochanteric fractures, candidate for extramedullary or intramedullary surgery, ability to walk without any assistance before the fracture, signed informed consent **Exclusion criteria:** uncontrolled diabetes mellitis, using immunosuppressive drugs, any kind of malignancies as well as those who refused to continue the trial **Setting:** multi-centre; 2 trauma centres; Iran **Baseline characteristics** (data only for those not lost to follow-up/excluded) **Intervention group 1** (intramedullary)

Andalib 2020 *(Continued)*

- Age, mean (SD): 64.4 (± 15.5) years
- Gender, M/F: 17/21
- BMI, mean (SD): 25.17 (± 4.7) kg/m^2
- Additional information:
  - LEM, mean (SD): 71.24 (± 9.3)

Intervention group 2 (extramedullary)

- Age, mean (SD): 61.45 (± 17.0) years
- Gender, M/F: 26/29
- BMI, mean (SD): 25.03 (± 3.9) kg/m^2
- Additional information:
  - LEM, mean (SD): 70.65 (± 9.8)

Note:

- study authors reported no baseline data for: smoking history, medication, comorbidities, place of residence, cognitive status, ASA status, fracture classification, preoperative waiting times

Interventions	**General details:** no details **Intervention group 1:** • Cephomedullary nail (supplied by Osveh Asia Medical Instrument Company, Mashhad, Iran). Study authors did not report the manufacturer, length of the nail, details about the lag screw or the configuration of distal locking • Number randomised to group = 43; losses = 5 (3 died; 2 unable/unwilling to continue); analysed at 12 months = 38 **Intervention group 2:** • Mix of DHS and DCS (supplied by Osveh Asia Medical Instrument Company, Mashhad, Iran) • Randomised = 70 (51 DHS, 19 DCS); losses = 15 (6 died and 5 unable/unwilling to continue in DHS; 2 died and 2 unable/unwilling to continue in DCS); analysed = 55 (40 DHS; 15 DCS) **Note:** • study authors do not explain why 2 different types of extramedullary implant are used, and we note that these devices are not equally balanced between participants in this group • study authors report no surgical management information for: number of clinicians (and their skills and experience), type of anaesthesia, pre- and postoperative care (e.g. use of prophylactic antibiotics or antithromboembolics), rehabilitation (e.g. time to mobilisation or weight bearing)
Outcomes	**Outcomes measured/reported by study authors:** ADL (using LEM score; measured at baseline, 1, 3, 6 and 12 months after surgery); device failure (cut out, migration of screw, breakage of implant); need for re-operation; fracture union; limb shortening; return to previous level of activity (before fracture); superficial and deep infections; mortality **Outcomes relevant to the review:** mortality (12 months), unplanned return to theatre (reported as re-operation; at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** March 2016 to June 2018

Risk of bias

Bias	Authors' judgement	Support for judgement

Andalib 2020 *(Continued)*

Random sequence generation (selection bias)	Low risk	Quote: "Randomization into the groups was performed using stratification and blocking methods"
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	We did not expect lack of blinding of surgeons to influence performance and outcome data for this review.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors did not describe how many surgeons were involved in the study and whether they were equally experienced with the types of implants used in this study.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most losses were explained by death which is expected in this population. Other losses (due to being unable or unwilling to continue in the study) were few and were reasonably balanced between study groups.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trial register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Andreani 2015

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: intramedullary nail versus intramedullary nail: Gamma 3 or ENDOVIS nail
Participants	**Total number of randomised participants:** 81 **Inclusion criteria:** > 65 years of age; with a pertrochanteric fracture (31A1 and 31A2) after a low-energy trauma **Exclusion criteria:** people who had pathological fractures; high-energy trauma; 31A3 fractures; those who were not walking; < 65 years of age **Setting:** single centre; hospital; Italy **Baseline characteristics** **Intervention group 1** (Gamma 3 nail) • Age, mean: 81.1 years • Gender, M/F: 16/25

Andreani 2015 *(Continued)*

- ASA status, I/II/III/IV/V, n: 5/10/20/7/4
- Fracture classification, A1/A2, n: 26/15

Intervention group 2 (ENDOVIS nail)

- Age, mean: 80.7 years
- Gender, M/F: 18/22
- ASA status, I/II/III/IV/V, n: 4/11/18/5/2
- Fracture classification, A1/A2, n: 24/16

Note:

- study authors report no baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status/dementia, preoperative waiting time

Interventions	**General details:** prophylactic IV second-generation cephalosporin administered preoperatively and continued until 24 hours postoperatively; heparin was received for 5 weeks postoperatively; all surgery performed by the same group of trauma surgeons; all operations done on traction table in supine position; mobilisation on POD1, with weight bearing as tolerated on POD2 **Intervention group 1** • cephalomedullary nail - Gamma nail (Synthes); 180 mm length, single dynamic lag screw; 17 mm proximal diameter, 11 mm distal diameter; 1 transverse distal locking screw and 12 mm diameter lag screw • number randomised = 41; losses = 5 (reasons not clearly reported); analysed for HRQoL = 36 **Intervention group 2** • cephalomedullary nail - Endovis (Citieffe); total length of 195 mm; proximal diameter 13 mm, distal diameter 10 mm; two holes for dynamic cephalic screw insertion, one distal locking screw • number randomised = 40; losses = 12 (reasons not clearly reported); analysed for HRQoL = 28 **Note:** • study authors do not report type of anaesthesia, and the skills and experience of surgeons. • reasons for losses are not specified by group. Overall, 3 participants were lost to follow-up, and 14 died.
Outcomes	**Outcomes measured/reported by study authors:** serum haemoglobin level; mobility status; hospitalisation; mortality (available at 12 months); functional status (ADL, mobility score and HRQoL); radiographical findings; fracture healing; EQ-5D (available at 1, 3, 6 and 12 months); DVT **Outcomes relevant to the review:** mortality (reported at 12 months); EQ-5D (reported at 12 months) **Note:** • we were unable to use mortality data because study authors only reported overall data.
Notes	**Funding/sponsor/declarations of interest:** study authors report "no conflicts of interest of interest to disclose" **Study dates:** March 2012 to June 2013 **Note:** • We did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Bajpai 2015

Study characteristics	
Methods	Quasi-randomised trial; parallel design **Review comparison group**: screw PFN versus helical PFN
Participants	**Total number of randomised participants:** 77 **Inclusion criteria:** skeletally-mature participants > 50 years of age; new mobility score of 9 (Palmer and Parker 1993); closed unstable trochanteric fracture classified as AO 31A2 and A3 **Exclusion criteria:** immature skeleton; pathological fracture of any cause other than osteoporosis, open fractures, inability to walk independently prior to injury event **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (screw PFN) • Age, mean: 69.1 years • Gender, M/F ratio: 1:2 • Preoperative waiting time, mean: 6.12 days • Fracture classification, 31A2/31A3, n: 28/12 **Intervention group 2** (helical PFN) • Age, mean: 71.2 years • Gender, M/F: 9/28 • Preoperative waiting time, mean: 5.90 days • Fracture classification, 31A2/31A3, n: 27/10 **Note:** • study authors report no data for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status
Interventions	**General details:** all operations were performed on fracture table in supine position under general anaesthesia; crutch walking with partial weight bearing was allowed after 48-hour drain removal; suture was removed on 12th day **Intervention group 1** • Proximal femoral nail (PFN) screw (manufacturer not reported), fixed with two dynamic cephalic screws and distal locking • Number randomised = 40 **Intervention group 2** • Proximal femoral nail (PFN) helical blade (manufacturer not reported), fixed with dynamic cephalic helical blade and distal locking • Number randomised = 37 **Note:** • study authors did not report the number of clinicians (or their skills and experience), and use of prophylactic antibiotics or antithromboembolics
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss; duration of hospitalisation; time before operation; HHS; time to union **Outcomes relevant to the review:** none

Bajpai 2015 *(Continued)*

	Note: • study authors did not include date on mortality, HRQoL or unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** June 2008 to August 2011 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Bannister 1990

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus Jewett nail plate
Participants	**Total number of randomised participants:** 155 **Inclusion criteria:** > 64 years of age; trochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre, hospital, UK **Baseline characteristics** **Overall:** • Age, mean (SD): 80 (65 to 101) years **Note:** • study authors report no baseline characteristics for: gender, smoking history, medication, comorbidities, mobility assessment, place of residence, BMI, preoperative waiting time, fracture classification
Interventions	**General details:** 95% of procedures were carried out by orthopaedic residents; neither antibiotic nor antithromboembolic prophylaxis was used routinely; the postoperative management was identical in both participating institutions; weight bearing after 2 days; participants were reviewed 2, 4 and 12 months after fracture **Intervention group 1:** • Dynamic Hip Screw; 135 degree AO • Number randomised = not reported **Intervention group 2:** • Jewett Nail Plate (type of fixed angle blade plate) • Number randomised = not reported **Note:** • 3% lost to follow-up; 55 participants died within 12 months; not reported by group; 95 participants overall were followed-up

Bannister 1990 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** pain; mobility; manner of walking; social independence; deep infection; superficial infection; failed union; mortality (available at 12 months); mechanical failures; unplanned return to theatre (available at 12 months) **Outcomes relevant to the review:** none **Note:** • we did not include mortality data because this was reported overall and not by group • we did not include unplanned return to theatre data because we could not be certain if this was complete or if it was just for some individual cases
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 1981 **Note:** • we did not conduct risk of bias assessment because we were unable to include outcome data in the review

Barrios 1993

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Ender Nails versus SSP
Participants	**Total number of randomised participants:** 149 recruited; 92 reported **Inclusion criteria:** > 50 years of age, trochanteric hip fractures **Exclusion criteria:** not reported **Setting:** single centre; hospital; Spain **Baseline characteristics (only participants completing follow-up are reported)** **Intervention group 1** (Ender) • Age, mean (range): 74 (52 to 93) years • Gender, M/F: 12/24 • Mobility assessment, no aids/some support: 19/17 • Fracture classification, stable/unstable, n: 18/18 **Intervention group 2** (SSP) • Age, mean (range): 75 (54 to 90) years • Gender, M/F: 17/39 • Mobility assessment, no aids/some support: 36/20 • Fracture classification, stable/unstable, n: 24/32 **Overall:** • Age, average: 75 years • Fracture classification, stable/unstable, n: 42/50 **Note:**

Barrios 1993 *(Continued)*

	• study authors reported no details on: age; gender; smoking history; medication; BMI; comorbidities; place of residence; cognitive status; ASA status; preoperative waiting time
Interventions	**General details:** not reported **Intervention group 1:** • Ender nails (no further implant details reported) • number randomised = 36 **Intervention group 2:** • SSP (no further implant or technique details reported) • number randomised = 56
Outcomes	**Outcomes measured/reported by study authors:** quality of reduction; healing status; implant failures; pain; mobility **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** no details on funding or conflict of interest were reported **Study dates:** June 1982 to May 1985 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Barton 2010

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** long Gamma intramedullary nail versus SHS
Participants	**Total number of randomised participants:** 210 **Inclusion criteria:** > 18 years of age; AO/OTA 31-A2 fracture of the proximal part of the femur **Exclusion criteria:** pathological fractures; previous proximal femoral fractures; reverse oblique fractures (AO/OTA 31-A3), decision by surgeon not to include individual in the study **Setting:** single centre; orthopaedic hospital; UK **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean (range): 83.1 (42 to 99) years • Gender, M/F: 19/81 • Cognitive status, Mini-mental score, 10 points/<10, n: 45/55 • ASA status, I/II/III/IV: 0/47/49/4 **Intervention group 2** (SHS) • Age, mean (range): 83.3 (56 to 97) years • Gender, M/F: 25/85 • Cognitive status, Mini-mental score, 10 points/<10, n: 67/43 • ASA status, I/II/III/IV: 2/46/59/3

Barton 2010 *(Continued)*

	Overall: • Age, mean (range): 83.2 (42 to 99) years • Gender, M/F: 44/166 • Cognitive status, Mini-mental score, 10 points/<10, n: 112/98 • ASA status, I/II/III/IV: 2/93/108/7 **Note:** • study authors did not report smoking history; medication; BMI; preoperative waiting time; comorbidities; mobility; place of residence • study authors reported no significant difference with baseline characteristics (except for mini mental test score)
Interventions	**General details:** traction table; aspirin and thromboembolism-deterrent stockings for thromboprophylaxis; mobilisation with weight bearing; clinical follow-up at 3, 6 and 12 months; 32 consultant orthopaedic surgeons all had experience with both techniques **Intervention group 1** • Long Gamma intramedullary nail; 130 degree nail; distal locking with 2 screws • Randomised = 100; 2 died prior to surgery; 65 followed up at 12 months (losses due to 32 deaths and 3 re-operations) **Intervention group 2** • SHS; 4 hole; 135 degree plate • Randomised = 110; 86 followed up at 12 months (losses due to 24 deaths and 2 re-operations)
Outcomes	**Outcomes measured/reported by study authors:** number of participants transfused; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union; deep wound infection; re-operation; LOS; mortality; change in mobility score (measured on a 5-point ordinal scale); change in residential status (measured on a 5-point ordinal scale); quality-adjusted life-years (EQ-5D scores); length of follow-up: 12 months **Outcomes relevant to the review:** mortality; unplanned return to theatre (12 months) **Note:** • study authors collected data for HRQoL (EQ-5D) but did not report these data
Notes	**Funding/sponsor/declarations of interest:** no external funding **Study dates:** April 2003 to April 2006 (from trial registration documents) **Notes:** • significance testing was corrected for a significantly higher proportion of participants with a lower mini-mental score in the nail group • information on methods and extra data received from lead study author (5 May 2010)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Sequence generation was prepared by a medical statistician and we assumed that this was done adequately and independently.
Allocation concealment (selection bias)	Unclear risk	Quote: "Randomization was carried out with use of sealed envelopes generated by a medical statistician. Once a patient was considered to be appropri-

Barton 2010 *(Continued)*

		ate for inclusion, consent was obtained. An envelope was then selected and opened at a daily trauma meeting." Comment: study authors do not report if envelopes were opaque or sequentially-numbered.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	All 32 surgeons were experienced with both implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most losses were explained by death, which is expected in this population, and were reasonably balanced between groups.
Selective reporting (reporting bias)	Unclear risk	Retrospective trial registration document (ISRCTN79362886; received in March 2009). It is not feasible to use these retrospective documents to effectively assess risk of selective reporting bias.
Other bias	Low risk	We identified no other sources of bias.

Barwar 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus DHS: conventional side plate or locking side plate
Participants	**Total number of randomised participants:** 50 **Inclusion criteria:** people with intertrochanteric fracture; people who gave written and informed consent for the surgery **Exclusion criteria:** not reported **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (conventional DHS) • Age, average: 53.48 years • Gender, M/F: 10/15 • Preoperative waiting time: within 48 hours of admission • Fracture classification, 31A1/31A2/31A3, n: 11/8/6

Barwar 2014 *(Continued)*

	Intervention group 2 (DHS with locking side plate) • Age, average: 52.30 years • Gender, M/F: 8/17 • Preoperative waiting time: within 48 hours of admission • Fracture classification, 31A1/31A2/ 31A3, n: 0/22/3 **Note:** • study authors report no baseline characteristics for smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status
Interventions	**General details:** a single injection of cephazolin was given 30 minutes before incision as prophylaxis; all participants were placed in supine position on a traction table under spinal or general anaesthesia; postoperatively, weight bearing on tolerance was allowed in both groups; full weight bearing was not allowed in both groups till good amount of fracture consolidation; participants were followed up at 6 weeks, 12 weeks, 6 months and 1 year **Intervention group 1:** • Dynamic hips screw (manufacturer not reported) • Number randomised = 25 **Intervention group 2:** • Dynamic hip screw (manufacturer not reported) locking screws used in combi plate • Number randomised = 25 **Note:** • study authors did not report data on the number of clinicians or their skills and experience
Outcomes	**Outcomes measured/reported by study authors:** mobility; rate of restoration; TAD; angle of anteversion restoration; fracture union duration; deep infection; avascular necrosis; DVT; unplanned return to theatre **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months) **Note:** • overall, 4% had unplanned return to theatre. We could not use these data because study authors did not specify these data by group.
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Baumgaertner 1998

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** IMHS versus SHS

Baumgaertner 1998 *(Continued)*

Participants	**Total number of randomised participants:** 131; 135 trochanteric femoral fractures (4 of these were fractures which occurred several months later in the same participants)
	
	Inclusion criteria: intertrochanteric fracture
	
	Exclusion criteria: pathological fractures
	
	Setting: 2 orthopaedic hospitals; USA
	
	Baseline characteristics (overall)
	
	• Age, mean (range): 79 (40 to 99) years
	• Gender, M/F: 45/86
	
	Baseline characteristics
	
	Intervention group 1 (hip screw)
	
	• Mobility assessment:
	  ◦ Barthel Index > 90: 54%
	  ◦ community ambulators: 54%
	• Fracture classification, stable/unstable, n: 30/37
	
	Intervention group 2 (SHS)
	
	• Mobility assessment,
	  ◦ Barthel Index > 90: 74%
	  ◦ community ambulators: 70%
	• Fracture classification, stable/unstable, n: 35/33
	
	Note:
	
	• study authors did not report smoking history; medication; BMI; preoperative waiting time; comorbidities; mobility; place of residence

Interventions	**General details:** antibiotic and DVT prophylactic; weight bearing according to individual participant characteristics (17 allowed weight bearing as tolerated, 107 restricted to partial weight bearing); surgical experience: Gamma nail: familiar with Intramedullary nailing but not the Gamma nail; SHS routine; surgery by residents under supervision, 30 participating surgeons (all had been using SHS, but had not used the IMHS); clinical follow-up at 6 weeks, 3, 6, 12 and 24 months **Intervention group 1** • IMHS (Smith and Nephew), nail length 21 cm; diameter 12 to 16 mm; 37 of the 67 screws were distally locked • Randomised = 67; analysed for mortality = 65 **Intervention group 2** • SHS; 3- to 8-hole plates • Randomised = 68; analysed for mortality = 66
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; transfusion; radiographic screening time; operative fracture of the femur; later fracture of the femur; cut-out of implant; wound haematoma; major medical complication; LOS; hospital charges; mortality; hip pain at follow-up; return to pre-fracture residence; patient mobility; length of follow-up: mean 28 months (range 4 to 54 months) **Outcomes relevant to the review:** mortality (12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported

Baumgaertner 1998 *(Continued)*

Study dates: March 1992 to March 1994

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Use of sealed envelopes, but method of sequence generation is not reported
Allocation concealment (selection bias)	Low risk	Quote: "two hundred sealed opaque envelopes were randomly (cards were shuffled) assigned to either the IMHS or CHS, and numbered in sequential order, after enrolment in the study the next envelope was opened to reveal the device selected for the patient, no one was aware of the next upcoming device."
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	All participating attending surgeons had been using SHS before the start of the study, and although they were familiar with nailing, they previously had not used the IMHS.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced between groups and were mostly explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trial register or reference for a pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Benum 1994

Study characteristics

Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus CHS **Note:** • this study included multiple interim reports and abstracts. For the overall number of randomised participants, we used the publication that had the highest number of participants because we expected that this was a summary of the completed study. We also used this report for the number of randomised participants per group and for unplanned return to theatre data. However, this report was an abstract with very limited detail. For adverse event data, we used data from an earlier abstract with 460 participants.
Participants	**Total number of randomised participants:** 912

Benum 1994 *(Continued)*

Inclusion criteria: trochanteric and subtrochanteric proximal femoral fractures. One study publication referred to the Jensen and Zickel classifications and tabulated stable, unstable and subtrochanteric fractures (Aune 1994).

Exclusion criteria: not reported

Setting: orthopaedic hospitals, Norway

Baseline characteristics (overall)

- Age, mean (range): not stated (of 378: mean 81 years; range 45 to 96 in Aune 1994)
- Gender, M/F: not stated (41% in Aune 1994)

Note:

- we have only reported baseline data as described in the previous version of this study. The abstract for 912 participants did not report baseline data.

Interventions	**General details:** surgical experience is unknown for all centres but for a subgroup in 1 centre (Aune 1993) **Intervention group 1** • Gamma intramedullary nail (Howmedica). Short nails were used in all cases; study authors did not report if the lag screw was static or dynamic; distal locking was used in 119 of 177 and no distal locking was used in 58 of 177 • Randomised = 435; losses = unknown; analysed for unplanned return to theatre = 429 **Intervention group 2** • CHS (Smith and Nephew) • Randomised = 477; losses = unknown; analysed for unplanned return to theatre = 467
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; operative fracture of the femur; later fracture of the femur; cut-out of implant (fracture dislocation); non-union (fracture healing); re-operation; wound infection; DVT; PE; length of hospital stay; mortality; institutional stay; walking function **Outcomes relevant to the review:** mortality; unplanned return to theatre (reported as re-operation; 6 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 1990 to 1992

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	Quote: "The randomization was done by drawing on among mixed envelopes containing information allocating the patient to either treatment." Comment: study authors do not report if envelopes are sealed, sequentially-numbered or opaque
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.

Benum 1994 *(Continued)*

Other performance bias: surgeon experience of both implants	High risk	Report from one centre (Aune 1994) refers to treatment by "younger surgeons" and in consequence that "the learning curve becomes important". We have assumed from this information that surgeons may not be equally experienced using both implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	High risk	Because studies are reported in numerous abstracts with interim publications and later publications for only subsets of participants, we were concerned that attrition was not well-explained or justified.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	High risk	For most data, we have used information reported in an abstract, which we expected was not peer-reviewed and likely at high risk of bias.

Berger-Groch 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: 2-screw cephalomedullary nail versus single-screw cephalomedullary nail: InterTan or Gamma 3
Participants	**Total number of randomised participants:** 104 **Inclusion criteria:** skeletally-mature participants with a displaced intertrochanteric fracture **Exclusion criteria:** pathological fractures; previous ipsilateral fracture treatment; acute neurologic or psychiatric disorders **Setting:** single centre; hospital; Germany **Baseline characteristics** **Intervention group 1** InterTan • Age, mean (SD): 81.6 (± 9.4) years • Gender, M/F: 12/43 • ASA status, mean (SD): 2.7 (± 0.6) • Preoperative waiting time, mean (SD): 22.3 (± 16.7) hours • Fracture classification, A1.1/A2.1/subtrochanteric fracture, n: 14/31/7 **Intervention group 2** Gamma 3 nail • Age, mean (SD): 82 (± 9.2) years • Gender, M/F: 12/37 • ASA status, mean (SD): 2.7 (± 0.5)

Berger-Groch 2016 *(Continued)*

- Preoperative waiting time, mean (SD): 18.4 (± 14.9) hours
- Fracture classification, A1.1/A2.1/subtrochanteric fracture, n: 14/31/7

Overall: IT + G3

- Age, mean (SD): 81.8 (± 9.2) years
- Gender, M/F: 24/80
- ASA status, mean (SD): 2.7 (± 0.5)
- Fracture classification, A1.1/A2.1, n: 28/62

Note:

- study authors did not report baseline characteristics for smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia

Interventions	**General details:** full weight bearing was achieved earlier in the IT group collective (IT group: 3.0 ± 1.6 days, G3 group: 12.9 ± 0.7 days; P = 0.03) **Intervention group 1:** 2-screw • InterTan (Smith and Nephew), integrated 2-screw cephalic screw • Number randomised = 55 **Intervention group 2:** single screw • Gamma third-generation cephalomedullary nail (Stryker), single screw • Number randomised = 49 **Note:** • neither length nor distal locking reported for either implant
Outcomes	**Outcomes measured/reported by study authors:** time to surgery; hospital stay; surgery time; x-ray; ICU stay; mortality (available in hospital, 6 months and at 5 years); HRQoL (using SF-36; available at hospital discharge, 6 weeks, 3 months and 6 months); HHS **Outcomes relevant to the review:** mortality (reported at 6 months and 5 years); SF-36 (reported at 3 months and 6 months) **Note:** • we did not include data for unplanned return to theatre because we could not be certain if these were reported only for some cases • data were reported without denominator values and we could not include these data in the review
Notes	**Funding/sponsor/declarations of interest:** funding not reported. Study authors report no conflicts of interest **Study dates:** 2009 to 2010 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Bridle 1991

Study characteristics	
Methods	RCT; parallel design

Bridle 1991 *(Continued)*

	Review comparison group: Gamma intramedullary nail versus DHS
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** intertrochanteric proximal femoral fractures **Exclusion criteria:** < 60 years of age **Setting:** single centre; hospital; UK **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean: 81 years • Gender, M/F: 9/40 • Cognitive status, mental test score, mean: 7 • ASA status, I/II/III/IV: 2/23/20/4 • Fracture classification, stable/unstable, n: 18/31 **Intervention group 2** (DHS) • Age, mean: 82.7 years • Gender, M/F: 7/44 • Cognitive status, mental test score, mean: 7 • ASA status, I/II/III/IV: 2/22/16/11 • Fracture classification, stable/unstable, n: 23/28 **Note:** • study authors did not report smoking history; medication; BMI; preoperative waiting time; comorbidities; mobility; place of residence
Interventions	**General details:** 4 senior surgeons experienced with closed nailing techniques; general anaesthesia (n = 87), spinal anaesthesia (n = 13); clinical follow-up 6 months **Intervention group 1** • Gamma intramedullary nail; all nails were short cephalomedullary nails. All lag screws were dynamic and distal locking was not used in any cases • Randomised = 49; all losses due to death; analysed = 49 **Intervention group 2** • DHS (Straumann) • Randomised = 51; all losses due to death; analysed = 51
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union; re-operation (incomplete data); wound infection; wound haematoma; bronchopneumonia; pressure sore; PE; any medical complication; LOS; shortening of femur (leg) (no information); mortality; pain (no information); eventual discharge residence; patient mobility; length of follow-up: 6 months **Outcomes relevant to the review:** mortality (during hospital stay, 6 months)
Notes	**Funding/sponsor/declarations of interest:** quote: "no benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article" **Study dates:** not reported **Note:**

Bridle 1991 *(Continued)*

- we noted some discrepancies between tables and text in the study report

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Described as randomised but no additional details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Quote: "All the operations were performed by one of four senior surgeons, all experienced in closed nailing techniques."
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced and explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Brostrom 1992

Study characteristics

Methods	RCT; parallel design **Review comparison group**: DHS versus Ender nail
Participants	**Total number of randomised participants:** 149 **Inclusion criteria:** > 50 years of age; with trochanteric fractures **Exclusion criteria:** people with pathological fractures (tumours) **Setting:** single site; hospital; Sweden **Baseline characteristics** **Intervention group 1** (DHS; baseline data reported for 76 participants) • Age, mean (SD): 77 (± 9) years • Gender, M/F: 21/55 • Comorbidities: concomitant disease, n: 41

Brostrom 1992 *(Continued)*

- Preoperative waiting time: all operations performed first day after admission to hospital
- Fracture classification, stable/unstable, n: 31/45

Intervention group 2 Ender flexible nails (baseline data reported for 44 participants)

- Age, mean (SD): 76 (± 10) years
- Gender, M/F: 12/32
- Comorbidities, concomitant disease, n: 28
- Preoperative waiting time: all operations performed first day after admission to hospital
- Fracture classification, stable/unstable, n: 20/24

Overall:

- Age, mean (SD): 77 (± 10) years
- Gender, M/F: 120/87
- Comorbidities, concomitant disease, n: 69
- Preoperative waiting time: all operations performed first day after admission to hospital
- Fracture classification, stable/unstable, n: 51/69

Note:

- study authors did not report baseline characteristics for smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; ASA status

Interventions	**General details:** operations performed by 12 different surgeons (7 were regarded as experienced and 5 were regarded as inexperienced); if no contraindications were present, all operations were performed the first day after admission to the hospital under spinal or epidural anaesthesia; all participants received dextran antithrombotic therapy preoperatively and 3 days postoperatively but prophylactic antibiotics were not used routinely; exercises were started on POD1 and all participants encouraged to walk with full weight bearing and all had the same postoperative regimen **Intervention group 1** • Dynamic hip screw (manufacturer not reported) • Number randomised = unclear; losses = 5 (death) full number of losses per group is unknown but the total number of losses within the study was 29, number analysed for mortality = 81 **Intervention group 2** • Enders nails • number randomised to group = unclear; losses = 3 (death) full number of losses per group is unknown but the total number of losses within the study was 29, number analysed for mortality = 47 **Note:** • study authors excluded from their outcome data those participants who died. Because the number of deaths were reported in each group, we re-included these participants.
Outcomes	**Outcomes measured/reported by study authors:** DVT; mortality (available at six week); mean hospital stay time; walking aid; blood loss; mean operation time; leg shortening; general complications; pain level; use of walking aids **Outcomes relevant to the review:** mortality (reported at 6 weeks)
Notes	**Funding/sponsor/declarations of interest:** study authors have not reported any study information **Study dates:** not reported
Risk of bias	

Brostrom 1992 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Although participants were randomly selected, method of randomisation is not specified.
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors report that the interventions were performed by 7 experienced surgeons and 5 surgeons regarded as inexperienced but we could not be certain whether experienced surgeons were equally experienced in using the study implants.
Other performance bias: surgeon experience of both implants	High risk	Some surgeons were inexperienced and study authors do not specify whether inexperienced surgeons were equally balanced in use of both implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Incomplete outcome data (attrition bias) All outcomes	High risk	It is not specified how many participants were lost from each group except for death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Buciuto 1998

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: RAB plate versus CHS plate
Participants	**Total number of randomised participants:** 233 **Inclusion criteria:** unstable trochanteric hip fractures **Exclusion criteria:** not reported **Setting:** single centre, hospital, Norway **Baseline characteristics** **Intervention group 1** (RAB) • Age, average (range): 82 (47 to 96) years • Gender, M/F: 33/78 • Fracture classification, 3-part medial fragment/3-part lateral fragment/4-part complex/associated subtrochanteric, n: 60/16/30/5 **Intervention group 2** (CHS)

Buciuto 1998 *(Continued)*

- Age, average (range): 80 (52 to 97) years
- Gender, M/F: 31/91
- Fracture classification, 3-part medial fragment/3-part lateral fragment/4-part complex/associated subtrochanteric, n: 39/28/44/11

Interventions	**General details:** all fractures were operated on within 24 hours of admission; the mean follow-up time for remaining participants was 2 years; all participants were encouraged to bear full weight from the first postoperative day; serial radiographs were taken until union was complete **Intervention group 1:** • RAB (Gambro Engstrom, Stockholm, Sweden); one piece, cannulated blade plate; angle of 120° and a buttress rod (diameter 6.0 mm) supporting the lower surface of the proximal portion of the blade; blade is variable in length (65 to 95 mm) • Number randomised = 111; losses = 13 (death), 7 (lost to follow-up) **Intervention group 2:** • Compression hip screw (Smith and Nephew, Memphis, TN); inserted using standard technique • Number randomised = 122; losses = 22 (death), 5 (lost to follow-up)
Outcomes	**Outcomes measured/reported by study authors:** penetration of femoral head; cutting-out; implant failure; varus dislocation > 10°; malunion; non-union; femoral head necrosis; deep infection; median perioperative blood loss; median operation time; fractures healed without complication; mortality (available at 12 months) **Outcomes relevant to the review:** mortality (reported at 12 months) **Note:** • study authors did not provide clear outcome data for unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors do not provide details on funding or conflicts of interest **Study dates:** August 1991 to January 1994

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomisation not reported
Allocation concealment (selection bias)	Unclear risk	Method of allocation not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Experience of surgeons is not reported, and it is therefore uncertain whether they were equally experienced both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.

Buciuto 1998 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Few participants were lost, these losses were balanced between groups, and reasons for loss were clearly explained.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Butt 1995

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group:** Gamma nail versus DHS

Participants	**Total number of randomised participants:** 95
	
	Inclusion criteria: trochanteric and subtrochanteric proximal femoral fractures
	
	Exclusion criteria: not reported
	
	Setting: single centre; orthopaedic hospital, UK
	
	Baseline characteristics
	
	Intervention group 1 (Gamma nail)
	
	• Age, mean (range): 79 (55 to 92) years
	• Gender, M/F: 16/31
	• Cognitive status, mental test score, mean: 6.8
	• Fracture classification, stable/unstable, n:
	  ◦ intertrochanteric, 18/16
	  ◦ subtrochanteric, 5/8
	
	Intervention group 2 (DHS)
	
	• Age, mean (range): 78 (47 to 101) years
	• Gender, M/F: 13/35
	• Cognitive status, mental test score, mean: 6.9
	• Fracture classification, stable/unstable, n:
	  ◦ intertrochanteric, 12/14
	  ◦ subtrochanteric, 3/4
	
	Note:
	
	• study authors did not report: smoking history; medication; BMI; preoperative waiting time; comorbidities; mobility; place of residence

Interventions	**General details:** standard surgical procedures; surgical experience is unknown; same surgeons did both operations **Intervention group 1** • Gamma nail (Howmedica); predominantly short nails; 3 cases that suffered further fractures were treated with long nails;

Butt 1995 *(Continued)*

- Randomised = 47; no reported losses; analysed for all outcomes = 47

Intervention group 2

- DHS (Stratec); no further details reported
- Randomised = 48; no reported losses; analysed for all outcomes = 48

Notes:

- details regarding distal locking of nails were not reported in the manuscript
- study authors did not report details for: surgeon experience, type of anaesthesia, prophylactic use of antibiotics or antithromboembolics, postoperative mobilisation and weight bearing

Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; later fracture of the femur; cut-out of implant (incomplete data); non-union (time to union); re-operation (total inferred); wound infection; pneumonia; pressure sore; DVT; any medical complication; LOS; mortality; length of follow-up: 'to fracture union' (generally < 6 months) **Outcomes relevant to the review:** mortality (5 months); unplanned return to theatre **Notes:** • participants were followed up until satisfactory union occurred, time to union stated as (mean) 150 days for Gamma nails and 142 days for DHS
Notes	**Funding/sponsor/declarations of interest:** quote: "No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article" **Study dates:** not reported **Note:** • we noted that the Gamma nail technique was modified without apparent advantage after 37 participants were treated with a Gamma nail

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "Patients admitted on even-numbered weeks were treated with a DHS and patients admitted on odd-numbered weeks were treated with a gamma nail."
Allocation concealment (selection bias)	High risk	It is not possible to conceal allocation because of methods used to randomise participants.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Same surgeons did both operations, but no mention of experience and interim modification of surgical technique by the manufacturers
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.

Butt 1995 *(Continued)*

Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced and explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Cai 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: intramedullary versus extramedullary implants
Participants	**Total number of randomised participants:** 222 **Inclusion criteria:** stable, comminuted, intertrochanteric femoral fracture; > 65 years of age; the ability to walk independently (with or without an aid) prior to fracture; and the sustaining of a low-energy injury within 24 hours prior to admission **Exclusion criteria:** a compound femoral fracture; < 65 years of age; a history of previous fracture; any contraindication to surgery; nonambulatory status prior to the presenting injury, or any other traumatic fracture **Setting:** single site; hospital; China **Baseline characteristics** (only for analysed participants) **Intervention group 1** (intramedullary) • Age, mean (range; SD): 75.8 (65 to 100; ± 6.20) years • Gender, M/F: 39/67 • ASA status, I/II/III: 3/53/50 • Preoperative waiting time, mean (SD): 3.58 (± 1.57) days • Fracture classification, Evans Type-I/Type-II, n: 30/76 **Intervention group 2** (extramedullary) • Age, mean (range; SD): 75.9 (65 to 88; ± 6.06) years • Gender, M/F: 29/63 • ASA status, I/II/III: 2/50/40 • Preoperative waiting time, mean (SD): 3.61 (± 1.73) days • Fracture classification, Evans Type-I/Type-II, n: 32/60 **Overall:** • Age, mean (range): 75.9 (65-100) years • Gender, M/F: 68/130

Cai 2016 *(Continued)*

	Note: • study authors did not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia
Interventions	**General details:** all surgeries were carried out by 3 surgeons all of whom had more than 15 years of clinical experience (all were familiar with both techniques) **Intervention group 1** • type not clearly defined. We assumed DHS from information in the introduction, but possibly at the discretion of the surgeon • Number randomised = 105 **Intervention group 2** • type not clearly defined. We assumed PFNA and/or Gamma nails from information within the introduction and conclusion • Number randomised = 117 **Note:** • study authors do not provide information on anaesthesia used, use of prophylactic antibiotics or antithrombotic medication, or rehabilitation/weight-bearing protocols
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss; functional recovery; postoperative complications (superficial wound infection, deep wound infection, pneumonia, UTI, delayed union, nonunion, cutting of lag screw, implant failure, electrolyte imbalance, hypoproteinaemia); mortality (available at 12 months) **Outcomes relevant to the review:** mortality (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** supported by the National Natural Science Foundation. Study authors declare no conflicts of interest **Study dates:** 2011 to 2014 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Caiaffa 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: short intramedullary nails with no distal locking versus static distal locking
Participants	**Total number of randomised participants:** 357 **Inclusion criteria:** the presence of an acute (treatment within 15 days from trauma) pertrochanteric stable fracture type 31A1/31A2; people > 65 years of age; able to walk before the injury with or without crutches **Exclusion criteria:** medical contraindications; medical illness; cognitive disorders precluding participation in follow-up examination; unwillingness to participate; open fracture; bilateral fractures; pathological fractures and previous ipsilateral hip or femur surgery

Caiaffa 2016 *(Continued)*

Setting: hospital; 6 sites; Italy

Baseline characteristics (only for analysed participants)

Intervention group 1 (locking)

- Age, mean (SD): 78.4 (± 7.1) years
- Gender, M/F: 41/89
- Comorbidities, diabetes/cardiovascular disease and hypertension/pulmonary disease/osteoporosis, n: 34/97/7/91
- ASA status, I/II/III/IV: 18/28/61/23
- Fracture classification, 31A1/31A2, n: 37/93

Intervention group 2 (unlocking)

- Age, mean (SD): 77.9 (± 7.2) years
- Gender, M/F: 52/84
- Comorbidities, diabetes/cardiovascular disease and hypertension/pulmonary disease/osteoporosis, n: 47/111/9/89
- ASA status, I/II/III/IV: 14/31/72/19
- Fracture classification, 31A1/31A2, n: 48/88

Overall:

- Age, mean (range): 78.9 (65 to 96) years
- Gender, M/F: 93/173
- Fracture classification, 31A1/31A2, n: 85/181

Note:

- study authors did not report baseline characteristics for: smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time

Interventions	**General details:** 13 different surgeons with more than 10 years of experience performed the operations; depending on their general condition, participants in both groups were allowed to sit upright on the second postoperative day, and partial weight bearing with a walker was allowed on fourth postoperative day; follow-up at 1 month, 3 months, 6 months and 1 year **Intervention group 1** • No distal locking; Endovis BA Citieffe nail (Calderara di Reno [BO], Italy); two cervico-cephalic screws • Number randomised = 171 **Intervention group 2** • Distal locking (static); Endovis BA Citieffe nail (Calderara di Reno [BO], Italy), two cervico-cephalic screws without proximal locking screws • Number randomised = 186 **Note:** • study authors do not report data on general anaesthesia used
Outcomes	**Outcomes measured/reported by study authors:** operation time; fluoroscopy time; blood loss; total length of incision; time of fracture union; mortality (available at 30 days, 90 days, 180 days and 12 months); participants infused; length of hospital stay; complications; cutting out; diaphyseal fracture; avascular necrosis of the femoral head; deep infection; haematomas; superficial infections; DVT; mobility; SF-36 (available at 12 months); VAS; HHS; thigh pain **Outcomes relevant to the review:** mortality (reported at 3 months and 12 months) HRQoL using SF-36 (reported at 12 months)

Caiaffa 2016 *(Continued)*

Notes	**Funding/sponsor/declarations of interest:** study authors report that they have no conflicts of interest **Study dates:** April 2012 to October 2014 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Calderon 2013

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus DHS
Participants	**Total number of randomised participants:** 32 **Inclusion criteria:** 60 to 90 years of age; type II intertrochanteric fracture of Boyd and Griffin classification, < 48 hours from injury **Exclusion criteria:** previous fractures on limb or contralateral side which affected rehabilitation; pathological fractures; dementia; non-consent to participate. Also excluded were participants who failed to attend follow-up, participants with incomplete medical records and participants who withdrew from the trial. **Setting:** single centre; university hospital, Mexico **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean: 79.8 years **Intervention group 2** (DHS) • Age, mean: 81.3 years **Overall:** • Age, mean: 80.5 years • Gender, M/F: 8/24 **Note:** • authors did not specify: gender for each group; smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; undisplaced/displaced
Interventions	**General details:** experience of surgeons not reported; clinical follow-up at 2, 4 and 8 weeks and 6 months after surgery; active and passive mobility from first postoperative day, then full weight bearing as indicated by daily VAS assessment **Intervention group 1** • PFN; details regarding the length of nail used, proximal and distal locking were not reported in the study report • Randomised = 16 **Intervention group 2**

Calderon 2013 *(Continued)*

- DHS (Synthes)
- Randomised = 16

Outcomes	**Outcomes measured/reported by study authors:** pain (VAS - range of scores not reported); incision size; intraoperative bleeding; length of surgery; HHS; time to start partial or total weight bearing; time to union; complications: reported on later fracture, 'varus collapse' (without clinical implication); length of follow-up: 6 months (or 16 weeks - inconsistently reported in article) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Cao 2017

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** HA versus HA; distal fixation augmented with or without bone cement
Participants	**Total number of randomised participants:** 250 **Inclusion criteria:** intertrochanteric fracture; age of no less than 66 years old; indication of artificial hip joint replacement; normal walking without or with single stick before intertrochanteric fracture; Evans-Jensen type III-V fracture complicated with many underlying diseases, inappropriate for long-term bedridden after the surgery or complicated with serious osteoporosis; or Evans-Jensen type II fracture with the contraindication of fracture reduction and internal fixation **Exclusion criteria:** new or old cerebral thrombosis or Evans-Jensen type I fracture; cardiac insufficiency; pathological fracture; complicated with coagulation disorders; mental diseases **Setting:** single centre; hospital; China **Baseline characteristics (overall)** • Age, "average" (range): 79.6 (66 to 98) years • Gender, M/F: 36/49 • Comorbidities: 85 osteoporosis; 35 coronary heart disease; 40 hypertension; 18 diabetes; 14 chronic bronchitis and emphysema; 15 hypoproteinaemia and anaemia; 14 cerebral infarction; 2 renal insufficiency • Preoperative waiting time: ranged from 3 hours to 12 days; average 5.5 days • Fracture classification, Evans-Jensen classification: 8 type II; 42 type III; 22 type IV; 13 type V **Note:** • study authors did not report: smoking history, medication, BMI, cognitive status, mobility assessment, place of residence
Interventions	**General details:** subarachnoid block combined epidural anaesthesia; postlateral approach; prophylactic anticoagulation and antibiotics; DVT prevention; mobilisation within 3 days to 1 week postoperatively; partial weight bearing after 3 weeks post-surgery; full weight bearing after 3 months **Intervention group 1**

Cao 2017 *(Continued)*

	• Hemiarthroplasty (manufacturer not reported); bipolar, proximally porous-coated uncemented stem, distal stem fixation augmented with bone cement • Randomised = 43 **Intervention group 2** • Hemiarthroplasty (manufacturer not reported); bipolar, fully porous-coated uncemented stem • Randomised = 42
Outcomes	**Outcomes measured/reported by study authors:** operation time; total blood loss; ambulation time; HHS; loosening; neurovascular injury; infection; fracture; dislocation; pain in non-femoral region; mortality **Outcomes relevant to the review:** mortality **Note:** • mortality reported for overall group only
Notes	**Funding/sponsor/declarations of interest:** declared no conflicts of interest **Study dates:** January 2012 to January 2016 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Carulli 2017

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN vs DHS
Participants	**Total number of randomised participants:** 140 **Inclusion criteria:** adults with trochanteric fracture (31A1 or 31A2), able to give full consent **Exclusion criteria:** people with 31A3 fracture; psychiatric diseases; any form of neurologic deficit to lower limbs; any contraindication to surgery **Setting:** single centre; university hospital; Italy **Baseline characteristics** **Intervention group 1** (intramedullary) • Age, mean (SD): 81.62 (± 7.82) years • Gender, M/F: 29/42 • Comorbidities, n: 55 had comorbidities, mostly related to cardiologic, metabolic and circulatory issues • Fracture classification, n: 31.A1 25 (35.21%), 31.A2 46 (64.69%) **Intervention group 2** (DHS) • Age, mean (SD): 83.41 (± 7.90) years • Gender, M/F: 25/44 • Comorbidities, n: 54 had comorbidities (no additional detail) • Fracture classification, n: 31.A1 28 (40.57%), 31.A2 41 (59.43%)

Carulli 2017 *(Continued)*

	Note: • study authors report no baseline data for: smoking history, medication, BMI, mobility assessment, cognitive status, ASA status, preoperative waiting times • study authors report that 38 participants lived alone with support or with other relatives and with some support, and the remainder lived in residential. However, it is unclear whether this is reported for all participants or only those in the intramedullary group.
Interventions	**General details:** all participants were studied by conventional radiology in emergency room, received antibiotic and antithromboembolic prophylaxis. For postoperative care: all participants given 2 bags of heterologous blood. For rehabilitation, POD1 - passive motion in bed. POD2 - allowed to sit in bed with active knee and ankle exercises. POD3 - assisted standing and gait exercises. Participants sent to rehabilitation facilities to complete functional recovery. **Intervention group 1:** • PFNA (Synthes); all nails used were 200 mm long; cephalic fixation was performed with a helical blade; nail diameter 10 mm or 11 mm; all nails were distally locked statically • Randomised = 71; losses = 5 (2 died; 1 did not go to outpatient appointment at 3 months; 2 did not attend last follow-up); analysed for mortality = 71; analysed for other outcomes at 12 months = 66 **Intervention group 2:** • Dynamic Hip Screw (DHS) (Synthes) • Randomised = 69; losses = 7 (4 died; 1 did not go to outpatient appointment at 3 months; 2 did not attend last follow-up); analysed for mortality = 69; analysed for other outcomes at 12 months = 62 **Note:** • study authors do not report number of surgeons (and their skills or experience)
Outcomes	**Outcomes measured/reported by study authors:** mortality (at 12 months); blood loss; complications (pulmonary infection, DVT, UTI, superficial wound infection; mechanical complications - spiral blade migration, lateral blade protrusion, migration of plate screws, failure); LOS; walking with partial or full weight bearing at discharge; independent walking at 3 months; restore walking activity and health status to pre-fracture level; HRQoL **Outcomes relevant to the review:** HRQoL (SF-12, PCS and MCS at 12 months); mortality (at 12 months); unplanned return to theatre (at 12 months) **Note:** • for all outcomes (except mortality), we have assumed that data are reported for 66 in the intramedullary group and 62 in the extramedullary group
Notes	**Funding/sponsor/declarations of interest:** funding not reported. "All authors disclose any financial and personal relationships with other people or organizations that could have inappropriately influenced or biased their work" - these disclosures are not detailed in the study report **Study dates:** January 2007 to December 2009

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	Use of sealed envelopes. Study authors do not report if envelopes were opaque and sequentially numbered.

Carulli 2017 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors did not describe how many surgeons were involved in the study and whether they were equally experienced with the types of implants used in this study.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Blinding of outcome assessment: HRQoL (detection bias)	Low risk	We did not expect lack of blinding to influence participant-reported outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced and mostly explained by death, which is expected in this population
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Catania 2019

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Elos-Intrauma nail versus Gamma 3-Stryker nail
Participants	**Total number of randomised participants:** 323 **Inclusion criteria:** pertrochanteric fractures; between 65 and 90 years of age; fracture pattern AO/OTA 31.A1 or 31.A2; being able to walk without aids before fracture; good cognitive and motor abilities **Exclusion criteria:** pathological fractures or presence of an ongoing metastatic disease; polytrauma; presence of a high grade of hip osteoarthrosis; haematological disease or therapy with anticoagulants and antiplatelet drugs; ASA score of V **Setting:** single centre; hospital; Italy **Baseline characteristics** **Intervention group 1** (Elos) • Age, mean (SD) (range): 85.1 (± 6.42) (65 to 90) years • Gender, M/F: 51/104 • Fracture classification, 31.A1/31.A2, n: 28/127

Catania 2019 *(Continued)*

	Intervention group 2 (Gamma) • Age, mean (SD) (range): 85.7 (± 5.48) (66 to 90) years • Gender, M/F: 55/113 • Fracture classification, 31.A1/31.A2, n: 27/141 **Note:** • study authors do not report baseline characteristics for smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time
Interventions	**General details:** surgeries were performed by experienced surgeons; minimum follow-up was 12 months; cefazolin 2 g was administered 30 minutes before surgery; participants received spinal anaesthesia and were operated on in a supine position with the use of a traction table; participants underwent a standard postoperative rehabilitation protocol (when allowed by their clinical status and osteosynthesis stability). It consisted of 1 day bed rest with passive mobilisation of the lower limb, followed by assisted walking with tolerance weight bearing; follow-up was done every 5 days for the first 15 days and at 1, 6 and 12 months **Intervention group 1:** • Elos intramedullary nail (Intrauma®); short nail, two cephalic screws, distal or dynamic distal locking according to the fracture • Number randomised = 155 **Intervention group 2:** • Gamma third-generation intramedullary nail (Stryker®); short nail, single cephalic screw, distal or dynamic distal locking according to the fracture • Number randomised = 168
Outcomes	**Outcomes measured/reported by study authors:** duration of surgery; intraoperative blood loss; VAS; HHS; WOMAC; lag screw cut-outs; local infections; malunion; proximal screw dislocation; nail breakage; unplanned return to theatre (available at 12 months); mortality (available at 12 months) **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months), mortality (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** funding is described as "not applicable" but study authors declare no conflict of interest **Study dates:** 1 July 2015 to 31 October 2017 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Chapman 1981

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: compression sliding hip screw versus Ender pins
Participants	**Total number of randomised participants:** 100

Chapman 1981 *(Continued)*

Inclusion criteria: people with extracapsular hip fractures (all fractures at the base of the femoral neck, intertrochanteric fractures, subtrochanteric fractures not more than 2.5 cm distal to lesser trochanter, and any combination thereof)

Exclusion criteria: pathological fractures

Setting: single centre; hospital; USA

Baseline characteristics

Intervention group 1 (compression sliding hip screw)

- Age, average (range): 67.5 (21 to 97) years
- Gender, M/F: 29/21
- Fracture classification, basilar neck/intertroch./subtroch./intertroch. and subtroch., stable/unstable, n: 2/41/0/7, 31/19

Intervention group 2 (Ender pins)

- Age, average (SD): 68 (25 to 93) years
- Gender, M/F: 30/20
- Fracture classification, basilar neck/intertroch./subtroch./intertroch. and subtroch., stable/unstable, n: 3/40/2/5, 32/18

Overall

- Comorbidities, alcoholism/cardiac disease, %: 23/38
- Cognitive status, 'senile dementia', %: 18

Note:

- study authors report no baseline characteristics for: smoking history; medication; BMI; mobility assessment; place of residence; ASA status; preoperative waiting time

Interventions	**General details:** no prophylaxis against DVT used; prophylactic sodium cefazolin routinely used; all participants were initially placed on skeletal traction with a pin in the proximal part of the tibia; all operations were performed by resident surgeons with an attending surgeon; unless contraindicated, all participants were placed in a chair at bedside on the first postoperative day; walking with immediate partial weight bearing and rapid progression to full weight bearing, using appropriate assistive devices, was begun as soon as possible; participants were discharged to their homes or an extended-care facility as their condition warranted; minimum follow-up of 6 months **Intervention group 1** • Compression sliding hip screw (manufacturer not reported) • Number randomised to group = 50; number of losses = 14 (2 were lost to follow, 12 died), number analysed = 50 **Intervention group 2** • Ender's pins (American Ortomed Corporation, Poughkeepsie, New York) • Number randomised to group = 50; losses = 15 (2 lost to follow-up, 12 died less than 6 months after operation, 1 participant's initial operative procedure was not completed), number analysed = 50
Outcomes	**Outcomes measured/reported by study authors:** time under anaesthesia; time from incision to closure; blood loss; mortality (available at 6 weeks, 6 months and later than 6 months - study authors report average end of follow-up at 13.5 months); unplanned return to theatre (available at end of follow up); deep wound infections; complications (UTI; pneumonia or pulmonary atelectasis, or both; cardiac arrhythmia; acute congestive heart failure; subphrenic abscess; upper gastrointestinal haemorrhage; renal lithiasis; decubitus ulcers); thrombophlebitis; pulmonary embolisms; total period of hospitalisation

Chapman 1981 *(Continued)*

	Outcomes relevant to the review: mortality (reported at 6 weeks and an average of 13.5 months); unplanned return to theatre (reported at end of follow-up)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** October 1976

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Participants assigned based on even/odd number basis
Allocation concealment (selection bias)	High risk	We could not be certain of the criteria used to allocate participants and assume that this meant no concealment.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. All surgeries were attended by a consultant but it is not specified whether consultant was equally experienced in both methods.
Other performance bias: surgeon experience of both implants	Unclear risk	Performed by resident surgeons alongside the attending surgeon. It is uncertain whether resident surgeons were equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few participants were lost, these losses were balanced between groups, and reasons for loss were clearly explained.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trials registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Chechik 2014

Study characteristics

Methods	RCT; parallel design **Review comparison group**: EPFN vs DHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** unilateral extracapsular (31A1 and 31A2) hip fracture following low-energy trauma

Chechik 2014 *(Continued)*

Exclusion criteria: < 60 years of age, pathologic fractures, life-threatening disease (ASA ≥ 4), subtrochanteric or reverse oblique fracture patterns (31A3), inability to give informed consent due to dementia or confusional state, previous fracture or previous surgery of the affected leg

Setting: single centre; hospital; Israel

Baseline characteristics

Intervention group 1 (intramedullary)

- Age, mean (SD): 83.1 (± 5.7) years
- Gender, M/F: 6/21
- BMI, mean (SD): 24.9 (± 4.8) kg/m^2
- Comorbidities, type, n: heart disease: 7; diabetes: 8; renal failure: 4; Parkinson's disease: 0
- Mobility assessment, Parker and Palmer, mean (SD): 6.34 (± 2.64)
- Place of residence, n: own home: 24; nursing institution: 5
- Dementia, n: 6
- ASA status, mean (SD): 2.31 (± 0.54)
- Preoperative waiting time, from fall to surgery, mean (SD): 45 (± 25) hours
- Fracture classification, n: 31A1: 10; 31A2: 19

Intervention group 2 (extramedullary)

- Age, mean (SD): 83.1 (± 6.7) years
- Gender, M/F: 8/23
- BMI, mean (SD): 25.5 (± 4.7) kg/m^2
- Comorbidities, type, n: heart disease: 7; diabetes: 6; renal failure: 3; Parkinson's disease:2
- Mobility assessment, Parker and Palmer, mean (SD): 6 (± 2.73)
- Place of residence: own home: 25; nursing institution: 6
- Dementia, n: 3
- ASA status, mean (SD): 2.26 (± 0.63)
- Preoperative waiting time, from fall to surgery mean (SD): 55 (± 35) hours
- Fracture classification, n: 31A1: 10; 31A2: 21

Note:

- study authors report no baseline characteristics for: smoking history or medication

Interventions

General details: IV antibiotics given immediately before surgery; spinal anaesthesia (15) and general anaesthesia (45); low-molecular-weight heparin for 6 weeks after surgery. After surgery, participants allowed weight bearing as tolerated, all encouraged to begin walking with a frame on POD 1

Intervention group 1

- EPFN (Fixion; HMB Medical Technologies, Herzliya, Israel). Either a 10 mm or a 12 mm nail with a 130-degree nail-peg angle was used; the nail was inflated to a maximum diameter of 16 mm or 19mm respectively at a pressure of 70 mmHg to achieve static distal locking; the head peg was inflated with a pressure of 100 mmHg to 140 mmHg and then locked at the nail peg interface.
- Randomised = 29

Intervention group 2

- CHS (Smith & Nephew)
- Randomised = 31

Note:

- nail length was not reported in the manuscript; the expandable PFN is manufactured in two lengths 220 mm or 340 mm

Chechik 2014 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** mortality (30 days); CVA (time point described as 'early postoperative'); LOS (days); re-operation (1 year); discharge location (1 year); mobility score (Parker & Palmer; 1 year); functional outcome at 1 year (HHS; total mean score - also reported as pain, support, distance, and limp); periprosthetic fracture; ADL (used Jensen's independence score; at 1 yr); pain (measured as a separate category in HHS); loosening of prosthesis (plate/screw failure; 1 yr); wound infection (defined as wound discharge); acute coronary syndrome; cut out; plate screw failure; independence (Jensen's score); change of independence; femur shortening; reduced offset; shaft medialisation; heterotopic ossification; blood transfusion (reported as mean units); radiation time, scar length, quality of reduction, intraoperative fracture, acute coronary syndrome, CVA, wound discharge, hospitalisation **Outcomes relevant to the review:** mortality (30 days); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** funding not reported; study authors declare no conflicts of interest **Study dates:** June 2008 to February 2010 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Chen 2017

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Proximal femoral nail versus hemiarthroplasty
Participants	**Total number of randomised participants:** 67 **Inclusion criteria:** unstable intertrochanteric fractures and osteoporosis **Exclusion criteria:** not reported **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 71.23 (± 2.62) years • Gender, M/F: 17/18 • Fracture classification, A2.2/A2.3/A3.1, n: 17/16/2 **Intervention group 2** (hemiarthroplasty) • Age, mean (SD): 72.31 (± 2.96) years • Gender, M/F: 15/17 • Fracture classification, A2.2/A2.3/A3.1, n: 15/13/4 **Note:** • study authors report no baseline characteristics for: BMI, smoking history, medication, comorbidities, mobility, place of residence, cognitive status, preoperative waiting times
Interventions	**General details:** unknown

Chen 2017 *(Continued)*

	Intervention group 1 • Proximal femoral nail (no manufacturer details provided), short proximal femoral nails were used for this study with a single cephalic screw • Number randomised = 35 **Intervention group 2** • Hemiarthroplasty (no manufacturer details provided) • Number randomised = 32 **Note:** • No further implant details were provided
Outcomes	**Outcomes measured/reported by study authors:** operation time; intraoperative blood loss; length of incision; postoperative bed time; HHS **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** unknown **Study dates:** unknown **Note:** • Study is reported in Chinese. We did not seek translation and we used only the English abstract to collect data. • We did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Chen 2018

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFNA versus SHS
Participants	**Total number of randomised participants:** 36 **Inclusion criteria:** meeting the international definition of the elderly and diagnostic criteria for intertrochanteric fracture of femur **Exclusion criteria:** people with the following conditions: HIV; coagulation disorders; hepatic and renal insufficiency; severe circulatory system diseases; mental disorder **Setting:** single centre; orthopaedic hospital; China **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD): 63.2 (± 2.3) years • Gender, M/F: 10/8 • Fracture classification, Evan-Jensen I/II/III/IV: 4/5/7/2 • Complications, n: 5 (includes cardio-cerebrovascular disease, diabetes and respiratory) **Intervention group 2** (SHS) • Age, mean (SD): 64.3 (± 1.9) years

Chen 2018 *(Continued)*

- Gender, M/F: 9/9
- Fracture classification, Evan-Jensen, I/II/III/IV: 5/5/6/2
- Complications, n: 6 (includes cardio-cerebrovascular disease, diabetes and respiratory)

Note:

- study authors did not report smoking history; medication; BMI; preoperative waiting time; mobility, cognitive status

Interventions	**General details:** combined spinal-epidural anaesthesia; conventional anti-inflammatory treatment after operation, and antithrombotic drugs were given on day one; no details reported regarding experience of surgeons or familiarity with interventions **Intervention group 1** • PFNA, placed through a guiding needle, adjusted under X-ray fluoroscopy, with an angle of about 13° with the femur • Randomised = 18 **Intervention group 2** • SHS, introduced with an anteversion of 15° below the lesser trochanter tip of femur under X-ray fluoroscopy • Randomised = 18 **Note:** • study authors do not report whether surgeons were experienced with both implants
Outcomes	**Outcomes measured/reported by study authors:** intraoperative bleeding; length of surgery; LOS; short-term complications; time to weight bearing (partial/full); fracture healing time; functions (Sanders: 55 to 60, excellent; 45 to 54, good; 35 to 44, poor; < 34, fail) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** funding not reported; study authors declare no conflicts of interest **Study dates:** June 2016 to June 2017 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Cheng 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PCCP versus DHS
Participants	**Total number of randomised participants:** 133 **Inclusion criteria:** > 65 years of age; an intertrochanteric fracture amenable to satisfactory reduction (type AO/OTA 31.A1 to A2, Evans type 2); ability to ambulate independently prior to the fracture with or without assistive devices; people who were mentally competent and gave their consent to participate **Exclusion criteria:** reversed oblique fractures (type AO/OTA 31.A3 or Evans type 2); nonunion, pathological fractures, or the presence of metastatic disease; bilateral hip fractures, previous ipsilateral low-

Cheng 2014 *(Continued)*

er-limb surgery, or contralateral hip fracture within the last year; people who required intensive care or treatment in other departments; people with diabetes difficult to control

Setting: single centre; hospital; China

Baseline characteristics

Intervention group 1 (PCCP)

- Age, mean (SD): 72.4 (± 4.18) years
- Gender, M/F: 28/37
- Comorbidities, hypertension/coronary heart disease/diabetes/COPD, n: 18/6/8/3
- ASA status, I/II/III/IV, n: 6/39/18/2
- Fracture classification, 31A1.1/31A1.2/31A1.3/31A2.1/31A2.2/31A2.3, n: 18/28/3/10/4/2

Intervention group 2 (DHS)

- Age, mean (SD): 78.6 (± 3.92) years
- Gender, M/F: 22/34
- Comorbidities, hypertension/coronary heart disease/diabetes/COPD, n: 15/7/6/1
- ASA status, I/II/III/IV, n: 5/31/19/1
- Fracture classification, 31A1.1/31A1.2/31A1.3/31A2.1/31A2.2/31A2.3, n: 15/24/4/8/2/3

Note:

- study authors do not report baseline characteristics for smoking history; medication; BMI; mobility assessment; preoperative waiting time

Interventions	**General details:** prophylactic antibiotics, and prophylactic low-molecular-weight heparin given subcutaneously for 6 weeks postoperatively; all participating surgeons were experienced in both techniques; short-term antibiotic regimens were used to clear infections; ambulation with partial weight-bearing form POD2 or POD3 for stable fractures, and delayed for at least 2 weeks for unstable fractures; each patient was reviewed monthly for the initial 6 months, then 9, 12, 18 and 24 months after surgery **Intervention group 1:** • Percutaneous compression plate (Orthofix Inc. USA), implanted using technique described by Gotfried in 2000 • Number randomised = unknown **Intervention group 2:** • Conventional DHS (Richards Inc. USA), using a standard lateral approach in accordance with the manufacturer's instructions • Number randomised = unknown **Note:** • number randomised to each group is unknown: overall 133 participants were randomised, 12 could not be followed up postoperatively due to death (due to other diseases, 2 cases) or changing residence (10 cases) • study authors do not report number of clinicians
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss and transfusion necessity; pain evaluation; length of hospital stay; HHS; time until fracture union; postoperative complications (up to 6 months); implant-related failure; mortality **Outcomes relevant to the review:** none **Note:**

Cheng 2014 *(Continued)*

	• study authors report no data for mortality, and although some complications required return to theatre, it is not clear whether this was consistently reported for all participants
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** October 2007 to February 2011 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Ciaffa 2018

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: unlocked femoral nail versus dynamic femoral nail versus static femoral nail
Participants	**Total number of randomised participants:** 240 **Inclusion criteria:** presence of an acute (treatment within 15 days from trauma) stable (31-A1) or unstable (31-A2) intertrochanteric fracture; > 65 years of age; ability to walk prior to injury, with or without crutches **Exclusion criteria:** people with medical contraindications; medical illness or cognitive disorders precluding participation in the follow-up examination; unwillingness to participate; open fracture; bilateral fractures; pathological fracture; previous ipsilateral hip or femur surgery **Setting:** multi-centre (9 centres): level II trauma centres; Italy **Baseline characteristics (**for analysed participants at the end of follow-up, excluding those who died) **Intervention group 1** (unlocked) • Age, mean (SD): 75.6 (± 3.4) years • Gender, M/F: 49/24 • Comorbidities, diabetes/cardiovascular disease and hypertension/pulmonary disease/osteoporosis, n: 25/57/16/42 • ASA status, I/II/III/IV, n: 6/24/27/14 • Fracture classification, 31A1/31A2, n: 25/48 **Intervention group 2** (dynamic) • Age, mean (SD): 77.4 (± 2.8) years • Gender, M/F: 45/23 • Comorbidities, diabetes/cardiovascular disease and hypertension/pulmonary disease/osteoporosis, n: 19/45/11/38 • ASA status, I/II/III/IV, n: 5/28/25/10 • Fracture classification, 31A1/31A2, n: 22/46 **Intervention group 3** (static) • Age, mean (SD): 76.8 (± 1.7) years • Gender, M/F: 44/27 • Comorbidities, diabetes/cardiovascular disease and hypertension/pulmonary disease/osteoporosis, n: 21/51/15/47 • ASA status, I/II/III/IV, n: 5/23/30/13

Ciaffa 2018 *(Continued)*

	• Fracture classification, 31A1/31A2, n: 24/47 **Overall:** • Age, mean (SD): 76.2 (±) years • Gender, M/F: 74/138 • Fracture classification, 31A1/31A2, n: 71/141 **Note:** • study authors reported no baseline characteristics for: smoking history; medication; BMI; mobility assessment; place of residence; cognitive status; preoperative waiting time
Interventions	**General details:** 10 different surgeons with more than 10 years of experience performed surgeries; clinical and radiological follow-up was at 1, 3, 6 and 12 months; depending on their general condition, participants of all groups were allowed to sit upright on POD2; partial weight bearing with a walker was allowed on POD4; all cases of wound infections were successfully treated with debridement and antibiotic therapy **Intervention group 1** • No distal locking; Endovis BA Intramedullary nail (Citieffe nail); short nail; two cephalic screws • Number randomised to group = 80; losses = 7 (6 due to death; 1 declined participation); analysed = 73 **Intervention group 2** • Dynamic distal locking; Endovis BA Intramedullary nail (Citieffe nail); short nail; two cephalic screws • Number randomised to group = 80; losses = 12 (9 due to death; 3 declined participation); analysed = 68 **Intervention group 3** • Static distal locking; Endovis BA Intramedullary nail (Citieffe nail); short nail; two cephalic screws • Number randomised to group = 80; losses = 9 (7 due to death; 2 declined participation); analysed = 71 **Note:** • study authors did not report the type of anaesthesia used
Outcomes	**Outcomes measured/reported by study authors:** blood loss; fluoroscopy time; blood transfusion; length of incision; surgery time; length of hospital stay, mortality (available at 12 months); HHS; HRQoL (available at 12 months); time of fracture union; length of lag screws back out; weight bearing; Barthel Index; walking ability; level of satisfaction; hip pain (VAS); complications (haematoma, DVT, cut out, loss of reduction > 5, diaphyseal fracture, non-union, lag screws breakage, AVN, wound infection, deep infection); patient satisfaction **Outcomes relevant to the review:** mortality (reported at 12 months); HRQoL (using SF-12, reported at 12 months) **Note:** • re-operation data reported for some complications (lag screw cut outcomes and femoral head necrosis). We did not include these data because we could not be certain if they included both groups for all complications • SF-12 reported without SD so unable to include in analysis
Notes	**Funding/sponsor/declarations of interest:** study authors report 'no funding was received in support of this study. None of the other authors have any conflicts of interest to declare.' **Study dates:** January 2015 to March 2016 **Note:**

Ciaffa 2018 *(Continued)*

- we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Dalen 1988

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: Ender nail versus McLauglin nail-plate fixation
Participants	**Total number of randomised participants:** 130 **Inclusion criteria:** trochanteric fractures **Exclusion criteria:** pathological fractures; outside of catchment area; default allocation (not specified in the study report); different medical reasons (not specified in the study report) **Setting:** single centre; hospital; Sweden **Baseline characteristics** **Intervention group 1** (Ender) • Preoperative waiting time: generally performed on day after admission • Fracture classification, stable/unstable, n: 28/45 **Intervention group 2** (nail-plate fixation) • Preoperative waiting time: generally performed on day after admission • Fracture classification, stable/unstable, n: 19/38 **Note:** • study authors report no baseline data for: age; gender; smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status
Interventions	**General details:** participants with displaced fractures had pin traction preoperatively; general or epidural anaesthesia, extension fracture table and biplane fluoroscopy were used; operations were performed by all staff surgeons; antibiotics as prophylactics were not used; after operation, full weight bearing was allowed, and rehabilitation programme was identical for the 2 methods of operation; follow-up time was about 6 years **Intervention group 1:** • Condylocephalic nails (Ender); static unlocked fixation • Number randomised to group = 73; losses = 15 (death within the first two weeks postoperatively); analysed = 73 **Intervention group 2:** • Nail-plate fixation (McLaughlin); cephalic blade inserted into femoral head and fixed onto extramedullary plate with bolt to form a fixed angle device • Number randomised to group = 57 losses = 10 (death within the first two weeks postoperatively); analysed = 57
Outcomes	**Outcomes measured/reported by study authors:** mortality (available at 2 weeks, 6 years); unplanned return to theatre (available at 6 years); days in hospital; deep infections; blood loss; operation time; leg lengths; range of hip movement; hip pain; knee pain; walking capability

Dalen 1988 *(Continued)*

	Outcomes relevant to the review: mortality (reported at two weeks); unplanned return to theatre (reported at 6 years) **Note:** • although study authors report total number of deaths after 6 years (63), study authors do not report to which groups these people belonged
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 1978 to December 1980

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Randomisation based on birth year: even years in one group; odd years in the other
Allocation concealment (selection bias)	High risk	It is not possible to conceal allocation because method is based on year of birth.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors report all surgeries were performed by 'staff surgeons' but it is not reported whether surgeons were equally experienced in both techniques.
Other performance bias: surgeon experience of both implants	Low risk	All operations by staff surgeons. We assumed that they were equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No apparent losses
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Dall'Oca 2010

Study characteristics

Methods	Quasi-randomised; parallel design

Dall'Oca 2010 *(Continued)*

	Review comparison group: Gamma nail (cephalic screw cement augmentation technique) versus Gamma nail (conventional technique)
Participants	**Total number of randomised participants:** 80 **Inclusion criteria:** unstable trochanteric fracture, defined as fracture with 3 parts or more; > 80 years of age; Singh score of 1 or 2 **Exclusion criteria:** dementia, neuromuscular or musculoskeletal deficiency which could limit the ability to perform objective functional tests; malignancy; massive corticosteroid treatment; concurrent other fractures or operations which could affect postoperative functional outcome **Setting:** single centre; hospital; Italy **Baseline characteristics** **Intervention group 1** (cement augmentation) • Age, mean (range): 85.27 (82 to 92) years • Gender, M/F: 14/36 • Fracture classification, A2.1/A2.2/A2.3/A3.1/A3,2/A3.3, n: 6/6/8/8/4/3 • HHS, mean (range): 56.49 (26 to 89) **Intervention group 2** (conventional) • Age, mean (range): 82.27 (81 to 84) years • Gender, M/F: 10/30 • Fracture classification, A2.1/A2.2/A2.3/A3.1/A3,2/A3.3, n: 4/9/9/6/5/3 • HHS, mean (range): 56.75 (22 to 89) **Overall:** • Age, mean (range): 84 (80 to 94) years • Gender, M/F: 24/56 • Fracture classification, A2/A3, n: 48/32 • HHS, mean (range): 56.49 (19 to 89) **Note:** • study authors did not report baseline characteristics for smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; ASA status; preoperative waiting time
Interventions	**General details:** participants were followed up at 6 months and 12 months; the day after surgical operation, participants, according to their clinical conditions, started passive and active physiotherapy allowing free weight bearing of the operated limb **Intervention group 1** • Gamma nail, third generation (manufacturer not reported); single cephalic screw with cement augmentation of femoral head inserted using Mendec Spine needle (diameter 13 G) inserted through head screw • Number randomised = 40 **Intervention group 2** • Gamma nail, third generation (manufacturer not reported); single cephalic screw, no cement augmentation of femoral head • Number randomised = 40 **Note:**

Dall'Oca 2010 *(Continued)*

	• study authors do not report the number of clinicians or their skills and experience or the type of anaesthesia used
Outcomes	**Outcomes measured/reported by study authors:** functional status (HHS); mortality (available at 12 months); blood loss; operation time; mean hospital stay; TAD; mean sliding distance of screw; screw displacement; fracture; non-unions; infections **Outcomes relevant to the review:** mortality (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** 'the author did not receive any outside funding or grants in support of their research for or preparation of this work. Neither they nor any immediate member of their families received payments or other benefits or commitment or agreement to provide such benefits from commercial entity' **Study dates:** January 2006 to March 2010 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Dalsgaard 1986

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: Ender versus SSP
Participants	**Total number of randomised participants:** 101 **Inclusion criteria:** pertrochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre, hospital, Denmark **Baseline characteristics** **Intervention group 1** (Ender) • Age, average (range): 79 (47 to 97) years • Fracture classification, stable/unstable, n: 21/36 **Intervention group 2** (SSP) • Age, average (range): 80 (49 to 93) years • Fracture classification, stable/unstable, n: 17/27 **Note:** • study provided no baseline characteristics
Interventions	**General details:** prophylactic antibiotics were not used. 30% of participants were operated on by senior house officers, and remaining were operated on by consultants and senior registrars; regular clinical follow-up for minimum of 6 months **Intervention group 1:** • Ender nails (manufacturer not reported) • Number randomised to group = 57; losses = not reported, number analysed = 57

Dalsgaard 1986 *(Continued)*

	Intervention group 2: • Sliding nail plate (manufacturer not reported) • Number randomised to group = 44; losses = not reported, number analysed = 48
Outcomes	**Outcomes measured/reported by study authors:** unplanned return to theatre (available at six-months); operations time; distal slipping; deep infection; shortening of the leg; walking ability **Outcomes relevant to the review:** unplanned return to theatre (reported at 6 months); mortality (6 months)
Notes	**Funding/sponsor/declarations of interest:** no details on funding or conflict of interest are provided **Study dates:** not reported **Note:** • study reported in Danish. We used an English translation of this paper by SU Sjølin.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Randomised using date of birth
Allocation concealment (selection bias)	Unclear risk	Method of allocation not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors do not report the experience and skills of the surgeons and we could not be certain whether surgeons were equally experienced with both types of implants.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No losses are reported.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Davis 1988

Study characteristics

Davis 1988 *(Continued)*

Methods	RCT; parallel design **Review comparison group:** Küntscher-Y nail versus SHS

Participants	**Total number of randomised participants:** 230
	
	Inclusion criteria: intertrochanteric proximal femoral fractures; fit for surgery
	
	Exclusion criteria: < 50 years of age; pathological and Paget's fractures
	
	Setting: 2 orthopaedic hospitals, UK
	
	Baseline characteristics
	
	Intervention group 1 (nail)
	
	• Age, mean (SD): 80.2 (± 9.4) years
	• Gender, M/F: 27/89
	• Mobility assessment; walking ability (1 independent to 6 bedridden), mean (SD): 3.0 (± 1.49)
	• Cognitive status, mental test score, mean (SD): 6.9 (± 4.8)
	• Fracture classification, n:
	  ○ two part displaced, 22
	  ○ three part lateral, 28
	  ○ three part medial, 18
	  ○ complex, 35
	  ○ associated subtrochanteric, 9
	  ○ basi-trochanteric, 4
	
	Intervention group 2 (SHS)
	
	• Age, mean (SD): 81 (± 11.4) years
	• Gender, M/F: 13/101
	• Mobility assessment; walking ability (1 independent to 6 bedridden), mean (SD): 3.1 (± 1.49)
	• Cognitive status, mental test score, mean (SD): 7.4(± 4.7)
	• Fracture classification, n:
	  ○ two part displaced, 13
	  ○ three part lateral, 22
	  ○ three part medial, 7
	  ○ complex, 56
	  ○ associated subtrochanteric, 11
	  ○ basi-trochanteric, 5
	
	Overall:
	
	• Age, mean (SD): 80.6 (± 9.9) years
	• Gender, M/F: 40/190
	• Mobility assessment; walking ability, mean (SD): 3.05 (± 1.49)
	• Cognitive status, mental test score, mean (SD): 7.15 (± 4.8)
	• Fracture classification, n:
	  ○ two part displaced, 35
	  ○ three part lateral, 50
	  ○ three part medial, 25
	  ○ complex, 91
	  ○ associated subtrochanteric, 20
	  ○ basi-trochanteric, 9
	
	Note:

Davis 1988 *(Continued)*

	• study authors did not report: smoking history; medication; BMI; preoperative waiting time; comorbidities
Interventions	**General details:** general or spinal anaesthetic; prophylactic antibiotics image intensification; weight bearing encouraged after 48 hours; clinical follow-up at 6 weeks, 3, 6 and 12 months; operations performed by consultants or trainees **Intervention group 1** • Küntscher-Y nail; the U shape blade is inserted through the lateral cortex of the femur into the femoral neck and then the intramedullary nail is inserted through the greater trochanter and through blade into the intramedullary canal of the femur; the Küntscher-Y nail cannot be locked distally • Randomised = 116 **Intervention group 2** • SHS, no further details reported • Randomised = 114 **Note:** • study authors do not report whether surgeons are experienced with both implants
Outcomes	**Outcomes measured/reported by study authors:** LOS; LOS and convalescence; mortality (1 month and 6 months); radiographic healing time; time to weight bearing; Salvati and Wilson score; functional deficit; power and motion at hip; knee mobility; time till painless mobilisation and failure to regain pre-fracture mobility; complications: infection, UTI, chest infection, venous thromboembolic phenomena; implant failure; cut out; LOS (not reported by group); Mental Test Score **Outcomes relevant to the review:** mortality (12 months); unplanned return to theatre **Notes:** • reasons for unplanned return to theatre: non-union, cut-out and infection
Notes	**Funding/sponsor/declarations of interest:** funded by the Northern Regional Health Authority **Study dates:** June 1983 to May 1985 **Notes:** • We noted that the nail used was described as an experimental device which is not available commercially. This outdated implant is now superseded by newer intramedullary nails that have improved instrumentation and the capacity for distal locking to reduce the risk of limb shortening. • We did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

De Grave 2012

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma 3 nail versus ACE trochanteric nail
Participants	**Total number of randomised participants:** 112 **Inclusion criteria:** pertrochanteric femoral fracture resulting from a low-energy fall **Exclusion criteria:** pathological fractures; multiple injuries; high likelihood of loss to follow-up

De Grave 2012 *(Continued)*

Setting: single centre; hospital; Belgium

Baseline characteristics

Intervention group 1 (Gamma 3)

- Age, mean (SD): 73 (± 12.5) years
- Gender, M/F: 35/26
- Preoperative waiting time: all treated within 24 hour of admission
- Fracture classification, stable/unstable, n: 18/43

Intervention group 2 (ACE)

- Age, mean (SD): 77 (± 14) years
- Gender, M/F: 32/19
- Preoperative waiting time: all treated within 24 hours of admission
- Fracture classification, stable/unstable, n: 20/31

Overall:

- Age, mean (SD): 74.9 (± 13.2) years

Note:

- study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status

Interventions	**General details:** a senior orthopaedic resident performed the operations; all participants were given one dose of cefuroxime before the operation and low-molecular-weight heparin for 4 weeks post surgery; they were mobilised with full weight bearing as tolerated; regular radiographic and clinical examinations were performed in all participants between 6 weeks and 1 year postoperatively **Intervention group 1** • Gamma third-generation nail (Stryker); short (180 mm), single cephalic screw and single distal locking screw • Number randomised = 61 **Intervention group 2** • ACE trochanteric nail (Depuy); short (200 mm), an antirotation screw was used in addition to the 10.5 mm cephalic screw, depending on rotational stability, single distal locking screw • Number randomised = 51
Outcomes	**Outcomes measured/reported by study authors:** non-union; DVT; peripheral nerve injury; failure of internal fixation; wound infection; implant failure; mortality (available at 12 months); Merle d'Aubigné hip score **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors report no benefits or funds were received in support of this study **Study dates:** August 2006 to July 2009 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Delgado 1990

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Richards hip compression plate with and without Universal Angle Guide
Participants	**Total number of randomised participants:** 20 **Inclusion criteria:** intertrochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre; hospital; Mexico **Baseline characteristics** **Intervention group 1** (using Universal Angle Guide) • Age, average: 78 years • Gender, M/F: 1/11 **Intervention group 2** (conventional method) • Age, average: 66 years • Gender, M/F: 8/0 **Note:** • study authors report no baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status, preoperative waiting time, fractures classification
Interventions	**General details:** all participants given prophylactic antibiotics **Intervention group 1** • Richards hip screw compression plate (Richards); sliding hip screw, lag screw guide wire inserted with Universal Angle Guide (developed at Military Central Hospital, Mexico) • Number randomised = 12 **Intervention group 2** • Richards hip screw compression plate (Richards); sliding hip screw, lag screw guide wire inserted free-hand using clinical observation • Number randomised = 8
Outcomes	**Outcomes measured/reported by study authors:** fracture angle, complications, duration of surgery, mortality **Outcomes relevant to the review:** none **Note:** • we did not include the data for mortality because it was unclear if this was reported only for a subset of participants
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** December 1988 to May 1990 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Desteli 2015

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus cementless bipolar hemiarthroplasty
Participants	**Total number of randomised participants:** 92 **Inclusion criteria:** isolated, unstable intertrochanteric fractures; > 60 years of age **Exclusion criteria:** pathological fractures due to primary and metastatic tumours; fractures associated with polytrauma; people with psychiatric or neurologic disorders; accompanying major systemic diseases; fracture type 31A1.1 and 31A1.2 **Setting:** single centre; hospital; Turkey **Baseline characteristics** (only for participants that did not die) **Intervention group 1** (PFN) • Age, mean (SD): 67.0 (± 1.21) years • Gender, M/F: 27/15 • ASA status, I/II/III/IV: 2/21/17/2 • Fracture classification, 31A1.3/31A2.2/31A2.3/31A3.1/31A3.3, n: 6/18/9/6/3 • HRQoL, EQ-5D, mean (SD; median): 0.61 (± 0.01; 0.61) **Intervention group 2** (HA) • Age, mean (SD): 65.0 (± 1.52) years • Gender, M/F: 26/16 • ASA status, I/II/III/IV: 2/21/18/3 • Fracture classification, 31A1.3/31A2.2/31A2.3/31A3.1/31A3.3, n: 6/18/10/6/4 • HRQoL, EQ-5D, mean (SD; median): 0.62 (± 0.01; 0.62) **Overall:** • Fracture classification, 31A1.3/31A2.2/31A2.3/31A3.1/31A3.3, n: 12/36/19/12/7 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time
Interventions	**General details:** all of the participants in each treatment arm received similar operative treatment and postoperative care from the same medical staff; follow-up visits were performed at the 3rd, 12th and 24th months postoperatively; participants were treated with either regional anaesthesia or general anaesthesia **Intervention group 1** • Antirotation-Proximal Femoral Nail (A-PFN) (TST Medical); short nail ranging from 160 mm to 200 mm, intramedullary nailing, integrated cephalic lag screw and blade • Number randomised = not reported **Intervention group 2** • Cementless bipolar hemiarthroplasty (Osteonics, Allendale, NJ, USA) • Number randomised = not reported **Note:**

Desteli 2015 *(Continued)*

	• study authors do not report the experience of the medical staff or details about their pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** social function score, mobility score, HRQoL (available at 3 months, 12 months and 24 months); fracture union; operation time; time in hospital **Outcomes relevant to the review:** HRQoL (using EQ-5D, at ≤ 4 months and 12 months) **Note:** • we could not use data for HRQoL because of the method used by study authors to report this outcome which was not comparable to other studies
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 2009 to 2013 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Dhamangaonkar 2013

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: proximal femoral locking plate versus DHS
Participants	**Total number of randomised participants:** 44 **Inclusion criteria:** unstable intertrochanteric femoral fractures **Exclusion criteria:** children and people with compound fractures and associated head, chest or abdominal injuries were excluded **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (proximal femoral locking plate) • Age, mean (range): 55 (32 to 78) years • Gender, M/F: 15/5 • Preoperative waiting time, mean: 12.4 days **Intervention group 2** (DHS) • Age, mean (range): 58 (38 to 75) years • Gender, M/F: 14/6 • Preoperative waiting time, mean: 12.2 days **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; fracture classification
Interventions	**General details:** antibiotics and analgesics were given according to hospital protocol; participants were allowed to perform quadriceps-strengthening exercises the next day; mobilisation with no weight

Dhamangaonkar 2013 *(Continued)*

	bearing was allowed, followed by partial weight bearing on crutches or with walking frame after 6 to 8 weeks; follow-up at 2 weeks, 6 weeks and thereafter monthly for 18 months **Intervention group 1** • Proximal femoral locking plate (Universal Orthosystems, Gujarat, India); locking plate with up to six options for cephalic screws and four-shaft screws • Number randomised = unknown **Intervention group 2** • Dynamic hip screw (manufacturer details not reported) • Number randomised = unknown **Note:** • study authors provide no information on the number of clinicians or their skills and experience
Outcomes	**Outcomes measured/reported by study authors:** blood loss; mean hospital stay; mean time to union; mean neck shaft angle; mean limb shortening; mean normal-side neck shaft angles; medialisation of the shaft; varus collapse; functional hip score; deep wound infection; implant cut-out **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** study authors declared no conflicts of interest. No details of funding **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Dong 2018

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus Gamma nail
Participants	**Total number of randomised participants:** 178 **Inclusion criteria:** ≥ 60 years of age; have self-care ability prior to injury; femoral intertrochanteric fracture; eligible for surgery **Exclusion criteria:** pathological fractures; multiple injuries; those who had received another operation on affected side **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD) (range): 70.2 (± 2.3) (63 to 87) years • Gender, M/F: 49/40

Dong 2018 *(Continued)*

- Comorbidities, n:
  - Cardiovascular and cerebrovascular disease: 35
  - Diabetes: 16
  - Cerebral embolism: 11
  - Pulmonary infection: 16
  - Other disease: 7
  - Osteoporosis, mild/moderate/severe: 18/19/9
- Evans-Jensen classification, I/II/III/IV/V, n: 14/11/32/18/14

Intervention group 2 (Gamma)

- Age, mean (SD) (range): 70.7 (± 2.8) (63 to 87) years
- Gender, M/F: 48/41
- Comorbidities, n:
  - Cardiovascular and cerebrovascular disease: 35
  - Diabetes: 16
  - Cerebral embolism: 11
  - Lung infection: 16
  - Other disease: 7
  - Osteoporosis, mild/moderate/severe: 21/16/11
- Evans-Jensen classification, I/II/III/IV/V, n: 12/13/31/18/15

Note:

- study authors report no baseline characteristics for: smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time

Interventions	**General details:** participants underwent continuous epidural anaesthesia, in supine position, in traction bed before operation **Intervention group 1** • PFNA • Number randomised = 89 **Intervention group 2** • Gamma nail • Number randomised = 89 **Note:** • study authors do not report the number of surgeons or their skills and experience, or any details on the pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss; length of stay; postoperative haemoglobin decline values; rotation of caput femoris; amount of fixing needle slippage; TAD; collodiaphyseal angle; time to discharge; healing time; infections; femoral ruptures; hip varus; nonunion; dysfunction; pain; functional status (HHS) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2015 to April 2016 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Dujardin 2001

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** mini-invasive static intramedullary nail versus SHS

Participants	**Total number of randomised participants:** 60
	
	Inclusion criteria: intertrochanteric proximal femoral fracture (stable and unstable fractures), informed consent, ≥ 60 years of age; surgery within first 2 days after fracture
	
	Exclusion criteria: pathological; lower limb arteriopathy; fractures extending to the diaphysis; previous lesions of the hip; cutaneous lesions; abnormal calcium or phosphorus metabolism and no consent
	
	Setting: single centre; orthopaedic hospital; France
	
	Baseline characteristics
	
	Intervention group 1 (intramedullary nail)
	
	• Age, mean (SD): 83 (± 9.4) years
	• Gender, M/F: 6/24
	• Mobility assessment; walking (Salvati 1973), mean (SD): 5.4 (± 2.9)
	• ASA status, mean (SD): 2.1 (± 0.7)
	• Fracture classification, stable/unstable, n: 8/22
	• Additional information:
	  ○ Function, mean (SD): 4.3 (± 3.1)
	  ○ Singh index (Singh 1970), mean (SD): 2.9 (± 0.9)
	
	Intervention group 2 (SHS)
	
	• Age, mean (SD): 84 (± 6.2) years
	• Gender, M/F: 6/24
	• Mobility assessment; walking (Salvati 1973), mean (SD): 6.5 (± 2.2)
	• ASA status, mean (SD): 2.3 (± 0.5)
	• Fracture classification, stable/unstable, n: 14/16
	• Additional information:
	  ○ Function, mean (SD): 5.1 (± 2.9)
	  ○ Singh index (Singh 1970), mean (SD): 2.5 (± 0.9)
	
	Note:
	
	• study authors did not report: smoking history; medication; BMI; cognitive status; preoperative waiting time; comorbidities

Interventions	**General details:** traction table; 6 week thromboembolic prophylaxis with low-molecular-weight heparin; postoperative care identical in both groups; weight bearing authorised when no pain existed; all operations were undertaken by 2 surgeons with experience of the surgical technique; 1 surgeon did all the SHS operations and the other did all the nail operations; both described as a senior surgeon; type of anaesthesia is at the discretion of attending anaesthetist **Intervention group 1** • Cephamedullary nail (an experimental device used only for this study and not available commercially); 170 mm long; 12 mm diameter; cephalic fixation is achieved with 2 converging screws resulting in static proximal fixation; all nails were locked distally • Randomised = 30; no reported losses; analysed = 30

Dujardin 2001 *(Continued)*

	Intervention group 2 • SHS (Smith and Nephew) • Randomised = 30; no reported losses; analysed = 30
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; mean units blood transfused; radiographic screening time; non-union; time to union; early postoperative complications (infection, thromboembolism, further operation); pneumonia; pressure sores; all medical complications; LOS; varus deformity (reported for the nail group); angular restoration; mortality; various aspects of hip function, including pain, power and mobility, were measured using the Salvati and Wilson score; pain; time to effective weight bearing; hip function; knee mobility; length of follow-up: 6 months **Outcomes relevant to the review:** mortality (1 and 6 months)
Notes	**Funding/sponsor/declarations of interest:** no external funding **Study dates:** not reported **Note:** • study authors state that the experimental nail is not available commercially

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	All operations were undertaken by two surgeons with experience of the surgical technique; one surgeon did all the SHS operations and the other did all the nail operations.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All losses explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Eceviz 2020

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: cephalomedullary nail vs SHS

Participants	**Total number of randomised participants:** 64
	
	Inclusion criteria: basicervical fracture, ≥ 65 years of age, isolated fracture, ability to walk independently (with or without an aid) before fracture, fracture that had occurred < 1 week prior to admission
	
	Exclusion criteria: history of ipsilateral femoral fracture, fracture due to malignancy, limited life expectancy due to medical comorbidities, any contraindication to surgery, diagnosed dementia, any other traumatic fracture
	
	Setting: tertiary hospital; single centre; Turkey
	
	Baseline characteristics
	
	Intervention group 1 (intramedullary)
	
	• Age, mean (SD): 81.34 (± 6.92) years
	• Gender, M/F: 15/14
	• Mobility score, average: 8.5
	• Preoperative waiting time, mean (SD): 5.76 (± 3.47) days
	• Additional information:
	  ○ Barthel index, average: 93.0
	
	Intervention group 2 (extramedullary)
	
	• Age, mean (SD): 80.11 (± 8.23) years
	• Gender, M/F: 11/16
	• Mobility score, average: 8.4
	• Preoperative waiting time, mean (SD): 5.37 (± 3.47) days
	• Additional information:
	  ○ Barthel Index, average: 94.5
	
	Note:
	
	• study authors report no baseline characteristics for: smoking history, medication, BMI, comorbidities, place of residence, cognitive status, ASA status, fracture classification

Interventions	**General details:** 2 senior surgeons (> 10 years of surgical experience in treating basicervical fractures and familiar with both surgical techniques); closed reduction under fluoroscopic guidance on a traction table; postoperatively, all participants were allowed immediate weight bearing as tolerated, regardless of the method of fixation; clinical follow-up at 6 weeks, 3 months, 6 months, and 12 months **Intervention group 1:** • Cehphalomedullary nail (Profin®); manufactured nails lengths are 220 mm and 250 mm (specific lengths of nails used in the study were not reported); cephalic fixation was performed with 2 dynamic screws; all nails were locked distally • Randomised = 32; losses = 3 (1 unable/unwilling to continue; 2 death); analysed for mortality = 32; analysed for unplanned return to theatre = 31 **Intervention group 2:** • Dynamic hip screw; secured to femur with 3-hole plate • Randomised = 32; losses - 5 (1 unable/unwilling to continue; 4 death); analysed for mortality = 32; analysed for unplanned return to theatre = 31

Eceviz 2020 *(Continued)*

	Note: • study authors do not report type of anaesthesia
Outcomes	**Outcomes measured/reported by study authors:** mobility score (0 to 9), HHS; ADL (using modified Barthel Index, range 0 to 100); tip apex distance and fracture settling, quality of reduction; mortality; revision surgery; wound infections **Outcomes relevant to the review:** mortality (12 months); unplanned return to theatre (revision surgery; at 12 months)
Notes	**Funding/sponsor/declarations of interest:** no funding; study authors declare no conflicts of interest **Study dates:** January 2016 to January 2018

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "The patients were randomly allocated to a study group by permuted blocks of randomly mixed sizes and stratification according to the type of surgery (CMN or SHS)"
Allocation concealment (selection bias)	Low risk	Quote: "Randomization was applied using pre-prepared randomisation cards, which were placed in opaque, sealed envelopes and given to the surgeons to open just prior to surgery, and the designated procedure was then performed".
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Surgeons were experienced with both implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	Low risk	Quote: "The clinical follow-up evaluations were performed by two independent orthopaedic surgeons who had access to all the patients' files and documents. They were also blinded to the preceded treatment." Comment: participants were assigned a four-digit number to conceal their identity and the radiographs were kept in digital folders.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced and mostly explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors reported registration with a clinical trials register (NCT04240743); however, this registration was made after completion of the study (in January 2020) and it was not feasible to effectively assess risk of selective reporting bias from these documents.
Other bias	Low risk	We identified no other sources of bias.

Efstathopoulos 2007

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma trochanteric nail versus ACE trochanteric nail
Participants	**Total number of randomised participants:** 112 **Inclusion criteria:** intertrochanteric hip fracture **Exclusion criteria:** < 65 years of age; pathological fractures; non-ambulatory people; ASA score V; previous ipsilateral or contralateral hip fractures **Setting:** single centre; hospital; Greece **Baseline characteristics** **Intervention group 1** (Gamma) • Age, mean: 79.5 years • Gender, M/F: 19/37 • ASA status, I/II/III/IV: 8/16/23/9 • Fracture classification (using Evans Type I/II), stable/unstable, n: 12/44 **Intervention group 2** (ACE) • Age, mean: 78.1 years • Gender, M/F: 13/43 • ASA status, I/II/III/IV: not reported in this group • Fracture classification (using Evans Type I/II), stable/unstable, n: 8/48 **Overall:** • Age, mean (range): 78 (69 to 89) years • Gender, M/F: 32/80 • Preoperative waiting time: 66 participants were treated within 6 hours • Fracture classification, stable/unstable, n: 20/92 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time
Interventions	**General details:** operations were performed by 2 experienced surgeons; type of anaesthesia was spinal for most participants; postoperatively, all participants were given prophylactic antibiotics for 24 to 48 hours and DVT prophylactics (low-molecular-weight heparin) for 6 weeks; participants were mobilised on the first postoperative day, regardless of fracture pattern, and full weight bearing was permitted as tolerated; regular radiological and clinical examinations were performed in all participants 1,3 and 6 months postoperatively **Intervention group 1** • Gamma trochanteric nail (Stryker); 18 cm long; 11 mm distal diameter; single cephalic screw; single distal locking screw • Number randomised = 56 **Intervention group 2**

Efstathopoulos 2007 *(Continued)*

- ACE trochanteric nail (DePuy); 18 to 20 cm long; 11 mm distal diameter used in all participants; cephalic locking performed with 10.5 mm lag screw with the optional addition of a superior 5 mm antirotation screw; single distal locking screw
- Number randomised = 56

Outcomes	**Outcomes measured/reported by study authors:** operation time; blood transfusion; fluoroscopy time; complications (implant failures, DVT, superficial wound infection, general complications); mobility status; mortality (available at first week) **Outcomes relevant to the review:** mortality (reported in first week) **Note:** • study authors report that 19 participants died within the study period but these are not reported by group, and therefore we have not included these in analysis.
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Ekstrom 2007

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus the Medoff sliding plate

Participants	**Total number of randomised participants:** 210
	
	Inclusion criteria: unstable trochanteric fracture classified 3-5 (Jensen 1981); AO/OTA: 31 A2.1-3 and A3.1-3; subtrochanteric fracture classified as AO/OTA: 32 A1.1 and B1.1 (Seinsheimer 1978); adults with a closed growth plate and an unstable trochanteric fracture or a subtrochanteric fracture with the most distal fracture ending < 5 cm distal to the lesser trochanter
	
	Exclusion criteria: people with stable trochanteric fractures, high-energy trauma, pathological fractures, previous surgery to the proximal femur, daily steroids of more than 10 mg of prednisolone, ongoing chemotherapy, irradiation treatment, presence of degenerative osteoarthrosis of the injured hip
	
	Setting: two orthopaedic hospitals, Sweden
	
	Baseline characteristics (only for 203 participants)
	
	Intervention group 1 (PFN)
	
	• Age, mean (range): 82 (48 to 96) years
	• Gender, M/F: 24/76
	• Mobility assessment; without aid/2 crutches or frame/human support, n: 65/34/1
	• Place of residence, own home/nursing home/institution, n: 81/8/11
	• Fracture classification, n:
	  ◦ Trochanteric; Jenson, type 3/4/5: 16/10/56
	  ◦ Subtrochanteric; Seinsheimer, type 1/2/3/4/5: 0/0/1/8/9
	
	Intervention group 1 (Medoff sliding plate)

Ekstrom 2007 *(Continued)*

- Age, mean (range): 82 (52 to 97) years
- Gender, M/F: 25/75
- Mobility assessment; without aid/2 crutches or frame/human support, n: 62/35/3
- Place of residence, own home/nursing home/institution, n: 74/16/10
- Fracture classification, n:
  - Trochanteric; Jenson, type 3/4/5: 11/19/57
  - Subtrochanteric; Seinsheimer, type 1/2/3/4/5: 0/0/5/1/7

Note:

- study authors did not report: smoking history; medication; BMI; cognitive status; preoperative waiting time; comorbidities

Interventions	**General details:** preoperative antibiotics; subcutaneous low-molecular-weight heparin (thromboembolic prophylaxis) for 7 days; spinal anaesthesia was used, although 13 participants had general anaesthesia and 1 participant had a combination of both; participants were mobilised according to the treatment protocol at the 2 hospitals; weight bearing as tolerated or restricted weight bearing; clinical follow-up at 6 weeks, 4 and 12 months; operations performed by 43 different surgeons, consultants or trainees; 2 senior consultants with extensive experience with both implants gave theoretical and practical instructions before start of study **Intervention group 1** • PFN (Stratec, Switzerland); 240 mm long nail, available in 10, 11, 12 mm diameters; a shaft angle of 130 degrees was used; cephalic fixation was performed with 2 screws; distal locking of the PFN was not reported • Randomised = 110; losses/exclusions = 5 (excluded due to improper inclusion of 1 femoral shaft fracture, 2 pathological fractures, 2 fractures treated with another method); analysed = 105 **Intervention group 2** • Medoff Sliding Plate (Medpac Inc., Calafornia, USA); 4- or 6-hole plate used in biaxial mode for trochanteric fractures and uni-axial mode for the subtrochanteric fractures; locking set screw was used in all subtrochanteric fractures to prevent dynamisation of the femoral neck screw and direct dynamisation along the shaft of the femur • Randomised = 100; losses/exclusions = 2 (excluded due to 1 Jensen-Michaelsen fracture and 1 due to treatment with another method); analysed = 98
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; radiographic screening time; cut-out of implant; non-union; operative fracture of the femur; later fracture of the femur; other fracture healing complications; re-operation; wound infection; wound haematoma; LOS; mortality; failure to return to pre-fracture residential status; pain; inability to walk 15 metres; inability to rise from the chair; inability to climb a curb; need to use walking aids; abductor strength **Outcomes relevant to the review:** mortality (12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "based on a computer generated list. Randomization was stratified according to trochanteric or subtrochanteric fractures."
Allocation concealment (selection bias)	Low risk	Randomised "using consecutive numbered and sealed envelopes"

Ekstrom 2007 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Quotes: "Surgery was undertaken by 43 different surgeons employed as regular staff at the two hospital", "two senior consultations ... with extensive experience and familiar with both surgical methods, gave theoretical and practical instructions before the start of the study". Comment: we did not expect that this provided sufficient protection against performance bias.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Large loss to follow-up at 12 months for some outcomes (and reasons are not reported by group, and explained by "general health problems and death"). However, for outcomes relevant to the review, we included most participants.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Esser 1986

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus Jewett nail plate
Participants	**Total number of randomised participants:** 98 **Inclusion criteria:** elderly women, > 60 years of age, with trochanteric fractures; residents of North Wales **Exclusion criteria:** not reported **Setting:** single centre; hospital; Wales **Baseline characteristics (overall):** • Age, mean: 81.7 years **Note:** • study authors report no baseline data except for the mean age between both groups
Interventions	**General details:** clinical follow-up at 6 weeks, 3 months, and 6 months

Esser 1986 *(Continued)*

Intervention group 1

- Dynamic hip screw (manufacturer details not reported)
- Number randomised to group = 50 (1 from the Jewett nail group was treated with DHS); losses = 9 (death), analysed = 51

Intervention group 2

- Jewett nail plate (manufacturer not reported)
- Number randomised to group = 50 (2 were subsequently treated with other devices, and 1 was treated with DHS); losses = 11 (death), analysed = 47

Note:

- study authors provide no general details
- study authors report data according to numbers treated with each intervention (rather than as ITT)
- no further implant details were provided

Outcomes	**Outcomes measured/reported by study authors:** operation time; mobility; pain; complications; mortality **Outcomes relevant to the review:** mortality (during study period; 6 months)
Notes	**Funding/sponsor/declarations of interest:** supported by a grant from Gwynedd Research Committee **Study dates:** November 1981 to February 1983

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to treatment groups. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors do not report the experience and skills of the surgeons and we could not be certain whether they were equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Data are reported only for participants that were treated with the interventions. However, the number of losses are few.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Fitzpatrick 2011

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus Dynamic Helical Hip System
Participants	**Total number of randomised participants:** 51 **Inclusion criteria:** > 50 years of age; intertrochanteric hip fractures (AO/OTA classification 31A1, 31A2); admitted to study hospitals **Exclusion criteria:** reverse obliquity fractures; basicervical fractures; fractures extending into the subtrochanteric region; pathological fractures; previous ipsilateral hip surgery; multiple injuries; non-ambulators prior to injury; dementia severe enough to limit ability to comply with postoperative rehabilitation **Setting:** multicentre (2 sites: level 2 trauma centre, and level 3 trauma centre); hospital; USA **Baseline characteristics** **Intervention group 1** (DHS) • Age, mean (SD): 80.04 (± 11.49) years • Gender, M/F: 3/21 • ASA status, healthy/minimal medical comorbidities/major medical comorbidities: 1/10/12 • Preoperative waiting time, mean (SD): 1.04 (± 0.69) days • Fracture classification, 31A1.1/31A1.2/31A1.3/31A2.1/31A2.2, n: 5/6/2/9/2 • Evens Class 1/2/3/4/5: 7/4/3/8/1 **Intervention group 2** (Dynamic Helical Hip System) • Age, mean (SD): 80.41 (± 12.01) years • Gender, M/F: 9/18 • ASA status, healthy/minimal medical comorbidities/major medical comorbidities: 1/6/20 • Preoperative waiting time, mean (SD): 1 (± 0.68) days • Fracture classification, A1.1/A1.2/A1.3/A2.1/A2.2, n: 8/4/8/8/5 • Evens Class 1/2/3/4/5: 8/4/3/7/5 **Note:** • study authors did not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia
Interventions	**General details:** sessions were held to make sure all surgeons were experienced with both techniques, and personnel were encouraged to use the Dynamic Helical Hip System exclusively for 3 months during the run-up to the study; antibiotic prophylaxis was provided for 24 hours; spinal or general anaesthesia at the discretion of attending anaesthetist; in absence of bleeding concerns, participants were placed on low-molecular-weight heparin beginning postoperative day one, which continued 2 weeks postoperatively, at which time participants were switched to aspirin; compression hose and compression devices were used routinely while participants were in the hospital; all participants were allowed weight bearing as tolerated with physical therapy beginning on first postoperative day; participants were discharged to a skilled nursing facility or home when medically stable; clinical follow-up at 2 weeks, 6 weeks, and then at 6-weekly intervals until healing occurred **Intervention group 1:** • Dynamic hip screw (Synthes); head fixation with a screw • number randomised to group = 24

Fitzpatrick 2011 *(Continued)*

	Intervention group 2: • Dynamic Helical Hip System (Synthes); head fixation with a blade • number randomised to group = 27 **Notes:** • plate length in both groups was chosen according to the preference of the operating surgeon
Outcomes	**Outcomes measured/reported by study authors:** mean amount of sliding; TAD; screw-tip location; quality of fracture reduction; cut-out **Outcomes relevant to the review:** none **Note:** • although some complications (cut-out) required return to theatre, we could not be certain if data for re-operation were collected for other complications, and therefore we have not collected this data.
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Fritz 1999

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: gliding nail versus Gamma nail **Note:** • study includes data for an additional group of stable fractures treated with DHS - these participants were not randomised and we have not included these data in the review
Participants	**Total number of randomised participants:** 80 **Inclusion criteria:** unstable trochanteric fractures (A2, A3) **Exclusion criteria:** intracapsular femoral neck fractures; pathological fractures as well as a concomitant severe coxarthrosis **Setting:** single centre; hospital; Germany **Baseline characteristics** **Intervention group 1** (gliding) • Age, mean: 83.4 years • Gender, M/F: 4/36 • Place of residence, at home/geriatric institution, hospital, n: 26/12/2 • ASA status, III or IV: 30 • Fracture classification, 31A2/31A3, n: 33/7 **Intervention group 2** (Gamma)

Fritz 1999 *(Continued)*

- Age, mean: 81.8 years
- Gender, M/F: 7/33
- Place of residence, at home/geriatric institution, hospital, n: 22/17/1
- ASA status, III or IV: 32
- Fracture classification, 31A2/31A3, n: 35/5

Note:

- study authors do not report any baseline characteristics for; smoking history; medication; BMI; co-morbidities; mobility assessment; cognitive status/dementia; preoperative waiting time

Interventions	**General details:** 6 surgeons with sufficient traumatological experience with the fixation systems did the operation; if one of the 7 surgeons-in-training carried out the operation, this was done only under the supervision of a specialist; all participants had either spinal or general anaesthesia used; follow-up was done at 6 months **Intervention group 1** • Gliding nail (manufacturer not reported); all nails were short (220 mm); fixation in the femoral head is with a blade with a double-T profile; proximal fixation was dynamic; distal locking was performed with two scores (static) • Number randomised to group = 40 **Intervention group 2** • Gamma nail (Stryker); all nails were short (220 mm); fixation in the femoral head with a single screw; proximal fixation was dynamic; distal locking was performed with two scores (static) • Number randomised to group = 40 **Note:** • study authors do not give any details on the pre-/postoperative care, including time until weight bearing
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss; hospital stay; discharge destination; dislocation; distraction of fraction; CCD angle difference; score; intraoperative complications; postoperative complications (local and general); mortality (available before discharge and 6 months); general complications (cerebrovascular accident, bronchopneumonia, apoplexy, UTI, decubitus, fracture of forearm); mobility; pain; lengthening of length; internal malrotation; external malrotation **Outcomes relevant to the review:** mortality (reported before discharge and 6 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** December 1995 to December 1996 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Galanopoulos 2018

Study characteristics	
Methods	Quasi-randomised; parallel design

Galanopoulos 2018 *(Continued)*

Review comparison group: short intramedullary nail versus long intramedullary nail

Participants	**Total number of randomised participants:** 50 **Inclusion criteria:** low-energy unstable (AO/OTA 31A2 and 31A3) pertrochanteric hip fractures **Exclusion criteria:** unstable pertrochanteric pathological fractures; previous pertrochanteric fractures of the contralateral hip **Setting:** single centre; hospital; Greece **Baseline characteristics** **Intervention group 1** (short) • Age, mean (range): 81 (74 to 92) years **Intervention group 2** (long) • Age, mean (range): 79 (74 to 93) years **Overall:** • Age, mean (range): 80 (74 to 93) years • Gender, M/F: 17/33 • Comorbidities, CAD or CHF/endocrinopathies (such as diabetes mellitus and hyperthyroidism)/chronic renal failure: 5/13/2 **Note:** • study authors report no baseline characteristics for: gender (except for overall data); smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** all participants were operated under spinal anaesthesia in a supine position on a fracture table; all participants were mobilised in the sitting position on POD2, and allowed protective, partial (approx. 30% of body weight) weight bearing with a walker for 1 month, allowing weight bearing with the walker or canes as tolerated, thereafter; routine postoperative clinical and radiographic examination was done at 1, 3, 6 and 12 months and then annually until the last follow-up **Intervention group 1** • Affixus Hip Fracture Nail System® (Zimmer Biomet); short intramedullary nail (180 mm); a single head screw; static distal locking was performed in all cases • Number randomised = 25 **Intervention group 2** • Orthofix VeroNail Trochanteric Nail® (Orthofix); long intramedullary nail, the nail is available in lengths from 280 mm to 440 mm, in all cases the nail length chosen was such that it extended three diameters of the bone distal to the fracture; proximal fixation into the femoral head was performed with two convergent femoral head (resulting in static fixation); static distal locking was performed in all cases • Number randomised = 25 **Note:** • study authors report no details on the number or skills and experience of the surgeons
Outcomes	**Outcomes measured/reported by study authors:** time for weight bearing with the use of a single crutch or cane; leg length discrepancy; Trendelenburg gait; fracture healing; varus/valgus loss of reduction on anteroposterior radiographs; distance between the distal line of the fracture and the distal locking screw of the nail; operation time; complications (periprosthetic fracture, z-effect phenomenon) **Outcomes relevant to the review:** none

Galanopoulos 2018 *(Continued)*

	Note: • although study authors report complications for which some had re-operation, we could not be certain that data for unplanned return to theatre were reported consistently in both groups; we therefore did not report data for unplanned return to theatre.
Notes	**Funding/sponsor/declarations of interest:** authors declare that they have no conflicts of interest in relation to this article **Study dates:** 2012 to 2016 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Giraud 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Targon PFN versus DHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** intertrochanteric proximal femoral fracture (stable and unstable fractures: AO 31-A1, A2 and A3) **Exclusion criteria:** not reported **Setting:** single centre; orthopaedic hospital; France **Baseline characteristics** **Intervention group 1** (Targon PFN) • Age, mean (SD, range): 81 (± 12.8, 23 to 86) years • Gender, M/F: 6/28 • ASA status, I/II/III/IV: 1/9/20/4 • Fracture classification, 31A1/A2/A3, n: 11/20/3 **Intervention group 2** (DHS) • Age, mean (SD, range): 82 (± 9.8, 47 to 97) years • Gender, M/F: 8/18 • ASA status, I/II/III/IV: 2/8/16 • Fracture classification, 31A1/A2/A3, n: 14/11/1 **Overall:** • Gender, M/F: 14/46 • Fracture classification, stable/unstable, n: 31/29 **Note:** • study authors did not report: smoking history; medication; BMI; place of residence; cognitive status; preoperative waiting time; comorbidities
Interventions	**General details:** experience of surgeons is unknown

Giraud 2005 *(Continued)*

	Intervention group 1 • Targon PFN (B. Brawn Ltd, Tuttlingen, Germany); surgical procedures and implant details not reported; length of nails was not reported; however, it is highly probable that all nails used were short nails; details of distal locking of nails was not reported; cephalic fixation was performed with a screw and a pin • Randomised = 34; no reported losses; analysed = 34 **Intervention group 2** • DHS (Synthes) • Randomised = 26; no reported losses; analysed = 26
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; cut-out of implant; later fracture of the femur; re-operation; wound infection (none); pneumonia (pulmonary congestion: "Pulmonaire"); DVT; LOS; mortality; time to walking; HHS; length of follow-up: 3 months **Outcomes relevant to the review:** mortality (at 3 months); unplanned return to theatre (due to cut-out)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** December 2003 and June 2004 **Note:** • additional information (on methods of randomisation and data for mortality and complications) supplied by study authors

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random numbers table
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors did not describe how many surgeons were involved in the study and whether they were equally experienced with the types of implants used in this study.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses explained by death, which is expected in this population

Giraud 2005 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Goldhagen 1994

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus CHS
Participants	**Total number of randomised participants**: 75 **Inclusion criteria:** adults; trochanteric and subtrochanteric proximal femoral fractures; fracture amenable to being treated with Gamma nail or CHS **Exclusion criteria:** previous ipsilateral hip fracture, hip surgery or congenital abnormality **Setting:** single centre; orthopaedic hospital, USA **Baseline characteristics (overall)** • Age: median 78 years (range 28 to 91 years) • Gender: 22/50 • Preoperative waiting time: 93% of participants had surgery within 48 hours **Baseline characteristics** **Intervention group 1** (Gamma nail) • Mobility assessment, ambulatory status, n: community, 24; community with aid, 5; household, 7 • Fracture classification, intertrochanteric/subtrochanteric, n: 28/6 **Intervention group 2** (CHS) • Mobility assessment, ambulatory status, n: community, 33; community with aid, 5; household, 1 • Fracture classification, intertrochanteric/subtrochanteric, n: 34/4 **Notes:** • study authors did not report smoking history; medication; BMI; place of residence; cognitive status; preoperative waiting time; comorbidities • one pathological fracture included • approximately 50% were stable
Interventions	**General details:** prophylactic antibiotics and DVT; physical therapy commenced on the first or second POD; weight bearing as tolerated; clinical follow-up minimum of 6 months; experience of surgeons is not reported **Intervention group 1** • Gamma nail; nail length short; cephalic fixation was performed with a single screw locked dynamically; all nails were locked distally • Randomised = 35; losses = 1 (death) **Intervention group 2**

Goldhagen 1994 *(Continued)*

- CHS; no details reported
- Randomised = 40; losses = 2 (death)

Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; radiographic screening time; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union; re-operation; LOS; mortality; pain at follow-up; non-return to previous residence; impaired walking **Outcomes relevant to the review:** mortality (6 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 1990 to January 1991

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: " ..fractures ..were prospectively randomized into two groups according to their medical record number."
Allocation concealment (selection bias)	High risk	It is not possible to conceal allocation because of methods used to allocate participants to groups.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Study authors refer to "a significant learning curve for the GN [Gamma nail]", and a "multiplicity of operating surgeons". We expected that surgeons were not all equally experienced with each implant.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were due to death, which is expected in this population. Although we noted some small discrepancies in denominators in some outcomes, we did not expect these to influence data.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Gou 2013

Study characteristics

Methods	RCT; parallel design

Gou 2013 *(Continued)*

Review comparison group: PFNA versus PCCP

Participants	**Total number of randomised participants:** 90
	
	Inclusion criteria: > 60 years old; intertrochanteric fractures (type 31-A1 and 31-A2 based on OTA classification); Evans stable and unstable; ASA status score of I to IV
	
	Exclusion criteria: subtrochanteric fractures (type 31-A3 in OTA classification); ASA V; existing or previous fractures in the same or contralateral hip; injuries that could affect the outcome measures; abnormalities that could affect the outcome measures
	
	Setting: single centre; orthopaedic hospital, China
	
	Baseline characteristics
	
	Intervention group 1 (PFNA)
	
	• Age, mean (SD): 74.2 (± 8.8) years
	• Gender, M/F: 19/26
	• Comorbidities, type, n:
	  ◦ Hypertension and cardiovascular diseases 35
	  ◦ Diabetes mellitus 19
	  ◦ Osteoporosis 7
	  ◦ Sequelae of cerebral infarction 2
	  ◦ Pulmonary infection 3
	  ◦ Chronic renal insufficiency 0
	• Mobility assessment, pre-injury walking score, mean (SD): 7.6 (± 2.3)
	• ASA status, I/II/III/IV: 7/12/21/5
	• Fracture classification, A1/A2; stable/unstable, n: 22/23; 18/27
	
	Intervention group 2 (PCCP)
	
	• Age, mean (SD): 71.6 (± 7.5) years
	• Gender, M/F: 16/29
	• Comorbidities, type, n:
	  ◦ Hypertension and cardiovascular diseases 33
	  ◦ Diabetes mellitus 16
	  ◦ Osteoporosis 5
	  ◦ Sequelae of cerebral infarction 2
	  ◦ Pulmonary infection 2
	  ◦ Chronic renal insufficiency 1
	• Mobility assessment, pre-injury walking score, mean (SD): 7.4 (± 2.9)
	• ASA status, I/II/III/IV: 6/13/19/7
	• Fracture classification, A1/A2; stable/unstable, n: 18/27; 23/22
	
	Note:
	
	• study authors did not report: smoking history; medication; BMI; place of residence; cognitive status; preoperative waiting time
	• no differences in prognostic variables were reported as statistically significant

Interventions	**General details:** performed according to the standard protocols provided by the manufacturer; inserted using a percutaneous technique; regional anaesthesia; preoperative antibiotics; traction table; prophylactic antibiotics for 3 days; exercise from first POD; walking with weight bearing as soon as possible; clinical follow-up at 3, 6, 9, and 12 months; surgical experience: "all operations were performed by expert surgeons who had equal levels of experience with both the PCCP and PFNA" **Intervention group 1**

Gou 2013 *(Continued)*

- PFNA (Synthes, USA); solid titanium nail with a length of 170 mm or 240 mm; cephalic fixation was performed with the helical blade; details of distal locking were not reported
- Randomised = 45; no reported losses; analysed = 45

Intervention group 2

- PCCP (Orthofix Orthopedics International, Italy); a 125 mm plate, two dynamic neck screws (lengths: 90 mm to 140 mm); three shaft screws (lengths: 31 mm to 43 mm)
- Randomised = 45; no reported losses; analysed = 45

Outcomes	**Outcomes measured/reported by study authors:** operation time; intraoperative blood loss; perioperative blood loss; LOS; mortality; hip pain; OHS; HHS; mobility; cardiac failure; pneumonia; UTI; DVT; postoperative fracture; superficial infection; cerebral infarction; urosepsis; haematoma; fat embolism syndrome **Outcomes relevant to the review:** mortality
Notes	**Funding/sponsor/declarations of interest:** funding not reported; authors state that no conflicts exist **Study dates:** January 2008 and October 2009

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	Quote: "using a sealed-envelope system" Comment: study authors do not report if envelopes are opaque and sequentially-numbered
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	“All operations were performed by expert surgeons who had equal levels of experience with both the PCCP and PFNA”
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No apparent losses
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Griffin 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: X-bolt dynamic hip plating system versus SHS
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** ≥ 60 years of age, with an AO/OTA type A2 and A3 fracture of the proximal femur; including those with cognitive impairment **Exclusion criteria:** treated non-operatively **Setting:** single centre; hospital; UK **Baseline characteristics** **Intervention group 1** (X-bolt) • Age, mean (SD): 84 (± 7) years • Gender, M/F: 14/37 • Smoking history, n: 10 • Comorbidities, diabetes/CRF, n: 7/4 • Mobility assessment, walk unaided indoors, n: 19 • Cognitive impairment, n: 15 • ASA status, mean (SD): 3 (± 0.7) • Fracture classification, A2/A3, n: 45/6 • HRQoL, EQ-5D, mean (SD): 0.54 (± 0.36) **Intervention group 2** (SHS) • Age, mean (SD): 85 (± 8) years • Gender, M/F: 3/46 • Smoking history, n: 6 • Comorbidities, diabetes/CRF, n: 5/1 • Mobility assessment, walk unaided indoors, n: 18 • Cognitive impairment, n: 24 • ASA status,mean (SD): 3 (± 0.7) • HRQoL, EQ-5D, mean (SD): 0.59 (± 0.29)
Interventions	**General details:** all participants received perioperative antibiotics; surgery on fracture table, closed reduction when possible; performed or supervised by an appropriately trained surgeon; length of plate and supplementary fixation at the discretion of the attending surgeon; clinical assessment at 4, 16 and 52 weeks **Intervention group 1:** • X-Bolt Dynamic Hip Plating System (O-Bolt Orthopaedics, Dublin, Ireland) • Number randomised to group = 51 **Intervention group 2:** • SHS • Number randomised to group = 49 **Note:** • study authors do not report weight bearing/mobility protocols

Griffin 2016 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** EQ-5D-3L; OHS; ICECAP-O; mortality; revision; length of hospital stay **Outcomes relevant to the review:** HRQOL (EQ-5D-3L); mortality; unplanned return to theatre. All at 12 months
Notes	**Funding/sponsor/declarations of interest:** funded by X-Bolt Orthopaedics; study authors report that "benefits have been or will be directed to a research fund, foundation, educational institution, or other nonprofit organisation with which one or more of the authors are associated" **Study dates:** February 2013 to June 2014 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Griffin 2021

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: X-Bolt Dynamic Plating System versus SHS

Participants	**Total number of randomised participants:** 1128
	
	Inclusion criteria: trochanteric fracture of the hip (determined with AO/OTA classification)
	
	Exclusion criteria: < 60 years of age; subtrochanteric fractures; people who were managed non-operatively
	
	Setting: 10 hospitals; multicentre; UK
	
	Baseline characteristics
	
	Intervention group 1 (X-Bolt)
	
	• Age, median (IQR): 85.8 (80.3 to 90.6) years
	• Gender, M/F: 163/401
	• Smoker, n: 40
	• Comorbidities, diabetes, n: 69
	• Mobility assessment, n/total:
	  ○ freely mobile 197/540
	  ○ one aid: 111/540
	  ○ 2 aids or frame: 98/540
	  ○ doesn't go outside without help: 120/540
	  ○ no functional mobility: 5/540
	  ○ unknown, n: 9/540
	• Place of residence, n/total:
	  ○ own home: 247/315
	  ○ residential care: 41/315
	  ○ nursing care: 21/315
	  ○ rehab unit (hospital bed in current unit): 1/315
	  ○ rehab (hospital bed in another trust): 1/315
	  ○ rehab (NHS funded care home bed): 0/315
	  ○ acute hospital: 4/315

Griffin 2021 *(Continued)*

- Cognitive status, AMTS, median (IQR): 8 (3 to 10)
- Fracture classification, 31A1/A2/A3, n: 222/303/14
- Pre-injury EQ-5D-5L, median (IQR): 0.7 (0.4 to 0.8)

Intervention group 2 (SHS)

- Age, median (IQR): 85.6 (78.8 to 90.9) years
- Gender, M/F: 139/424
- Smoker, n: 48
- Comorbidities, diabetes, n: 78
- Mobility assessment, n/total:
  - freely mobile: 186/534
  - one aid: 99/534
  - 2 aids or frame: 102/534
  - doesn't go outside without help: 134/534
  - no functional mobility: 8/534
  - unknown: 5/534
- Place of residence, n/total:
  - own home: 260/335
  - residential care: 46/335
  - nursing care: 25/335
  - rehab unit (hospital bed in current unit): 1/335
  - rehab (hospital bed in another trust): 0/335
  - rehab (NHS funded care home bed): 1/335
  - acute hospital: 2/335
- Cognitive status, AMTS, median (IQR): 8 (4 to 10)
- Fracture classification, 31A1/A2/A3, n: 204/307/21
- Pre-injury EQ-5D-5L, median (IQR): 0.7 (0.4 to 0.8)

Overall:

- Age, median (IQR): 86 (79 to 91) years
- Gender, M/F: 303/825
- Pre-injury EQ-5D, median (IQR): 0.7 (0.4 to 0.8)

Note:

- study authors do not report any baseline characteristics for: medication; BMI; cognitive status/dementia; ASA status; preoperative waiting time

Interventions	**General details:** routine investigations, anaesthetic management, antibiotic and venous thromboprophylaxis used according to local policy; internal fixation followed manufacturer guidelines; positioning of participant, surgical approach and wound closure at discretion of attending surgeon; mobilisation of participants through early, active, full weight bearing; follow-up was at 4 months and 12 months **Intervention group 1** • X-Bolt Dynamic Plating System (X-Bolt) • Number randomised to group = 564 **Intervention group 2** • Sliding hip screw (manufacturer not reported) • Number randomised to group = 564 **Note:** • study authors do not report data on the number of clinicians or their skills and experience

Griffin 2021 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** HRQoL (available at 4 months and 12 months); mortality (available at 12 months); functional status; residential status; re-operations (available at 12 months) **Outcomes relevant to the review:** HRQoL (using EQ-5D-5L, reported at 4 months and 12 months); mortality (available at 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report that "although none of the authors has received or will receive benefits for personal or professional use from commercial party related directly or indirectly to the subject of this article, benefits have been or will be received but will be directed solely to a research fund, foundation, educational institution, or other non-profit organisation with which one or more of the authors are associated. The study was sponsored by the University of Oxford. The study was funded by X-Bolt Ltd and was supported by the National Institute for Health Research Oxford Biomedical Research Centre. All decisions relating to the design, conduct, analysis, write-up, and publication of research are independent of each of these funders". **Study dates:** June 2016 to April 2018 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Guerra 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus DHS
Participants	**Total number of randomised participants:** 31 **Inclusion criteria:** > 65 years old; intertrochanteric fracture of the femur (AO classification 31 A1 or 31 A2) **Exclusion criteria:** compound femoral fracture; contraindications to surgery; non ambulatory before the presenting injury or presence of any other fractures **Setting:** single centre; orthopaedic hospital, Brazil **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 80.17(± 4.73) years • Gender, M/F: 1/11 • ASA status, I/II/III/IV: 0/5/5/2 **Intervention group 2** (DHS) • Age, mean (SD): 77.89 (± 6.92) years • Gender, M/F: 5/14 • ASA status, I/II/III/IV: 0/9/9/1 **Note:** • study authors did not report: smoking history; medication; BMI; comorbidities; mobility; place of residence; cognitive status; preoperative waiting time

Guerra 2014 *(Continued)*

Interventions	**General details:** clinical follow-up at 3, 6 and 12 months; experience of surgeon is not reported **Intervention group 1** • PFN; no further details • Randomised = 12; losses = 2 (death); analysed = 12 **Intervention group 2** • DHS; no further details • Randomised = 19; losses = 8 (death); analysed = 19
Outcomes	**Outcomes measured/reported by study authors:** FRS questionnaire (available at 3 months, 6 months, and 12 months); ASA status; mortality **Outcomes relevant to the review:** mortality (12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors declare that no funding was received and that they have no conflicts of interest **Study dates:** from October 2007; no end date

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Random selection from a box containing 20 envelopes. (10 DHS and 10 PFN)" Comment: envelopes replaced following selection
Allocation concealment (selection bias)	Unclear risk	Study authors do not report if envelopes are sealed, opaque and sequentially-numbered.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors did not describe how many surgeons were involved in the study and whether they were equally experienced with the types of implants used in this study.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses are explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Guo 2015

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS (conventional) versus DHS with lesser trochanteric reduction fixation system
Participants	**Total number of randomised participants:** 66 **Inclusion criteria:** intertrochanteric fractures of Evans type III **Exclusion criteria:** unknown **Setting:** single centre; hospital; China **Baseline characteristics unknown**
Interventions	**General details:** unknown **Intervention group 1** • Dynamic hip screw with additional lesser trochanteric reduction fixation system (manufacturer not reported) • Number randomised = 32 **Intervention group 2** • Dynamic hip screw (manufacturer not reported) • Number randomised = 34
Outcomes	**Outcomes measured/reported by study authors:** operation time; intraoperative blood loss; neck-shaft angle; bone healing time; ratio of successful fixations; functional evaluation of hip joint after operation **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** NR **Study dates:** January 2010 to July 2012 **Note:** • study is reported in Chinese. We did not seek translation and used only data included in the English abstract. • we did not complete risk of bias assessment because we did not include any review outcome data from this study.

Guyer 1991

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus DHS
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** trochanteric and subtrochanteric proximal femoral fractures. Classification Evans modified by Jensen (stable and unstable)

Guyer 1991 *(Continued)*

Exclusion criteria: not reported

Setting: single centre; orthopaedic hospital, Switzerland

Baseline characteristics (overall)

- Age, mean: 80 years

Baseline characteristics

Intervention group 1 (Gamma nail)

- Age, mean: 79.5 years
- Gender, M/F: 9/41
- Fracture classification, n:
  - pertrochanteric, stable/unstable: 23/24
  - intertrochanteric: 3

Intervention group 2 (DHS)

- Age, mean: 80.3 years
- Gender, M/F: 6/44
- Fracture classification, n:
  - pertrochanteric, stable/unstable: 19/26
  - intertrochanteric: 5

Note:

- study authors report no baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status

Interventions	**General details:** surgeons inexperienced with both devices; surgery within 24 hours; prophylactic antibiotics and low-dose heparin; mobilisation as tolerated within 3 days of surgery **Intervention group 1** • Gamma intramedullary nail; cephalic fixation was performed with a single screw; nail length was not reported; however, it is highly probable that all nails were short nails; details regarding distal locking were not provided • Randomised = 50; losses = 22 (8 deaths, 14 lost to follow-up); analysed = 50 **Intervention group 2** • DHS; no further implant or operative details were provided • Randomised = 50; losses = 18 (8 deaths, 10 lost to follow-up); analysed = 50
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union; re-operation; deep wound infection; wound haematoma; LOS; shortening of leg (> 1 cm); mortality (available at 3 days, 30 days, and 3 months); pain at follow-up (pain on walking); place of residence at 3 months; mobility (impaired walking and categorical data according to walking aids) **Outcomes relevant to the review:** mortality (3 months); unplanned return to theatre (3 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** September 1989 to June 1990

Risk of bias

Bias	Authors' judgement	Support for judgement

Guyer 1991 *(Continued)*

Random sequence generation (selection bias)	High risk	Quote (translation from German): "AO DHS and gamma nails were implanted alternatively."
Allocation concealment (selection bias)	High risk	It is not possible to conceal allocation using this method of randomisation.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance. Surgeons, care personnel and participants not blinded
Other performance bias: surgeon experience of both implants	High risk	Study authors describe surgeons as inexperienced with the implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses are explained by death which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Haddon 2019

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: SHS with trochanteric support plates (TSP) versus SHS without trochanteric support plates
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** low-energy, unstable, trochanteric fractures (Evans Jensen type 3 to 5); in later stages of the study (from 2011 onwards), also included people with cognitive impairment (previously excluded) **Exclusion criteria:** reverse oblique fractures; subtrochanteric fractures **Setting:** single centre; hospital; Norway **Baseline characteristics** **Intervention group 1** (with TSP) • Age, average: 81.9 years

Haddon 2019 *(Continued)*

- Gender, M/F: 10/40
- Ambulation, using modified D'Aubigne scale (score 1 to 6): 3.5
- Place of residence, own house/temporary rehabilitation centre/permanent institution, n: 37/5/8
- Fracture classification, Evans Jenson 3/4/5, n: 6/23/21

Intervention group 2 (no TSP)

- Age, average: 82.4 years
- Gender, M/F: 12/38
- Ambulation (score 1 to 6) before admission: 3.5
- Place of residence, own house/temporary rehabilitation centre/permanent institution: 35/6/9
- Fracture classification, Evans Jenson 3/4/5, n: 6/33/11

Note:

- study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; cognitive status; ASA status; preoperative waiting times

Interventions	**General details:** front and lateral standard radiographs were obtained pre- and immediately postoperatively and new radiographs were obtained at 12 month follow-up **Intervention group 1** • Dynamic hip screw with Universal Locking Trochanter Stabilisation Plate (ULTSP) (Synthes) and dynamic hip screw with trochanteric support plate (Smith and Nephew); both trochanteric plates were fixed with three screws • Number randomised = 50 **Intervention group 2** • Dynamic hip screw (Synthes) and sliding hip screw (Smith and Nephew) • Number randomised = 50 **Note:** • study authors do not report any information on the number of clinicians or their skills and experience; anaesthesia used; postoperative care
Outcomes	**Outcomes measured/reported by study authors:** place of residence; modified Merle d'Aubigné-Postel score; postoperative radiograph; healed fracture; fixation failure (including those needing re-operation); mortality (available at 12 months); pain; deep infections; DVT; stroke; pulmonary embolism; ileus; amputation **Outcomes relevant to the review:** mortality reported at 12 months; unplanned return to theatre because of fixation failure **Note:** • we included data for unplanned return to theatre which was reported for those with fixation failure. We could not be certain whether there were other re-operations for other causes.
Notes	**Funding/sponsor/declarations of interest:** study authors report "this study was funded solely by our employer, St.Olavs University Hospital" and declare no conflicts of interest. **Study dates:** 2008 to 2013 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Han 2012

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma nail vs Proximal femoral locking plate
Participants	**Total number of randomised participants:** 83 **Inclusion criteria:** > 60 years of age; Jenson type II and above classification of fracture **Exclusion criteria:** ASA grade IV and V; unable to tolerate anaesthesia **Setting:** single centre; orthopaedic hospital; China **Baseline characteristics** **Intervention group 1** (intramedullary) • Age, range: 65 to 90 years • Gender, M/F: 24/17 • ASA status, range: 2 to 4 **Intervention group 2** (extramedullary) • Age, range: 64 to 92 years • Gender, M/F: 23/19 • ASA status, range: 2 to 4 **Note:** • study authors did not report baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence; cognitive status, preoperative waiting times, fracture classification
Interventions	**General details:** no mention of surgical experience **Intervention group 1** • Gamma nail; cephalic fixation is achieved with a single screw; length of the nails used was not reported nor were details about distal locking • Randomised = 41 **Intervention group 2** • Proximal femoral locking plate; there are 4 locking screw holes available for static cephalic fixation • Randomised = 42
Outcomes	**Outcomes measured/reported by study authors:** length of operation; intraoperative bleeding; haemoglobin reduction on POD 2; fracture healing - local pain and percussion pain as a marker of healing; fracture healing - radiographic parameters; functional recovery - Parker and Palmer mobility score **Outcomes relevant to the review:** none **Note:** • average follow-up time of 10.6 months (range 8 to 12)
Notes	**Funding/sponsor/declarations of interest:** unknown **Study dates:** June 2008 to June 2010

Han 2012 *(Continued)*

Note:

- we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Haq 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus reverse distal femoral locking plate
Participants	**Total number of randomised participants:** 40 **Inclusion criteria:** unstable intertrochanteric fracture with compromised lateral wall (AO 31A 2.2 to 3.3); surgery within 3 weeks **Exclusion criteria:** aged < 18 years; pathological fracture; multiple injuries; fractures with significant subtrochanteric extension (> 3 cm); unable or unwilling to give informed consent; unfit for surgical intervention **Setting:** single centre; university hospital; India **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 55.55 (± 17.09) years • Gender, M/F: 10/10 • ASA status, I/II/III/IV: 8/12/0/0 • Fracture classification, A 2.2 to 2.4/A 3.1 to 3.3, n: 9/11 **Intervention group 2** (distal femoral locking plate) • Age, mean (SD): 53.95 (± 14.75) years • Gender, M/F: 18/2 • ASA status, I/II/III/IV: 9/9/2/0 • Fracture classification, A 2.2 to 2.4/A 3.1 to 3.3, n: 12/8 **Overall:** • Age, mean (range): 54.7 years • Gender, M/F: 28/12 • ASA status, I/II/III/IV: 17/21/2/0 • Fracture classification, A 2.2 to 2.4/A 3.1 to 3.3, n: 21/19 **Note:** • study authors did not report: smoking history; medication; BMI; comorbidities; mobility; place of residence; cognitive status; preoperative waiting time. • difference in gender distribution was reported as statistically significant; no other categories produced a meaningful difference.
Interventions	**General details:** weight bearing as soon as possible; clinical follow-up at 2 and 6 weeks, 3, 6 and 12 months; surgical experience: "the surgeons doing the procedure were adequately trained in both the procedures and had been doing it regularly before the start of the trial" **Intervention group 1**

Haq 2014 *(Continued)*

- PFN (Green Surgicals, Gujarat, India); cephalic fixation was performed with two screws; length of nails used was not reported; however, it is highly probable that all nails were short nails; details regarding distal locking were not provided
- Randomised = 20; losses (see note); analysed = 17

Intervention group 2

- Distal femoral locking compression plate (Green Surgicals, Gujarat, India); 4 to 6 proximal locking screws; 3 or 4 screws for distal fixation
- Randomised = 20; losses (see note): analysed = 17

Note:

- we noted some discrepancies in the study report main text and tables. We used data from the text.
- reasons for loss to follow-up are not reported.

Outcomes	**Outcomes measured/reported by study authors:** duration of surgery; blood loss during surgery; fluoroscopy time; type of reduction; difficulty in reduction; surgeon's perception of surgery; position of implant; Parker Palmer mobility score; HHS (mean scores and categorical data); ADL: SF-12 (physical and mental component scores); revision surgery; non-union; malunion; shortening; length of follow-up: 1 year **Outcomes relevant to the review:** HRQoL (SF-12, 12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** November 2011 and October 2012

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Use of a computer-generated randomisation table
Allocation concealment (selection bias)	Unclear risk	Quotes: “opaque envelope technique”. "The envelope was opened 24 hours before surgical intervention by the treating surgeon." Comment: study authors do not report if envelopes are sealed and sequentially-numbered.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	“The surgeons doing the procedure were adequately trained in both the procedures and had been doing it regularly before the start of the trial".
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Blinding of outcome assessment: HRQoL (detection bias)	Low risk	We did not expect lack of blinding to influence participant-reported outcomes.

Haq 2014 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were few and balanced between groups.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Hardy 1998

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group:** IMHS versus SHS
Participants	**Total number of randomised participants:** 100 (see notes) **Inclusion criteria:** trochanteric proximal femoral fractures; classification according to Jensen: stable (types I & II) and unstable (types II, IV & V) **Exclusion criteria:** < 60 years of age; pathological fractures; incorrect anatomy; history of fracture or operation involving same limb; Paget's disease **Setting:** single centre; hospital; Belgium **Baseline characteristics** **Intervention group 1** (IMHS) • Age, mean (SD): 81.7 (± 11.8) years • Gender, M/F: 8/42 • BMI, mean (SD): 21.9 (± 6.2) kg/m2 • Comorbidities, type I/II/III (Fitts 1959), n: 12/36/2 • Mobility assessment, Group 1/2/3/4 (Jensen 1981), n: 11/10/5/24; mobility score 5.2 (± 3.3) (Parker 1993) • Place of residence, n: home, 26; nursing home, 24 • Cognitive status, mental score (Qureshi 1974): 6.1 (± 4.1) • ASA status, I/II/III/IV/V, n: 5/12/23/10/0 • Fracture classification, stable/unstable, n: 13/37 **Intervention group 2** (SHS) • Age, mean (SD): 79.5 (± 10.7) years • Gender, M/F: 15/35 • BMI, mean (SD): 23.4 (± 7.1) kg/m2 • Comorbidities, type I/II/III (Fitts 1959), n: 14/30/6 • Mobility assessment, Group 1/2/3/4 (Jensen 1981), n: 10/7/7/26; mobility score 4.4 (± 2.9) (Parker 1993) • Place of residence, n: home, 24; nursing home, 26 • Cognitive status, mental score (Qureshi 1974): 5.4 (± 4.1) • ASA status, I/II/III/IV/V, n: 5/13/18/13/1 • Fracture classification, stable/unstable, n: 16/34 **Note:**

Hardy 1998 *(Continued)*

	• baseline data not described for: smoking history, medication, comorbidities
Interventions	**General details:** spinal or general anaesthesia; weight bearing on POD 4; clinical assessment at 1, 6 and 12 months; surgeon experience - for IMHS, study report refers to prolonged learning curve required for insertion and SHS is routine; 2 senior operating surgeons, 3 junior attending surgeons **Intervention group 1** • IMHS (Smith and Nephew), in all cases a short nail was used (21 cm long). Nail diameters were 12/14/16 mm, n:36/12/2. Distal locking, 2 screws/1 screw/no screws, n: 28/18/4 • Randomised = 50; losses = 15 (death); analysed for unplanned return to theatre = 35; analysed for mortality = 50 **Intervention group 2** • SHS (Oseto hip screw, Switzerland); 135 degree barrel • Randomised = 50; losses = 15 (death); analysed for unplanned return to theatre = 35; analysed for mortality = 50
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; transfusion; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union; re-operation; wound infection; wound haematoma; pneumonia; thromboembolic complications (DVT, PE); UTI; leg shortening; mortality; mid-thigh pain; hip pain at follow-up; mobility (available at 1, 3, 6, and 12 months); social function; length of follow-up: 1 year (see notes) **Outcomes relevant to the review:** mortality (during hospital stay; 12 months); unplanned return to theatre (all at 12 months)
Notes	**Funding/sponsor/declarations of interest:** funding received from Smith and Nephew Richards **Study dates:** December 1993 to January 1995 **Note:** • since a full report of the trial was published in 1998, a conference abstract presenting the results of 160 participants at 18 months became available (Hardy 1999). We have not included the data from Hardy 1999 because these data require further clarification.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "prospectively randomised into two treatment groups according to the medical record number"
Allocation concealment (selection bias)	High risk	It is not possible to conceal allocation with this method of randomisation.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Quote: "The different levels of experience of the ...operating surgeons and ... attending surgeons ..and the prolonged learning curve for insertion of intramedullary hip-screws may have also affected the operative time."
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding to influence participant-reported outcomes.

Hardy 1998 *(Continued)*

Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All losses were explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Hardy 2003

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: IHS statically locked versus IHS dynamically locked
Participants	**Total number of randomised participants:** 81 **Inclusion criteria:** fracture featuring loss of the medial buttress (type IV and V of the classification of Jensen and Michaelsen) or reversed oblique fracture **Exclusion criteria:** not reported **Setting:** single centre; hospital; Belgium **Baseline characteristics** **Intervention group 1** (IHS - statically locked) • Age, mean (SD): 75.8 (± 11.80) years • Gender, M/F: 13/26 • Parker and Palmer's mobility score (SD): 5.3 (3.04) • Jensen's autonomy index I/II/III/IV: 11/6/9/13 • Mental status score (SD): 6.3 (4.22) • ASA status, I/II/III/IV/V: 4/10/19/5/1 • Fracture classification, Jensen and Michaelsen's type of fracture IV/V/reverse oblique, n: 6/29/4 **Intervention group 2** (IHS - dynamically locked) • Age, mean (SD): 78.4 (± 13.05) years • Gender, M/F: 17/24 • Parker and Palmer's mobility score (SD): 5.0 (2.85) • Jensen's autonomy index I/II/III/IV: 10/8/4/19 • Mental status score (SD): 6.7 (3.53) • ASA status, I/II/III/IV/V: 4/14/15/5/2 • Fracture classification, Jensen and Michaelsen's type of fracture IV/V/reverse oblique, n: 1/35/5 **Note:**

Hardy 2003 *(Continued)*

	• study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; place of residence; preoperative waiting time
Interventions	**General details:** antibiotics (2 g cefazolin given at induction of anaesthesia) were administered to all participants, and prophylactic doses of low-molecular-weight heparin (calcium nadroparin, 7500 IU Anti-Xa, Sanofi-Winthrop, France) were given once a day for 15 days to participants who did not have a history of myocardial infarction or stroke in the previous 6 months, haemorrhage (genitourinary tract, gastrointestinal), tendency to bleed (thrombocytes < 150 X $10\wedge6$/mL or prothrombin time < 65%), or known allergies to low-molecular-weight heparin; all participants allowed to weight bear as tolerated; followed up after 1 month, 3 months, 6 months, 1 year, 2 years and 3 years; in IHS static group, 23 doctors were junior and 16 were senior and in the IHS dynamic group, 28 doctors were junior and 13 were senior **Intervention group 1** • Intramedullary hip screw (IMHS) (Smith and Nephew); proximal fixation with a single dynamic femoral head screw; static distal locking with two screws • Number randomised = 39 **Intervention group 2** • Intramedullary hip screw (IMHS) (Smith and Nephew); proximal fixation with a single dynamic femoral head screw; dynamic distal locking with a single screw • Number randomised = 42
Outcomes	**Outcomes measured/reported by study authors:** operation time; intraoperative blood loss; postoperative drainage; level of haemoglobin; transfused packed blood cells; mode of reduction; tip-apex distance; discharge destination; mortality (available at 3 months, 6 months, 1 year and 2 years) **Outcomes relevant to the review:** mortality (3 months, 1 year)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Harrington 2002

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** IMHS versus SHS
Participants	**Total number of randomised participants:** 102 **Inclusion criteria:** unstable trochanteric proximal femoral fractures; > 65 years of age; Evans classification III, IV and V **Exclusion criteria:** pathological fractures; previous fracture; other fracture; dementia meaning inability to consent **Setting:** single centre; orthopaedic hospital, UK **Baseline characteristics**

Harrington 2002 *(Continued)*

Intervention group 1 (IMHS)

- Age, mean (SD): 83.8 (± 8.5) years
- Gender, M/F: 10/40
- Mobility assessment, n:
  - Non ambulator, 6
  - Household ambulator, 8
  - Community ambulator (with aid), 21
  - Independent, 15
- ASA status, I/II/III/IV: 3/22/16/9/0
- Fracture classification, type III/IV/V (Evans 1949), n: 13/11/26

Intervention group 2 (SHS)

- Age, mean (SD): 82.1 (± 8.6) years
- Gender, M/F: 11/41
- Mobility assessment, n:
  - Non ambulator, 10
  - Household ambulator, 6
  - Community ambulator (with aid), 26
  - Independent, 10
- ASA status, I/II/III/IV: 4/20/17/11
- Fracture classification, type III/IV/V (Evans 1949), n: 15/10/27

Note:

- baseline data not described for: smoking history, medication, comorbidities, mobility, place of residence, cognitive status, ASA status

Interventions	**General details:** no details on prophylaxis or rehabilitation program; clinical follow-up at 3, 6 and 12 months by observers blind to procedure; surgeons familiarised themselves with the IMHS prior to the study, but experience was not balanced between both implants **Intervention group 1** • IMHS (Smith and Nephew Richards); short nails were used in all cases: 21 cm long. Nail diameter was 12 mm in all cases. Distal locking was performed with 2 screws in all cases • Randomised = 50; analysed = 50 **Intervention group 2** • SHS (Smith and Nephew) • Randomised = 52; analysed = 52
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; radiographic screening time; transfusion requirements; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union of fracture; other fracture healing complications; LOS; mortality; patient mobility; regain of pre-fracture living status; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (during hospital stay and at 6 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • we received additional information from study authors.

Harrington 2002 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	Quote: "randomised on admission using a sealed envelope method". Comment: study authors do not report if envelopes are opaque and sequentially-numbered.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Quote: "Participating surgeons were required to familiarise themselves with the intramedullary implant and its insertion in supervised bone model sessions prior to using it in the clinical setting". Comment: we considered this insufficient for the purposes of the trial.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were because of death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Haynes 1996

Study characteristics

Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus DHS
Participants	**Total number of randomised participants:** 50 **Inclusion criteria:** trochanteric or 'high' subtrochanteric proximal femoral fractures **Exclusion criteria:** previous non-consolidated femur fracture **Setting:** single centre; orthopaedic hospital, UK **Baseline characteristics (overall)** • Age, mean (range): 80 years • Gender, M/F: 14/36

Haynes 1996 *(Continued)*

Baseline characteristics

Intervention group 1 (Gamma nail)

- Cognitive status, mental ability (Qureshi 1974), mean: 8.7
- Preoperative waiting time, mean: 1.8 days
- Fracture classification, stable/unstable, n: 4/13; high subtrochanteric (unstable), 2

Intervention group 2 (DHS)

- Cognitive status, mental ability (Qureshi 1974), mean: 7.1
- Pre-operative waiting time, mean: 2.4 days
- Fracture classification, stable/unstable, n: 10/21

Note:

- baseline data not described for: smoking history, medication, comorbidities, mobility, place of residence, cognitive status, ASA status
- age and gender not reported by group

Interventions	**General details:** manufacturer's recommended procedures; mobilised as quickly as possible. For experience of surgeon: DHS commonly used but a minimum of 5 Gamma nails were used by each surgeon before any cases were included in the trial (also see note about unfamiliarity of the surgeons as a reason for exclusion) **Intervention group 1** • Gamma intramedullary nail (Howmedica); distal locking was performed at the discretion of the operating surgeon; nail length was not reported; however, it is highly probable that all nails used in the study were short nails • Randomised = 19; losses = 1 (death); analysed = 19 **Intervention group 2** • DHS • Randomised = 31; losses = 8 (death); analysed = 31 **Note:** • fewer participants in the Gamma nail group because surgeons were more likely to drop these participants from the trial because of their unfamiliarity with the Gamma nail.
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; operative fracture of femur; cut-out; non-union; re-operation; wound infection; pneumonia; pressure sore; wound haematoma; DVT; PE; LOS; shortening of leg; mortality; pain at follow-up; place of residence (6 months after surgery); impaired walking **Outcomes relevant to the review:** mortality (6 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** sponsored and part administered by Howmedica **Study dates:** not reported **Note:** • we noted that the study report was part of a PhD research project.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Use of "randomisation cards". However, the imbalance in numbers was explained by the unfamiliarity of surgeons with Gamma nail treatment. Quote:

Haynes 1996 *(Continued)*

		"This resulted in a temptation to omit the patient from the trial if a Gamma nail was drawn as treatment, from the randomisation cards".
Allocation concealment (selection bias)	Low risk	We presumed from the information regarding selection of participants, that allocation on the randomisation cards was adequately concealed with decisions made by surgeons after selection of a card.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Surgical procedures were as recommended by the implant manufacturers, and a "minimum of 5 Gamma nails were then inserted by each surgeon before any cases were included in the trial". Comment: SHS was used routinely. However, mention of unfamiliarity of the surgeons (various) with the treatment was a putative reason for post-randomisation exclusion and we therefore assumed that not all surgeons were sufficiently experienced with the Gamma nails.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All losses were explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Herrera 2002

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma nail versus PFN
Participants	**Total number of randomised participants:** 250 **Inclusion criteria:** trochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre; hospital; Spain **Baseline characteristics**

Herrera 2002 *(Continued)*

Intervention group 1 (Gamma)

- Comorbidities, cardiopathy/diabetes/chronic obstructive pulmonary disease/neoplasia/hypertension, n: 30/15/19/6/41
- ASA status, III or IV: 60
- Fracture classification, A1/A2/A3, n: 19/79/30

Intervention group 2 (PFN)

- Comorbidities, cardiopathy/diabetes/chronic obstructive pulmonary disease/neoplasia/hypertension, n: 39/11/16/7/48
- ASA status, III or IV: 71
- Fracture classification, A1/A2/A3, n: 13/83/28

Overall:

- Age, average: 78.9 years
- Gender, M/F: 71/179
- Preoperative waiting time, average: 2.9 days

Note:

- study authors reported no baseline characteristics for: age (except overall); gender (except overall); smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time (except overall data)

Interventions	**General details:** follow-up was done at 1, 3, 6 and 12 months; general anaesthesia was administered to 191 participants and intradural in the remainder; attempts were systematically made to have all participants adopt a sitting position within the first 48 hours after surgery; participants were encouraged to try weight bearing with the aid of crutches or a frame during the first postoperative week **Intervention group 1** • Gamma nail (Howmedica); femoral head fixation performed with a single screw; distal locking with either a single or two screws; diameter of 11 mm and neck-shaft angle of 130° • Number randomised = 125 **Intervention group 2** • Proximal femoral nail (PFN) (Synthes); femoral head fixation with two screws; distal locking performed with either a single or two screws; diameter of 10 mm and a neck-shaft angle of 130° • Number randomised = 125 **Note:** • study authors do not report any data on the number of clinicians or their skills and experience. • the length of the nails was not reported; however, it is probable that all nails used were short nails.
Outcomes	**Outcomes measured/reported by study authors:** length of operation; average haematocrit; transfusion; average healing time; fracture reduction; complications; re-operations (available at 12 months); average hospitalisation time; mortality (available at 12 months) **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months); mortality (available at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 1997 to 2000 **Note:**

Herrera 2002 *(Continued)*

- we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Hoffman 1996

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus SHS (AMBI hip screw)

Participants	**Total number of randomised participants:** 69 (2 died prior to surgery and were not reported in the numbers randomised to each group)
	
	Inclusion criteria: trochanteric proximal femoral fractures. Jensen types 1 to 5; stable and unstable based on Evans; > 50 years of age
	
	Exclusion criteria: pathological fractures
	
	Setting: single centre; orthopaedic hospital; New Zealand
	
	Baseline characteristics
	
	Intervention group 1 (Gamma nails)
	
	• Age, mean (SD): 83.2 (± 8.1) years
	• Gender, M/F: 4/27
	• ASA status, I/II/III/IV/V: 0/10/15/5/1
	• Preoperative waiting time, mean (SD): 1.6 (± 1.1) days
	• Fracture classification, Type 1/2/3/4/5 (Jensen 1981), n: 2/8/12/2/7; stable, 10; unstable, 21
	• Additional information:
	  ○ Osteoporosis, Singh index 3/4/5/6 (Singh 1970), n: 3/2/9/15
	
	Intervention group 2 (SHS)
	
	• Age, mean (SD): 79 (± 10.4) years
	• Gender, M/F: 12/24
	• ASA status, I/II/III/IV/V: 0/18/15/3/0
	• Preoperative waiting time, mean (SD): 1.9 (± 1.4) days
	• Fracture classification, Type 1/2/3/4/5 (Jensen 1981), n: 2/10/11/4/9; stable, 12; unstable, 24
	• Additional information:
	  ○ Osteoporosis, Singh index 3/4/5/6 (Singh 1970), n: 2/1/12/16
	
	Overall
	
	• Age, mean (range): 81 years
	• Gender, M/F: 16/53
	
	Note:
	
	• baseline data not described for: smoking history, medication, comorbidities, mobility, place of residence, cognitive status, ASA status

Interventions	**General details:** prophylactic antibiotics; general anaesthesia (50 participants), spinal anaesthesia (17 participants); closed reduction; image intensifier; manufacturer's guidelines followed for each device; mobilised with weight bearing as soon as possible; clinical assessment at 6 and 12 weeks and 6 months; surgeons did not have comparable experience with implants (longer learning curve with Gamma nail than with SHS; 4 orthopaedic trainees, normal supervision)

Hoffman 1996 *(Continued)*

	Intervention group 1 • Gamma intramedullary nail (Howmedica); protocol for distal locking changed during the study - the first 5 cases were all locked, thereafter only unstable fracture configurations were locked; study report does not specify the length of nails used; however, it is highly probable that all nails were short nails • Randomised = 31; analysed = 31 **Intervention group 2** • SHS (AMBI) (Smith and Nephew) • Randomised = 36; analysed = 36 **Note:** • 2 participants died before surgery
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; radiographic screening time; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union (time to union); re-operation; wound infection; pneumonia; pressure sores; DVT; any medical complication; LOS; shortening of leg; mortality; pain at follow-up (unresolved pain in patients with intertrochanteric fractures); non return to previous residence; participant mobility; length of follow-up: 6 months **Outcomes relevant to the review:** mortality (in hospital and during follow-up); unplanned return to theatre (6 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "computer-generated blocked randomization"
Allocation concealment (selection bias)	Low risk	Quote: "The treatment selections ... were sealed into opaque numbered envelopes that also contained a stiff card to further prevent disclosure of allocation."
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Quotes: most operations carried out by "one of four orthopaedic trainees ... supervised as appropriate.." and "longer learning curve for the Gamma nail may be the reason for the differences noted."
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.

Hoffman 1996 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	All losses explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Hoffmann 1999

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** IMHS versus SHS

Participants	**Total number of randomised participants:** 110
	
	Inclusion criteria: pertrochanteric proximal femoral fractures. Classification based on Evans-Jensen: all 5 categories: stable and unstable fractures. Also AO 31 A1, A2 and A3 (just 2 fractures)
	
	Exclusion criteria: pathological fractures, old fractures, bedridden patients, polytrauma
	
	Setting: single centre; orthopaedic hospital, Germany
	
	Baseline characteristics
	
	Intervention group 1 (intramedullary)
	
	• Age, median: 82 years
	• Gender, M/F: 10/46
	• Comorbidities, type, n:
	  ◦ none: 3
	  ◦ respiratory/pulmonary: 4
	  ◦ cardiovascular: 21
	  ◦ gastrointestinal: 22
	  ◦ urogenital: 22
	  ◦ diabetes mellitus: 23
	  ◦ obesity: 24
	  ◦ other: 26
	• Fracture classification, stable, unstable, n: 20/36
	  ◦ 31 A1: 19
	  ◦ 31 A2: 35
	  ◦ 31 A3: 2
	
	Intervention group 2 (extramedullary)
	
	• Age, median: 81 years
	• Gender, M/F: 12/42

Hoffmann 1999 *(Continued)*

- Comorbidities, type, n:
  - none: 12
  - respiratory/pulmonary: 13
  - cardiovascular: 20
  - gastrointestinal: 20
  - urogenital: 20
  - diabetes mellitus: 20
  - obesity: 20
  - other: 20
- Fracture classification, stable/unstable, n: 20/34
  - 31 A1: 22
  - 31 A2: 32
  - 31 A3: 0

Note:

- study authors report no baseline characteristics for: smoking history, medication, BMI, mobility assessment, place of residence, cognitive status, ASA status

Interventions	**General details:** surgeons were not experienced (operations by junior and senior staff); surgery within 24 hours of admission; prophylactic antibiotics; postoperative thromboembolics with heparin **Intervention group 1** • IMHS (Smith and Nephew); nail length 210 mm; nail diameter 12 mm; cephalic fixation was with a single screw; distal locking was performed at the discretion of the operating surgeon • Randomised = 56; analysed = 56 **Intervention group 2** • DHS • Randomised = 54; analysed = 54
Outcomes	**Outcomes measured/reported by study authors:** length of anaesthesia; length of surgery; operative blood loss; difference in haemoglobin; radiographic screening time; operative fracture of the femur; later fracture of the femur; loss of fracture reduction requiring re-operation; re-operation; wound infection; deep wound infection; wound haematoma; thromboembolic complication; clinical complications; LOS (acute); shortening of leg (> 1 cm); rotational deformity ('relevant'); mortality; pain (on walking); return to pre-fracture residential status; impaired walking; Merle d'Aubigné hip score; length of follow-up: mean 3.7 months **Outcomes relevant to the review:** mortality (3 to 4 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 1994 to 1996 **Note:** • study reported in German; we obtained only a limited translation.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details

Hoffmann 1999 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Use of sealed envelopes, but no additional details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Involved both senior and junior surgeons - tendency for more senior surgeons for the nail operations, and we could not be certain whether experience in both devices was equivalent
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most losses explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Hogh 1981

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Ender versus McLaughlin
Participants	**Total number of randomised participants:** 145 **Inclusion criteria:** trochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre, hospital, Denmark **Baseline characteristics** **Intervention group 1** (Ender) • Gender, M/F: 22/50 • Fracture classification, stable/unstable/subtrochanteric, n: 32/28/12 **Intervention group 2** (McLaughlin) • Gender, M/F: 12/61 • Fracture classification,stable/unstable/subtrochanteric, n: 37/24/12

Hogh 1981 *(Continued)*

	Overall • age, average (range): 76 (19 to 88) years **Note:** • no baseline characteristics are reported
Interventions	**General details:** heparin given twice a day, until participant was mobilised. Use of traction table. Programme of exercises on POD 1. Walk with weight bearing and crutches on POD7. Clinical follow-up at 1, 3, 6 and 12 months **Intervention group 1:** • Enders nail (no manufacturer details provided); condylocephalic nails • Number randomised = 72; losses = not reported, analysed = 72 **Intervention group 2:** • McLaughlin nail plate (no manufacturer details provided); blade plate • Number randomised = 73; losses = not reported, analysed = 73
Outcomes	**Outcomes measured/reported by study authors:** anaesthesia time; operation time; duration of hospitalisation; mortality (available at 1 month, 6 months and 12 months); unplanned return to theatre; complications; deep infection **Outcomes relevant to the review:** mortality (reported at 1 month; 12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** April 1976 to September 1978

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "on the principle of random numbers"
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Surgeon experience is not reported. It is unclear if surgeons were equally experienced with both implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.

Hogh 1981 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	No apparent losses
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Hong 2011

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus DHS
Participants	**Total number of randomised participants:** 20 **Inclusion criteria:** > 60 years of age; intertrochanteric fracture; AO classification A1 or A2; surgery within 2 weeks of fracture; no prior disease that could affect serum markers **Exclusion criteria:** pathologic fracture; multi trauma or open fractures; drug or alcohol abuse; non-ambulatory status; surgery beyond 2 weeks after trauma **Setting:** single centre; hospital; South Korea **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 76.5 (± 5.4) years • Gender, M/F: 6/4 • BMI, mean: 26.9 (± 4) kg/m^2 **Intervention group 2** (DHS) • Age, mean (SD): 81.1 (± 5.3) years • Gender, M/F: 5/5 • BMI, mean (SD): 25.7 (± 4.6) kg/m^2 **Overall:** • Gender, M/F: 11/9 • BMI, mean: 26.3 kg/m2 **Note:** • baseline data not described for: smoking history, medication, comorbidities, mobility, place of residence, cognitive status, ASA status
Interventions	**General details:** single surgeon; fracture reduction; fluoroscopic guidance; clinical follow-up at 6 months **Intervention group 1** • PFN; femur was reamed using a 17 mm reamer; cephalic blade was inserted; a distal static locking screw was used in all cases

Hong 2011 *(Continued)*

	• Randomised = 10 **Intervention group 2** • DHS; 3 hole plate • Randomised = 10 **Note:** • study authors do not report skills and experience of surgeon, type of anaesthesia, prophylactic use of antibiotics or antithromboembolics, postoperative mobilisation or weight bearing
Outcomes	**Outcomes measured/reported by study authors:** pre- and postoperative bone healing status; data related to complications; incision length; operation time (skin to skin); estimated blood loss; blood samples at screening and on the morning before surgery for creatinine kinase, c-reactive protein and serum myoglobin; blood samples taken postoperatively in the recovery room and at 8, 16, 24, 36, 48 and 72 hours postoperatively; haemoglobin and haematocrit measured preoperatively and at 16, 36 and 72 hours postoperatively; cardiac troponin I levels taken on the morning before surgery and 16 hours postoperatively **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** authors state that no funding was received and no conflicts exist **Study dates:** May 2009 to October 2009 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Hopp 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma 3 nail or InterTAN nail
Participants	**Total number of randomised participants:** 78 **Inclusion criteria:** > 60 years of age; unstable intertrochanteric femur fractures as a result of low-impact trauma **Exclusion criteria:** inability to walk prior to the fracture; pathological fractures; associated severe osteoarthritis of the affected hip; comorbidities that preclude surgical intervention; refusal to give informed consent for the study **Setting:** single centre; hospital; Germany **Baseline characteristics** **Intervention group 1** (Gamma) • Age, mean (SD): 80.73 (± 8.44) years • Gender, M/F: 13/26 • BMI, mean (SD): 26.32 (± 3.87) kg/m2 • Mobility assessment/use of walking aides, independent from aids/crutches or cane/walking frame/wheel chair (some steps indoor): 27/5/4/3 • ASA score (SD): 2.83 (± 0.46)

Hopp 2016 *(Continued)*

- Preoperative waiting time, < 24 hours/> 24 hours, n: 29/10
- Fracture classification, A2/A3, n: 26/13

Intervention group 2 (InterTAN)

- Age, mean (SD): 82.70 (± 7.06) years
- Gender, M/F: 7/32
- BMI, mean (SD): 24.57 (± 4.76) kg/m2
- Mobility assessment/use of walking aides, independent from aids/crutches or cane/walking frame/wheel chair (some steps indoor): 30/1/1/0
- ASA score (SD): 2.77 (± 0.66)
- Preoperative waiting time, < 24 hours/> 24 hours, n: 32/7
- Fracture classification, undisplaced/displaced, n: 28/11

Overall:

- Age, mean (SD): 81.7 (± 7.78) years
- Gender, M/F: 20/58
- Fracture classification, A2/A3, n: 54/24

Note:

- study authors reported no baseline characteristics for: smoking history; medication; comorbidities; place of residence; cognitive status/dementia; preoperative waiting time
- only 75 total assessed for mobility

Interventions	**General details:** all surgeries were performed by 5 consultants with experience of at least 5 procedures with both Gamma and InterTAN nails, or the resident doctors under supervision inclusive; the procedures were done under general anaesthesia and both groups received a standard dose of single-shot cefuroxime as routine prophylaxis; all procedures were performed using a traction table and by insertion of the nail via a percutaneous approach; follow-ups were done at 6 weeks, 12 weeks, 6 months or until union or failure of the fracture **Intervention group 1** • Gamma nail third-generation (Stryker); femoral head fixation with single screw; all nails locked distally but mode of locking not reported • Number randomised = 39 **Intervention group 2** • InterTAN (Smith-Nephew); femoral head fixation with integrated lag screw; all nails locked distally but mode of locking not reported • Number randomised = 39 **Note:** • study authors provide little detail on the postoperative care
Outcomes	**Outcomes measured/reported by study authors:** intraoperative complications; fracture reduction time; intraoperative blood loss; image intensifier time during surgery; pre-/postoperative haemoglobin value; requirement for blood transfusion; postoperative time on ICU; initial postoperative pain; time to discharge; difficulty of surgery; adequacy of osteosynthesis; rating of the implant; mortality (available at 6 months); quality of reduction; lateral sliding of the lag screw; CCD angle; reduction loss; heterotopic ossification; secondary dislocation; re-operations (available at 6 months); HHS; mobility; leg-length discrepancy **Outcomes relevant to the review:** mortality (reported at 6 months); unplanned return to theatre (reported at 6 months, for secondary dislocation with or without cut-out)

Hopp 2016 *(Continued)*

Notes	**Funding/sponsor/declarations of interest:** study authors report 'no benefits or funds were received in support of this study. The authors report no conflict of interest' **Study dates:** October 2007 to May 2009 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Hornby 1989

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus conservative (traction) treatment

Participants	**Total number of randomised participants:** 106
	
	Inclusion criteria: > 60 years of age; extracapsular fractures
	
	Exclusion criteria: lack of fitness for operation; refusal; unavailability of informed consent
	
	Setting: Single centre; hospital; UK
	
	Baseline characteristics
	
	Intervention group 1 (operative)
	
	• Age, n:
	  ◦ 60 to 64 years: 3
	  ◦ 65 to 69 years: 5
	  ◦ 70 to 74 years: 7
	  ◦ 75 to 79 years: 9
	  ◦ 80 to 84 years: 17
	  ◦ 85 to 89 years: 8
	  ◦ > 90 years: 6
	• Gender, M/F: 10/45
	• Mental test score (Evans et al 1979a; Ions and Stevens 1987), 0-2/3-10/10-13: 9/19/27
	• Fracture classification, stable/unstable, n: 16/39
	
	Intervention group 2 (traction)
	
	• Age, n:
	  ◦ 60 to 64 years: 5
	  ◦ 65 to 69 years: 4
	  ◦ 70 to 74 years: 5
	  ◦ 75 to 79 years: 16
	  ◦ 80 to 84 years: 12
	  ◦ 85 to 89 years: 4
	  ◦ > 90 years: 5
	• Gender, M/F: 17/34
	• Mental test score (Evans et al 1979a; Ions and Stevens 1987), 0-2/3-10/10-13: 9/15/27
	• Fracture classification, stable/unstable, n: 14/37
	
	Note:

Hornby 1989 *(Continued)*

- study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; ASA status; preoperative waiting time

Interventions	**General details:** general or spinal anaesthesia was used for the operative technique and local anaesthesia was used for the conservative technique; all but 6 operations were performed by the same surgeon **Intervention group 1** • Dynamic hip screw (manufacturer not reported) • Number randomised = 55; losses = 13 (death), analysed = 55 **Intervention group 2:** • Conservative technique, Hamilton Russell traction applied through a threaded pin inserted into the tibia • Number randomised = 51; losses = 11 (death), analysed = 51 **Note:** • study authors do not report the skills or experience of the surgeon or the pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** mortality (available at 6 months); average operation time; length of hospital stay; re-operations (available at 6 months); complications (pin track infection, pin loosening, nerve palsy, traction sores, delayed union, other complications); varus/valgus deformity; rotational misalignment; fixed flexation deformity; leg shortening; pain, leg swelling; unhealed sore **Outcomes relevant to the review:** mortality (reported at 6 months) **Note:** • no participants in the operative group had unplanned return to theatre. We did not included these data in analysis because the comparison group was non-operative.
Notes	**Funding/sponsor/declarations of interest:** study authors report 'this study was supported by a grant from the Newcastle District Research Committee. No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article'. **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomisation not reported
Allocation concealment (selection bias)	Unclear risk	Study authors report 'using a system of sealed envelopes, patients within each stratum were randomly allocated for treatment by operation or traction'
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to treatment groups. However, we did not expect that this would influence performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors do not report the experience and skills of the surgeons, and we could not be certain whether experience was equivalent for both types of implants.

Hornby 1989 *(Continued)*

Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding to influence detection bias for this outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Study authors reported that no participants were lost to follow-up. Only participant loss was because of death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Huang 2006

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: hip joint replacement versus DHS
Participants	**Total number of randomised participants:** 156 **Inclusion criteria:** intertrochanteric fractures **Exclusion criteria:** no details **Setting:** single centre; hospital; China **Baseline characteristics unknown**
Interventions	**General details:** unknown **Intervention group 1** • Hip joint replacement (with manufacturer details); no further implant details were reported • Number randomised to group = 76; losses = 1 (lost to follow-up) 2 (death), analysed =75 **Intervention group 2** • Dynamic hip screw (with manufacturer details) • Number randomised to group = 80; losses = 2 (lost to follow-up) 3 (death), analysed = 78
Outcomes	**Outcomes measured/reported by study authors:** length of operation; intraoperative blood loss; total volume of blood transfusion; complications; walking time; function of affected limb; HHS **Outcomes relevant to the review:** mortality (end of follow-up)
Notes	**Funding/sponsor/declarations of interest:** unknown **Study dates:** September 1999 to June 2004 **Note:** • study is reported in Chinese. We did not seek translation, and data are taken from the English abstract.
Risk of bias	

Huang 2006 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to treatment groups. However, we did not expect that this would influence performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeons are unknown
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding to influence detection bias for this outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few participants lost to follow-up.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Unclear risk	We were unable to ascertain other risks of bias because we were only able to extract data from an English abstract.

Irvine 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma nail 3 versus PFNA
Participants	**Total number of randomised participants:** 151 **Inclusion criteria:** AO/OTA 31-A2 fractures **Exclusion criteria:** not reported **Setting:** single centre; hospital; Austria **Baseline characteristics not reported**
Interventions	**General details:** no details **Intervention group 1** • Gamma Nail third-generation (Stryker); femoral head fixation with a single screw • Number randomised = 79 **Intervention group 2**

Irvine 2014 *(Continued)*

- Proximal femoral nail antirotation (Synthes); femoral head fixation with a blade
- Number randomised = 72

Outcomes	**Outcomes measured/reported by study authors:** Parker's ratio values; re-operations **Outcomes relevant to the review:** unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Notes:** • data reported only as an abstract • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Janzing 2002

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PCCP versus DHS
Participants	**Total number of randomised participants:** 115 **Inclusion criteria:** 31A1 or 31A2 pertrochanteric hip fractures; > 60 years of age; **Exclusion criteria:** severe coxarthrosis of the ipsilateral hip; multiple injuries; reverse or bifocal fractures **Setting:** single centre, hospital, Belgium **Baseline characteristics** **Intervention group 1** (PCCP) • Age, average (range): 82 (65 to 96) years • Gender, M/F: 4/35 • Mobility assessment, unaided/with aid/wheelchair or bedridden: 25/10/4 • Place of residence, independent/family or old people's home/nursing home or hospital: 20/12/7 • ASA status, I/II/III/IV: 2/16/20/1 • Singh classification, I/II/III/IV/V: 0/9/19/9/2 • Fracture classification, 31A11/31A12/31A13/31A21/31A22/31A23, n: 9/6/1/2/14/7 **Intervention group 2** (DHS) • Age, average (range): 83 (64 to 98) years • Gender, M/F: 10/34 • Mobility assessment, unaided/with aid/wheelchair or bedridden: 30/13/1 • Place of residence, independent/family or old people's home/nursing home or hospital: 27/15/2 • ASA status, I/II/III/IV: 0/24/19/1 • Singh classification, I/II/III/IV/V: 1/11/15/10/7 • Fracture classification, 31A11/31A12/31A13/31A21/31A22/31A23, n: 5/15/5/6/10/3 **Note:**

Janzing 2002 *(Continued)*

	• study authors do not report any baseline characteristics for: smoking history; medication; BMI; co-morbidities; cognitive status; preoperative waiting time
Interventions	**General details:** enoxaparin postoperatively; low-molecular-weight heparin as prophylaxis; cefazolin was given in a single dose at induction; mobilised immediately with full weight-bearing status **Intervention group 1:** • Gotfried percutaneous compression plate (Efratgo Ltd); femoral head fixation with two dynamic screws • Number randomised = 53 **Intervention group 2:** • Dynamic hip screw (Mathys); 135 degree with anti-rotational screw; trochanteric stabilising plate was added to 17 participants • Number randomised = 62 **Note:** • study authors do not provide information on: number of surgeons or their skills and experience; pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** mortality (available at 12 months); unplanned return to theatre (available at 12 months); time in theatre; postoperative transfusion; decrease in haemoglobin level; postoperative pain; postoperative fracture; fracture impaction **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** June 1998 to May 1999 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Jolly 2019

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus cemented hemiarthroplasty
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** written informed consent; unstable intertrochanteric fractures of femur; > 75 years of age and < 85 years of age **Exclusion criteria:** stable intertrochanteric fractures of femur; unfit or unwilling for surgery; polytrauma; pathological fractures; compound fractures; those who dropped out later in the study **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (PFN)

Jolly 2019 *(Continued)*

- Age, mean (SD): 81.2 (± 7.8) years
- Comorbidities, n: 32
- Mobility score prior to fracture, mean (SD): 4.0 (± 2.1)
- Preoperative waiting time, mean (SD): 28.3 (± 7.3) hours

Intervention group 2 (hemiarthroplasty)

- Age, mean (SD): 78.7 (± 8.3) years
- Comorbidities, n: 30
- Mobility score prior to fracture, mean (SD): 4.1 (± 1.9)
- Preoperative waiting time, mean (SD): 30.4 (± 9.1) hours

Note:

- study authors do not report any baseline characteristics for gender; smoking history; medication; BMI; place of residence; cognitive status; ASA status; fracture classification

Interventions	**General details:** study authors do not provide any of the general details; followed-up at 3 and 6 weeks, and 3 months intervals **Intervention group 1** • PFN; short or standard length femoral head fixation • Number randomised = 50; losses = 10 (died) 4 (lost to follow-up), analysed = 50 **Intervention group 2** • Cemented, bipolar hemiarthroplasty • Number randomised = 50; losses = 12 (died) 2 (lost to follow-up), analysed = 50 **Note:** • Participants initially included in the study, but who dropped out later, were excluded but numbers not clearly reported
Outcomes	**Outcomes measured/reported by study authors:** operating time; blood loss; HHS; mobility score; superficial infections; deep infections; bed sores; UTI; venous thromboembolism; time to full weight bearing; lower respiratory tract infection; mortality (available at 1 month, 3 months, 6 months and 12 months); functional status (HHS); mobility (MMS) **Outcomes relevant to the review:** mortality (reported at 1 months and 12 months) **Note:** • complications are reported as cut-out, dislocation and closed reduction but not clear exactly how many returned to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflicts of interest to be declared but no details on funding are reported **Study dates:** January 2012 to January 2016

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation reported as being from a table of random numbers, no further details on randomisation
Allocation concealment (selection bias)	Unclear risk	Method of allocation is not reported

Jolly 2019 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeons are not specified, and we were uncertain if surgeons were equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding to influence detection bias for this outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few participants were lost, these losses were balanced between groups, and reasons for loss were clearly explained.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Juhn 1988

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: nail-plate fixation versus Ender's nailing
Participants	**Total number of randomised participants:** 201 **Inclusion criteria:** intertrochanteric fractures of the hip **Exclusion criteria:** not reported **Setting:** single centre; hospital; Israel **Baseline characteristics** **Intervention group 1** (nail-plate) • Comorbidities, ASCVD/diabetes mellitus/hypertension/CHF/Parkinson/asthma/chronic pulmonary disease/organic brain syndrome, n: 10/15/27/15/6/7/7/13 • Fracture classification (Evans), stable/unstable, n: 54/50 **Intervention group 2** (Ender) • Comorbidities, ASCVD/diabetes mellitus/hypertension/CHF/Parkinson/asthma/chronic pulmonary disease/organic brain syndrome, n: 7/19/33/7/5/2/6/12 • Fracture classification (Evans), stable/unstable, n: 50/47 **Overall:** • Age, average (range): 76 (23 to 104) years • Gender, M/F: 71/130 **Note:**

Juhn 1988 *(Continued)*

	• study authors did not report any baseline characteristics for age (except overall); gender (except overall); smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time
Interventions	**General details:** 'the operations were performed with patients under general or regional anaesthesia (except for 5 cases in which Ender's nailing was done with the patient initially under local anaesthesia; in our opinion this is not to be recommended)'; all participants received antibiotics perioperatively; none were treated with coagulants; participants were out of their bed the day after surgery, weight bearing was allowed according to individual capacity **Intervention group 1** • Compression hip screw and plate (Richards Co.) • Number randomised = 104 **Intervention group 2** • Ender's nails (manufacturer details not provided); condylocephalic nails • Number randomised = 97 **Note:** • study authors do not report the number of surgeons or their skills and experience.
Outcomes	**Outcomes measured/reported by study authors:** anaesthesia time; operative time; length of hospital stay; complications (backing-out of nails; proximal penetration of nails; fracture, femoral cortex; supracondylar fracture - femur; superficial wound infection; deep wound infection) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** April 1979 to August 1983 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Kammerlander 2018

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus PFNA: with or without cement augmentation
Participants	**Total number of randomised participants:** 253 (30 were later excluded due to post-enrolment eligibility failures, 16 with augmentation, 14 without) **Inclusion criteria:** ≥ 75 years of age; closed trochanteric fractures (AO type 31 A2-A3) due to low-energy trauma; indication for fixation with a PFNA within 72 hours after admission; ability to walk independently (customary walking aids were allowed); basic knowledge of the national language; informed consent **Exclusion criteria:** fractures due to malignancy; additional or open fractures; polytrauma; any implant at the same hip or hemiplegia; recent history of substance abuse; active malignancy; classified according to the ASA classification as class V and VI; participation in any other clinical trial of a drug or device possibly affecting the result of the present study within the previous months; those with a legal guardian; anyone for whom surgeons decided to use a different operative technique

Kammerlander 2018 *(Continued)*

Setting: 9 sites; hospitals; Germany, Austria, Norway, Belgium, Switzerland, Israel

Baseline characteristics

Intervention group 1 (with cement augmentation)

- Age, mean (SD), median (min; max): 86.1 (± 4.6), 86.3 (75.4; 94.4) years
- Gender, M/F: 18/87
- Smoker, yes/no: 7/97
- BMI, mean (SD), median (min; max): 24.1 (± 4.0), 24.0 (15.6; 36.5) kg/m^2
- Charlson comorbidity index, mean (SD), median (min; max): 2.01 (± 2.15), 1.00 (0.00; 10.00)
- ASA status, I/II/III/IV: 10/31/59/4
- Fracture classification, AO 31 - A2.1/A2.2/A2.3/A3.1/A3.2/A3.3, n: 34/36/26/3/3/3

Intervention group 2 (without cement augmentation)

- Age, mean (SD), median (min; max): 85.6 (± 4.9) 86.2 (75.2; 95.6) years
- Gender, M/F: 19/99
- Smoker, yes/no: 14/103
- BMI, mean (SD), median (min; max): 24.8 (± 4.6), 24.0 (15.0; 41.6) kg/m^2
- Charlson comorbidity index, mean (SD), median (min; max): 2.04 (± 2.00), 1.50 (0.00; 10.00)
- ASA status, I/II/III/IV: 13/44/55/5
- Fracture classification, AO 31 - A2.1/A2.2/A2.3/A3.1/A3.2/A3.3, n: 43/37/16/5/8/9

Overall:

- Age, mean (SD), median (min; max): 85.8 (± 4.8) 86.3 (75.2; 95.6) years
- Gender, M/F: 37/186
- Smoker, yes/no: 21/200
- BMI, mean (SD), median (min; max): 24.5 (± 4.3) 24.0 (15.0; 41.6) kg/m^2
- Charlson comorbidity index, mean (SD), median (min; max): 2.02 (2.07), 1.00 (0.00; 10.00)
- ASA status, I/II/III/IV: 23/75/114/9
- Fracture classification, AO 31 - A2.1/A2.2/A2.3/A3.1/A3.2/A3.3, n: 77/73/42/8/11/12

Note:

- study authors did not report any baseline characteristics for: medication; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time

Interventions	**General details:** follow-up data were taken immediately after surgery, and at 3 months, 6 months and 12 months; full weight bearing as tolerated was allowed right after surgery; all participants were mobilised under physiotherapeutic supervision within the first 2 days after surgery, starting as soon as the participants' condition allowed it **Intervention group 1** • Proximal femoral nail antirotation (PFNA) with cement augmentation (Synthes); femoral head fixation with blade augmented with injection of up to 6 mL of poly methylmethacrylate (PMMA) into the femoral head • Number randomised = 105 **Intervention group 2** • Proximal femoral nail antirotation (PFNA) without cement augmentation (Synthes) • Number randomised = 118 **Note:** • study authors did not report the number of surgeons or their skills and experience

Kammerlander 2018 *(Continued)*

- configuration of distal locking was not reported

Outcomes	**Outcomes measured/reported by study authors:** TUG; mortality (available at 12 months); blade migration, joint space, blade position, tip-apex distance, complications; Parker Mobility Score; Barthel Index; re-operations related to the implant **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors report 'the present clinical investigation was performed with the support of the AO foundation via the AOTK Trauma and the AOTrauma networks' and 'C Kammerlander declares grants and personnel fees from AOTrauma and DePuy Synthes during the conduct of the study, and personal fees from DePuy Synthes and Eli Lilly outside the submitted work. T Klopfer, A Sermon and O Bach report research support from the AO foundation via the AOTK Trauma and the AOTrauma networks during the conduct of the study. M Blauth declares grants and personal fees from DePuy Synthes and personal fees from the AO foundation outside the submitted work. R Babst, M Dietrich, F Gebhard, ES Hem, and Y Weil have nothing to disclose'. **Study dates:** March 2012 to July 2015 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Karn 2006

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: external fixation versus SHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** trochanteric fractures **Exclusion criteria:** presenting more than a week after injury; pathological fractures; subtrochanteric extensions; reverse obliquity; multiple fractures; bone and joint disease that could interfere with rehabilitation **Setting:** hospital, single centre, Nepal **Baseline characteristics** **Intervention group 1** (External fixation) • Age, mean (range): 66.56 (53 to 100) years • Gender, M/F: 14/16 • ASA status, I/II/III/IV: 26/3/1/0 • Fracture classification, stable/unstable, n: 27/3 • Preoperative waiting time, time from injury to surgery, mean (range) days: 3.13 (1 to 7) days **Intervention group 2** (SHS) • Age, mean (range): 67.80 (50 to 87) years • Gender, M/F: 16/14 • ASA status, I/II/III/IV: 24/6/0/0 • Fracture classification, stable/unstable, n: 27/3 • Preoperative waiting time, time from injury to surgery, mean (range) days: 5.70 (2 to 9) days

Karn 2006 *(Continued)*

	Overall: • Age, mean (range): 67(50 to 100) years **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment/use of walking aides, place of residence, cognitive status
Interventions	**General details:** gradually progressive programme of weight bearing using a walking frame, from the first day of surgery. All the participants were reviewed at 6, 12, 18 and 24 weeks. No details reported of surgeons' experience with each technique. **Intervention group 1:** • External fixation; single 4.5 mm or 6.5 mm self-tapping pin inserted into the femoral neck and femoral head and two 4.5 mm pins into the proximal femur (Greens surgical); pin sites were cleaned daily and pins were removed after three months • Number randomised = 30 **Intervention group 2:** • Sliding hip screw (manufacturer not reported) • Number randomised = 30
Outcomes	**Outcomes measured/reported by study authors:** functional status (WOMAC, HHS); surgery time; blood loss; LOS; shortening; malrotation; knee movement; varus angulation; superficial infection; deep infection; cost of treatment **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** authors declared no conflicts of interest **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Kazemian 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus external fixation
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** intertrochanteric fracture from a minor trauma **Exclusion criteria:** reverse oblique fractures; previous hip fracture; pathological fractures; an open fracture; hard- or soft-tissue infection at the fracture site; multiple fractures **Setting:** hospital; number of sites not reported; Iran **Baseline characteristics** **Intervention group 1** (DHS) • Fracture classification, AO/OTA A1/A2, n: 11/19

Kazemian 2014 *(Continued)*

	Intervention group 2 (external fixation) • Fracture classification, AO/OTA A1/A2, n: 13/17 **Overall:** • Age, mean (range): 78 (61 to 98) years • Gender, M/F: 19/41 **Note:** • study authors did not report: age, smoking history, medication, BMI, comorbidities, mobility assessment/use of walking aides, place of residence, cognitive status/dementia, ASA status, preoperative waiting time, fracture classification • participants described as elderly high-risk people with several comorbidities such as heart failure, coronary artery disease, hypertension, renal failure, malignancy, thyroid disease, anaemia, or pulmonary disease
Interventions	**General details:** Cephalosporin (1 g intravenously) preoperatively and every 8 hours during the first postoperative day; we noted some differences in mobilisation strategy in each group; in DHS group, 22 had spinal anaesthesia and 8 had general anaesthesia and in external fixation group, all had spinal anaesthesia; follow-up at 14, 45, 90, 180 and 360 days **Intervention group 1:** • Dynamic hip screw (Mathys); 135 degrees, four-hole plate; participants were mobilised on the first postoperative day, partial weight bearing with a walker or crutches • Number randomised = 30; analysed = 30 **Intervention group 2:** • External fixation; two 6.5 mm Schanz pins were inserted into the femoral neck either parallel or slightly convergent and two distal 6.5 mm Schanz pins were inserted perpendicular to the long axis of the femur; pin sites cleaned daily; participants were mobilised with a walker on the second postoperative day, non-weight bearing until union was confirmed with radiographs; removal of fixation in a mean time of 73 days after surgery • Number randomised = 30; analysed = 30
Outcomes	**Outcomes measured/reported by study authors:** cut out; radiographic union; infection; operative time; blood transfusions; LOS; walking ability; functional status (HHS, at 12 months); pain (VAS); bedsores; pneumonia; UTI; DVT; mortality **Outcomes relevant to the review:** mortality (postoperative, described as death unrelated to causes)
Notes	**Funding/sponsor/declarations of interest:** study authors state they received no external funding and state that they have no conflicts of interest **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "randomly placed in two groups, by a computer-generated list"
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias)	Unclear risk	It is not possible to blind surgeons to treatment groups. We could not be certain whether surgeons were equally experienced in using the study implants.

Kazemian 2014 *(Continued)*
All outcomes

Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeons are not reported and it is uncertain whether surgeons have comparable experience with both types of implants
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of assessors of objective measures would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Participant loss was because of death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report a pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Kazemian 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: external fixation versus non-operative
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** age above 60, an AO/OTA A1 or A2 type fracture from low-energy trauma **Exclusion criteria:** reverse obliquity fractures, previous hip fracture, pathological fractures, infection at the fracture site and open or multiple fractures **Setting:** hospital, number of sites not reported, Iran **Baseline characteristics** **Intervention group 1** (external) • Age, mean (range): 77 (61 to 96) years • Fracture classification, AO/OTA A1/A2, n: 13/17 **Intervention group 2** (non-operative) • Age, mean (range): 82 (63 to 98) years • Fracture classification, AO/OTA A1/A2, n: 11/19 **Overall:** • Gender, M/F: 21/39 • Comorbidities, type, n: heart failure/coronary artery disease, 34; hypertension, 45; renal disease, 10; thyroid disease, 7; anaemia, 36; pulmonary disease, 28; malignancy 3 **Note:**

Kazemian 2016 *(Continued)*

- study authors did not report: smoking history, medication, BMI, mobility assessment/use of walking aides, place of residence, cognitive status/dementia, ASA status, preoperative waiting time, fracture classification
- participants described as elderly high-risk individuals with several comorbidities such as heart failure, coronary artery disease, hypertension, renal failure, malignancy, thyroid disease, anaemia, or pulmonary disease

Interventions	**General details:** Cephalosporin (1 g intravenously) preoperatively and then every eight hours for the first postoperative day; low-molecular-weight heparin (enoxaparin) administered to both groups for 28 days; follow-up at 14, 45, 90, 180 and 360 days after surgery **Intervention group 1:** • External fixation; two 6.5 mm Schanz pins were inserted into the femoral neck either parallel or slightly convergent and two distal 6.5 mm Schanz pins were inserted perpendicular to the long axis of the femur; pin sites cleaned daily; participants were mobilised with a walker on the second postoperative day, non-weight bearing until union was confirmed with radiographs • Number randomised = 30; analysed = 30 **Intervention group 2:** • Skeletal traction; 5 mm pin inserted into proximal tibia under local anaesthetic and traction of 10% body weight applied; mean time under traction 42 days; weight bearing allowed after signs of union • Number randomised = 30; analysed = 30
Outcomes	**Outcomes measured/reported by study authors:** mobility (independent walking); blood transfusions; pain (VAS); functional status (HHS, 12 months); range of motion; infection; bed sores; pneumonia; UTI; DVT; LOS **Outcomes relevant to the review:** mortality (described as unrelated reasons, at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** June 2011 and August 2012

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "patients were randomized by a computer-generated list"
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. We could not be certain whether surgeons were equally experienced in using the study implants.
Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeons are not reported and it is uncertain whether surgeons have comparable experience with both types of implants
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of assessors of objective measures would influence objective outcome data.
Incomplete outcome data (attrition bias)	Low risk	Participant loss was because of death, which is expected in this population.

Kazemian 2016 *(Continued)*
All outcomes

Selective reporting (reporting bias)	Unclear risk	Study authors do not report a pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Kim 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: cementless calcar-replacement hemiarthroplasty versus PFN
Participants	**Total number of randomised participants:** 58 **Inclusion criteria:** unstable comminuted intertrochanteric femoral fracture (AO/OTA type 31-A2 and Evans type III or IV); ≥ 75 years of age; informed consent **Exclusion criteria:** AO/OTA type 31-A1 or A3 fracture **Setting:** single centre; hospital; South Korea **Baseline characteristics** **Intervention group 1** (hemiarthroplasty) • Age, mean (SD): 82 (± 3.4) years • Gender, M/F: 6/23 • Cognitive status, MMSE, mean (SD): 23.1 (3.5) • ASA status, mean (SD): 1.9 (0.6) **Intervention group 2** (intramedullary nail) • Age, mean (SD): 81 (± 3.2) years • Gender, M/F: 8/21 • Cognitive status, MMSE, mean (SD): 22.9 (3.3) • ASA status, mean (SD): 1.8 (0.6) **Note:** • study authors do not report any baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** the same surgeon performed the surgery for both arms of the trial; the mean duration of follow-up was 35 months, ranging from 24 to 58 months in hemiarthroplasty group and 24 to 57 months in intramedullary nail group; the use of prophylactic antibiotics was the same in the two groups; prophylaxis against DVT was not administered in either group, as it is customary with patients with hip fractures in Korea as a result of low incidence of this complication **Intervention group 1** • Mallory-Head Cementless hemiarthroplasty (Biomet); long-stem cementless calcar-replacement hemiarthroplasty • Number randomised to group = 29; losses = 16 (death), analysed = 29

Kim 2005 *(Continued)*

	Intervention group 2: • Proximal femoral nail (PFN) (Mathys); 240 mm long; femoral head fixation is performed with an 11 mm and 6.5 mm screw • Number randomised to group = 29; losses = 5 (death), analysed = 29 **Note:** • study authors do not report the skills and experience of surgeons or the details on the pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** HHS; operative time; blood loss; transfusion data; complications (respiratory complication, cardiovascular complication, UTI, DVT, neurological complication, wound complication, superficial infection, deep infection) mortality (available at hospital stay, 12 months and between 1 and 3 years); mean fluoroscopy time; non-unions; mobility; mean hospital stay; reduction; re-operations (available at 3 years); cutting-out of lag screw; delayed infection; breakage of antirotatory pin; breakage of distal locking screw; dislocation **Outcomes relevant to the review:** mortality (hospital stay, 12 months) and unplanned return to theatre (reported at 3 years)
Notes	**Funding/sponsor/declarations of interest:** study authors report 'the authors did not receive grants or outside funding in support of their research or preparation of this manuscript. They did not receive payments or other benefits or a commitment or agreement to provide such benefits from a commercial entity. No commercial entity paid or directed, educational institution, or other charitable or nonprofit organisation with which the authors are affiliated or associated' **Study dates:** November 1998 to May 2001

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random numbers
Allocation concealment (selection bias)	Unclear risk	Method of allocation not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeons are not reported and it is uncertain whether surgeons have comparable experience with both types of implants
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Study authors reported that no participants were lost to follow-up. The only participant loss was because of death, which is expected in this population.

Kim 2005 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Kosygan 2002

Study characteristics	
Methods	RCT, parallel groups **Review comparison group**: CHS versus PCCP
Participants	**Total number of randomised participants:** 111 **Inclusion criteria:** extracapsular fractures **Exclusion criteria:** pathological fractures; subtrochanteric fractures **Setting:** hospital, single centre, UK **Baseline characteristics** **Intervention group 1** (CHS) • Age, mean (SD; range): 82.8 (± 9; 57 to 97) years • Gender, M/F: 12/44 • Cognitive status/dementia, mini-mental state score, mean (SD): 7.8 (± 2.7) • Fracture classification, stable/unstable, n: 25/31 **Intervention group 2** (PCCP) • Age, mean (SD; range): 82.7 (± 8.5; 53 to 93) years • Gender, M/F: 8/44 • Cognitive status/dementia, mini-mental state score, mean (SD): 8.6 (± 2.1) • Fracture classification, stable/unstable, n: 24/28 **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment/use of walking aides, place of residence, ASA status, preoperative waiting time
Interventions	**General details:** perioperative antibiotics were given and antithromboembolic stockings were worn; "three experienced surgeons who had been instructed in the use of the PCCP by its inventor before embarking on this project"; postoperative rehabilitative regime was identical for the two groups; weight bearing on first or second postoperative day; follow-up at 6 weeks and 3 and 6 months after surgery **Intervention group 1** • Compression Hip Screw (Smith & Nephew) • Number randomised = 56 **Intervention group 2:** • Gotfried percutaneous compression plate (PCCP) (Efratgo Ltd); femoral head fixation with two dynamic neck screws; plate fixation with three cortical shaft screws • Number randomised = 52

Kosygan 2002 *(Continued)*

	Note: • 3 participants switched from PCCP to CHS due to technical difficulties; these were reported separately, but included in analysis as PCCP due to intention-to-treat
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; blood transfusion; LOS; DVT; PE; chest infection; cardiac complication; CA; gastrointestinal bleeding; superficial and deep infection; pressure sore; cut-out; heel raise required; mortality (available within 48 hours, 2 to 30 days, and 30 days to 6 months) **Outcomes relevant to the review:** mortality (with 30 days, 6 months) **Note:** • 1 death from the PCCP to CHS group reported on intention-to-treat basis with the PCCP group
Notes	**Funding/sponsor/declarations of interest:** study authors state no external funding was received **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Kouvidis 2012

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Endovis nail ("dual lag screw cephalomedullary nail") versus DHS
Participants	**Total number of randomised participants:** 165 **Inclusion criteria:** low-energy intertrochanteric fractures (AO type 31-A) **Exclusion criteria:** < 65 years of age; multi-trauma patients; people with previous ipsilateral hip or femur surgery possibly affecting functional outcome; people with pathological fractures **Setting:** single setting; orthopaedic ward in hospital, Greece **Baseline characteristics** **Intervention group 1** (cephalomedullary nail) • Age, mean (SD): 81.95 (± 7.21) years • Gender, M/F: 18/72 • ASA status, I or II/III or IV: 31/55 • Preoperative waiting time, mean (SD): 3.24 (± 2.44) hours • Fracture classification, stable (A1)/unstable (A2 or A3), n: 26/60 • Additional information: ○ FRS, mean (SD): 85.43 (± 16.69) **Intervention group 2** (SHS) • Age, mean (SD): 82.53 (± 6.79) years • Gender, M/F: 26/49 • ASA status, I or II/III or IV: 27/52 • Preoperative waiting time, mean (SD): 3.18 (± 2.46) hours

Kouvidis 2012 *(Continued)*

- Fracture classification, stable (A1)/unstable (A2 or A3), n: 21/58
- Additional information:
  - FRS, mean (SD): 84.05 (± 15.25)

Note:

- baseline data not described for: smoking history, medication, BMI, comorbidities, mobility, place of residence, cognitive status, ASA status

Interventions	**General details:** fracture table; spinal anaesthesia; closed reduction; use of an image intensifier; small lateral approach; standard postoperative protocol; immediate passive exercises; weight bearing encourage on second day; clinical examinations at 3 weeks and 4 months. Surgical experience: most operations were carried out by orthopaedic residents under a senior surgeon's assistance. Residents had almost equal experience with both implants. **Intervention group 1** • Endovis Cephalomedullary nail ("dual lag screw cephalomedullary nail"); cervico-diaphyseal angle of 130 degrees, a metaphyseal angle of 5 degrees; the nail is only made in one length measuring 195 mm; 2 holes for insertion of dynamic cephalic screws and 1 for a distal locking screw was utilised in all cases • Randomised = 86; analysed = 86 **Intervention group 2** • SHS; either the keyed (CLASSIC) or key-less (AMBI) systems in angles 130 to 140 degrees with 2 to 4 slots (Smith & Nephew) • Randomised = 79; analysed = 79
Outcomes	**Outcomes measured/reported by study authors:** FRS; mortality; length of surgery; LOS; duration of fluoroscopy; number receiving blood transfusion; later fracture of the femur; cut-out of implant; implant breakage; non-union; re-operation; wound infection; implant-related complications (non-union, cut-out); LOS; tip-apex distance to assess position of implants; participant mobility (90% recovery or bed-bound or wheelchair dependent); length of follow-up: 12 months **Outcomes relevant to the review:** mortality (12 months); unplanned return to theatre (12 months) **Note:** • although the text states that follow-up was at 36 months, we have reported follow-up as 12 months because this is the time line described in study report tables and the flow diagram.
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2005 to December 2006

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	Use of sealed envelopes, but study authors do not reported if envelopes are opaque and sequentially-numbered
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.

Kouvidis 2012 *(Continued)*

Other performance bias: surgeon experience of both implants	Low risk	Quote: "vast majority of operations in our study were performed by orthopaedic residents under a senior surgeon's experience. The participating residents had almost equal experience in both implants. The senior surgeons had already performed more than fifteen Endovis procedures each prior to this study".
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most losses explained by death, which is expected in this population
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Kukla 1997

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma nail versus DHS
Participants	**Total number of randomised participants:** 120 **Inclusion criteria:** > 60 years old; unilateral fracture (AO/ASIF 31-A1.1 to A3.3); ambulatory prior to trauma **Exclusion criteria:** pathological fractures; people with multiple injuries **Setting:** single setting; orthopaedic hospital, Austria **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean (SD): 83 (± 9.1) years • Gender, M/F: 14/46 • Mobility assessment; ambulate without aid/crutch or cane/2 elbow crutches/frame, n: 29/10/5/1 • Preoperative waiting time: within 24 hours, whenever possible • Fracture classification, A1.1-1.3/A2.1-2.3/A3.1-3.3, n: 31/28/1 **Intervention group 2** (DHS) • Age, mean (SD): 84 (± 8.3) years • Gender, M/F: 4/56 • Mobility assessment; ambulate without aid/crutch or cane/2 elbow crutches/frame, n: 30/11/2/1

Kukla 1997 *(Continued)*

- Preoperative waiting time: within 24 hours, whenever possible
- Fracture classification, A1.1-1.3/A2.1-2.3/A3.1-3.3, n: 23/34/3

Overall

- Age, mean (range): 83 (60 to 99) years
- Gender, M/F: 18/102
- Mobility assessment; ambulate without aid/crutch or cane/2 elbow crutches/frame, n: 59/21/7/2
- Fracture classification, A1.1-1.3/A2.1-2.3/A3.1-3.3, n: 54/62/4

Note:

- baseline data not described for: smoking history, medication, BMI, comorbidities, mobility, place of residence, cognitive status, ASA status

Interventions	**General details:** spinal or general anaesthesia; clinical follow-up at 6 months. Senior surgeons experienced in both operations **Intervention group 1** • Gamma intramedullary nail (Howmedica, Germany); although the authors did not specify the length of nail used, from the text it can be inferred that short nails were likely used in all cases; no surgical details reported • Randomised = 60 **Intervention group 2** • DHS (Rob Mathys, Switzerland); no surgical details reported • Randomised = 60
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union; re-operation; wound infection; deep wound infection; wound haematoma; pneumonia; DVT; PE; any medical complication; LOS; shortening of leg (> 2 cm); mortality; non-return to previous residence; impaired walking; length of follow-up: 6 months **Outcomes relevant to the review:** mortality (in hospital, and 6 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** authors do not report funding or conflicts of interest **Study dates:** August 1993 to March 1994 • we received additional information from study authors which included a draft report prior to publication

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote (from direct communication with study authors): "random permutation" Comment: insufficient information
Allocation concealment (selection bias)	Unclear risk	Quote: "Allocation to the 2 groups was achieved by randomized, sealed envelopes" Comment: study authors do not report whether envelopes are opaque and sequentially numbered

Kukla 1997 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Comment: "Senior surgeons who, having operated on at least 80 cases each, were experienced in the use of both devices."
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few losses which we did not expect to influence data
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Kumar 2019

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus PFNA
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** independently ambulant before injury; closed unstable trochanteric fracture classified as AO A2.2-A2.3 and A3.1-A3.3; written and informed consent **Exclusion criteria:** < 50 years of age; pathological fractures of any cause other than osteoporosis; open fractures; inability to walk independently prior to injury event; neurological and psychiatric disorders that would preclude assessment (e.g. Parkinsonism, multiple sclerosis, severe depression) **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD) (range): 64.36 (± 8.28) (51 to 82) years • Gender, M/F: 13/17 • Fracture classification, AO 31A2.2/2.3/3.1/3.2, n: 19/6/5/0 **Intervention group 2** (PFNA) • Age, mean (SD) (range): 65.36 (± 8.66) (51 to 84) years

Kumar 2019 *(Continued)*

	• Gender, M/F: 13/17 • Fracture classification, AO 31A2.2/2.3/3.1/3.2, n: 23/4/2/1 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessments; place of residence; cognitive status/dementia; ASA status; preoperative waiting time
Interventions	**General details:** minimum follow-up was at 12 months and maximum follow-up was 2 years; surgery was performed on a fracture table in supine position under regional anaesthesia (combined spinal and epidural anaesthesia) by the on-call surgeon or under their supervision by a resident; a 3rd generation cephalosporin was used for antibiotic prophylaxis for first 24 hours only, with first dose being administered at induction of anaesthesia; participants were mobilised early as per institutional protocol with protected weight bearing (partial weight bearing) on day one after operation; soluble aspirin along with anti-embolism stockings were given for 6 weeks as thromboprophylaxis in most cases who could be mobilised early within first 24 hours postoperatively whereas low-molecular-weight heparin was used if there was any delay in mobilising the participant; ambulation with weight bearing as tolerated was continued till radiological evidence of union; each participant was followed up postoperatively clinically, radiologically and functionally at 6 weeks, 3 months, 6 months and 1 year **Intervention group 1** • Proximal femoral nail (manufacturer not reported); femoral head fixation with two screws • Number randomised = 30 **Intervention group 2:** • Proximal femoral nail antirotation (PFNA) (manufacturer details not reported); femoral head fixation with a helical blade • Number randomised = 30
Outcomes	**Outcomes measured/reported by study authors:** duration of surgery; blood loss; intraoperative imaging requirements; postoperative complications; time in hospital; implant-related complications; mortality (available at 12 months); HHS; use of walking aid; persistent pain; return to pre-fracture walking status **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflicts of interest. No details of funding are reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Kuwabara 1998

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus CHS
Participants	**Total number of randomised participants:** 43

Kuwabara 1998 *(Continued)*

	Inclusion criteria: trochanteric proximal femoral fractures. Evans classification: stable, unstable and 'type 2' (1 fracture) **Exclusion criteria:** < 65 years of age **Setting:** single centre; orthopaedic hospital; Japan **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean (SD): 82.8 (± 7.1) years • Gender, M/F: 5/15 • Fracture classification, stable/unstable (Evans 1949), n: 15/5 **Intervention group 2** (CHS) • Age, mean (SD): 80 (± 6) years • Gender, M/F: 7/16 • Fracture classification, stable/unstable (Evans 1949), n: 15/7; type 2 = 1 **Note:** • baseline data not described for: smoking history, medication, BMI, comorbidities, mobility, place of residence, cognitive status, ASA status, preoperative waiting time
Interventions	**General details:** level of surgical experience is unknown **Intervention group 1** • Gamma intramedullary nail; no further surgical or implant details provided • Randomised = 20 **Intervention group 2** • CHS; no further surgical or implant details provided • Randomised = 23
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; operative fracture of the femur; later fracture of the femur; cut-out of implant; wound infection; inversion deformity; inversion deformity; loss in mobility and use of walking aids; length of follow-up: mean 6 months (5.7 and 6.5 months, respectively, for the two groups) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** no details of funding or conflicts being reported **Study dates:** not reported **Note:** • study report published in Japanese. We obtained only a limited translation. • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Leung 1992

Study characteristics	
Methods	Quasi-RCT; parallel design

Leung 1992 *(Continued)*

	Review comparison group: Gamma intramedullary nail versus DHS
Participants	**Total number of randomised participants:** 225 participants; 226 fractures **Inclusion criteria:** peritrochanteric proximal femoral fractures; classified as "pertrochanteric or intertrochanteric with or without subtrochanteric extension" **Exclusion criteria:** < 65 years of age; purely subtrochanteric fractures **Setting:** single-centre; orthopaedic hospitals; Hong Kong **Baseline characteristics (only for survivors)** **Intervention group 1** (Gamma nail) • Age, mean (SD): 80.86 (± 8.41) years • Gender, M/F: 25/68 • Mobility assessment, independent/ aided/bed bound, n: 58/34/1 • Place of residence, home/institution, n: 74/19 • ASA status, I/II/III/IV: 15/47/23/8 • Fracture classification, stable/unstable (Evans 1949), n: 30/63 **Intervention group 2** (DHS) • Age, mean (SD): 78.27 (± 9.46) years • Gender, M/F: 30/63 • Mobility assessment, independent/ aided/bed bound, n: 44/44/5 • Place of residence, home/institution, n: 64/29 • ASA status, I/II/III/IV: 10/42/38/3 • Fracture classification, stable/unstable (Evans 1949), n: 20/73 **Note:** • study authors did not report: smoking history, medication, BMI, waiting time for surgery
Interventions	**General details:** prophylactic antibiotics; general or spinal anaesthetic; traction table for closed reduction under fluoroscopic control; immediate mobilisation with full weight bearing; clinical follow-up at 6 weeks, 3 and 6 months. Most of the Gamma nail operations were performed by 1 senior surgeon with a special interest in intramedullary nailing, whilst the SHS operations were performed by a number of less experienced surgeons (from email communication with study authors). **Intervention group 1** • Gamma intramedullary nail (Howmedica International, Staines, Middlesex, England); distal locking was performed at the discretion of the operating surgeon. Although the authors did not specifically report the length of the nails used, it can be inferred from the manuscript that all nails were likely short. • Randomised = 113; analysed = 113 **Intervention group 2** • DHS; no further surgical or implant details were provided • Randomised = 113; analysed = 113
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; radiographic screening time; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union (fracture healing); re-operation; deep wound infection; chest infection/pneumonia; any medical complication; LOS (mixed location); external rotational deformity; shortening of leg (> 2 cm); varus displacement (> 10 degrees); mortality; pain at follow-up (pain in hip and pain in thigh); impaired walking; length of follow-up: mean 7 months

Leung 1992 *(Continued)*

	Outcomes relevant to the review: mortality (6 months); unplanned return to theatre (at 6 months)
Notes	**Funding/sponsor/declarations of interest:** quote: "No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article" **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	We identified no other sources of bias.
Allocation concealment (selection bias)	High risk	We identified no other sources of bias.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Most of the Gamma nail operations were performed by one senior surgeon with a special interest in intramedullary nailing, whilst the SHD operations were performed by a number of less experienced surgeons.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Li 2010

Study characteristics

Methods	RCT; parallel design **Review comparison group**: anatomical plate versus DHS
Participants	**Total number of randomised participants:** 48 **Inclusion criteria:** intertrochanteric fractures

Li 2010 *(Continued)*

	Exclusion criteria: unknown **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (anatomical plate group) • Age, mean (SD): 80.4(± 13.5) years • Gender, M/F: 18/6 • Fracture classification, Evans III/IV, n: 4/20 **Intervention group 2** (DHS) • Age, mean (SD): 78.8 (± 11.6) years • Gender, M/F: 15/9 • Fracture classification, Evans III/IV, n: 3/21
Interventions	**General details:** all participants were followed up for 12.6 months (range 5 to 18 months) **Intervention group 1** • Proximal femoral plate (manufacturer not reported); femoral head fixation with three screws • Number randomised to group = 24 **Intervention group 2** • Dynamic hip screw (manufacturer not reported) • Number randomised = 24
Outcomes	**Outcomes measured/reported by study authors:** operative time; blood loss; walking time; HHS **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** May 2007 to June 2009 **Note:** • study published in Chinese. We did not seek translation for this study, and data are taken only from the English abstract. • we did not complete risk of bias assessments because study reported no review-relevant outcomes.

Li 2015b

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: distally locked PFNA II versus unlocked nailing PFNA II
Participants	**Total number of randomised participants:** 70 **Inclusion criteria:** > 65 years of age; pertrochanteric fractures classified as AO/OTA 31-A1 and 31-A2 according to the orthopaedic Trauma Association classification system **Exclusion criteria:** pathological fractures; open fractures; bilateral fractures; fractures associated with a neurovascular injury as well as previous ipsilateral hip or femur surgery

Li 2015b *(Continued)*

Setting: single centre; hospital; China

Baseline characteristics

Intervention group 1 (locking)

- Age, mean (SD): 78.1 (± 6.9) years
- Gender, M/F: 11/24
- Comorbidities, hypertension and cardiovascular diseases/diabetes/osteoporosis/pulmonary infection, n: 6/12/19/2
- ASA status, I/II/III/IV: 2/8/23/2
- Fracture classification, AO/OTA classification A1/A2, n: 7/28

Intervention group 2 (unlocking)

- Age, mean (SD): 78.3 (± 7.0) years
- Gender, M/F: 10/25
- Comorbidities, hypertension and cardiovascular diseases/diabetes/osteoporosis/pulmonary infection, n: 28/17/22/1
- ASA status, I/II/III/IV: 1/6/25/3
- Fracture classification, AO/OTA classification A1/A2, n: 11/24

Overall:

- Age, average (range): 78.2 (65 to 93) years
- Gender, M/F: 21/49
- Fracture classification, AO/OTA classification A1/A2, n: 18/52

Note:

- study authors reported no baseline characteristics for: smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time

Interventions

General details: all operations were performed by the same group of experienced surgeons; the rehabilitation protocol was identical in each group; all participants were encouraged to move their hip, knee and ankle joints on the first postoperative day under guidance of the surgeon; on the following day, partial weight bearing, or restricted weight bearing as tolerated or walking with full weight bearing assisted by a walking frame was allowed in accordance with surgeons' advice; clinical and radiographic re-examinations were performed at 3 months, 6 months and 12 months postoperatively

Intervention group 1

- Proximal femoral nail antirotation II (PFNA-II) (manufacturer not reported); with distal locking; femoral head fixation with a helical blade
- Number randomised to group = 35

Intervention group 2:

- Proximal femoral nail antirotation II (PFNA-II) (manufacturer not reported); without distal locking; femoral head fixation with a helical blade
- Number randomised to group = 35

Note:

- study authors do not report the use of antibiotics used

Outcomes

Outcomes measured/reported by study authors: operation time; volume of intraoperative blood loss; blood transfusion; total fluoroscopy time; length of incision; mortality (available at 12 months); postoperative complications; hospital stay length; HHS; mobility

Outcomes relevant to the review: mortality (reported at 12 months)

Li 2015b *(Continued)*

Notes	**Funding/sponsor/declarations of interest:** the authors declare no conflict of interest but no details on funding are reported **Study dates:** March 2013 to July 2014 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Li 2018

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA vs DHS
Participants	**Total number of randomised participants:** 80 **Inclusion criteria:** elderly people ≥ 60 years of age, with osteoporosis, with femoral intertrochanteric fractures **Exclusion criteria:** people with bone or joint motor system diseases, diabetes mellitus, severe cardiorespiratory, hepatic, or renal dysfunctions, mental disorders, coagulation disorders, systemic malignant tumours, malignant tumour cachexia, or contraindications after intra-spinal anaesthesia puncture; using analgesia devices or drugs after the operation; declined to consent to enrolment **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (intramedullary) • Age, mean (SD): 75.6 (± 2.5) years • Gender, M/F: 20/20 • Fracture classification, n: Evans, I: 4; II: 10; III: 16; IV: 10 **Intervention group 2** (extramedullary) • Age, mean (SD): 75.5 (± 2.6) years • Gender, M/F: 21/19 • Fracture classification, n: Evans, I: 3; II: 12; III: 15; IV: 10 **Note:** • study authors report no baseline data for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status, preoperative waiting times
Interventions	**General details:** spinal epidural anaesthesia; wound drain for all cases **Intervention group 1** • PFNA; no further implant details are provided • Randomised = 40 **Intervention group 2** • DHS helical blade; no further implant details are provided • Randomised = 40

Li 2018 *(Continued)*

	Note: • study authors report no surgical details for: number of surgeons (and their skills and experience); or pre-/postoperative care (e.g. use of prophylactic antibiotics or antithromboembolics), or rehabilitation (e.g. time to mobilisation or weight bearing)
Outcomes	**Outcomes measured/reported by study authors:** operation duration, blood loss, postoperative drainage volume, HHS, pain, bone mineral density and calcitonin level, 10-metre walking speed, 5-times sit-to-stand test time, fracture healing and weight bearing time, complications (coxa vara, loose nail, bone non-union, delayed union of fracture, femoral head necrosis and DVT) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** funding not reported. Study authors declared no conflicts of interest **Study dates:** January 2013 to December 2014 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Liem 1993

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus Ender
Participants	**Total number of randomised participants:** 136 **Inclusion criteria:** pertrochanteric fractures of the femur **Exclusion criteria:** not reported **Setting:** single centre; hospital; Netherlands **Baseline characteristics** **Intervention group 1** (DHS) • Age, mean: 81.1 years • Gender, M/F: 17/48 • Fracture classification, stable (A1)/unstable (A2, A3)/unknown, n: 38/27/0 **Intervention group 2** (Ender) • Age, mean: 82.5 years • Gender, M/F: 14/57 • Fracture classification, stable (A1)/unstable (A2, A3)/unknown, n: 36/34/1 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time

Liem 1993 *(Continued)*

Interventions	**General details:** preoperative antibiotic prophylaxis was started with 1 g Keforal IV which was repeated 3 times during the first 24 hours; unless contraindicated, all participants were permitted immediate weight bearing; follow-up for 6 months **Intervention group 1** • Dynamic hip screw (manufacturer not reported); 135° angled plate was used as standard • Number randomised = 65; losses = 21 (death), analysed for mortality = 65, analysed for unplanned return to theatre = 44 **Intervention group 2** • Ender nails (manufacturer not reported); three to five condylocephalic nails • Number randomised = 71; losses = 18 (death), analysed for mortality = 71, analysed for unplanned return to theatre = 53 **Note:** • study authors do not report the number of surgeons or their skills and experience
Outcomes	**Outcomes measured/reported by study authors:** operating time; operative blood loss; mean hospital stay; superficial wound infections; mortality (available at 14 days and 6 months); intercurrent disease; re-operations (available at 6 months); other complications **Outcomes relevant to the review:** mortality (reported at 14 days and 6 months); unplanned return to theatre (reported at 6 months) **Note:** • 14-day data only given as percentage
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** October 1982 to October 1985

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomisation not reported
Allocation concealment (selection bias)	Unclear risk	Method of allocation not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeons are not reported and it is uncertain whether surgeons were equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned re-	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.

Liem 1993 *(Continued)*

turn to theatre (detection bias)		
Incomplete outcome data (attrition bias) All outcomes	Low risk	Study authors reported that no participants were lost to follow-up. Only participant loss was because of death, which is expected in this population
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Little 2008

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** long Holland intramedullary nail versus CHS
Participants	**Total number of randomised participants:** 190 **Inclusion criteria:** low-energy extracapsular intertrochanteric fracture; classification AO/ASIF A1, A2 and A3 (stable and unstable fractures) **Exclusion criteria:** people with subtrochanteric fractures **Setting:** single centre; orthopaedic hospital; United Kingdom **Baseline characteristics** **Intervention group 1** (Holland nail) • Age, mean (range): 82.6 (54 to 102) years • Gender, M/F: 8/84 • Mobility assessment, Parker and Palmer score, mean (SD): 6.5 (± 2.7) • Cognitive status, mini mental test, mean (SD): 8.1 (± 2.8) • ASA status, I/II/III/IV: 2/57/33/0 • Fracture classification, A1/A2/A3, n: 15/38/39 **Intervention group 2** (DHS) • Age, mean (range): 84.2 (50 to 98) years • Gender, M/F: 20/78 • Mobility assessment, Parker and Palmer score, mean (SD): 5.8 (± 2.8) • Cognitive status, mini mental test, mean (SD): 7.5 (± 2.7) • ASA status, I/II/III/IV: 3/55/37/3 • Fracture classification, A1/A2/A3, n: 29/51/18 **Overall:** • Age, mean (range): 83.4 (50 to 102) years • Gender, M/F: 28/157 • Mobility assessment, preoperative mobility, mean (SD): 6.2 (± 2.8) • Cognitive status, mini mental test, mean (SD): 7.8 (± 2.8) • ASA status, I/II/III/IV: 5/112/70/3

Little 2008 *(Continued)*

	• Fracture classification, A1/A2/A3, n: 44/89/57 **Note:** • study authors did not report: smoking history, medication, BMI, waiting time for surgery
Interventions	**General details:** pre- and postoperative care was the same for both groups; single-dose antibiotic teicoplanin and gentamicin at induction; anaesthesia was either regional, regional and general, or general; traction table for closed reduction; standard operative technique either recommended by the manufacturer or by previous studies; antibiotic and thromboembolism prophylaxis were routinely given; aspirin once daily for 6 weeks; standardised pain relief; mobilised (fully weight bearing) on POD1; rehabilitation was standardised; clinical follow-up at six weeks, 6 and 12 months; specialist registrar under supervision or by a consultant who was familiar with both procedures is claimed, but there is also a reference to the possible influence of a learning curve on some outcomes **Intervention group 1** • Long Holland intramedullary nail (Biomet, Swindon, UK); the nail is locked proximally into the femoral neck with two partially threaded cannulated screws and can be locked distally with two static screws; details of distal locking were not provided by the study authors. • Randomised = 92; 76 at 12-month follow-up (16 died) **Intervention group 2** • CHS (Biomet, Swindon, UK) • Randomised = 98; 80 at 12-month follow-up (17 died, 2 fixation failure)
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; radiographic screening time; number of participants transfused; cut-out of the implant; re-fracture around the implant; re-operation; superficial wound infection; deep wound infection; pneumonia; DVT; PE; TIA; mortality; failure to regain mobility; mobility score; days until mobilisation; length of follow-up: mean 12 months **Outcomes relevant to the review:** mortality (30 days and 12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors clearly state that no funding was received and no conflicts existed **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Patients were allocated a sequential study number and were randomised by computer to be treated with a DHS or a Holland nail."
Allocation concealment (selection bias)	Unclear risk	No additional details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Quote: "Each procedure was carried out by a specialist registrar under supervision or by a consultant who was familiar with both procedures." Comment: the report suggested that the longer operating and radiation times in the Holland nail group "may be a function of the learning curve in its use".

Little 2008 *(Continued)*

Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses are explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Lopez 2002

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group:** Gamma nail versus DHS

Participants	**Total number of randomised participants:** 103
	
	Inclusion criteria: trochanteric proximal femoral fractures (no prominent subtrochanteric extension)
	
	Exclusion criteria: not reported
	
	Setting: single centre; orthopaedic hospital; Spain
	
	Baseline characteristics
	
	Intervention group 1 (Gamma nail)
	
	• Age, mean (range): 83.9 (65 to 101) years
	• Gender, M/F: 13/30
	• Comorbidities, type, n:
	  ◦ diabetes mellitis: 7
	  ◦ heart failure: 6
	  ◦ cardiac arrhythmia: 4
	  ◦ renal insufficiency: 1
	  ◦ Parkinson's: 3
	  ◦ Others: 28
	• Place of residence, n: own home, 13; family home, 33; residential home, 14
	• Cognitive level, MMSE, mean: 15.1
	• ASA status, mean: 2.47
	• Fracture classification, stable/unstable, n: 31/12
	
	Intervention group 2 (DHS)
	
	• Age, mean (range): 84.4 (67 to 102) years
	• Gender, M/F: 23/37

Lopez 2002 *(Continued)*

- Comorbidities, type, n:
  - diabetes mellitis: 9
  - heart failure: 9
  - cardiac arrhythmia: 5
  - renal insufficiency: 4
  - Parkinson's: 5
  - Others: 35
- Place of residence, n: own home, 15; family home, 24; residential home, 44
- Cognitive status, MMSE, mean: 16
- ASA status, mean: 2.51
- Fracture classification, stable/unstable, n: 45/15

Note:

- study authors do not baseline characteristics for: smoking history, medication, BMI, preoperative waiting time

Interventions	**General details:** experience of surgeons is not reported **Intervention group 1** • Gamma intramedullary nail; no further implant or operative details were provided • Randomised = 43 **Intervention group 2** • Dynamic hip screw ; no further implant or operative details were provided • Randomised = 60
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; postoperative transfusion; change in haematocrit; radiographic screening time; operative fracture of the femur; later fracture of the femur; cut-out of implant; re-operation; wound infection; wound haematoma; DVT; pneumonia; pressure sores; mortality; mobility score; mean time to fracture consolidation; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** February 1998 to April 1999 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Lopez-Vega 2015

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group**: Gamma 3 nail with distal lock versus Gamma 3 nail without distal lock
Participants	**Total number of randomised participants:** 177 **Inclusion criteria:** intertrochanteric femoral fractures (31-A1 or 31-A2 in the AO classification)

Lopez-Vega 2015 *(Continued)*

Exclusion criteria: high-energy trauma (falls and traffic accidents); people who were incorrectly randomised according to their date of birth; unstable fractures requiring the use of a blocked nail or longer nails (particularly in AO 31-A2.3 and 31-A3 fractures); pathological fractures; implants from other commercial brands; people who did not wish to be included in the study

Setting: single centre; hospital; Spain

Baseline characteristics

Intervention group 1 (with)

- Age, mean (SD): 84.59 (± 9.11) years
- Gender, M/F: 17/73
- Preoperative waiting time, mean (SD): 2.99 (± 2.05) days
- Fracture classification, 31-A1/31-A2, n: 34/56

Intervention group 2 (without)

- Age, mean (SD): 83.68 (± 6.90) years
- Gender, M/F: 19/68
- Preoperative waiting time, mean (SD): 2.97 (± 1.97) days
- Fracture classification, 31-A1/31-A2, n: 46/41

Overall:

- Age, mean (SD) (range): 84.14 (± 8.09) (43 to 99) years
- Gender, M/F: 36/141
- Preoperative waiting time, mean (SD) (range): 2.98 (± 2.01) (0 to 14) days

Note:

- study authors do not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status

Interventions	**General details:** all participants were allowed immediate load depending on their tolerance; antibiotic prophylaxis was prescribed for the first 24 hours after the intervention, along with antithrombotic prophylaxis with low-molecular-weight heparins for 30 days after discharge **Intervention group 1** • Gamma 3 nail (Stryker); with distal locking • Number randomised = 90 **Intervention group 2** • Gamma 3 nail (Stryker); without distal locking • Number randomised = 87 **Note:** • study authors do not declare the number of surgeons or their skills and experience or any details on the pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** surgical time; blocking screw; angulation of the screw; cephalic screw; distance from tip to apex; level of reduction; radiation absorbed; fluroscopy time; blood loss; re-interventions; medical complications; biomechanical complications; mortality (available at 12 months) **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflict of interest; however, no information on funding is reported

Lopez-Vega 2015 *(Continued)*

Study dates: June 2011 to January 2013

Note:

- we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Lunsjo 2001

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: SHS versus MSP
Participants	**Total number of randomised participants:** 569 **Inclusion criteria:** unstable intertrochanteric fracture, low-energy trauma **Exclusion criteria:** pathological fractures; previous fractures; fractures > 5 cm distal to lesser trochanter; two-part fractures **Setting:** 8 hospitals, Sweden **Baseline characteristics** **Intervention group 1** (SHS) • Age, mean (range) years: DHS, 81 (50 to 97); DHS/TSP, 83 (50 to 97); DCS 81 (47 to 95) • Gender, M/F: 85/216 • Independence of walking, no aid/aids/non-walker/unknown: 139/133/15/14 • Place of residence, own home/residential home/institution: 199/73/29 • Fracture classification, Jensen 3/4/5, n: 50/31/217 (3 missing) **Intervention group 2** (MSP) • Age, mean (range) years: 81 (42 to 99) • Gender, M/F: 201/67 • Independence of walking, no aid/aids/non-walker/unknown: 12/115/14/14 (query on numbers reported) • Place of residence, own home/residential home/institution: 183/60/25 • Fracture classification, Jensen 3/4/5, n: 33/26/207 (2 missing) **Note:** • study authors did not report: comorbidities, smoking history, medication, BMI, cognitive status/dementia, ASA status, preoperative waiting time
Interventions	**General details:** MSP recently introduced; low-molecular-weight heparin; spinal anaesthesia; immediate weight bearing; follow up at 1 and 12 months **Intervention group 1** • Fixation with one of three different methods as per the preference of the operating surgeon: dynamic hip screw with or without trochanteric stabilisation plate and dynamic condylar screw (manufacturer not reported) • Number randomised = 301 **Intervention group 2:**

Lunsjo 2001 *(Continued)*

	• Medoff sliding plate (manufacturer not reported); femoral head fixation with a single screw • Number randomised = 268 **Note:** • Included the 3 plate systems as one intervention in the analyses
Outcomes	**Outcomes measured/reported by study authors:** blood loss, operating time, deep and superficial infection; PE; DVT; fixation failures; lag screw penetration; cut-out; mobility; postoperative fractures; mobility; place of residence at 12 months; LOS **Outcomes relevant to the review:** unplanned return to theatre; mortality (12 months)
Notes	**Funding/sponsor/declarations of interest:** supported by grants from the Thelma Zoéga Foundation and the Stig and Ragna Gorthon Foundation, Helsingborg, and the Clinical Research Foundation of Malmöhus County Council, Lund, and the Swedish Medical Research Council **Study dates:** March 1993 to June 1995 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Makridis 2010

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: intramedullary nail versus intramedullary nail: IMHS or Endovis
Participants	**Total number of randomised participants:** 215 **Inclusion criteria:** pertrochanteric fractures after low-energy injury; > 60 years of age **Exclusion criteria:** pathological fractures; high-energy injury; < 60 years of age **Setting:** single centre; hospital; Greece **Baseline characteristics** **Intervention group 1** (IMHS) • Age, mean (distribution value not described): 83.5 (69 to 95) years • Gender, M/F: 34/76 • Independence of walking/assisted walking/bedridden: 62/45/3 • Fracture classification, stable/unstable, n: 37/73 **Intervention group 2** (Endovis) • Age, mean (distribution value not described): 83.9 (71 to 96) years • Gender, M/F: 33/72 • Independence of walking/assisted walking/bedridden: 64/37/4 • Fracture classification, stable/unstable, n: 39/66 **Note:**

Makridis 2010 *(Continued)*

	• study authors report no baseline characteristics for smoking history; medication; BMI; comorbidities; place of residence; cognitive status/dementia; ASA status; preoperative waiting time
Interventions	**General details:** prophylactic intravenous second-generation cephalosporin was administered before operation and discontinued 48 hours postoperatively; participants were mobilised on second postoperative day, allowing them to bear weight as much as they could tolerate; all cases received anticoagulant prophylactic therapy with low-molecular-weight heparin, starting on admission and for 4 weeks postoperatively; operations were performed on a fracture table under spinal anaesthesia and image intensifier control; clinical follow-up at 1, 3, 6, and 12 months after surgery **Intervention group 1:** • Intramedullary hip screw (Smith and Nephew); length 210 mm; femoral head fixation with a single screw • Number randomised = 110 **Intervention group 2:** • Endovis nail (Citieffe); length 195 mm; femoral head fixation with two screws • Number randomised = 105 **Note:** • study authors do not report the number of clinicians or their skills and experience
Outcomes	**Outcomes measured/reported by study authors:** surgical time; blood loss; any intraoperative complication; level of haemoglobin; mobility status at time of discharge; duration of hospital stay; mortality (available in hospital and at 12 months); functional status; fracture healing; tip to apex distance; transfusions; re-operations (available at 12 months) **Outcomes relevant to the review:** mortality (reported in hospital and at 12 months) **Note:** • it was not clear from the study report whether data about re-operations were reported for all participants or only individual cases.
Notes	**Funding/sponsor/declarations of interest:** study authors declare they have no conflicts of interest. No detail on funding is provided. **Study dates:** July 2005 and June 2007 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Marques 2005

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: intertrochanteric Gamma nail versus AO PFN
Participants	**Total number of randomised participants:** 156 **Inclusion criteria:** > 65 years of age; unstable trochanteric fracture with any subtrochanteric fracture extension less than 2 cm

Marques 2005 *(Continued)*

Exclusion criteria: pathological fractures, types A2 3.1 and A3

Setting: single centre; hospital; Spain

Baseline characteristics

Intervention group 1 (Gamma)

- Age, mean: 82.34 years
- Gender, M/F: 19/57
- Comorbidities, diabetes/chronic cardiac insufficiency/arrhythmia/cerebral vascular accident/chronic renal insufficiency/neoplasia/Parkinson's/arterial hypertension/chronic obstructive pulmonary disease, %: 15/15/8.3/21.7/5/1.7/8.3/23.3/11.7
- Mobility assessment, previous independent mobility: 2.33
- Place of residence, own home/relatives' home/nursing home: 19/43/14
- Mean cognitive level: 16
- ASA grading: 2.51

Intervention group 2 (PFN)

- Age, mean: 82.10 years
- Gender, M/F: 18/59
- Comorbidities, diabetes/chronic cardiac insufficiency/arrhythmia/cerebral vascular accident/chronic renal insufficiency/neoplasia/Parkinson's/arterial hypertension/chronic obstructive pulmonary disease, %: 16.3/14/4.93/20.9/2.3/2.3/7/32.6/11.6
- Mobility assessment, previous independent mobility: 2.44
- Own home/relatives' home/nursing home: 28/29/20
- Mean cognitive level: 15.1
- ASA grading: 2.47

Overall:

- Age, mean (range): 82.4 (65 to 101) years
- Gender, M/F: 37/116

Note:

- study authors do not report any baseline characteristics for: smoking history; medication; BMI; preoperative waiting time; fracture classification

Interventions

General details: in the postoperative period, participants were allowed to weight bear as tolerated; surgeries were performed by a combination of junior residents, senior residents and staff

Intervention group 1

- Gamma trochanteric nail, (Stryker Howmedica) 180 mm long, 11 mm diameter distally, 17 mm diameter proximally, 6° angulation, locking to prevent rotation of the proximal screw and reaming to 12 mm distally and 17 mm distally. 1 distal locking screw
- Number randomised = 77

Intervention group 2

- PFN, (Statrec Medica) made from polished titanium, 240 mm long with a diameter of 10, 11 or 12 mm distally and 17 mm proximally and angulation medial to lateral of 6°
- Number randomised = 79

Note:

- study authors do not report the type of anaesthesia used

Marques 2005 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** operative time; transfusion requirements; mechanical complications; pain; intertrochanteric bursitis; re-operations (available at 12 months); length of stay; mortality (available at hospital admission, 12 months); final independent mobility **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months); mortality (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** November 1999 to May 2002 **Notes:** • study report in Spanish. Translation by Dr Susana Ramirez-Florez, kept on file by the BJMT group • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Matre 2013

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Trigen Intertan versus SHS

Participants	**Total number of randomised participants:** 684 (697 were initially randomised but 13 were excluded because of preoperative deaths, withdrawal from study before surgery, and due to not meeting inclusion criteria)
	
	Inclusion criteria: > 60 years of age; trochanteric or subtrochanteric fracture
	
	Exclusion criteria: pathological fractures
	
	Setting: 5 centres, hospitals, Norway
	
	Baseline characteristics
	
	Intervention group 1 (intramedullary nail)
	
	• Age, mean: 84.1 years
	• Gender, M/F: 83/258
	• Mobility assessment/use of walking aides, n:
	  ◦ walks outdoors alone: 186
	  ◦ walks outdoors with support: 24
	  ◦ walks indoors alone: 79
	  ◦ walks indoors with support: 26
	  ◦ no walking ability: 5
	• Place of residence, n: home, 208; nursing home, 94; other, 33
	• Cognitive impairment, n/total: Yes, 105; No, 192; uncertain, 38
	• ASA status, I/II/III/IV: 22/138/164/11
	• Fracture classification, A1/A2/A3/subtrochanteric, n: 150/113/71/7
	• Additional information:
	  ◦ Functional status, HHS, mean: 68
	
	Intervention group 2 (SHS)
	
	• Age, mean: 84.1 years
	• Gender, M/F: 88/255

Matre 2013 *(Continued)*

- Mobility assessment/use of walking aides, n:
  - walks outdoors alone: 198
  - walks outdoors with support: 31
  - walks indoors alone: 77
  - walks indoors with support: 23
  - no walking ability: 1
- Place of residence, n: home, 230; nursing home, 62; other, 42
- Cognitive impairment, n: Yes, 68; No, 231; uncertain, 31
- ASA status, I/II/III/IV: 15/143/162/15
- Fracture classification, A1/A2/A3/subtrochanteric, n: 140/122/68/13
- Additional information:
  - Functional status, HHS, mean: 69

Note:

- study authors did not report: smoking history, medication, BMI, waiting time for surgery

Interventions	**General details:** surgeons participated in at least 5 operations involving use of the Intertan nail before they could participate; clinical examinations at 5 days, 3 and 12 months **Intervention group 1** • Intramedullary nail; Trigen Intertan (Smith and Nephew, Memphis, Tennessee); long and short nails were used, all were locked distally • Randomised = 341; 84 died, outcomes analysed at 12-month follow-up: HRQoL (EQ-5D, n = 195); overall at 12 months = 204 **Intervention group 2** • SHS (Smith and Nephew) or DHS (Synthes, Basel, Switzerland); a trochanteric stabilising plate was used for all A3 fractures • Randomised = 343; 87 died, outcomes analysed at 12-month follow-up: HRQoL (EQ-5D, n = 199); overall at 12 months = 202
Outcomes	**Outcomes measured/reported by study authors:** duration of the surgery; participants' haemoglobin level; number of blood transfusions; LOS; radiographs (quality of fracture reduction + tip-apex distance); EQ-5D questionnaire; postoperative pain - VAS; TUG; LOS; complication and re-operation rates; participants' residence; walking ability; HHS; mortality; major complications (failure of osteosynthesis; deep infection or postoperative haematoma requiring surgical intervention; cut-out; femoral fracture; removal of whole implants); minor complications (locking screws missing the nail or removal of a single locking or lag screw; surgical removal of a drain) **Outcomes relevant to the review:** HRQoL (EQ-5D at 3 and 12 months); unplanned return to theatre (assumed to be 12 months); mortality (at 4 & 12 months)
Notes	**Funding/sponsor/declarations of interest:** quote: "Smith & Nephew supported the study, but otherwise the company had no influence on the study." Quote: "One or more of the authors received payments or services, either directly or indirectly (i.e., via his or her institution, has had a financial relationship, in the thirty-six months prior to submission of this work, with an entity in the biomedical arena that could be received to influence or have the potential to influence what is written in this work. No author has had any other relationships, or has engaged in any other activities, that could be perceived to influence or have the potential to influence what is written in this work". **Study dates:** February 2008 to February 2009 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Mattsson 2004

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus DHS augmented with calcium-phosphate cement
Participants	**Total number of randomised participants:** 26 **Inclusion criteria:** unstable trochanteric fracture (Jensen types IV to V), AO 31 A2, caused by a low-energy trauma; signed informed consent; ambulatory without walking aid or with 1 cane prior to injury; a normal contralateral hip **Exclusion criteria:** senility; pathological fracture; concurrent fracture that would affect postoperative weight bearing **Setting:** single centre; hospital; Sweden **Baseline characteristics** **Intervention group 1** (DHS) • Age, mean (range): 81.7 (2 to 10) years • Gender, M/F: 2/10 **Intervention group 2** (augmentation) • Age, mean (range): 83.7 (2 to 12) years • Gender, M/F: 2/12 **Overall:** • Age, mean (range): 82.8 (66 to 99) years • Gender, M/F: 4/22 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** all operations were performed under spinal anaesthesia by the authors; the first RSA examination was done within 24 hours after surgery, before weight bearing, after which all participants were allowed unrestricted weight bearing; the normal postoperative rehabilitation regime at the department **Intervention group 1** • Dynamic hip screw (Stratec) • Number randomised = 12 **Intervention group 2** • Dynamic hip screw (Stratec) augmented with injection of calcium-phosphate cement (Norian SRS) • Number randomised = 14 **Note:** • the study authors did not report the number of clinicians or their skills and experience or details on the preoperative care

Mattsson 2004 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** re-operations (available at 12 months); degrees of rotation; amount of translation; mortality (available at 12 months) **Outcomes relevant to the review:** re-operations (reported at 12 months) **Note:** • although mortality is reported as an outcome, it is not reported to which groups the deaths belonged, and therefore has not been included in the analysis table.
Notes	**Funding/sponsor/declarations of interest:** cement supplied by manufacturer **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Mattsson 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus DHS augmented with calcium-phosphate cement
Participants	**Total number of randomised participants:** 112 **Inclusion criteria:** unstable trochanteric fractures (Jensen types 4 to 5 or AO 31 to A2); > 65 years of age; walking with or without support; less than 72 hours between the fracture and surgery; signed informed consent **Exclusion criteria:** dementia; serious concomitant illness or mental instability; neurosensory, neuromuscular or musculoskeletal deficiency which limited the ability to perform objective functional tests; soft-tissue infection at the operation site; ongoing radiotherapy or chemotherapy for malignancy; pathological fracture; a clotting disorder; corticosteroid treatment exceeding 5 mg/day; a concurrent fracture which would affect the postoperative functional outcome or an earlier operation on the contralateral hip **Setting:** single centre; hospital; Sweden **Baseline characteristics** **Intervention group 1** (DHS) • Age, mean (SD): 82.0 (± 6.3) years • Gender, M/F: 10/47 • Walking aid, yes/no: 34/23 • Fracture classification, Jensen fracture type 4/5, n: 14/43 **Intervention group 2** (augmentation) • Age, mean (SD): 81.2 (± 7.0) years • Gender, M/F: 11/44 • Walking aid, yes/no: 37/18 • Fracture classification, Jensen fracture type 4/5, n: 9/46 **Note:**

Mattsson 2005 *(Continued)*

	• study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; place of residence; cognitive status/dementia; ASA status; preoperative waiting time
Interventions	**General details:** all surgeries were performed by the study authors; 98 surgeries were under spinal anaesthesia with sedation and 14 under general anaesthesia; all participants were allowed immediate weight bearing after surgery and were followed by clinical and radiological examination immediately after surgery and at 1 week, 6 weeks and 6 months after the procedure **Intervention group 1** • Dynamic hip screw (Stratec, Obersdorf, Switzerland) • Number randomised = 57 **Intervention group 2** • Dynamic hip screw (Stratec) augmented with injection of calcium-phosphate cement (Norian SRS) • Number randomised = 55 **Note:** • study authors do not report the number of clinicians, their skills and experience or the preoperative care.
Outcomes	**Outcomes measured/reported by study authors:** pain; HRQoL (available at 1 week, 6 weeks and 6 months); isometric hip abductor muscle strength; reduction of fracture; adequacy of fixation; mortality (available at 6 months); failure of the implant; sliding of lag screw; healing of the fracture; non-union; blood loss; mean hospital stay; re-operations (available at 6 months) **Outcomes relevant to the review:** HRQoL (in SF-36, reported at 6 months); mortality (reported at 6 months); unplanned return to theatre (reported at 6 months) **Notes:** • HRQoL was reported without distribution values
Notes	**Funding/sponsor/declarations of interest:** implants supplied by manufacturer. Funding from Trygg Hansa **Study dates:** 1997 to 2000 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

McCormack 2013

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus MSP
Participants	**Total number of randomised participants:** 163 **Inclusion criteria:** > 60 years of age; unstable intertrochanteric hip fracture (determined by the treating surgeon) as defined by Type IV and Type V in the Jensen and Michaelsen (modified Evans) classification or OTA 31-A2 (fractures involving the lesser trochanter - loss of posteromedial support)

McCormack 2013 *(Continued)*

	Exclusion criteria: stable intertrochanteric fracture (determined by treating surgeon) as defined by- types I, II and III in the Jensen and Michaelsen (modified Evans) classification or OTA 31-A1; a previous hip fracture on the affected side; confinement to bed (non-ambulatory people); a pathological fracture; a fracture with significant medical comorbidities (Detsky score > 30 points and ASA Grades IV and V); reverse obliquity fracture **Setting:** 3 centres; hospitals; Canada **Baseline characteristics** **Intervention group 1** (DHS) • Age, average: 83 years • Gender, M/F: 21/65 • Place of residence, home/assisted living/external care or hospital, n: 43/28/15 • Cognitive status, MMSE score, ≥ 25/< 25: 53/33 **Intervention group 2** (MSP) • Age, average: 83.6 years • Gender, M/F: 18.59 • Place of residence, home/assisted living/external care or hospital, n: 48/21/8 • Cognitive status, MMSE score, ≥ 25/< 25: 48/29 **Overall:** • Age, median (range): 83 (63 to 100) years • Gender, M/F: 39/124 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** mobilisation on POD1, unrestricted weight bearing and physiotherapy whilst in hospital; follow-up assessments at 4 to 6 weeks, 3 or 4 months and 6 months after surgery **Intervention group 1** • Dynamic hip screw (Synthes); 135°; 4-hole plate fixed with cortical screws • Number randomised to group = 86 **Intervention group 2** • Medoff sliding plate (manufacturer not reported); femoral head fixation with a single screw • Number randomised to group = 77
Outcomes	**Outcomes measured/reported by study authors:** re-operations (available at 6 months); participant function; morbidity; mortality (reported at 6 months); hospital stay; quality of reduction; radiographs, fixation, ROM, leg length; incidence of malunion and non-union; ADL **Outcomes relevant to the review:** unplanned return to theatre (reported at 6 months); mortality (reported at 6 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflicts of interest but no information on funding is provided **Study dates:** October 1998 to March 2006 **Note:**

McCormack 2013 *(Continued)*

- we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

McLaren 1991

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: Pugh nail versus DHS
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** intertrochanteric fractures of the femur **Exclusion criteria:** not reported **Setting:** single centre; hospital; UK **Baseline characteristics** **Intervention group 1** (Pugh) • Age, average (range): 81.1 (66 to 95) years • Gender, M/F: 10/40 • Preoperative waiting time: within 24 hours (unless there were serious anaesthetic contraindications) • Fracture classification, stable/unstable, n: 28/22 **Intervention group 2** (DHS) • Age, average (range): 80.2 (68 to 97) years • Gender, M/F: 9/41 • Preoperative waiting time: within 24 hours (unless there were serious anaesthetic contraindications) • Fracture classification, stable/unstable, n: 23/27 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** participants were seen at 6 weeks, 3 months and 6 months postoperatively **Intervention group 1** • Pugh nail plate (manufacturer not reported); extramedullary dynamic nail plate with trifin shaped blade for fixation of the femoral head • Number randomised to group = 50 **Intervention group 2** • Dynamic hip screw (manufacturer not reported) • Number randomised to group = 50 **Note:** • study authors do not reported the number of surgeons or their skills and experience; the level of pre-/postoperative care; the anaesthetic and other drugs used

McLaren 1991 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** pain; operation time; mortality (available at 6 months); length of hospital stay; walking ability; complications **Outcomes relevant to the review:** mortality (reported at 6 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** September 1986 to December 1987 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Mehdi 2000

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** IMHS versus SHS
Participants	**Total number of randomised participants:** 180 **Inclusion criteria:** extracapsular proximal femoral fractures; AO 31 A1, A2, A3; stable and unstable fractures **Exclusion criteria:** not reported **Setting:** single centre; orthopaedic hospital; UK **Baseline characteristics** **Intervention group 1** (IMHS) • Age, mean: 78 years **Intervention group 2** (SHS) • Age, mean: 75 years **Note:** • study authors only reported age data
Interventions	**General details:** no surgical details described **Intervention group 1** • IMHS (Smith and Nephew); the implant is 21 cm long; no further operative details were reported regarding proximal or distal locking • Randomised = 90 **Intervention group 2** • SHS (Smith and Nephew) • Randomised = 90
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; operative fracture of the femur; later fracture of femur (none); cut-out of implant; perioperative complication; fracture reduction; wound infection (superficial and deep); mortality; mobility; HHS

Mehdi 2000 *(Continued)*

	Outcomes relevant to the review: none **Note:** because of the large range of final follow-up times and high and unequal losses to follow-up, we decided against presenting final follow-up results (mortality) in the review.
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • abstract only published. We received an unpublished report by the study author. • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Merenyi 1995

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Ender nail versus angle-plate **Note:** • this study also included an initial group with which 3 types of Gamma nails were used. However, the Gamma nails group was not included in randomisation, and we have therefore not included its data in the review.
Participants	**Total number of randomised participants:** 80 **Inclusion criteria:** unstable inter- or subtrochanteric fracture (AO type A2.2 - A3.3) **Exclusion criteria:** NR **Setting:** single centre; hospital; Hungary **Baseline characteristics** **Intervention group 1** (Ender) • Age, average (range): 74 (54 to 91) years **Intervention group 2** (angle-plate) • Age, average: 70 years; note, we assume that there is a typo in the range which is reported as 3 to 84 years **Note:** • study authors report no baseline characteristics for: gender; smoking history; medication; BMI; co-morbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** not reported **Intervention group 1** • Ender nail • Number randomised = 40; losses not reported, analysed = 40 **Intervention group 2**

Merenyi 1995 *(Continued)*

- Angle plate
- Number randomised = 40; losses not reported, analysed = 40

Note:

- study authors do not report any general details in the abstract data

Outcomes	**Outcomes measured/reported by study authors:** surgical trauma; blood loss; time till weight bearing; fracture healing; resumption of level of activity previous to trauma; local and general complications; re-operations (time point not reported) **Outcomes relevant to the review:** unplanned return to theatre (time point not reported)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** August 1992 to March 1994 **Note:** • study report only available as abstract which has limited information

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomisation not reported
Allocation concealment (selection bias)	Unclear risk	Method of allocation not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Skills and experience of surgeons are not reported. It is uncertain whether surgeons were equally experienced both types of implants.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No apparent losses
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	High risk	Study report was available only as an abstract which we expected was not peer-reviewed. In addition, because of limited detail in the abstract, we could not be certain of other risks of bias.

Michos 2001

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma nail versus SHS
Participants	**Total number of randomised participants:** 52 **Inclusion criteria:** trochanteric proximal femoral fractures. Some may have had subtrochanteric extension **Exclusion criteria:** not reported **Setting:** single site; orthopaedic hospital; Greece **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean: 79 years **Intervention group 2** (SHS) • Age, mean: 78 years **Note:** • study authors did not report: smoking history, medication, comorbidities, cognitive status/dementia
Interventions	**General details:** experience of surgeon is not reported **Intervention group 1** • Gamma nail; no further details • Randomised = 26 **Intervention group 2** • SHS; no further details • Randomised = 26
Outcomes	**Outcomes measured/reported by study authors:** operative blood loss; later fracture of the femur; cut-out of implant; non-union; plate detachment; mortality (perioperative); length of follow-up: 3 to 6 months **Outcomes relevant to the review:** mortality (during perioperative period); unplanned return to theatre (up to 6 months) **Note:** • follow-up period varied from 3 to 6 months
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • study is reported only as an abstract • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Miedel 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma nail versus Medoff sliding plate

Participants	**Total number of randomised participants:** 217
	
	Inclusion criteria: unstable trochanteric (Jensen & Michaelsen type 3 to 5) fractures; subtrochanteric (Seinsheimer) proximal femoral fractures; fractures occurred due to a simple fall
	
	Exclusion criteria: pathological fractures; rheumatoid arthritis; osteoarthritis; fractures extending more than 5 cm distal to the lesser trochanter
	
	Setting: single centre; orthopaedic hospital; Sweden
	
	Baseline characteristics
	
	Intervention group 1 (Gamma nail)
	
	• Age, mean (SEM): 84.6 (± 0.6) years
	• Gender, M/F: 17/92
	• Comorbidities, groups A (full health) or B (illness not affecting rehabilitation), n: 45
	• Mobility assessment, no walking aids or 1 stick, n: 67
	• Place of residence, live independently, n: 92
	• Cognitive status/dementia, SPMSQ, mean (SEM): 5.7 (± 0.3)
	• Fracture classification:
	  ○ Trochanteric fractures, J-M 3/4/5, n: 12/28/53
	  ○ Subtrochanteric fractures, S2B/2C/3A/3B/4/5, n: 1/11/3/1/0/0
	• Additional information:
	  ○ HQoL, EQ-5D, mean (SEM): 0.66 (± 0.03)
	  ○ ADL, indices Katz A or B, n: 82
	
	Intervention group 2 (sliding plate)
	
	• Age, mean (SEM): 82.7 (± 0.6) years
	• Gender, M/F: 24/84
	• Comorbidities, groups A (full health) or B (illness not affecting rehabilitation), n: 48
	• Mobility assessment, no walking aids or 1 stick, n: 71
	• Place of residence, live independently, n: 95
	• Cognitive status/dementia, SPMSQ, mean (SEM): 5.8 (± 0.4)
	• Fracture classification:
	  ○ Trochanteric fractures, J-M 3/4/5, n: 11/24/61
	  ○ Subtrochanteric fractures, S2B/2C/3A/3B/4/5, n: 0/6/2/1/1/2
	• Additional information:
	  ○ HQoL, EQ-5D, mean (SEM): 0.63 (± 0.03)
	  ○ ADL, indices Katz A or B, n: 72
	
	Note:
	
	• study authors did not report any baseline data for: smoking history, BMI, preoperative waiting time

Interventions	**General details:** fracture table; low-molecular-weight heparin before and for approximately 10 to 14 days after operation; single dose of antibiotic preoperatively; mobilised with full weight bearing as tolerated; identical care programmes; 50% of operations performed by consultant orthopaedic surgeons **Intervention group 1**

Miedel 2005 *(Continued)*

- Gamma nail (Stryker Howmedica); diameter 11 mm, length 200 mm; medullary canal reamed to 13 mm distally and 17mm proximally; distal locking screw used in all cases
- Randomised = 109; available at 4 months = 87; at 12 months = 82 (24 died, 3 lost to follow-up)

Intervention group 2

- Medoff sliding plate (Swemac); neck angle 135 degrees; six-hole plate; (Swemac); biaxial dynamisation mode allows dynamisation of the femoral neck and shaft
- Randomised = 108; available at 4 months = 81; at 12 months = 74 (31 died, 3 lost to follow-up)

Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; postoperative transfusion; operative fracture of the femur; technical failure; later fracture of the femur; cut-out of implant; displacement (medialisation of the femur requiring surgery); re-operation; wound infection (superficial and deep); severe medical complications (cardiac, pulmonary, thromboembolic or cerebrovascular); LOS; discharge location; mortality (available in hospital, at 4 months and at 12 months); mobility; pain; hip function; ADL; HRQoL **Outcomes relevant to the review:** unplanned return to theatre (12 months); mortality (4 & 12 months) **Note:** • we did not include data for HRQoL (EQ-5D) because this outcome was reported in a figure from which we could not confidently extract numerical data.
Notes	**Funding/sponsor/declarations of interest:** supported in part from grants from the Trygg-Hansa Insurance Company, the Swedish Orthopaedic Association, and from Stryker Howmedica (Gamma nail) and Swemac (Medoff sliding plate) **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The patients were randomised (sealed-envelope system)" Comment: no additional details
Allocation concealment (selection bias)	Unclear risk	Study authors do not report whether envelopes are opaque and sequentially numbered
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Quote: only half of the operations in each group "were performed by consultant orthopaedic surgeons". Comment: study authors did not describe whether all surgeons were equally experienced with the types of implants used in this study.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned re-	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.

Miedel 2005 *(Continued)*

turn to theatre (detection bias)		
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses are balanced between groups and mostly explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Moroni 2004

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus DHS with HA coating

Participants	**Total number of randomised participants:** 120
	
	Inclusion criteria: women with osteoporosis and trochanteric fractures
	
	Exclusion criteria: previous hip fracture, open fracture, fracture secondary to malignancy, hard or soft tissue infection at the fracture site, chemotherapy, multiple fractures
	
	Setting: single centre, hospital, Italy
	
	Baseline characteristics
	
	Intervention group 1 (standard DHS)
	
	• Age, mean (SD): 81 (± 8) years
	• Gender, M/F: 0/60
	• Fracture classification, A1/A2, n: 25/35
	• Additional information:
	  ○ BMD mean (SD): 538 (± 105)
	
	Intervention group 2 (Hydroxyapatite-coated DHS)
	
	• Age, mean (SD): 81 (± 6) years
	• Gender, M/F: 0/60
	• Fracture classification, A1/A2, n: 25/35
	• Additional information:
	  ○ BMD mean (SD): 568 (± 111)
	
	Note:
	
	• Study authors do not report: smoking history, medication, BMI, comorbidities, mobility assessment/use of walking aides, place of residence, cognitive status/dementia, ASA status, preoperative waiting time

Interventions	**General details:** follow up at 1, 3 and 6 months; all operated on with 48 hours; cephalosporin was administered preoperatively (1 g) and continued every 8 hours for 72 hours; spinal anaesthesia; completed by senior surgeons; mobilised with 24 hours of surgery; full weight bearing was encouraged **Intervention group 1:**

Moroni 2004 *(Continued)*

	• Dynamic hip screw (AO/ASIF); 135 degrees, 4-hole plate; standard lag screw • Number randomised = 60 **Intervention group 2:** • Dynamic hip screw (AO/ASIF); 135 degrees, 4-hole plate; hydroxyapatite-coated lag screw • Number randomised = 60 **Notes:** • participants who died before follow-up or who did not attend follow-ups were excluded from the study • the desired number of 60 participants for each group was achieved by replacing excluded individuals with other participants who met the inclusion criteria.
Outcomes	**Outcomes measured/reported by study authors:** functional status (HHS); HRQoL (SF-36); cut-out; femoral neck shaft angle; tip-apex distance; revision **Outcomes relevant to the review:** none **Note:** • unplanned return to theatre; not reported clearly for both groups so not included in analysis • HRQoL (SF-36; 6 months); mean and SD reported but number in each group after losses is not reported so not included in the analysis; methods state that those who died or failed to attend were excluded but this number is not presented
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Notes:** • we considered the 2003 paper to be an interim/subsidiary report of the 2004 report; • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Moroni 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus Orthofix Pertrochanteric Fixator (OPF)
Participants	**Total number of randomised participants:** 40 **Inclusion criteria:** female; ≥ 65 years of age; AO fracture type A1 or A2; pertrochanteric fracture resulting from minor trauma; ability to respond comprehensively; ability to walk unassisted prior to injury; BMD at the contralateral hip less than -2.5 T-score **Exclusion criteria:** **Setting:** single centre; hospital; Italy **Baseline characteristics** **Intervention group 1** (DHS) • Age, average (SD): 82 (± 8) years • Gender, M/F: • Smoking history, n:

Moroni 2005 *(Continued)*

- Medication, type, n:
- BMI, mean (SD): (±) kg/m2
- Comorbidities, type, n:
- Mobility assessment/use of walking aides:
- Place of residence:
- Cognitive status/dementia:
- ASA status, I/II/III/IV:
- Pre-operative waiting time, mean (SD): (±) hours
- Fracture classification, undisplaced/displaced, n:
- Additional information:

Intervention group 2 (OPF)

- Age, average (SD): 78 (± 6) years

Note:

- study authors report no baseline characteristics for gender, smoking history, medication, BMI, co-morbidities, mobility assessment, place of residence, cognitive status, ASA, preoperative assessment, fracture classification

Interventions	**General details:** not reported **Intervention group 1** • 135° 4-hole DHS fixed with stainless steel lag and cortical AO/ASIF screws • Number randomised = unknown **Intervention group 2:** • Orthofix Pertrochanteric Fixator (OPF) fixed with 4 hydroxyapatite-coated pins • Number randomised = unknown
Outcomes	**Outcomes measured/reported by study authors:** HHS; operative time; postoperative complications; number of blood transfusions; level of pain; length of hospital stay; femoral neck-shaft angle **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes

Mott 1993

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus SHS
Participants	**Total number of randomised participants:** 69 **Inclusion criteria:** trochanteric proximal femoral fractures. Defined as 2-, 3- or 4-part with additional classifications for basilar neck/high intertrochanteric (7 fractures) and high subtrochanteric/low in-

Mott 1993 *(Continued)*

	tertrochanteric (3 fractures). Reference made to classification according to Jensen's modification of Evans but types not reported **Exclusion criteria:** judged inoperable for medical reasons **Setting:** multi-centre; three orthopaedic hospitals; USA. **Baseline characteristics (overall)** • Age, mean (range): 75.7 (19 to 99) years • Gender, M/F: 28/41 **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, cognitive status/dementia, preoperative waiting times, place of residence; ASA status • baseline characteristics not reported by group
Interventions	**General details:** not reported **Intervention group 1** • Gamma nail; no further details • Randomised = 35; no loss to follow-up reported **Intervention group 2** • SHS; no further details • Randomised = 34; no loss to follow-up reported
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; blood transfusion; operative fracture of the femur; later fracture of the femur; cut-out of implant; re-operation; deep wound infection; superficial wound infection; wound haematoma; DVT; MI; pneumonia; UTI; mortality (1 week); length of follow-up: not stated **Outcomes relevant to the review:** unplanned return to theatre; mortality (1 week)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Note:** • data reported in an abstract. We obtained additional information from the study authors during a previous version of this review. • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Nungu 1991

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Ender nails versus SSP
Participants	**Total number of randomised participants:** 220 **Inclusion criteria:** intertrochanteric fractures

Nungu 1991 *(Continued)*

Exclusion criteria: fractures due to malignant metastasis; fractures older than 1 week

Setting: single centre; hospital; Sweden

Baseline characteristics

Intervention group 1 (Ender)

- Age, mean (SD): 81 (± 10) years
- Gender, M/F: 22/79
- Mobility assessment, independent/dependent/bed or wheelchair: 70/29/2
- Place of residence, own home/institution: 71/30
- Preoperative waiting time: all within 24 hours
- Fracture classification, Evans A/B/C/D, n: 28/21/24/28

Intervention group 2 (SSP)

- Age, mean (SD): 80 (± 11) years
- Gender, M/F: 35/87
- Mobility assessment, independent/dependent/bed or wheelchair: 66/47/6
- Place of residence, own home/institution:87/32
- Preoperative waiting time: all within 24 hours
- Fracture classification, Evans A/B/C/D, n: 34/25/30/29

Overall:

- Age, mean (SD) (range): 81 (± 10) (49 to 105) years
- Gender, M/F: 57/163

Note:

- study authors report no baseline data for: BMI, smoking history, medication and comorbidities

Interventions	**General details:** surgical procedure was carried out under spinal anaesthesia; operations performed by 30 different surgeons with varying range of experience; until they were mobile, participants received either high-molecular-weight dextran or heparin as thromboembolic prophylaxis; clinical follow-up at 4 months and 12 months **Intervention group 1** • Ender nails (manufacturer not reported); as many condylocephalic nails as possible were inserted • Number randomised to group = 101; losses = 29 (death) a total of 5 were lost to follow-up but it is not specified which group these people belonged to, analysed = 101 **Intervention group 2** • Dynamic hip screw (manufacturer not reported); 135° or 150° plate; four- or five-hole plate • Number randomised to group = 119; losses = 39 (death) a total of 5 were lost to follow-up but it is not specified which group these people belonged to, analysed = 119 **Note:** • study authors do not provide details on postoperative care
Outcomes	**Outcomes measured/reported by study authors:** operating time; blood loss; reduction; positioning of osteosynthesis materials; deep-wound infections; re-operations (available at 12 months); distal migration; mortality (available at 12 months); mobility; pain; rotation **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months); mortality (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported

Nungu 1991 *(Continued)*

Study dates: January 1987 to February 1989

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation described as 'closed envelope method'
Allocation concealment (selection bias)	Unclear risk	Randomisation described as 'closed envelope method'
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Surgeons with varying degrees of experience. It is uncertain whether experience was equally balanced for both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few participants were lost, these losses were balanced between groups, and reasons for loss were clearly explained
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

O'Brien 1995

Study characteristics

Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus DHS
Participants	**Total number of randomised participants:** 101 participants with 102 fractures **Inclusion criteria:** trochanteric proximal femoral fractures; stable and unstable (Evans) **Exclusion criteria:** fractures > 1 week old; pathological fractures; subtrochanteric fractures **Setting:** single centre; orthopaedic hospital; Canada **Baseline characteristics**

O'Brien 1995 *(Continued)*

Intervention group 1 (Gamma nail)

- Age, mean (range): 83 (57 to 95) years
- Gender, M/F: 9/43
- Mobility assessment/use of walking aides, n: wheelchair, 4; walker, 7; cane, 7; none, 34
- Place of residence, n: independent, 28; home with family, 6; nursing home, 19
- Fracture classification, stable/unstable, n: 30/23
- Preoperative waiting time, mean: 24 hours
- Additional information:
  - pre-fracture hip pain, n: yes, 4; no, 49

Intervention group 2 (DHS)

- Age, mean (range): 77 (39 to 94) years
- Gender, M/F: 13/32
- Mobility assessment/use of walking aides, n: wheelchair, 0; walker, 11; cane, 6; none, 31
- Place of residence, n: independent, 24; home with family, 5; nursing home, 20
- Fracture classification, stable/unstable, n: 28/21
- Preoperative waiting time, mean: 24 hours
- Additional information:
  - pre-fracture hip pain, n: yes, 3; no, 46

Note:

- study authors did not report: smoking history, medication, comorbidities, cognitive status/dementia

Interventions

General details: all but 4 participants received prophylactic antibiotics; fracture table; image intensifier; no details of surgeons' experience

Intervention group 1

- Gamma intramedullary nail (Synthes Howmedica); 88% were distally locked
- Randomised = 52 (with 53 fractures)

Intervention group 2

- DHS (Synthes); 135 degree 4-hole plate (> 80% of operations)
- Randomised = 49 (with 49 fractures)

Note:

- study authors report that they were unable to contact 18 participants for end of follow-up assessment.

Outcomes

Outcomes measured/reported by study authors: length of surgery; blood loss; radiographic screening time; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union (time to union); re-operation; wound infection; deep wound infection; wound haematoma; pneumonia; pressure sores; PE; any medical complication; LOS; mortality; pain at follow-up; loss of independence; loss in mobility (dropped ≥ 1 level in walking-aid dependence)

Outcomes relevant to the review: mortality (early postoperative period); unplanned return to theatre (12 months)

Notes:

- follow up, mean 12 months (range 11 to 82 weeks)

Notes

Funding/sponsor/declarations of interest: not reported

Study dates: November 1989 to April 1991

Note:

O'Brien 1995 *(Continued)*

- we received additional information from study authors
- we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Okcu 2013

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus PFNA: standard nail or long nail
Participants	**Total number of randomised participants:** 40 **Inclusion criteria:** reverse oblique type trochanteric fractures **Exclusion criteria:** AO/OTA 31-A1 to A2 fractures; pathological fractures; previous proximal femoral fractures; open fractures; polytrauma with Injury Severity Score of greater than 16; severe concomitant medical conditions **Setting:** 2 centres; hospitals; Turkey **Baseline characteristics (excludes participants who were lost to follow-up/died)** **Intervention group 1** (standard) • Age, average (range): 78 (67 to 95) years • Gender, M/F: 4/11 **Intervention group 2** (long) • Age, average (range): 81 (73 to 89) years • Gender, M/F: 4/14 **Overall:** • Age, mean (range): 79 (67 to 95) years **Note:** • study authors do not report any baseline characteristics for: smoking history; medication; BMI; co-morbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** 3 experienced orthopaedic surgeons performed all operations; all participants were followed up until fracture union or a revision operation was performed; the choice of anaesthetic method was made by the anaesthesiologist; postoperatively, all participants had antibiotic prophylaxis for 48 hours and DVT prophylaxis for 4 weeks; postoperative rehabilitation protocol was identical for both groups; participants were mobilised as soon as possible, usually on second postoperative day with unrestricted weight bearing; formal therapy was instituted, working on muscle strengthening, conditioning and hip and knee ROM exercises; participants were evaluated at 6 weeks, 12 weeks, 6 months and 12 months **Intervention group 1** • Proximal femoral nail antirotation (PFNA) (Synthes, Oberdorf, Switzerland); 130°; 240 mm long; static distal locking • Number randomised to group = 18; losses = 3 (death), analysed = 18 **Intervention group 2**

Okcu 2013 *(Continued)*

	• Long proximal femoral nail antirotation (PFNA) (Synthes, Oberdorf, Switzerland); 130°, 340 mm to 420 mm long; static distal locking • Number randomised to group = 22; losses = 4 (death), analysed = 22
Outcomes	**Outcomes measured/reported by study authors:** mortality (available at 12 months); operation time; fluoroscopy time; hospital stay; walking ability; HHS; complications; change in neck-shaft angle; migration of the blade; TAD; re-operations (available at 12 months); malunion **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report that each author certifies that he or she, or a member or his or her immediate family, has no funding or commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article **Study dates:** January 2009 to December 2009

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Using random allocation software
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons
Other performance bias: surgeon experience of both implants	Low risk	Experienced surgeons for all operations
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Study authors reported that no participants were lost to follow-up. Only participant loss was because of death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Olsson 2001

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: CHS versus Medoff sliding plate

Participants	**Total number of randomised participants:** 114
	
	Inclusion criteria: intertrochanteric fractures
	
	Exclusion criteria: surgery of the ipsilateral femur, pathological fractures
	
	Setting: single centre, hospital, Sweden
	
	Baseline characteristics
	
	Intervention group 1 (CHS)
	
	• Age, mean (SD, range): 84 (± 7.3, 61 to 96) years
	• Gender, M/F: 20/40
	• Comorbidities, type, n: ischaemic or congestive heart disease, 17; cerebrovascular lesion, 5; diabetes mellitus, 4; dementia, 14
	• Mobility assessment; independent walking, n: 25
	• Place of residence; own home, n: 40
	• Fracture classification, stable/unstable: 7/53
	• Additional information:
	  ◦ Independence of activities of daily living, n: 33
	
	Intervention group 2 (Medoff)
	
	• Age, mean (SD, range): 84 (± 7.5, 62 to 98) years
	• Gender, M/F: 14/40
	• Comorbidities, type, n: ischaemic or congestive heart disease, 13; cerebrovascular lesion, 8; diabetes mellitus, 5; dementia, 14
	• Mobility assessment; independent walking, n: 21
	• Place of residence; own home, n: 35
	• Fracture classification, stable/unstable: 5/49
	• Additional information:
	  ◦ Independence of activities of daily living, n: 30
	
	Note:
	
	• study authors do not report baseline characteristics for: smoking history; medication; BMI; ASA status

Interventions	**General details:** performed by 22 surgeons; subcutaneous enoxaparin (40 mg daily) was begun before the operation and continued until the participant was mobilised; antibiotic therapy (cefuroxime 1500 mg) was given intraoperatively with one subsequent dose after 24 hours; immediate weight bearing as tolerated **Intervention group 1** • Compression hip screw (Smith and Nephew, Tennesee); four-hole Richards classic (keyed) plate • Number randomised = 60 **Intervention group 2** • Medoff sliding plate (Medpac, California); dynamic fixation with single femoral head screw • Number randomised = 54

Olsson 2001 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** operative time; bleeding; LOS; mortality, residential status, mobility, femoral shortening, lag screw migration, sliding of the lag screw, fixation failure, blood transfusion, wound infection, thromboembolism **Outcomes relevant to the review:** mortality (4 months), unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** no conflicts of interest stated; supported by grants from the Stig and Ragna Gorthon Foundation and the Thelma Zoega Foundation, Helsingborg, and from the clinical research foundation of Malmöhus County Council, Lund **Study dates:** November 1998 and October 1999 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Ovesen 2006

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** trochanteric Gamma intramedullary nail (TGN) versus DHS
Participants	**Total number of randomised participants:** 150 participants with 151 fractures (see Notes) **Inclusion criteria:** intertrochanteric fractures; AO 31 A11, A2 & A3 **Exclusion criteria:** subtrochanteric or a pathological fracture **Setting:** single centre; orthopaedic hospital; Denmark **Baseline characteristics** **Intervention group 1** (TGN) • Age, mean (SD): 79.9 (± 10) years • Gender, M/F: 20/53 • Mobility assessment, walking ability, n: outdoor independent, 54; outdoor with company, 6; inside independent, 8; inside with company, 1; can't walk, 0; missing, 4 • Use of walking aides, n: sticks, crutches or no aid, 50; frame or chair, 22; missing, 1 • Place of residence, n: own home: 62; nursing home: 10; missing: 1 • ASA status, I/II/III/IV: 20/21/25/7 • Fracture classification, A1/A2/A3, n: 23/44/6 **Intervention group 2** (DHS) • Age, mean (SD): 78.5 (± 11.7) years • Gender, M/F: 21/52 • Mobility assessment, walking ability, n: outdoor independent, 53; outdoor with company, 4; inside independent, 12; inside with company, 0; can't walk, 1; missing, 3 • Use of walking aides, n: sticks, crutches or no aid, 50; frame or chair, 22; missing, 1 • Place of residence, n: own home: 61; nursing home: 8; missing: 4 • ASA status, I/II/III/IV: 19/18/26/10 • Fracture classification, A1/A2/A3, n: 17/52/4 **Note:**

Ovesen 2006 *(Continued)*

- study authors did not report: smoking history, medication, comorbidities, cognitive status/dementia; mobility; age; gender
- study authors stated no difference in baseline characteristics between groups

Interventions	**General details:** prophylaxis for DVT and PE once daily starting from admission until mobilisation; antibiotic prophylaxis; fracture table; fluoroscopy; clinical follow-up at 4 and 12 months **Intervention group 1** • Trochanteric Gamma intramedullary nail (Stryker); distal femur reamed to 13 mm; proximal femur to 18 mm; study authors do not report the length of the nail used; however, from given information, it is likely that a standard short nail was used for all cases. • Randomised = 73; 3 lost to follow-up at 4 months and 11 at 12 months; analysed = 73 **Intervention group 2** • DHS (Synthes); trochanteric stabilising plates were used in two cases • Randomised = 73; 4 lost to follow-up at 4 months and 4 at 12 months; analysed = 73 **Note:** • 5 exclusions after randomisation: 2 wrong initial diagnoses; 3 transferred to other hospitals. We have not included these exclusions in the numbers randomised to each group.
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; transfusion; operative fracture of the femur (none); later fracture of the femur; cut-out of implant; non-union (none); re-operation; wound infection; medical complications (none); LOS; mortality at 12 months; use of walking aids at discharge and 4 months; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (at 4 and 12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** April 2001 and October 2003 **Note:** • we received additional information from the study authors

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote (from direct communication with study authors): "computer-generated"
Allocation concealment (selection bias)	Low risk	Quote: "patients were randomized by consecutive drawing of opaque envelopes". Comment: envelopes were confirmed as sealed in direct communication with the study author
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Over two thirds of operations done by residents: 49 surgeons participated in trial. Study authors did not describe whether surgeons were equally experienced with the types of implants used in this study.

Ovesen 2006 *(Continued)*

Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few losses which were balanced between groups and explained by study authors
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Ozkayin 2015

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus hemiarthroplasty
Participants	**Total number of randomised participants:** 54 **Inclusion criteria:** > 75 years of age; intertrochanteric femur fractures **Exclusion criteria:** people who did not want to be included in the study; pathological fractures **Setting:** single centre; hospital; Turkey **Baseline characteristics** **Intervention group 1** (PFN) • Age, average (SD) (average): 79.57 (± 4.833) (75 to 91) years • Gender, M/F: 9/12 • Preoperative waiting time, average (SD) (range): 7.81 (± 6.462) (2 to 30) hours • Fracture classification, A1/A2/A3, n: 4/7/10 **Intervention group 2** (hemiarthroplasty) • Age, average (SD) (range): 83.94 (± 4.924) (75 to 97) years • Gender, M/F: 10/23 • Preoperative waiting time, average (SD) (range): 7.48 (± 4.731) (1 to 20) hours • Fracture classification, A1/A2/A3, n: 4/16/13 **Overall:** • Age, average (SD) (range): 82.24 (± 5.298) (75 to 97) years • Gender, M/F: 19/34 • Preoperative waiting time, average (SD) (range): 7.61 (± 5.413) (1 to 30) days • Fracture classification, A1/A2/A3, n: 8/23/23

Ozkayin 2015 *(Continued)*

	Note: • study authors do not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status
Interventions	**General details:** operations were performed by only 2 surgeons; participants were given either general or regional block anaesthesia; all participants were administered prophylactic antibiotics and low-molecular-weight heparin for 4 weeks as a means of thromboprophylaxis; all participants were mobilised full weight bearing within 48 hours after surgery; after hospital discharge, participants were followed up in the outpatient clinics for clinical and radiological evaluation at 1.5, 3, 6, 12 and 18 months **Intervention group 1** • Proximal femoral nail (manufacturer not reported); femoral head fixation with two screws • Number randomised = 21 **Intervention group 2** • Cemented hemiarthroplasty (manufacturer not reported) • Number randomised = 33 **Note:** • study authors do not report the skills or experience of the surgeons
Outcomes	**Outcomes measured/reported by study authors:** operation time; hospital stay; superficial infection; late deep infection; non-union; shortening; re-operations (available at 18 months); mobility; HHS; functional score **Outcomes relevant to the review:** unplanned return to theatre (reported at 18 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report 'the authors of this manuscript do not have financial or proprietary interest in the subject matter or materials discussed in the manuscript, including (but not limited to) employment, consultancies, stock ownership, honoraria, and paid expert testimony. No funds were received in the support of this study' and no conflict of interest **Study dates:** October 2006 to December 2012 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Pahlpatz 1993

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus DHS
Participants	**Total number of randomised participants:** 153 **Inclusion criteria:** trochanteric and subtrochanteric proximal femoral fractures; stable, unstable and subtrochanteric (Evans classification) **Exclusion criteria:** multiple fractures; open epiphyseal lines **Setting:** single centre; orthopaedic hospital; the Netherlands **Baseline characteristics**

Pahlpatz 1993 *(Continued)*

Intervention group 1 (Gamma nail)

- Fracture classification, stable/unstable/subtrochanteric, n: 35/16/7
- Additional information:
  - level of independence: Broos I and II = 39; III and IV = 19

Intervention group 2 (DHS)

- Fracture classification, stable/unstable/subtrochanteric, n: 39/14/2
- Additional information:
  - level of independence: Broos I and II = 37; III and IV = 18

Baseline characteristics (overall)

- Age, mean (range): NR
- Gender, M/F: 18% male

Note:

- study authors did not report: smoking history, medication, comorbidities, cognitive status/dementia; mobility; age; gender
- surgery mostly within 24 hours, but sometimes postponed for up to 5 days to improve patient cardiopulmonary status

Interventions	**General details:** mostly performed ≤ 24 hours; fracture table with image intensifier; operations by surgical residents with assistance of staff member as required; closed reductions; full weight bearing day after operation **Intervention group 1** • Gamma intramedullary nail (Howmedica); distal locking was performed at the discretion of the surgeon for stable fractures; distal locking was always performed on unstable fracture patterns • Randomised = unknown **Intervention group 2** • SHS (Synthes); 135 degree; 4 holes, unless unstable or subtrochanteric who received longer plates • Randomised = unknown **Note:** • details of withdrawals: 1 second fracture; 1 did not receive randomised treatment
Outcomes	**Outcomes measured/reported by study authors:** mortality; failure to regain residential status; length of follow-up: 6 months minimum **Outcomes relevant to the review:** mortality (3 months and 6 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** July 1989 to January 1991 **Note:** • study report indicates that these are preliminary study results. No additional results have since been made available • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks

Pajarinen 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus DHS
Participants	**Total number of randomised participants:** 108 **Inclusion criteria:** low-energy extracapsular pertrochanteric femoral fractures (AO category 31-A) **Exclusion criteria:** pathological fractures; multiple injuries **Setting:** single centre; orthopaedic hospital; Finland **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 80.9 (± 9.1) years • Gender, M/F: 13/41 • BMI, mean (SD): 21.4 (± 3.0) kg/m^2 • Mobility assessment/use of walking aides, n: no aids, 31; aids but independent, 19; needs assistance, 4; not reported 0 • Place of residence, n: own home, 36; nursing home, 12; institution, 6 • Dementia, n: 12 • ASA status, I/II/III/IV: 0/6/28/20 • Preoperative waiting time, mean (SD): 1.3 (± 1.1) days • Fracture classification, A1.1/A1.2/A2.1/A2.2/other, n: 9/12/12/14/7 **Intervention group 2** (DHS) • Age, mean (SD): 80.3 (± 10.8) years • Gender, M/F: 14/40 • BMI, mean (SD): 22.3 (± 3.6) kg/m^2 • Mobility assessment/use of walking aides, n: no aids, 34; aids but independent, 19; needs assistance, 0; not reported 1 • Place of residence, n: own home, 33; nursing home, 16; institution, 5 • Dementia, n: 14 • ASA status, I/II/III/IV: 0/8/32/14 • Preoperative waiting time, mean (SD): 1.5 (± 2.4) days • Fracture classification, A1.1/A1.2/A2.1/A2.2/other, n: 7/19/14/10/4 **Overall:** • Age, mean (SD): 80.6 (± 9.9) years • Gender, M/F: 27/81 • BMI, mean (SD): 21.8 (± 3.3) kg/m^2 • Mobility assessment/use of walking aides, n: no aids, 65; aids but independent, 38; needs assistance, 4; not reported 1 • Place of residence, n: own home, 69; nursing home, 28; institution, 11 • Dementia, n: 26 • ASA status, I/II/III/IV: 0/14/60/34 • Preoperative waiting time, mean (SD): 1.4 (± 1.8) days • Fracture classification, A1.1/A1.2/A2.1/A2.2/other, n: 16/31/26/24/11 **Note:**

Pajarinen 2005 *(Continued)*

- study authors did not report: smoking history, medication, comorbidities, cognitive status/dementia

Interventions	**General details:** operations usually performed within 2 days of admission; in most cases by a senior orthopaedic resident (study authors confirmed all surgeons were experienced in both procedures); closed reduction; prophylactic antibiotics; low-molecular-weight heparin during hospital stay; weight bearing on POD1 or POD2; clinical examinations at 6 weeks and 4 months **Intervention group 1** • PFN (Synthes-Stratec); all nails were locked proximally with 2 dynamic screws, study authors did not provide information about distal locking or the length of the nails but it is probable that all nails were 240 mm long • Randomised = 54; analysed = 54 **Intervention group 2** • DHS (Synthes-Stratec, Switzerland) • Randomised = 54; analysed = 54 **Note:** • study authors report that 21 participants were not eligible for analysis; these data were reported overall rather than by group (died in immediate post-operative period = 2; died before completion of follow-up = 4; did not attend final follow-up = 15). In addition, 4 people had revision surgery and were excluded from analysis.
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; units of blood transfused; later fracture of femur; cut-out; failure of fixation (re-displacement); re-operation; superficial wound infection; deep wound infection; DVT; femoral neck and shaft shortening on X-ray; LOS; mortality; failure to regain pre-fracture residential status; non-recovery of previous mobility; length of follow-up: 4 months **Outcomes relevant to the review:** unplanned return to theatre; mortality (at 4 months)
Notes	**Funding/sponsor/declarations of interest:** quote: "no benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article" **Study dates:** October 1999 and February 2001 **Note:** • study authors supplied additional information and confirmed that the participants of a separately-reported radiological study were also ("for most parts of the series") in the trial

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "strict randomisation" Comment: method used to generate random sequence is not described
Allocation concealment (selection bias)	Low risk	Quote: "The mode of treatment was determined by strict randomisation, using sealed envelopes." Comment: study author confirmed during direct communication that "it was impossible to see the number through the envelope".
Blinding of participants and personnel (performance bias)	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.

Pajarinen 2005 *(Continued)*
All outcomes

Other performance bias: surgeon experience of both implants	Low risk	Quotes (from direct communication with study authors): "both procedures are standard procedures at our clinic" and "our surgeons are very experienced"
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	High risk	25 participants were not included in final analysis and most of these losses were because participants were too ill to attend final follow-up. Study authors did not report attrition by group.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Pan 2009

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma nail versus PFN
Participants	**Total number of randomised participants:** 131 **Inclusion criteria:** femoral intertrochanteric fractures **Exclusion criteria:** **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean (SD): 78 (± 4.5) years • Gender, M/F: 19/46 **Intervention group 2** (PFN) • Age, mean (SD): 76 (± 4.3) years • Gender, M/F: 20/46 **Overall:** • Age, mean (range): 76 (70 to 81) years • Gender, M/F: 39/92 • Fracture classification, A1/A2, n: 56/75

Pan 2009 *(Continued)*

Interventions	**General details:** unknown **Intervention group 1** • Gamma nail (manufacturer not reported); femoral head fixation with a single lag screw; nail length not reported but highly likely that short nails were used • Number randomised = 65 **Intervention group 2** • Proximal femoral nail (manufacturer not reported); femoral head fixation with a helical blade; nail length not reported but highly likely that short nails were used • Number randomised = 66
Outcomes	**Outcomes measured/reported by study authors:** pre-/postoperative blood loss; blood transfusion volume; operating time; length of hospital stay; infection; non-union; delayed union of fracture; shortening of injured limb **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2005 to January 2008 **Note:** • study reported in Chinese. We did not seek translation and have used data only from the English abstract. • we did not complete risk of bias assessments because the study reported no review-relevant outcomes.

Papasimos 2005

Study characteristics	
Methods	RCT; parallel design; 3 study arms **Review comparison group:** PFN versus TGN versus DHS
Participants	**Total number of randomised participants:** 141 **Inclusion criteria:** unstable trochanteric proximal femoral fracture (see Notes); AO 31-A2 and A3; > 60 years of age **Exclusion criteria:** unable to walk before injury; pathologic fractures; previous ipsilateral hip or femur surgery; any fracture with extension 5 cm distal to the inferior border of the lesser trochanter; stable trochanteric fractures classified as AO Type 31-A1 **Setting:** single centre; orthopaedic hospital; Greece **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 79.4 years • Gender, M/F: 17/23 • ASA status, I/II/III/IV: 15/11/14/0 • Fracture classification, A2/A3, n: 24/16

Papasimos 2005 *(Continued)*

- Additional information:
  - Functional status (Salvati 1973, from 0 to 40 with higher scores indicating greater function), n: > 30 = 31; 20 - 29 = 5; < 20 = 4

Intervention group 2 (TGN)

- Age, mean (SD): 82.8 years
- Gender, M/F: 16/24
- ASA status, I/II/III/IV: 14/11/15/0
- Fracture classification, A2/A3, n: 26/14
- Additional information:
  - Functional status (Salvati 1973, from 0 to 40 with higher scores indicating greater function), n: > 30 = 30; 20 - 29 = 6; < 20 = 4

Intervention group 3 (DHS)

- Age, mean (SD): 81.4 years
- Gender, M/F: 14/26
- ASA status, I/II/III/IV: 13/10/17/0
- Fracture classification, A2/A3, n: 27/13
- Additional information:
  - Functional status (Salvati 1973, from 0 to 40 with higher scores indicating greater function), n: > 30 = 29; 20 - 29 = 6; < 20 = 5

Note:

- study authors did not report: smoking history, medication, BMI, comorbidities, cognitive status/dementia, mobility, preoperative waiting time

Interventions	**General details:** 4 surgeons (extensive experience of TGN and DHS but limited with PFN); prophylactic antibiotics intraoperatively and 2 doses postoperatively; subcutaneous low-molecular-weight heparin for 6 weeks; rehabilitation was identical in all groups; mobilisation on the second postoperative day and subsequent ambulation with weight bearing as tolerated **Intervention group 1** • PFN (Synthes); 11 mm or 12 mm diameter PFN; all nails were locked proximally with 2 screws and distally; the standard 240 mm nail was used • Randomised = unknown **Intervention group 2** • TGN (Stryker-Howmedica); 180 mm long; 135 degrees with 17 mm proximal diameter and 11 mm distal diameter and distal locking in all participants • Randomised = unknown **Intervention group 3** • SHS Ambi (Smith and Nephew); Ambi means the barrel is not keyed and so the lag screw can rotate • Randomised = unknown **Note:** • "Non-survivors prior to first postoperative year (ten patients) and those who lost last follow-up evaluation (11 patients) were excluded leaving a total of 120 patients for the outcome analysis"
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; radiographic screening time; operative fracture (some of greater trochanter); cut-out of implant; later fracture of the femur; non-union; re-operation; superficial wound infection; haematoma; medical complications; chest infection; pneumonia; mental disturbances; DVT; PE; urinary infection; LOS; time to fracture consolidation; function: scores using Salvati 1973; length of follow-up: mean 12 months

Papasimos 2005 *(Continued)*

	Outcomes relevant to the review: mortality (during hospital stay); unplanned return to theatre (at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2000 to December 2003 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Park 1998

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group:** Gamma AP (Asia-Pacific) intramedullary nail versus CHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** intertrochanteric femoral fracture. Tronzo classification: stable (II) and unstable (III & IV) **Exclusion criteria:** not reported **Setting:** single centre; university hospital; South Korea **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean: 73.7 years • Gender, M/F: 10/20 • Mobility assessment, independent/aided/bed bound, n: 22/8/0 • ASA status, I/II/III/IV, n: 3/19/8/0 • Fracture classification, Tronzo II stable/Tronzo III and IV unstable, n: 14/16 **Intervention group 2** (CHS) • Age, mean: 72.2 years • Gender, M/F: 14/16 • Mobility assessment, independent/aided/bed bound, n: 19/11/0 • ASA status, I/II/III/IV, n: 4/16/9/1 • Fracture classification, stable/unstable, n: 11/19 **Overall** • Age, mean (range): 73 (all > 60) years **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, cognitive status/dementia, preoperative waiting time
Interventions	**General details:** only limited details of clinical management reported. Mobilisation in Gamma nail group started using crutches 2 weeks after operation. In CHS group, people with unstable fractures were allowed to bear weight after minimal callus was evident on radiographs

Park 1998 *(Continued)*

	Intervention group 1 • Gamma nail Asia-Pacific (Howmedica) short nail, no implant or operative details were reported • Randomised = 30 **Intervention group 2** • CHS; no implant or operative details were reported • Randomised = 30
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; operative fracture of femur (none); later fracture of femur (greater trochanter); cut-out of implant; non-union (time to union); wound infection; varus deformity; mobility **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 1993 and June 1995 **Note:** • Gamma AP nail is a modification of the standard Gamma intramedullary nail for use in patients in Asia. • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Park 2010

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: PFN versus PFN: screw or helical
Participants	**Total number of randomised participants:** 40 **Inclusion criteria:** intertrochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre; hospital; Korea **Baseline characteristics** **Intervention group 1** (screw) • Age, mean (range): 67 (45 to 89) years • Gender, M/F: 3/14 • Preoperative waiting time, average: 6.34 days • Fracture classification, A1/A2/A3, n: 5/10/2 **Intervention group 2** (helical) • Age, mean (range): (64 to 91) years • Gender, M/F: 6/17 • Preoperative waiting time, average: 4.34 days • Fracture classification, A1/A2/A3, n: 7/13/3 **Note:**

Park 2010 *(Continued)*

	• study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status
Interventions	**General details:** clinical follow-up was during the immediate postoperative period, at discharge, and at 1, 3, 6, 12, 18, 24 and 48 months postoperatively; operations were performed under general anaesthesia; all participants had suction drains for 48 hours and received antibiotic and thromboembolic prophylaxis; the rehabilitation protocol was identical for both groups: participants remained in bed for 2 days but were allowed to sit up, and then, if able, ambulation with partial weight bearing with a parallel bar or walker was allowed; full weight bearing was allowed as tolerated and when fixation stability was adequate **Intervention group 1** • Proximal femoral nail (Synthes); femoral head fixation with two screws • Number randomised = 17 **Intervention group 2** • Proximal femoral nail antirotation (Synthes); femoral head fixation with a single helical blade • Number randomised = 23 **Note:** • study authors do not report the number of surgeons or their skills and experience
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss; mobility score; BMD; duration of hospital stay; social function score; time to ambulation; neck-shaft angle **Outcomes relevant to the review:** none **Note:** • although some data are reported for return to theatre, it is not clear whether these data are complete for all participants in the groups or describe specific cases. Therefore, we did not include these data in the review.
Notes	**Funding/sponsor/declarations of interest:** study authors report having no relevant financial relationships to disclose **Study dates:** January 2005 to January 2007 **Note:** • we did not complete risk of bias assessments because the study reported no review-relevant outcomes.

Parker 2012

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Targon PFN versus SHS
Participants	**Total number of randomised participants:** 598 participants with 600 fractures **Inclusion criteria:** trochanteric hip fractures

Parker 2012 *(Continued)*

Exclusion criteria: subtrochanteric fractures, subtrochanteric extension that required a plate longer than 5 holes, pathological fractures, previously-treated fractures, conservative treatments, people with senile dementia, people with significant arthritis to be treated with THA
Setting: single centre; hospital; UK

Baseline characteristics

Intervention group 1 (PFN)

- Age, mean (range): 82.4 (26 to 104) years
- Gender, M: 52
- Mobility assessment, Parker mobility score (higher scores indicate better mobility), mean: 4.1
- Place of residence, own home, n: 230
- Cognitive status, MMTS, mean: 6.1
- ASA status, mean: 2.7; ASA I or II, n: 99
- Fracture classification, n: displaced intracapsular: 1; basal fracture: 10; stable trochanteric (A1): 48; unstable trochanteric (A2): 211; transtrochanteric (A3): 30

Intervention group 2 (SHS)

- Age, mean (range): 81.4 (27 to 104) years
- Gender, M: 69
- Mobility assessment, Parker mobility score, mean: 4.3
- Place of residence, own home, n: 219
- Cognitive status, MMTS, mean: 6.1
- ASA status, mean: 2.7; ASA I or II, n: 107
- Fracture classification, n: displaced intracapsular: 0; basal fracture: 9; stable trochanteric (A1): 56; unstable trochanteric (A2): 207; transtrochanteric (A3): 28

Note:

- study authors do not report baseline characteristics for: smoking history, medication, BMI, comorbidities, preoperative waiting time

Interventions	**General details:** all undertaken or supervised by a single specialised hip fracture surgeon; early mobilisation with full weight bearing, early discharge to previous residence when possible **Intervention group 1:** • Targon PFN; standard nail 220 mm long, 130° angle telescoping, screw and barrel and anti-rotation pin, distal locking with single 4.5 mm screw • Randomised = 300; 215 completed 12-month follow-up; 83 died; 2 lost to follow-up (at 12 months) **Intervention group 2:** • SHS (Biomet Ltd, Bridgend, UK); 4-hole plate unless A3 fracture which used 5-hole; lag screw ≤ 80 mm • Randomised = 300; 215 completed 12-month follow-up; 81 died; 4 lost to follow-up (at 12 months) **Note:** • study authors do not report: type of anaesthesia; use of preoperative or postoperative antibiotics or antithromboembolics
Outcomes	**Outcomes measured/reported by study authors:** mortality (available at 6 weeks, 3, 6, 9 and 12 months); acute ward stay; blood transfusion and volume of transfused blood; non-union; avascular necrosis; re-operation (arthroplasty or revision fixation); superficial and deep wound infection; confusion/delirium; pneumonia; pressure sores; urine retention; DVT; PE; fat embolism; CVA; MI; clostridia diarrhoea; gastrointestinal bleed; peritonitis; septicaemia; acute renal failure; pain (Charnley scale at 2, 3, 6, 9 and 12 months; VAS; using a 6-point scale at 6 weeks, lower scores indicates no pain); available at 6 weeks, 3, 6, 9, 12 months); mobility score (9-point scale - 1 = no need for mobility aids; available at

Parker 2012 *(Continued)*

	8 weeks, 3, 6, 9, 12 months); penetration of lag screw, plate detachment from femur, fracture below implant **Outcomes relevant to the review:** mortality (at 3 and 12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** funded internally from the Peterborough Hospitals Hip Fracture Research Fund to cover research expenses and those of the research nurse. Study author received benefits for personal or professional use from a commercial party related directly or indirectly to the study **Study dates:** April 2002 to November 2009

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Envelopes prepared by person who was independent to the study
Allocation concealment (selection bias)	Low risk	Use of sealed, opaque, numbered envelopes
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	All surgeries undertaken by a single surgeon experienced with both implants
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes (such as decision to re-operate).
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most losses are explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report clinical trials registration or pre-published protocol. It is not possible to effectively assess risk of reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Parker 2017

Study characteristics

Methods	RCT; parallel design

Parker 2017 *(Continued)*

Review comparison group: Targon PFN versus SHS

Participants	**Total number of randomised participants:** 400 **Inclusion criteria:** surgically-treated trochanteric fractures (stable A1, unstable A2, and transtrochanteric A3); participants with dementia were included with consent of next of kin **Exclusion criteria:** subtrochanteric fractures; subtrochanteric extension that required a plate longer than 5 holes; pathological fractures; previously treated fractures; conservative treatments; participants with senile dementia for whom permission of their next of kin was not obtained; arthritis of the hip **Setting:** single centre; hospital; UK **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (range): 82 (36 to 101) years • Gender, M/F: 60/140 • Mobility assessment, Parker mobility score, mean: 3.8 • Place of residence, own home, n: 164 • Cognitive status, MMTS, mean: 6.7 • ASA status, mean: 2.7; ASA I or II, n: 68 • Fracture classification, n: basal fracture: 4; stable trochanteric (A1): 38; unstable trochanteric (A2): 141; transtrochanteric (A3): 17 **Intervention group 2** (SHS) • Age, mean (range): 83.2 (25 to 105) years • Gender, M/F: 47/153 • Mobility assessment, Parker mobility score, mean: 3.7 • Place of residence, home, n: 160 • Cognitive status, MMTS, mean: 6.7 • ASA status, mean: 2.7; ASA I or II, n: 72 • Fracture classification, n: basal fracture: 3; stable trochanteric (A1): 27; unstable trochanteric (A2): 156; transtrochanteric (A3): 14 **Note:** • study authors do not report baseline characteristics for: smoking history, medication, BMI, comorbidities, preoperative waiting time
Interventions	**General details:** all undertaken or supervised by a single specialised hip fracture surgeon; early mobilisation with full weight bearing; early discharge to previous residence when possible **Intervention group 1:** • Targon PFT (B Braun, Tuttlingen, Germany); 220 mm nail, locked proximally with a screw and derotation pin, locked distally with a single dynamic screw • Randomised = 200; 59 died; 1 lost to follow-up (at 12 months) **Intervention group 2:** • SHS (Biomet Ltd, Bridgend, UK); four or five hole 135° plate • Randomised = 200; 60 died; 1 lost to follow-up (at 12 months) **Note:** • study authors do not report type of anaesthesia; use of preoperative or postoperative antibiotics or antithromboembolics

Parker 2017 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** mortality (available at 30 days, 8 weeks, 3, 6, 9 and 12 months); acute ward stay; blood transfusion and volume of transfused blood; confusion/delirium; non-union; avascular necrosis; re-operation (arthroplasty or revision fixation); superficial and deep wound infection; pneumonia; DVT; CVA; MI; acute renal failure; pain (using a 6-point scale in the first 600 participants (in Parker 2012), and a 9-point scale in the later 400 participants - in both scales, lower scores indicate lower pain; available at 8 weeks, 3 months, 6 months, 9 months, 12 months); mobility score (9-point scale - 1 = no need for mobility aids; available at 8 weeks, 3, 6, 9, 12 months); pressure sores, urine retention, PE, congestive cardiac failure, cardiac arrhythmia, gastrointestinal bleed, peritonitis, intestinal obstruction, clostridia diarrhoea, septicaemia, fat embolism; cut-out, plate off the femur or fracture below implant **Outcomes relevant to the review:** mortality (at 3 and 12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** funded internally from the Peterborough Hospitals Hip Fracture Research Fund to cover research expenses and those of the research nurse. Study author received benefits for personal or professional use from a commercial party related directly or indirectly to the study **Study dates:** December 2010 to September 2015

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Participants were randomised by the opening of numbered, opaque, sealed envelopes. No further info in the paper or the 2012 or 2017 publications
Allocation concealment (selection bias)	Low risk	Participants were randomised by the opening of numbered, opaque, sealed envelopes to fixation of the fracture with either the SHS or an intramedullary nail
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	All surgeries undertaken by a single surgeon experienced with both implants
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding of participants to influence reporting of these outcomes. Data were collected from participants by a research nurse who was unaware of treatment allocation.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes (such as decision to re-operate).
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most losses are explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	The study was retrospectively registered on a clinical trials register (NCT02680028; first posted February 2016 and NCT03172923; June 2017); it is not feasible to effectively assess risk of selective reporting bias from this document.

Parker 2017 *(Continued)*

Other bias	Low risk	We identified no other sources of bias.

Parker 2020

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: short versus standard length intramedullary nail
Participants	**Total number of randomised participants:** 229 **Inclusion criteria:** stable trochanteric fracture (A1) or unstable trochanteric fracture (A2); consent **Exclusion criteria:** pathological fractures from tumours **Setting:** single centre; hospital; UK **Baseline characteristics** **Intervention group 1** (short) • Age, mean (range): 83.7 (47 to 103) years • Gender, M/F: 30/91 • Mobility grade, mean (SD): 3.6 (± 1.8) • Place of residence, own home, n: 96 • Mental test score, mean (SD): 6.0 (± 3.4) • ASA score, mean (SD); ASA I or II, n: 2.9 (± 0.6); 30 • Fracture classification, A1/A2, n: 31/90 • Social dependency grade, mean (SD): 3.3 (± 2.1) **Intervention group 2** (standard) • Age, mean (range): 81.8 (32 to 102) years • Gender, M/F: 37/71 • Mobility grade, mean (SD): 3.7 (± 2.0) • Place of residence, own home, n: 92 • Mental test score, mean (SD): 7.1 (± 3.0) • ASA score, mean (SD); ASA I or II, n: 2.7 (± 0.6); 32 • Fracture classification, A1/A2, n: 28/80 • Social dependency grade, mean (SD): 2.9 (± 2.1) **Note:** • study authors do not report any baseline characteristics for: smoking history; medication; BMI; co-morbidities; preoperative waiting time
Interventions	**General details:** all participants were encouraged to mobilise fully and bear weight as able with no restriction on hip movements; postoperative care protocols were identical for both groups; all participants without contraindications received chemical thrombopathy with low-molecular-weight heparin for 28 days; all surgeries performed (or supervised) by lead surgeon **Intervention group 1** • Short intramedullary nail (175 mm); Targon PFT nail (B. Braun, Tuttingham, Germany), the distal diameter for all the nails was 10 mm and the proximal diameter was 16.5 mm, the length of the thicker

Parker 2020 *(Continued)*

	proximal segment with its diameter of 16.5 mm was 63 mm, 4° valgus angulation, all nails were locked distally in a dynamic mode using the alignment jig • Number randomised = 121 **Intervention group 2** • Standard intramedullary nail (220 mm); Targon PFT nail (B. Braun, Tuttingham, Germany), the distal diameter for all the nails was 10 mm and the proximal diameter was 16.5 mm, the length of the thicker proximal segment with its diameter of 16.5 mm was 75 mm, 7° valgus proximal angulation, all nails were locked distally in a dynamic mode using the alignment jig • Number randomised = 108
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss; pain; mobility; social dependency; length of hospital stay; mortality (available at 12 months); amount of blood transfused; implant cut-out; non-union; femoral aneurysm; re-operations (available at 30 days, 120 days and 12 months); reaming of femur required; pneumonia; urinary retention; DVT; pressure sores; delirium; gastrointestinal bleed; congestive cardiac failure; acute renal failure; myocardial infarction; atrial fibrillation **Outcomes relevant to the review:** mortality (reported at 30 and 120 days, and 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report "the author or one or more of the authors have received or will receive benefits for personal or professional use from a commercial party related directly or indirectly to the subject of this article" and "M Parker has received royalties from B. Braun Inc. related to the design and development of an implant used for the internal fixation of intracapsular hip fractures. Travel expenses have been paid to M Parker to attend and speak at a number of meetings by implant manufacturers" **Study dates:** November 2015 to May 2018 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Pelet 2001

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma nail versus angled plate
Participants	**Total number of randomised participants:** 26 **Inclusion criteria:** trochanteric proximal femoral fractures, classified by the Kyle system as type IV. These are equivalent to type A3 (AO classification): reversed and transverse fracture lines at the level of the lesser trochanter **Exclusion criteria:** Kyle types I to III; < 16 years of age; refusing to consent; not operated within 4 days **Setting:** single centre; orthopaedic hospital; Switzerland **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean (range): 68.7 (21 to 94) years • Gender, M/F: 6/7

Pelet 2001 *(Continued)*

- Mobility assessment, active/sedentary/bedridden, n: 6/5/2
- ASA status, I/II/III/IV: 2/6/3/1
- Fracture classification, n:
  - Evans I/II/III/IV/V: 1/3/2/3/4
  - AO A1/A2/A3/B/C: 1/7/1/1/3

Intervention group 2 (angled plate)

- Age, mean (range): 72.9 (21 to 96) years
- Gender, M/F: 3/10
- Mobility assessment, active/sedentary/bedridden, n: 6/6/1
- ASA status, I/II/III/IV: 2/5/2/4
- Fracture classification, n:
  - Evans I/II/III/IV/V: 3/2/1/3/3
  - AO A1/A2/A3/B/C: 0/8/1/1/3

Note:

- study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment cognitive status/dementia, preoperative waiting time
- 6 high-energy fractures

Interventions	**General details:** all operated on within 48 hours; preoperative prophylactic antibiotics; general or epidural anaesthesia; mobilised after 24 hours with weight bearing according to radiographs; clinical follow-up at 10 days, 1, 2, 3,6 and 12 months **Intervention group 1** • Gamma nail; 12 short nails 200 mm long and one long nail 400 mm long were used • Randomised = 13 **Intervention group 2** • Angled blade plate, 90 degree; no further details • Randomised = 13
Outcomes	**Outcomes measured/reported by study authors:** quality of the reduction; length of surgery; operative blood loss; operative fracture of the femur; cut-out; non-union (and time to consolidation); avascular necrosis; implant failure; re-operation; wound infection; PE; cardiac failure; all medical complications; LOS; discharge destination, external rotation deformity; hip flexion; mortality; pain at follow-up; use of walking aids; time to start of weight bearing; time to full weight bearing; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (at 12 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** November 1993 to January 1995 **Note:** • study reported in French • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Pesce 2014

Study characteristics

Pesce 2014 *(Continued)*

Methods	RCT; parallel design **Review comparison group**: hydroxyapatite-coated screw versus nail and head standard screws
Participants	**Total number of randomised participants:** 54 **Inclusion criteria:** femoral lateral fractures; 60 to 94 years of age: AO classification 31-A3; co-operative people; osteoporosis disease if T-score < -2.5 DS; BMI < 30.0 kg/m^2 **Exclusion criteria:** people with heart, kidney, neurological diseases, diabetes and systemic diseases who were unable to follow the rehabilitation programme; previous surgery or severe osteoarthritis of lower limbs; specific drugs treatments such as anticoagulants or psychiatric drugs **Setting:** single centre; hospital; Italy **Baseline characteristics** **Intervention group 1** (hydroxyapatite-coated screw) • Age, range: 60 to 94 years • Gender, M/F: 5/22 **Intervention group 2** (standard) • Age, range: 65 to 90 years • Gender, M/F: 7/20 **Overall:** • Age, average (range): 77.56 (60 to 94) years • Gender, M/F: 12/42 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** all participants were under spinal anaesthesia and placed on a traction bed; weight bearing was delayed until 10 days then participants were permitted progressive weight bearing with crutches **Intervention group 1** • Uninail (Lima Corporate S.P.A.-Villanova di San Daniele del Friuli-Udine); 12 mm hydroxyapatite-coated femoral head screw; dynamic distal locking • Number randomised = 27 **Intervention group 2** • Uninail (Lima Corporate S.P.A.-Villanova di San Daniele del Friuli-Udine); standard 12 mm femoral head screw; nail length 180 mm or 205 mm; dynamic distal locking • Number randomised = 27 **Note:** • study authors do not report the number of surgeons or their skills and experience
Outcomes	**Outcomes measured/reported by study authors:** TAD; bone density; HHS **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported

Pesce 2014 *(Continued)*

Study dates: January 2010 to July 2011

Note:

- we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Peyser 2007

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PCCP versus CHS
Participants	**Total number of randomised participants:** 104 **Inclusion criteria:** ≥ 60 years of age; intertrochanteric fracture of the hip, type AO/OTA 31.A1 to A2, which was amenable to closed reduction; informed consent **Exclusion criteria:** reverse obliquity fractures (type AO/OTA 31.A3); pathological fractures; presence of metastatic disease; ipsilateral lower-limb surgery; contralateral hip fracture within the past 12 months **Setting:** single centre; hospital; Israel **Baseline characteristics** **Intervention group 1** (PCCP) • Age, mean (range): 78.9 (62 to 95) years • Gender, M/F: 16/34 • ASA status, I/II/III/IV: 0/22/24/5 • Preoperative waiting time, within 24 hours/25 to 48 hours/> 49 hours, n: 20/19/11 • AO/OTA classification, 31 A1.1/A1.2/A1.3/A2.1/A2.2/A2.3, n: 14/14/1/3/4/1 **Intervention group 2** (CHS) • Age, mean (range): 82.9 (63 to 95) years • Gender, M/F: 18/35 • ASA status, I/II/III/IV: 1/24/25/3 • Preoperative waiting time, within 24 hours/25 to 48 hours/> 49 hours, n: 25/19/9 • AO/OTA classification, 31 A1.1/A1.2/A1.3/A2.1/A2.2/A2.3, n: 16/14/1/5/5/4 **Note:** • study authors do not report any baseline characteristics for: smoking history; medication; BMI; co-morbidities; mobility assessment; place of residence; cognitive status/dementia
Interventions	**General details:** prophylactic antibiotics (1 g of cefazolin) were administered intravenously 3 times a day for the first 24 hours and low-molecular-weight heparin (enoxaparin 40 mg/d) was given prophylactically for 1 month postoperatively; participants in both groups were allowed immediate weight bearing as tolerated on the affected lower limb with the use of walking aids; the participants were reviewed at 6, 12 and 24 weeks and 12 months postoperatively **Intervention group 1** • Percutaneous compression plate 'Gotfried' (Orthofix Inc, McKinney, Texas); femoral head fixation with two dynamic screws and plate fixation with three non-locking screws • Number randomised = 52 **Intervention group 2**

Peyser 2007 *(Continued)*

	• Compression hip screw (Richards; Smith & Nephew, Memphis, Tennessee); four-hole short barrel plates were used in all cases with a plate barrel angle between 130˚ to 145˚ • Number randomised = 52 **Note:** • study authors do not report the skills and experience of the surgeons
Outcomes	**Outcomes measured/reported by study authors:** mean time of reduction; operating time; length of hospital stay; intensive-care unit admissions; re-admission for non-orthopaedic reasons; blood loss; DVT; UTI; pulmonary embolism; cardiovascular events (myocardial infarction; arrhythmia); cerebrovascular accident; gastrointestinal, renal and pulmonary (respiratory failure; pneumonia) complications; wound infection; mortality (available at 3, 6 and 12 months); cutting-out of the hip screw; secondary fractures; failure of the implant; axial compression; alteration of the neck-shaft angle; collapse **Outcomes relevant to the review:** mortality (reported at 3, and 12 months) **Note:** • for unplanned return to theatre, we could not be certain whether data were complete or were only reported for specific cases.
Notes	**Funding/sponsor/declarations of interest:** study authors report no benefits were received. No details on conflict of interest are reported. **Study dates:** March 2002 to June 2003 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Pitsaer 1993

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus McLaughlin nail plate
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** > 60 years of age; intertrochanteric fracture of the femur **Exclusion criteria:** pathological fractures **Setting:** single centre; hospital; France **Baseline characteristics** **Intervention group 1** (DHS) • Fracture classification, stable/unstable, n: 11/22 **Intervention group 2** (McLaughlin nail plate) • Fracture classification, stable/unstable, n: 6/20 **Note:**

Pitsaer 1993 *(Continued)*

- study authors do not include any baseline characteristics for: age; gender; smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time

Interventions	**General details:** not reported **Intervention group 1** • Dynamic hip screw (Synthes) • Number randomised to group = not reported; losses = a total of 33 died and 8 were lost to follow-up but it is not specified which groups these belonged to, analysed = 33 **Intervention group 2** • McLaughlin nail plate (Howmedica Ltd); extramedullary plate, femoral head fixation with trifin shaped blade • Number randomised to group = not reported; losses = a total of 33 died and 8 were lost to follow-up but it is not specified which groups these belonged to, analysed = 26 **Note:** • study authors did not include number of clinicians (and their skills and experience), type of anaesthesia, pre- and postoperative care (e.g. use of prophylactic antibiotics or antithromboembolics), rehabilitation (e.g. time to mobilisation or weight bearing)
Outcomes	**Outcomes measured/reported by study authors:** walking ability; pain; re-operations (available at 6 months); mortality (available at 6 months) **Outcomes relevant to the review:** unplanned return to theatre (reported at 6 months); mortality (reported at 6 months) **Note:** • outcome data for mortality is reported overall, rather than by group • data for unplanned return to theatre are only available for survivors
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Number of clinicians and their skills and experience is not reported. It is uncertain whether surgeons were equally experienced with both types of implants.

Pitsaer 1993 *(Continued)*

Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes (such as decision to re-operate).
Incomplete outcome data (attrition bias) All outcomes	High risk	Data are not complete, and do not include re-operation rates amongst those who died within 6 months
Selective reporting (reporting bias)	Unclear risk	Study authors do not report clinical trial registration or pre-published protocol. It is not possible to effectively assess risk of reporting bias without these documents.
Other bias	High risk	Short report. We could not be certain whether information in this report is complete.

Radford 1993

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma intramedullary nail versus DHS
Participants	**Total number of randomised participants:** 200 **Inclusion criteria:** > 60 years of age, pertrochanteric proximal femoral fractures. Stable and unstable fractures (Evans) **Exclusion criteria:** not reported **Setting:** single centre; orthopaedic hospital; UK **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean (range): 83 (60 to 97) years • Gender, M/F: 79/21 • Comorbidities, type, n: diabetes, 6 • Mobility assessment, mobility score, average: 3.9 • Place of residence, housing score, average: 4.3 • Cognitive status/dementia, MMSE < 23/30, n: 24 • Fracture type, unstable, n: 38 **Intervention group 2** (DHS) • Age, mean (range): 78 (60 to 90) years • Gender, M/F: 76/24 • Comorbidities, type, n: diabetes, 4 • Mobility assessment, mobility score, average: 3.7 • Place of residence, housing score: 4.1 • Cognitive status/dementia, MMSE < 23/30, n: 21

Radford 1993 *(Continued)*

- Fracture type, unstable, n: 43

Note:

- study authors did not report: smoking history, medication, BMI, preoperative waiting time
- no details provided of housing or mobility scales

Interventions	**General details:** surgeons at registrar level or higher, experienced in both techniques and supervised by the study authors; image intensifier; closed reduction where possible; traction table; aimed for central screw position, 5 mm to 10 mm from subchondral bone; suction drains; perioperative antibiotic prophylaxis; mobilised on POD2; clinical review at 3 and 12 months **Intervention group 1** • Gamma intramedullary nail (Howmedica, UK); distal locking performed when longitudinal instability existed; the length of nails used was not reported in the study report but it is probable that all were short nails • Randomised = 100; losses reported were due to mortality = 12 (3 months) **Intervention group 2** • DHS (Stratec Medical, UK); four-hole, 135 degree plate • Randomised = 100; losses reported were due to mortality = 10 (3 months)
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; operative fracture of the femur; later fracture of the femur; cut-out of implant; non-union; re-operation; wound infection; deep wound infection; DVT; LOS; mortality; transfer to long term care; mobility level; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (3 months); unplanned return to theatre (time point unclear unless stated, assumed to be 12 month as end of follow-up period)
Notes	**Funding/sponsor/declarations of interest:** quote: "No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article" **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Participants were randomly assigned to groups. No additional details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Quote: "only surgeons of registrar grade and above .. took part in trial. They were already experienced in the use of the DHS and intramedullary nailing, and were personally instructed in the operative technique for the Gamma nail. ...The first two Gamma nail operations performed by each surgeon were not included in the trial."

Radford 1993 *(Continued)*

Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Reported losses were explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Rahme 2007

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus blade plate

Participants	**Total number of randomised participants:** 60
	
	Inclusion criteria: subtrochanteric proximal femoral fractures, all types (Seinsheimer classification)
	
	Exclusion criteria: ipsilateral femoral shaft or femoral neck fractures
	
	Setting: multicentre; 2 orthopaedic hospitals; Australia
	
	Baseline characteristics
	
	Intervention group 1 (PFN)
	
	• Age, mean: 73 years
	• Gender, M/F: 13/16
	• Preoperative waiting time, mean: 3.0 days
	• Fracture classification, Seinsheimer classification, n:
	  ○ Type I (undisplaced or displaced < 2 mm), 1
	  ○ Type II (2-part fractures), 7
	  ○ Type III (3-part fractures), 10
	  ○ Type IV (comminuted with ≥ 4 fragments), 1
	  ○ Type V (extension through the greater trochanter), 10
	
	Intervention group 2 (blade plate)
	
	• Age, mean: 67 years
	• Gender, M/F: 12/17
	• Preoperative waiting time, mean: 2.9 days

Rahme 2007 *(Continued)*

- Fracture classification, Seinsheimer classification, n:
  - Type I (undisplaced or displaced < 2 mm), 0
  - Type II (2-part fractures), 8
  - Type III (3-part fractures), 8
  - Type IV (comminuted with ≥ 4 fragments), 4
  - Type V (extension through the greater trochanter), 9
- study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment cognitive status/dementia, preoperative waiting time

Interventions	**General details:** bone grafting was at the discretion of the surgeon. Non-weight bearing mobilisation was allowed postoperatively for 12 weeks, or until callus was seen on radiographs **Intervention group 1** • PFN (Synthes AG, Chur, Switzerland); no further implant or operative details were provided • Randomised = 30; 1 participant was treated with a SHS **Intervention group 2** • Blade plate (Synthes AG, Chur, Switzerland); 95 degree angled blade plate; no further implant or operative details were provided • Randomised = 30; 1 participant was treated with a PFN
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; mean units of blood transfused; non-union and delayed union; re-operation; wound infection; LOS; mortality; general health (SF-36); length of follow-up: 12 months **Outcomes relevant to the review:** unplanned return to theatre (at end of follow-up); mortality (unclear but assumed to be 12 months) **Note:** • study authors did not report numerical data for HRQoL. Quote: "Differences between the 2 groups were not significant in each of the 8 domains"
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** August 2001 and August 2003 **Note:** • study stopped early. Quote: "Due to a significantly higher revision rate in the BP [blade plate] group, recruitment was terminated after an interim analysis of the first 50 patients. By this time, 60 patients had been recruited, 30 in each group". • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Raimondo 2012

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** ITST nail versus PCCP plate
Participants	**Total number of randomised participants:** 70 **Inclusion criteria:** not reported; described as elderly participants

Raimondo 2012 *(Continued)*

	Exclusion criteria: not reported **Setting:** single centre; trauma unit; Italy **Baseline characteristics** (overall) • Age, range: 48 to 98 • Gender, M/F: 10/60 **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment cognitive status/dementia, preoperative waiting time • study authors reported that they matched for age (± 4 years), gender, type of fracture (according to AO and Evans indexes), comorbidity (evaluated with ASA and Charlson Index) and duration of preoperative hospitalisation
Interventions	**General details:** type of anaesthesia (general or locoregional) was consistent between groups **Intervention group 1** • ITST nail, no further details • Randomised = 35 **Intervention group 2** • PCCP plate, no further details • Randomised = 35
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood transfusion; LOS; complications; functional status (HHS, 40 days, 6 and 12 months) **Outcomes relevant to the review:** mortality (12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 2006 to 2010 **Note:** • study is reported only in an abstract with limited detail on study methodology • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Reindl 2015

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** intramedullary devices versus DHS
Participants	**Total number of randomised participants:** 204 **Inclusion criteria:** unstable intertrochanteric hip fracture; ≥ 55 years of age; type 2 (AO/OTA 31 - A2); isolated fracture; occurred < 2 weeks prior to the time of enrolment **Exclusion criteria:** fracture due to malignancy; inability to walk before the fracture; severe dementia; limited life expectancy due to substantial medical comorbidities; medical contraindication; inability to comply with rehab or complete the forms

Reindl 2015 *(Continued)*

	Setting: multicentre; 9 sites; Canada **Baseline characteristics** **Intervention group 1** (intramedullary device) • Age, mean (SD): 82 (± 8.6) years • Gender, M/F: 57/55 **Intervention group 2** (DHS) • Age, mean (SD): 80 (± 9.9) years • Gender, M/F: 31/61 **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment cognitive status/dementia, preoperative waiting time
Interventions	**General details:** fracture table; attempted closed reduction; use of fluoroscopic guidance; clinical evaluations at 6 weeks, 3, 6 and 12 months **Intervention group 1** • A choice of 3 intramedullary devices: trochanteric fixation nail (TFN) (Synthes), Gamma nail (Stryker) or Trigen Intertan nail (Smith & Nephew); short nails; dynamic fixation proximally and all were distally locked • Randomised = 112; devices: 42 = TFN, 48 = Intertan, 22 = Gamma nail; at 3 months = 96; at 12 months = 87 (13 died, 6 unwilling to continue, 5 unknown loss, 1 implant failure) **Intervention group 2** • DHS (Synthes); plate ranges in length from two to six holes at the surgeon's discretion • Randomised = 92; at 3 months = 85; at 12 months = 80 (6 died, 2 unwilling to continue, 2 unknown loss, 2 implant failure)
Outcomes	**Outcomes measured/reported by study authors:** available at 6 weeks, 3, 6 and 12 months: LEM; FIM; TUG; 2MWT; radiographic findings; implant position - tip-apex distance; femoral neck shortening; heterotopic ossification - Brooker stage; complications; length of follow-up: 12 months **Outcomes relevant to the review:** mortality and unplanned return to theatre (both 12 months)
Notes	**Funding/sponsor/declarations of interest:** the study was directed by the Canadian Orthopaedic Trauma Society (COTS) with no other conflicts reported **Study dates:** February 2007 to November 2012

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quotes: "Permuted block randomisation","randomly generated modality"
Allocation concealment (selection bias)	Unclear risk	Quote: "sealed envelopes" Comment: study authors do not report whether envelopes are opaque and sequentially numbered
Blinding of participants and personnel (performance bias)	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.

Reindl 2015 *(Continued)*

All outcomes		
Other performance bias: surgeon experience of both implants	Unclear risk	Trial appears pragmatic in design. Multicentre trial with no information available on surgeon expertise
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced between groups and were mostly explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Registration with clinical trials register NCT00597779: first registered in January 2008 although study commenced in February 2007. It was not feasible to effectively assess risk of reporting bias using retrospectively-prepared documents. We noted that SF-36 was listed as an outcome, but was later dropped from the outcome list on the clinical trials register and was not reported in the published study report.
Other bias	Low risk	We identified no other sources of bias.

Romero 2008

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: PCCP versus DHS
Participants	**Total number of randomised participants:** 26 **Inclusion criteria:** AO 31A1 and A2 fractures; > 60 years of age **Exclusion criteria:** A3 fractures, osteoarthritis, other diseases, previous hip surgery **Setting:** single centre; hospital; Mexico **Baseline characteristics** **Intervention group 1** (DHS) • Age, average (range): 78 (62 to 90) years • Gender, M/F: 11/2 • Fracture classification, 31 A1.1/A2.1/A2.2/A2.3, n: 0/7/5/1 **Intervention group 2** (PCCP) • Age, average (range): 80 (66 to 102) years • Gender, M/F: 12/1 • Fracture classification, 31 A1.1/A2.1/A2.2/A2.3, n: 2/4/6/1 **Note:**

Romero 2008 *(Continued)*

	• study authors report no baseline data for: smoking history, medication, BMI, mobility assessment, place of residence, cognitive status and ASA status
Interventions	**General details:** prophylactic antibiotics and antithromboembolics **Intervention group 1** • Gotfried percutaneous compression plate (manufacturer not reported); femoral head fixation with two dynamic screws; plate fixation with three cortical screws • Number randomised to group = 13 **Intervention group 2:** • Dynamic hip screw (manufacturer not reported) • Number randomised to group = 13
Outcomes	**Outcomes measured/reported by study authors:** hospital stay; wound length; postoperative complications; consolidation time; surgery time; pain **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** December 2004 to February 2005 **Note:** • we did not complete risk of bias assessment because this study did not report any review-relevant outcomes.

Sadowski 2002

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus DCS
Participants	**Total number of randomised participants:** 39 **Inclusion criteria:** 31-A3 low-energy fractures; ≥ 55 years of age **Exclusion criteria:** pathological fractures; fractures associated with polytrauma; a pre-existing femoral deformity preventing hip screw osteosynthesis or intramedullary nailing; previous surgery on the ipsilateral hip or femur; fractures extending 5 cm distal to the inferior border of the lesser trochanter **Setting:** single centre; orthopaedic hospital; Switzerland **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (SD): 80 (± 13) years • Gender, M/F: 7/13 • Mobility assessment, Parker scale (9 being greatest mobility), mean (SD): 6.25 (± 2.36) • Place of residence, n: own home, 13; nursing home, 7 • ASA status, I/II/III/IV: 0/6/11/3 • Additional information: ○ Social function, Jensen score (4 being dependent to 1 being independent), mean (SD): 2.05 (± 0.94)

Sadowski 2002 *(Continued)*

Intervention group 2 (DCS)

- Age, mean (SD): 77 (± 14) years
- Gender, M/F: 5/14
- Mobility assessment, Parker scale (0 to 9; 9 being greatest mobility), mean (SD): 7.0 (± 2.52)
- Place of residence, n: own home, 15; nursing home, 4
- ASA status, I/II/III/IV: 1/9/9/0
- Additional information:
  - Social function, Jensen score (4 being dependent to 1 being independent), mean (SD): 1.95 (± 0.97)

Note:

- study authors did not report: smoking history, medication, BMI, comorbidities, cognitive status/dementia, preoperative waiting time

Interventions	**General details:** single dose of prophylactic antibiotics preoperatively; low-molecular-weight heparin from the day of surgery; prophylactic anticoagulation on the fifth postoperative day; performed by staff surgeons on a fracture table; mobilised out of bed on the second postoperative day; walking with weight bearing as tolerated on the third or fourth day; rehabilitation protocol identical for both groups; surgeons were experienced with both devices (had performed at least eight of each operation before the study) **Intervention group 1** • PFN (Synthes-Stratec); length of nail was not reported but from the text description it is highly probable that all were short nails; interlocked distally with 2 screws • Randomised = 20; at 12 months: 0 lost to follow-up, 2 died **Intervention group 2** • DCS (Synthes); 95 degree fixed angle screw-plate • Randomised = 19; at 12 months: 1 lost to follow-up, 1 died
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; mean units transfused; number of participants transfused; radiographic screening time; cut-out; non-union (and time to consolidation); implant failure; re-operation; wound infection; pneumonia; pressure sores; DVT; PE; urinary infection; cardiac failure/infarction; all medical complications; mortality; pain at follow-up; social function; transfer to long-term care; mobility level; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (in hospital and 12 months); unplanned return to theatre (reported as major re-operation) (at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors clearly report that no grants or outside funding was received **Study dates:** March 1998 and June 1999 **Notes:** • additional information supplied by study authors • this study was concurrent with Saudan 2002, but included a different participant group

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "No patient refused randomization, which was accomplished with use of computer-generated random numbers."

Sadowski 2002 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Quote (from direct communication with study authors): "All the surgeons involved in this study had performed an average of eight procedures with the PFN prior to the initiation of the randomized clinical trial."
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were relatively balanced between groups and were mostly explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Sanders 2017

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Intertan (short and long nails) vs SHS
Participants	**Total number of randomised participants:** 250 **Inclusion criteria:** people with intertrochanteric fractures; ≥ 55 years of age; ambulatory; able to participate in follow-up activities; provided informed consent **Exclusion criteria:** polytrauma; pathological fractures; no fixed address **Setting:** multicentre (5 level-1 trauma centres); Canada **Baseline characteristics** **Intervention group 1** (intramedullary) • Age, mean (SD): 80.6 (± 0.8) years • Gender, M/F: 36/87 • Smoking history, n: never smoked: 54; quit: 46; current smoker: 22 • BMI, mean (SD): 23.4 (± 0.6) kg/m^2

Sanders 2017 *(Continued)*

- Comorbidities, type, n: none reported: 4; heart disease: 64; CVA:19; lung disease:29; diabetes 33; kidney disease: 12; anaemia/blood disease: 12; cancer: 17; rheumatoid arthritis: 6; osteoarthritis: 57; depression: 26; Alzheimer's/dementia: 8; affected vision: 6; Parkinson's: 3
- Place of residence, n: at home: 104; residential care facility: 11; long term care/hospital: 8
- Preoperative waiting time, median (range): 2 (0 to 8) days
- Fracture classification, n: 31A1: 21; 31 A2: 102

Intervention group 2 (extramedullary)

- Age, mean (SD): 81.0 (± 0.8) years
- Gender, M/F: 33/93
- Smoking history, n: never smoked 59; quit 8; current smoker 19
- BMI, mean (SD): 24.6 (± 0.6) kg/m^2
- Comorbidities, type, n: none reported: 5; heart disease: 59; CVA:13; lung disease: 31; diabetes 23; kidney disease: 15; anaemia/blood disease: 13; cancer: 18; rheumatoid arthritis: 9; osteoarthritis: 63; depression: 21; Alzheimer's/dementia: 9; affected vision: 6; Parkinson's: 3
- Place of residence, n: at home: 108; residential care facility 12; long term care/hospital 6
- Preoperative waiting time, median (range): 2 (0 to 10) days
- Fracture classification, n: 31 A1: 22; 31A2: 104

Note:

- study authors report no baseline characteristics for: medication, mobility assessment, cognitive status, ASA status

Interventions	**General details:** use of general or spinal anaesthesia; perioperative antibiotics; treated with indirect reduction and percutaneous techniques. Surgeon's preference determined reduction technique, plate length, number of screws, use of a compression screw, use of ancillary fixation, nail length (long or short), and number of distal interlocking screws **Intervention group 1:** • Trigen Intertan (Smith and Nephew) - 71 short nails, (49 long Intertan) and 3 other long IM nails, dual integrated proximal screw and distal locking performed at the preference of the operating surgeon • Randomised = 123 (cross-over to alternative implant in 7) **Intervention group 2:** • SHS (Smith and Nephew) • Randomised = 127 (cross-over to alternative implant in 2) **Note:** • study authors did not report number of clinicians (and their skills and experience), or postoperative rehabilitation, weight bearing, mobilisation
Outcomes	**Outcomes measured/reported by study authors:** functional measures (FIM and TUG; 2MWT, LEM; data available at discharge, 6 weeks, 3 months, 6 months, 1 year); union and non-union, complications (screw, plate, and rod breakage; loss of mechanical instability; alignment), place of residence at discharge, LOS, Self-Administered Comorbidities Questionnaire, Geriatric Depression Scale, transfusion rates and haemoglobin level; infection, medical complications, implant failure, or periprosthetic fracture; mortality **Outcomes relevant to the review:** mortality (3 and 12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** unrestricted educational grant from Smith and Nephew Richards **Study dates:** 2008 to 2013

Sanders 2017 *(Continued)*

Note:

- we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Saudan 2002

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PFN versus DHS

Participants	**Total number of randomised participants:** 206
	
	Inclusion criteria: low-energy trochanteric fractures; > 55 years of age
	
	Exclusion criteria: pathologic fractures; polytrauma; previous ipsilateral hip or femur surgery; any fracture with extension 5 cm distal to the inferior border of the lesser trochanter; AO/OTA Type 31-A3
	
	Setting: single setting; orthopaedic hospital; Switzerland
	
	Baseline characteristics
	
	Intervention group 1 (PFN)
	
	• Age, mean (SD): 83 (± 9.7) years
	• Gender, M/F: 24/76
	• Mobility assessment, Parker scale 0 to 9 with 9 being most mobile, mean (SD): 6.3 (± 2.74)
	• Place of residence, n: own home, 55; nursing home, 45
	• ASA status, I/II/III/IV: 1/30/63/6
	• Additional information:
	  ○ Social function, Jensen score (4 being dependent to 1 being independent), mean (SD): 2.39 (± 1.21)
	
	Intervention group 2 (DHS)
	
	• Age, mean (SD): 83.7 (± 10.1) years
	• Gender, M/F: 22/84
	• Mobility assessment, Parker scale 0 to 9 with 9 being most mobile, mean (SD): 6.2 (± 2.81)
	• Place of residence, n: own home, 65; nursing home, 41
	• ASA status, I/II/III/IV: 3/30/66/7
	• Additional information:
	  ○ Social function, Jensen score (4 being dependent to 1 being independent), mean (SD): 2.33 (± 1.22)
	
	Note:
	
	• study authors did not report: smoking history, medication, BMI, cognitive status/dementia, preoperative waiting time

Interventions	**General details:** preoperative prophylactic antibiotics; low-molecular-weight heparin followed by Coumadin (warfarin) as prophylactic anticoagulation for 6 weeks; identical rehabilitation protocol, mobilised out of bed on the second day, ambulation with weight bearing on the third or fourth day; clinical follow-up at 3, 6 and 12 months; all surgeons had performed ≥ 8 of each operation before the study **Intervention group 1** • PFN (Synthes-Stratec, Oberdorf, Switzerland); distal locking in all participants; the length of the nail was not reported in the study report but it is probable that all implants were short nails

Saudan 2002 *(Continued)*

- Randomised = 100; analysed = 100

Intervention group 2

- DHS (Synthes-Stratec, Oberdorf, Switzerland); in almost all cases, the side plate was 135 degrees with 4 holes
- Randomised = 106; analysed = 106

Outcomes	**Outcomes measured/reported by study authors:** length of surgery; operative blood loss; mean units transfused; number of participants transfused; radiographic screening time; cut-out; non-union (and time to consolidation); implant failure; re-operation; wound infection; pneumonia; pressure sores; DVT; PE; urinary infection; cardiac failure/infarction; all medical complications; mortality; pain at follow-up; social function; transfer to long-term care; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (during hospital stay and 12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** quote: "No benefits in any form have been received or will be received from a commercial party directly or indirectly to the subject of this article. No funds were received in support of this study" **Study dates:** March 1998 to July 2000 **Notes:** • we received additional information from study authors • this trial was concurrent with Sadowski 2002, and included a different participant group

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "No patient refused randomization, which was accomplished with use of computer-generated random numbers."
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Quote (from direct communication with study authors): "All the surgeons involved in this study had performed an average of eight procedures with the PFN prior to the initiation of the randomized clinical trial."
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Most participant loss was because of death, which is expected in this population. Additional loss to follow-up due to participants leaving the country, all clearly reported

Saudan 2002 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Schipper 2004

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma nail versus PFN
Participants	**Total number of randomised participants:** 424 **Inclusion criteria:** radiological diagnosis of an unstable trochanteric femoral fracture, classified as 31A2.1 to 3 and 31A3.1 to 3; > 60 years of age; signed informed consent **Exclusion criteria:** inability to walk before the fracture; other fracture interfering with rehabilitation; (suspicion of) pathological fracture **Setting:** multicentre; 9 hospitals; the Netherlands **Baseline characteristics** **Intervention group 1** (Gamma) • Age, mean: 82.2 years • Gender, M/F: 37/176 • Cognitive status, MMSE < 24, n: 76 • ASA status, I/II/III: 68/50/93 • Fracture classification, A2/A3, n: 165/48 • HHS, mean: 70.3 **Intervention group 2** (PFN) • Age, mean (SD): 82.6 years • Gender, M/F: 38/176 • Cognitive status, MMSE < 24, n: 76 • ASA status, I/II/III: 66/53/88 • Fracture classification, A2/A3, n: 156/55 • HHS, mean: 68.9 **Note:** • study authors report no baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time
Interventions	**General details:** follow-up was at 4 weeks, 4 months and 12 months; the anaesthesia was either general or regional but did not differ between groups nor did the level of experience of the surgeons; surgeons had experience with at least 5 procedures with both implants; routine prophylaxis for thrombosis given preoperatively and during postoperative hospital stay; prophylactic antibiotics given; all participants encouraged to walk fully weight bearing, starting as soon as possible after operation with support of a physiotherapist **Intervention group 1:**

Schipper 2004 *(Continued)*

- Gamma nail (Stryker); length 200 mm; femoral head fixation with a single screw
- Number randomised to group = 213

Intervention group 2:

- Proximal femoral nail (Mathys); length 240 mm; femoral head fixation with two screws
- Number randomised to group = 211

Note:

- study authors do not report pre-/postoperative care

Outcomes	**Outcomes measured/reported by study authors:** amount of fracture healing; intraoperative complications; re-operations (available at 4 weeks, 4 months and 12 months); mortality (available at 4 weeks, 4 months and 12 months); blood loss; complications; mobility; operating time; fluoroscopy time; reduction of fracture **Outcomes relevant to the review:** mortality (reported at 4 months and 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report "this research was equally supported by Stryker Howmedica and Mathys Medical Nederland. The authors have received benefits for professional use from both commercial parties related directly to the subject of this article. In addition, benefits have been directed to a research fund, foundation, educational institution, or other non-profit organisations with which one or more of the authors is associated". **Study dates:** September 1998 to January 2002 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Selim 2020

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS with trochanteric stabilising plate versus PFLP
Participants	**Total number of randomised participants:** 40 **Inclusion criteria:** unstable pertrochanteric fractures AO 31A2.2/AO 31A2.3; informed consent **Exclusion criteria:** open fractures; preoperative neurological deficits **Setting:** single centre; hospital; Egypt **Baseline characteristics not reported** **Note:** • study authors do not report any baseline characteristics for: age; gender; smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time; fracture classification
Interventions	**General details:** all surgeries were done by 3 senior surgeons; immediate weight bearing, as tolerated, was allowed for all participants under physiotherapeutic guidance utilising a frame; participants

Selim 2020 *(Continued)*

	were followed-up clinically and radiologically for a minimum of 1 year at intervals of 2 weeks, 6 weeks, 3 months, 6 months and at 1 year **Intervention group 1** • Dynamic hip screw with trochanteric stabilising plate (manufacturer not reported); four- or five-hole plate; trochanteric stabilising plate was secured by applying a screw into the 3rd hole distally and the proximal part was fixed to the greater trochanter by either sutures or 4 mm cancellous screws • Number randomised = not reported **Intervention group 2** • Proximal femur locking plate (manufacturer not reported); femoral head fixation with multiple locking screws (static) • Number randomised = not reported **Note:** • study authors do not report the type of anaesthesia or medication used
Outcomes	**Outcomes measured/reported by study authors:** TAD; time to union; operation time; blood loss; length of hospital stay; functional status (HHS); superficial infections; deep infections; DVT; non-union; implant failure; cut-out **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** study authors declare that "there are no potential conflicts of interest or financial relationships relevant to this review" **Study dates:** January 2016 to December 2018 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Sernbo 1988

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Ender pins versus CHS
Participants	**Total number of randomised participants:** 206 **Inclusion criteria:** unstable intertrochanteric fracture of the hip **Exclusion criteria:** fractures sustained more than a week preoperatively; people in very poor health; pathological or subtrochanteric fractures **Setting:** single centre; hospital; Sweden **Baseline characteristics** **Intervention group 1** (Ender) • Age, men, mean (SD): 72 (± 14) years • Age, women, mean (SD): 82 (± 8) years • Gender, M/F: 24/80 • Mobility assessment, able to walk outside, n: 50

Sernbo 1988 *(Continued)*

- Place of residence, own home, n: 66

Intervention group 2 (CHS)

- Age, men, mean (SD): 70 (± 10) years
- Age, women, mean (SD): 83 (± 8) years
- Gender, M/F: 24/78
- Mobility assessment, able to walk outside, n: 44
- Place of residence, own home, n: 73

Note:

- study authors report no baseline data for: BMI, smoking history, medication, cognitive assessment, preoperative waiting time, fracture classification

Interventions	**General details:** spinal anaesthesia was used in all participants except 6 in Ender group and 8 in CHS group; the postoperative regimens of mobilisation and weight bearing were ordered by the surgeon, with no set protocol; all participants in CHS group received prophylactic antibiotics **Intervention group 1** • Ender nails (Olmed Medical, Uppsala, Sweden); at least three condylocephalic nails were inserted in order to fill the intramedullary canal • Number randomised to group = 104; losses = 25 (death), analysed = 104 **Intervention group 2:** • Compression hip screw (Richards Medical, Memphis, Tennessee) • Number randomised to group = 102; losses = 21 (death), analysed = 102 **Note:** • study authors do not report the number of surgeons or their skills and experience or the pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** duration of operation; duration of hospitalisation; mortality (available at 6 months and 12 months); malrotation; place of residence; re-operations (available at 12 months); delayed and non-unions; technical failure of stabilisation; loss of fixation; varus deformity; superficial infection; deep infection; distal migration of pins; pain, use of walking aids **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report 'no benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article. No funds were received in support of this study' **Study dates:** July 1983 to December 1985

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method of randomisation: used a random-number generator
Allocation concealment (selection bias)	Unclear risk	Allocation concealment only described as using "sealed envelopes" with no other detail

Sernbo 1988 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons.
Other performance bias: surgeon experience of both implants	Unclear risk	Number of surgeons and their skills and experience is not reported. It is uncertain whether surgeons were equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Study authors reported that no participants were lost to follow-up. Only participant loss was because of death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trials registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Sernbo 1994

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: CHS with key and compressing screw versus CHS without compressing screw
Participants	**Total number of randomised participants:** 153 **Inclusion criteria:** trochanteric hip fractures **Exclusion criteria:** fracture over 5 days old, pathological fractures, subtrochanteric fractures **Setting:** single centre, hospital, Sweden **Baseline characteristics** **Intervention group 1** (CHS with key and compressing screws) • Age, mean: men 75 years; women 82 years • Gender, M/F: 36/62 **Intervention group 2** (CHS without key and compressing screws) • Age, mean: men 77 years; women 81 years • Gender, M/F: 28/74 **Note:**

Sernbo 1994 *(Continued)*

	• study authors did not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time
Interventions	**General details:** early weight bearing permitted in 75% of group 1 and 73% of group 2 participants **Intervention group 1** • Compression hip screw (Biomet); keyed and compressing of the lag screw • Number randomised = 98 **Intervention group 2** • Compression hip screw (Biomet) unkeyed and no compressing of the lag screw • Number randomised = 102
Outcomes	**Outcomes measured/reported by study authors:** length of surgery, bleeding, varsification, non-union, sliding of lag screw **Outcomes relevant to the review:** none **Note:** • cannot determine the mortality per group
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 1987 to 1988 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Seyhan 2015

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus InterTAN
Participants	**Total number of randomised participants:** 75 **Inclusion criteria:** trochanteric fractures **Exclusion criteria:** pathological fractures; multiple traumas; people who died in the early postoperative period; people who were lost to follow-up **Setting:** single centre; hospital; Turkey **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD): 75.91 (± 13.77) years • Gender, M/F: 11/32 • Fracture classification, 31A1/31A2/31A3, n: 11/16/16 **Intervention group 2** (InterTAN) • Age, mean (SD): 75.34 (± 13.52) years

Seyhan 2015 *(Continued)*

- Gender, M/F: 8/24
- Fracture classification, 31A1/31A2/31A3, n: 7/13/12

Overall:

- Age, mean (range): 75.7 (30 to 94) years

Note:

- study authors did not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time

Interventions	**General details:** same surgeon performed all surgeries on a fracture table using a closed approach; flexion exercises immediately after surgery; other than exceptional cases, 3 doses of cefazolin sodium (1 g IV) were used for antibiotic prophylaxis; subcutaneous enoxaparin sodium (1 x 40 mg (0.4 mL)) injection and antiembolic stockings were used to prevent DVT for 35 days; each participant was mobilised with a walker ≤ 48 hours postoperatively; participants were advised to use walkers with touch-down weight bearing, but those who failed to achieve this task proceeded with weight bearing as tolerated; clinical follow-up at 1, 2, 3, 6, 12 and 24 months **Intervention group 1** • Proximal femoral nail antirotation (Synthes, Oberdorf, Switzerland); length 240 mm; femoral head fixation with a single blade; distal locking of all nails was performed with a single screw • Number randomised = 43 **Intervention group 2:** • Trigen InterTAN (Smith and Nephew, Memphis, TN, USA); length 200 mm; femoral head fixation with an integrated screw; distal locking of all nails was performed with a single screw • Number randomised = 32
Outcomes	**Outcomes measured/reported by study authors:** duration of surgery; fluoroscopy use; tip-apex distance; tip-cortex distance; time to mobilisation; time to full weight bearing; time to union; HHS; fracture gap before and after compression; lateral extension of nail; length of proximal femur; femur neck-shaft angle; revision surgery **Outcomes relevant to the review:** unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflicts of interest and no detail of funding is reported **Study dates:** not reported **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Shannon 2019

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: cephalomedullary nail versus cephalomedullary nail: short or long
Participants	**Total number of randomised participants:** 220

Shannon 2019 *(Continued)*

Inclusion criteria: isolated OTA/AO 31A1-3 pertrochanteric femur fractures; ≥ 18 years of age

Exclusion criteria: < 18 years of age; dementia limiting the ability to engage in patient-reported outcomes; pathological fractures

Setting: single centre; level-1 trauma centre; USA

Baseline characteristics

Intervention group 1 (short)

- Age, mean (range): 82 (79 to 84) years
- Gender, M/F: 20/60
- Tobacco use, n: 3
- Comorbidities, diabetes/chronic kidney disease, n: 15/20
- ASA score, mean (range): 2.9 (2.8 to 3.1)
- Preoperative waiting time, mean (range): 23 (19 to 26) hours
- Fracture classification, 31A1/31A2/31A3, n: 13/61/6 (data are incomplete and not explained by study authors)

Intervention group 2 (long)

- Age, mean (range): 79 (76 to 82) years
- Gender, M/F: 30/58
- Tobacco use, n: 6
- Comorbidities, diabetes/chronic kidney disease, n: 17/23
- ASA score, mean (range): 2.9 (2.8 to 3.0)
- Preoperative waiting time, mean: 19 hours (77 to 22)
- Fracture classification, 31A1/31A2/31A3, n: 11/61/8 (data are incomplete and not explained by study authors)

Note:

- study authors do not report baseline characteristics for: medication; BMI; mobility assessment; place of residence; cognitive status/dementia

Interventions

General details: the supervising surgeon was 1 of 4 traumatologists for 70% of short nails and 76% of the long nails with the remaining participants being covered by general orthopaedic surgeons; follow-up occurred at 2 weeks, 6 weeks, 3 months, 6 months and 12 months

Intervention group 1

- 3 different short cephalomedullary nails: 53% TFN-a (DePuy Synthes) femoral head fixation with a single screw; 40% Gamma third-generation (Stryker) femoral head fixation with a single screw or 7% Affixus (Biomet) femoral head fixation with two screws; all short nails were locked distally with a single distal interlocking screw
- Number randomised = 110; losses = 25 (death) 5 (lost to follow-up), analysed for unplanned return to theatre and HRQoL = 80, analysed for mortality = 105

Intervention group 2

- Three different long cephalomedullary nails: 60% TFN-a (DePuy Synthes) femoral head fixation with a single screw; 35% Gamma third-generation (Stryker) femoral head fixation with a single screw or 5% Affixus (Biomet) femoral head fixation with two screws; all long nails were locked distally with double distal interlocking screw
- Number randomised = 110; losses = 14 (death) 8 (lost to follow-up), analysed for unplanned return to theatre and HRQoL = 88, analysed for mortality = 102

Note:

- study authors do not report details on the anaesthesia used or the pre-/postoperative care

Shannon 2019 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** HRQoL (available at 3 months); HHS; TAD subtrochanteric fracture line extension; operative time; estimated blood loss; re-operations (available at 12 months); mortality (available at 3 months) **Outcomes relevant to the review:** HRQoL (in SF-36, reported at 3 months); unplanned return to theatre (reported at 12 months); mortality (reported at 3 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** December 2014 to December 2017

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was done with computer-generated randomisation
Allocation concealment (selection bias)	Low risk	Done using computer-generated randomisation by block randomisation strategy
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors report that the interventions were all performed by senior surgeons but we could not be certain whether surgeons were equally experienced in using the study implants.
Other performance bias: surgeon experience of both implants	Low risk	Most operations were conducted by experienced surgeons.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Blinding of outcome assessment: HRQoL (detection bias)	Low risk	Study authors report participants were not blinded to the intervention. We did not expect lack of blinding to influence detection bias for this outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few participants were lost, these losses were balanced between groups, and reasons for loss were clearly explained.
Selective reporting (reporting bias)	Low risk	Prospectively registered with a clinical trials register (NCT02285127). Outcomes in the published report are consistent with those in the trial registration document.
Other bias	Low risk	We identified no other sources of bias.

Sharma 2018

Study characteristics

Sharma 2018 *(Continued)*

Methods	Quasi-randomised; parallel design **Review comparison group**: ultra-short PFN vs DHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** cases of stable intertrochanteric fractures in adults > 18 years of age **Exclusion criteria:** cases with marrow cavity blocked by another implant, deformed femur, narrow marrow cavity, pathological fracture or old, complicated fracture **Setting:** single centre; government secondary-level hospital; Brazil **Baseline characteristics** **Intervention group 1** (intramedullary) • Age, mean (range): 60.67 (40 to 80) years • Gender, M/F: not clearly reported • Preoperative waiting time, mean: 4.1 days • Fracture classification, n: 31 A1 (according to inclusion criteria, all were stable fractures) **Intervention group 2** (extramedullary) • Age, mean (range): 62.27 (44 to 81) years • Gender, M/F: not clearly reported • Preoperative waiting time, mean: 4.5 days • Fracture classification, n: 29 A1 (according to inclusion criteria, all were stable fractures) **Note:** • study authors report no baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status
Interventions	**General details:** 1 surgeon operated on all cases; exercises from POD1, early mobilisation with walker as soon as possible with non-weight bearing, later partial weight bearing started depending on compliance of participant **Intervention group 1:** • Ultra-short PFN (Sharma Surgicals, Chandigarh, India); 18 cm length, diameter of proximal part 14 mm, antirotation screw of 6.4 mm and hip screw of diameter 8.0 mm; distal locking not reported • Randomised = 31; no losses; analysed = 31 **Intervention group 2:** • DHS; 3-hole plate combined with an antirotation screw • Randomised = 29; no losses; analysed = 29 **Note:** • study authors did not report experience of surgeon, perioperative use of antibiotics of antithromboembolics, type of anaesthesia
Outcomes	**Outcomes measured/reported by study authors:** intraoperative observations (length of incision, radiation exposure, duration of surgery, average blood loss, need for blood transfusion, failure to achieve closed reduction, hospital LOS, duration of full weight bearing); early complications (iatrogenic fracture, technical error, superficial infection, DVT); late complications (loss of reduction, implant failure, second surgery, mean shortening, non-union, malunion, deaths); functional outcome (HHS; measured at 1 month, 3 months, 6 months, and 2 years)

Sharma 2018 *(Continued)*

	Outcomes relevant to the review: mortality (reported as after 3 months, we have assumed final time point of 24 months); unplanned return to theatre (assumed to be up to 24 months)
Notes	**Funding/sponsor/declarations of interest:** funding not reported. Study authors declare no conflicts of interest **Study dates:** 2011 to 2015

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quasi-randomised trial. Participants allocated alternately to each intervention
Allocation concealment (selection bias)	High risk	Allocation is alternate, with same surgeon performing all operations. It is not possible to conceal allocation
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors do not describe whether the surgeon was equally experienced with the types of implants used in this study.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No reported losses
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Shi 2018

Study characteristics

Methods	RCT; parallel design **Review comparison group**: hemiarthroplasty versus internal fixation with PFLP
Participants	**Total number of randomised participants:** 80

Shi 2018 *(Continued)*

	Inclusion criteria: intertrochanteric fractures; signed informed consent for enrolment, operation and anaesthesia **Exclusion criteria:** severe cardiopulmonary insufficiency; severe liver and kidney function deficiency; coagulation disorder; spinal deformity; malignant tumours; fractures in other parts of lower limbs; mental illness; used analgesia device after operation; refused enrolment **Setting:** single centre, hospital, China **Baseline characteristics** **Intervention group 1** (observation) • Age, average (SD) (range): 73.5 (1.3) (60 to 85) years • Gender, M/F: 20/20 • Evans-Jensen classification, I/II/III/IV, n: 3/3/16/18 • HHS, average (SD): 35.6 (± 2.1) points **Intervention group 2** (PFLP) • Age, mean (SD): 73.6 (± 1.3) years • Gender, M/F: 21/19 • Evans-Jensen classification, I/II/III/IV, n: 3/3/16/18 • HHS, average (SD): 35.5 (± 2.1) points **Note:** • study authors do not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time; and no baseline characteristics for group 2 (except preoperative HHS)
Interventions	**General details:** all participants were treated with spinal-epidural anaesthesia in a lateral position; followed up at 12 months **Intervention group 1** • Cemented hemiarthroplasty (manufacturer not reported) • Number randomised = 40 **Intervention group 2** • Proximal femoral locking plate (manufacturer not reported); static femoral head fixation with multiple screws • Number randomised = 40 **Note:** • study authors do not report: the number of clinicians or their skills and experience; any detail on the pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** operation time; intraoperative blood loss; postoperative drainage time; walking speed; 5-times sit-to-stand test time; HHS; pain; hospital stay; time walking on crutches and walking without; complications; HRQoL (available at 12 months) **Outcomes relevant to the review:** HRQoL (in SF-12, reported at 12 months, physical and psychological scores are available) **Note:** • we did not include data for HRQoL in analysis; losses were not reported and we expected these data were incomplete because of death

Shi 2018 *(Continued)*

Notes	**Funding/sponsor/declarations of interest:** study authors report no funding was received with no conflicts of interest **Study dates:** May 2014 to December 2016 **Note:** • we did not conduct risk of bias assessment because we were unable to include data for any outcomes in the review.

Shin 2017

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: cephalomedullary nail versus cephalomedullary nail: Zimmer natural nail or PFNA II
Participants	**Total number of randomised participants:** 380 **Inclusion criteria:** intertrochanteric hip fractures; written and informed consent **Exclusion criteria:** < 65 years of age; ASA score of V; poor pre-fracture walking ability; pathological intertrochanteric hip fractures; multiple fractures **Setting:** single centre; hospital; South Korea **Baseline characteristics (only for analysed participants)** **Intervention group 1** (Zimmer) • Age, mean (SD): 76.22 (± 16.40) years • Gender, M/F: 63/109 • Walking ability score pre-injury, mean (SD): 6.77 (± 1.69) • ASA risk score, I or II/III or IV: 93/79 • AO classification, 31-A1/A2/A3, n: 44/113/15 **Intervention group 2** (PFNA) • Age, mean (SD): 77.71 (± 16.44) years • Gender, M/F: 55/126 • Walking ability score pre-injury, mean (SD): 6.38 (± 1.43) • ASA risk score, I or II/III or IV: 95/86 • AO classification, 31-A1/A2/A3, n: 50/122/9 **Note:** • study authors do not report any baseline characteristics for: smoking history; medication; comorbidities; place of residence; cognitive status/dementia; preoperative waiting time
Interventions	**General details:** the same postoperative rehabilitation regimen was used in both groups; isometric quadriceps exercises were started on the first day after surgery and weight bearing as tolerated with a walker was resumed 2 days after surgery **Intervention group 1**

Shin 2017 *(Continued)*

- Natural Nail (Zimmer, Warsaw, IN, USA); length 215 mm solid titanium nail; femoral head fixation with a helical blade; diameter 10 mm distally and 15.5 mm proximally CCD angle of 125° or 130°; distal locking with a single interlocking screw
- Number randomised to group = 190; losses = 18 (lost to follow-up or death), analysed = 172

Intervention group 2

- Proximal femoral nail antirotation II (Synthes, Paoli, Switzerland); length 200 mm solid titanium nail; femoral head fixation with a single screw; diameter 10 mm distally and 16.5 mm proximally; neck angle of 125° or 130°; distal locking with a single interlocking screw
- Number randomised to group = 190; losses = 9 (lost to follow-up or death), analysed = 181

Note:

- study authors do not report: the number of surgeons or their skills and experience; the type of anaesthesia used; preoperative care

Outcomes	**Outcomes measured/reported by study authors:** HHS; operation time; fluoroscopy time; lateral hip pain; Parker and Palmer walking ability score; TAD; re-operations (available at 12 months); fracture reduction; screw sliding distance; cut-out distance; avascular necrosis; cleveland zone; mortality (available at 12 months) **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months), mortality (reported at 12 months) **Note:** • a total of 6 participants died but it is not specified to which groups these deaths belonged, and therefore they are not included in the analyses
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflict of interest and no details on funding **Study dates:** January 2011 to August 2014 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Singh 2017

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus locking compression plate (LCP)
Participants	**Total number of randomised participants:** 48 **Inclusion criteria:** people with unilateral, closed, unstable trochanteric fractures (31.A2 & 31.A3), > 18 years of age **Exclusion criteria:** bilateral fractures, polytrauma, pathologic fractures, open fractures (ASA status IV or V), associated hip osteoarthritic (Kellgren-Lawrence grade 3 or 4) **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (intramedullary)

Singh 2017 *(Continued)*

- Age, mean (SD): 58.3 (± 9.3) years
- Gender, M/F: 9/14
- Mobility assessment, n: independent: 17; assisted: 6; unable: 0
- Preoperative waiting time, mean (SD): 5.12 (± 2.24) days
- Fracture classification, n: 31A2: 14; 31A3: 9

Intervention group 2 (extramedullary)

- Age, mean (SD): 60.5 (± 8.1) years
- Gender, M/F: 7/15
- Mobility assessment, n: independent: 18; assisted: 4; unable: 0
- Preoperative waiting time, mean (SD): 6.18 (± 2.42) days
- Fracture classification, n: 31A2: 12; 31A3: 10

Note:

- study authors reported no baseline characteristics for: smoking history, medication, BMI, comorbidities, place of residence, cognitive status, ASA status

Interventions	**General details:** before surgery, each participant's standard plain radiographs (1 anteroposterior, 1 lateral) were evaluated. Participants underwent surgery as soon as their general medical condition allowed. Knee and ankle exercises on POD1. Non-weight bearing walking with bilateral axillary crutches usually on POD3 to 5. Progressive weight bearing started after 6 weeks **Intervention group 1:** • PFN; distal locking and length of nail were not reported in the study report • Randomised = 24 **Intervention group 2:** • Locking compression plate proximal femur • Randomised = 24 **Note:** • study authors did not report number of clinicians (and their skills or experience), type of anaesthesia, use of perioperative antibiotics or antithromboembolics
Outcomes	**Outcomes measured/reported by study authors:** perioperative measures: operative time, incision length, radiologic exposure, LOS, blood loss, union rate, time to union, reduction quality. Complications: deep and superficial infections; local site pain; non-union; implant-related breakage, cut-out, or Z-effect; unrelated to fracture (bed sore, chest infection and DVT; revision surgery, shortening). Functional outcome (HHS; at final 2-year follow-up); mobility (Palmer and Parker Mobility score; at final 2-year follow-up) **Outcomes relevant to the review:** unplanned return to theatre (at 2 years)
Notes	**Funding/sponsor/declarations of interest:** funding sources not reported. Study authors report no actual or potential conflicts of interest **Study dates:** April 2009 to June 2011 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Singh 2019

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus DHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** elderly participants (> 60 years of age); with stable intertrochanteric fractures (31 A.1 to A2.1); willing to give informed consent **Exclusion criteria:** younger people (< 60 years of age), with pathological fractures; unstable intertrochanteric fractures (31 A2.2 to A3.3); unfit for surgery; polytrauma; previous hip surgery; refusal to participate **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (intramedullary) • Age, mean (SD): 72.76 (± 9.5) years • Gender, M/F: 9/21 • ASA status, I/II/III/IV/V: 20/8/2/0/0 • Fracture classification, n: 31 A1.1 - A1.3: 22; 31A2.1: 8 **Intervention group 2** (extramedullary) • Age, mean (SD): 69.33 (± 5.7) years • Gender, M/F: 16/14 • ASA status, I/II/III/IV/V: 23/6/1/0/0 • Fracture classification, n: 31 A1.1 - A1.3: 20; 31A2.1: 10 **Note:** • study authors reported no baseline characteristics for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, preoperative waiting time
Interventions	**General details:** under supervision of 2 consultant surgeons with adequate skill in using both implants; encouraged to perform exercises on POD1. Weight bearing with a walker, and physiotherapy support, on POD2 **Intervention group 1** • PFNA (DePuy Synthes); distal locking and length of nail were not reported in the study report; the PFNA II utilises a blade for static fixation of the head and neck • Randomised = 24 **Intervention group 2** • DHS (DePuy Synthes) • Randomised = 24 **Note:** • study authors did not report type of anaesthesia, or perioperative use of antibiotics or antithromboembolics
Outcomes	**Outcomes measured/reported by study authors:** intraoperative variables (blood loss, fluoroscopy time, duration of surgery); neck shaft angle, TAD; functional outcomes (modified HHS; SF-12 PCS and MCS); complications (varus collapse; lateral migration of blade/screw; cut-out; non-union; implant fail-

Singh 2019 *(Continued)*

	ure; infection; fracture shaft of femur; re-operation; symptomatic DVT; decubitus ulcer, hyponatraemia; AF, pneumonia); mortality **Outcomes relevant to the review:** mortality (6 months); HRQoL (SF-12 PCS; at 1 year); unplanned return to theatre (at 1 year)
Notes	**Funding/sponsor/declarations of interest:** funding sources, or declarations of interest not reported **Study dates:** September 2014 to October 2016 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Song 2011

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma nail versus DHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** elderly people (> 60 years of age); with stable intertrochanteric fractures (31 A.1 to A2.1); willing to give informed consent **Exclusion criteria:** clinical signs of infection; neoplasia; other operative procedures within the previous 3 months; pathological fractures; unstable fractures; perioperative myocardial infarction; inflammatory myopathy **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (intramedullary) • Age, mean (SD): 67.9 (± 7.0) years • Gender, M/F: 6/24 • Fracture classification, n: 31.A1: 24; 31.A2: 6 • Comorbidities, n: hypertension, 8; diabetes, 9; COPD, 5 • Preoperative waiting time; time from fracture to surgery, days, mean (SD): 3.4 (± 1.2) **Intervention group 2** (extramedullary) • Age, mean (SD): 68.8 (± 6.7) years • Gender, M/F: 8/22 • Fracture classification, n: 31.A1: 25; 31.A2: 5 • Comorbidities, n: hypertension, 6; diabetes, 7; COPD, 6 • Preoperative waiting time; time from fracture to surgery, days, mean (SD): 3.5 (± 1.2) **Note:** • study authors reported no baseline characteristics for: smoking history, medication, BMI, ASA status, mobility assessment, place of residence, cognitive status
Interventions	**General details:** standard traction table; supine position; performed under an X-ray amplifier; low-molecular-weight heparin calcium injection

Song 2011 *(Continued)*

	Intervention group 1 • Gamma nail (Stryker); distal locking; interlocking of the lag screw 5 mm into the subchondral • Randomised = 30 **Intervention group 2** • DHS (DePuy Synthes) • Randomised = 30
Outcomes	**Outcomes measured/reported by study authors:** C-reactive protein levels; creatine kinase level **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** study authors declare no funding sources and that there were no conflicts of interest **Study dates:** January 2008 and December 2009 **Note:** • we did not conduct risk of bias assessment because study reported no review-relevant outcomes.

Stappaerts 1995

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus VDP endoprosthesis

Participants	**Total number of randomised participants:** 90
	Inclusion criteria: ≥ 70 years of age; fresh unstable peritrochanteric fractures; non-arthritic hip
	Exclusion criteria: reversed fractures
	Setting: single centre; hospital; Germany
	Baseline characteristics
	Intervention group 1 (DHS)
	• Age, mean: 87.7
	  ○ < 85 years, n: 23
	  ○ ≥ 85 years, n: 24
	• Evans-Jensen 1C-1D, 1C/1D, n: 34/13
	Intervention group 2 (VDP)
	• Age, mean: 82.7
	  ○ < 85 years, n: 25
	  ○ ≥ 85 years, n: 18
	• Evans-Jensen 1C-1D, 1C/1D, n: 27/16
	Overall:
	• Age, average (range): 83.2 (70 to 102) years
	• Gender, M/F: 17/73
	• Evans-Jensen 1C-1D, 1C/1D, n: 61/29

Stappaerts 1995 *(Continued)*

	Note: • study authors do not report any baseline characteristics for: gender (except overall); smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time
Interventions	**General details:** not reported **Intervention group 1** • Dynamic hip screw (AO/ASIF) • Number randomised to group = 47 **Intervention group 2** • Cemented Vandeputte (VDP) hemiarthroplasty (manufacturer not reported) • Number randomised to group = 43
Outcomes	**Outcomes measured/reported by study authors:** operation time; blood loss, transfusion need; mortality (available at 30 days and 3 months); severe hypotension; cardiac arrhythmia; functional capacity/mobility **Outcomes relevant to the review:** mortality (reported at 30 days and 3 months) **Note:** • total mortality is reported at these time points but it is not specified to which groups these deaths belong and therefore they could not be included in the analysis
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** May 1989 to May 1992 **Note:** • we did not complete risk of bias assessments because we did not include outcome data in the review.

Stark 1992

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: SHS versus Ender nails
Participants	**Total number of randomised participants:** 149 **Inclusion criteria:** > 50 years of age; trochanteric fractures **Exclusion criteria:** 18 who died; 3 with early re-operations; 2 who refused; 4 changed residence; 15 serious medical problems; 15 with weakness **Setting:** single centre; hospital; Sweden **Baseline characteristics** **Intervention group 1** (SHS) • Age, mean (range): 75 (54 to 90) years • Gender, M/F: 17/39

Stark 1992 *(Continued)*

- Comorbidities:
  - Free of disease, n: 30
  - Neurological, n: 8
  - Osteoarthritis, n: 7
  - Previous fractures, n: 5
  - Hip/knee arthroplasty, n: 2
  - Obesity, n: 1
  - Alcoholism, n: 3
- Walking before fracture:
  - No aid, n: 36
  - Minor support, n: 13
  - Major support, n: 6
  - Not walking, n: 1
- Fracture classification, stable/unstable, n: 24/32

Intervention group 2 (Ender)

- Age, mean (range): 74 (52 to 93) years
- Gender, M/F: 12/24
- Comorbidities:
  - Free of disease, n: 14
  - Neurological, n: 10
  - Osteoarthritis, n: 4
  - Previous fractures, n: 3
  - Hip/knee arthroplasty, n: 2
  - Obesity, n: 1
  - Alcoholism, n: 2
- Walking before fracture:
  - No aid, n: 19
  - Minor support, n: 14
  - Major support, n: 3
  - Not walking, n: 0
- Fracture classification, stable/unstable, n: 18/18

Note:

- study authors do not report any baseline characteristics for: smoking history; medication; BMI; place of residence; cognitive status/dementia; ASA status; preoperative waiting time

Interventions	**General details:** spinal anaesthesia was used in 86 participants and general anaesthesia in 6 participants; all participants received dextran or low-dose heparin; participants were examined 3 and 6 months after operation **Intervention group 1** • Sliding hip screw (manufacturer not reported) • Number randomised to group = 90; no apparent losses, analysed = 90 **Intervention group 2** • Ender nails (manufacturer not reported); at least three cephalocondylic nails were used • Number randomised to group = 59; no apparent losses, analysed = 59 **Note:** • study authors do not report the number of surgeons or their skills and experience; details on the pre-/postoperative care

Stark 1992 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** operation time; perioperative bleeding; postoperative bleeding; deep infections; re-operations (available at 6 months); fracture reduction; position of the implant; Ender nail migration; screw sliding; redislocation; bone healing; use of walking aids; union rate; pain evaluation; range of motion; walking distance; walkway function **Outcomes relevant to the review:** unplanned return to theatre (reported at 6 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** June 1982 to May 1985

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Number of surgeons and their skills and experience are not reported. It is uncertain whether surgeons were equally experienced with both types of implants.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes (such as decision to re-operate).
Incomplete outcome data (attrition bias) All outcomes	Low risk	No apparent losses
Selective reporting (reporting bias)	Unclear risk	Study authors do not report clinical trial registration or pre-published protocol. It is not possible to effectively assess risk of reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Stern 2011

Study characteristics

Methods	RCT; parallel design **Review comparison group**: screws versus helical blades **Note:**

Stern 2011 *(Continued)*

- this study did not compare SHS with Gamma nail or PFNA, but with the use of a screw or helical blade for either of these. Whether a SHS or nail was used was made at the discretion of the attending surgeon.

Participants	**Total number of randomised participants:** 335 **Inclusion criteria:** extracapsular hip fractures classified according to AO/OTA as 31-A1 and A2 (pertrochanteric fractures), and 31-A3 (intertrochanteric fractures); > 60 years of age; fracture caused by low-energy injury **Exclusion criteria:** pathological fractures; previous ipsilateral hip or femur surgery; refusal to participate in the study **Setting:** single centre; hospital; Switzerland **Baseline characteristics** **Intervention group 1** (screw) • Age, mean (SD): 85.9 (± 9.3) years • Gender, M/F: 39/133 • ASA status, II/III/IV: 51/117/4 • AO/OTA classification, A1/A2/A3, n: 59/96/17 **Intervention group 2** (blade) • Age, mean (SD): 86.8 (± 8.7) years • Gender, M/F: 39/124 • ASA status, II/III/IV: 50/107/6 • AO/OTA classification, A1/A2/A3, n: 61/88/14 **Note:** • study authors do not report any baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time
Interventions	**General details:** operations were performed by a large number of surgeons with varying levels of experience; all participants were managed in the same fashion postoperatively, regardless of implant; they were mobilised out of bed and started on a physical programme of weight bearing as tolerated within the first few days; implant was at the discretion of the operating surgeon **Intervention group 1** • Screw group using either DHS (Synthes, Solothrun, Switzerland; 83) or Gamma 3 Trochanteric Nail (Stryker Osteosynthesis, Geneva, Switzerland; 89) • Number randomised = 172 **Intervention group 2** • Blade group using either DHS blade (Synthes, Solothrun, Switzerland; 84) or PFNA (Synthes, Solothrun, Switzerland; 79) • Number randomised = 163 **Note:** • study authors do not report the type of anaesthesia used or details on the preoperative care
Outcomes	**Outcomes measured/reported by study authors:** position of cephalic implant in the femoral head; re-operations (available at 12 months); correlation of the implant position with cut-out of the screw or helical blade; TAD; degree of ambulation; pain; mortality (available at 12 months)

Stern 2011 *(Continued)*

	Outcomes relevant to the review: unplanned return to theatre (reported at 12 months); mortality (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report no funding was received for this work, any conflicts of interest are not reported **Study dates:** October 2006 to July 2009 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Su 2016

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma 3 versus InterTAN

Participants	**Total number of randomised participants:** 100
	
	Inclusion criteria: uniquely unstable intertrochanteric fractures (AO/OTA classification, 31-A2.2 to 31-A3.3); fracture caused by low-energy trauma; consent
	
	Exclusion criteria: polytrauma; high-energy trauma; open fractures; pathological fractures; ASA score of V; inability to work before injury; presence of arthritis in injured hip
	
	Setting: single centre; hospital; China
	
	Baseline characteristics
	
	Intervention group 1 (Gamma 3)
	
	• Age, mean (SD): 71.3 (± 8.7) years
	• Gender, M/F: 19/31
	• ASA status, I/II/III/IV: 4/17/19/10
	• Preoperative waiting time:
	  ◦ < 24 hours, n: 17
	  ◦ 24 to 48 hours, n: 30
	  ◦ > 48 hours, n: 3
	• AO classification, A2/A3, n: 41/9
	• Preoperative HHS, mean (SD): 66.7 (± 8.8)
	
	Intervention group 2 (InterTAN)
	
	• Age, mean (SD): 70.1 (± 9.2) years
	• Gender, M/F: 21/29
	• ASA status, I/II/III/IV: 3/18/21/8
	• Preoperative waiting time:
	  ◦ < 24 hours, n: 15
	  ◦ 24 to 48 hours, n: 31
	  ◦ > 48 hours, n: 4
	• AO classification, A2/A3, n: 40/10
	• Preoperative HHS, mean (SD): 65.3 (± 7.9)
	
	Note:

Su 2016 *(Continued)*

	• study authors do not report any baseline characteristics for: smoking history; medication; BMI; co-morbidities; mobility assessment; place of residence; cognitive status/dementia
Interventions	**General details:** all participants received prophylactic antibiotics (cefuroxime 1.5 g) intravenously 30 minutes before skin incision and for 48 hours after surgery; all participants were treated with rivaroxaban for 35 days from the first day after operation as prophylactic anticoagulation; all operations were performed by two experienced orthopaedic surgeons; all participants were placed supine on a fracture table after general anaesthesia and closed reduction; participants were instructed to use walkers with touch-down weight bearing postoperatively; 6 weeks after surgery, partial weight bearing with walker assistance was routine for all participants and full weight bearing was not permitted until sufficient bone consolidation; participants were followed at 1, 2, 3, 4, 6 and 12 months after surgery **Intervention group 1** • Gamma third-generation (Stryker); length 180 mm; solid titanium nail, proximal diameter is 15.5 mm; distal diameter of 11 mm; neck angle 130°; femoral head fixation with a single 10.5 mm lag screw; the nail was locked statically proximally and distally • Number randomised = 50 **Intervention group 2** • Trigen InterTAN (Smith and Nephew); length 182 mm; solid titanium nail of 182 mm; trapezoidal proximal end neck angle 125°; proximal diameter 16.25 x 15.25 mm; distal diameter 10 mm; the proximal end of the nail accepts two cephalocervical screws: a larger superior 11 mm lag screw and a smaller inferior 7 mm compression screw; the nail was locked statically proximally and distally • Number randomised = 50
Outcomes	**Outcomes measured/reported by study authors:** time required for the closed reduction, X-rayed times, operation time, estimated intraoperative blood loss; number of transfusions; TAD; decrease in length of the femoral neck; time to mobilisation; fracture healing; blood loss; pre- and postoperative haemoglobin; reduction results; superior position of lag screw; pulmonary embolism; DVT; lag screw cut-out; hip pain; mortality (available at 12 months); re-operations (available at 1 and 3 months); union time; HHS **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre (because of cut-out)
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflict of interest but no details on funding **Study dates:** January 2011 to August 2014 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Tao 2013

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus reverse less invasive stabilisation plate (LISS)
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** people with intertrochanteric femoral fractures; > 65 years of age **Exclusion criteria:** pathological fractures, osteoarthritis of the hips, ASA status IV or V

Tao 2013 *(Continued)*

Setting: single centre; hospital; China

Baseline characteristics

Intervention group 1 (intramedullary)

- Age, mean (SD): 80.4 (± 7.3) years
- Gender, M/F: 16/29
- Mobility assessment, n: independent walking: 41; assisted walking: 3; bedridden: 1
- Preoperative waiting time, mean (SD): 5.98 (± 3.2) days
- Fracture classification, n: 31 A1: 10; 31 A2: 21; 31 A3: 14

Intervention group 2 (extramedullary)

- Age, mean (SD): 79.6 (± 7.6) years
- Gender, M/F: 17/25
- Mobility assessment, n: independent walking: 40; assisted walking: 2: bedridden: 0
- Preoperative waiting time, mean (SD): 6.14 (± 3.9) days
- Fracture classification, n: 31.A1 9, 31 A2 21, 31 A3 12

Note:

- study authors reported no baseline characteristics for: smoking history, medication, BMI, comorbidities, place of residence, cognitive status, ASA status

Interventions	**General details:** 3 orthopaedic consultants (surgeons are familiar with PFNA but not with LISS); prophylactic IV first-generation cephalosporin started before surgery and continued up to 48 to 72 hours postoperatively; partial and full weight bearing allowed on 3rd and 6th postoperative week for PFNA group; partial and full weight bearing on 6th and 12th postoperative week for LISS group **Intervention group 1:** • PFNA; no further surgical or implant details reported • Randomised = unknown; losses not reported; analysed = 45 **Intervention group 2** • Reverse LISS (less invasive stabilisation plate); no further surgical or implant details reported • Randomised = unknown; losses not reported; analysed = 42 **Note:** • study authors did not report type of anaesthesia
Outcomes	**Outcomes measured/reported by study authors:** duration of surgery, fluoroscopy time, blood loss, quality of reduction (open reduction cases), LOS, bone-healing time, postoperative walking ability, HHS, postoperative complications (pressure sore, urinary infection, pulmonary infection, DVT), mortality **Outcomes relevant to the review:** mortality
Notes	**Funding/sponsor/declarations of interest:** funding or declarations of interest not reported **Study dates:** September 2010 to August 2011

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details

Tao 2013 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Study authors state that surgeons were familiar with PFNA but not with reverse LISS.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	High risk	Number randomised to each group and the numbers of losses in each group was not reported and we therefore could not ascertain amount of attrition in the study.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Unclear risk	We noted a difference in postoperative/rehabilitation management regarding time at which weight bearing was allowed in each group.

Teerenhovi 1984

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: AO angled plate versus DHS
Participants	**Total number of randomised participants:** 60 **Inclusion criteria:** proximal fracture of femur **Exclusion criteria:** not reported **Setting:** single centre; hospital; Finland **Baseline characteristics not available (see notes)**
Interventions	**General details:** no details **Intervention group 1** • AO angled blade plate • Number randomised to group = 22; analysed = 22 **Intervention group 2:** • Dynamic hip screw (manufacturer not reported) • Number randomised to group = 38; analysed = 38

Teerenhovi 1984 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** re-operations (available at 12 months); varus deformity; ability to move; range of hip flexion **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** October 1981 to March 1983 **Note:** • short report in Finnish. We did not seek translation and have used only the data in the English abstract, which was limited.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	We could not be certain whether surgeons were equally experienced with both implants.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No apparent losses
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Unclear risk	Because we had only a limited translation, we could not be certain of other risks of bias.

Trafton 1984

Study characteristics

Methods	RCT; parallel design **Review comparison group**: CHS versus Harris condylocephalic nail

Trafton 1984 *(Continued)*

Participants	**Total number of randomised participants:** 84 **Inclusion criteria:** intertrochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre, hospital, USA **Baseline characteristics** • study authors report no baseline characteristics
Interventions	**General details:** follow-up was done after 6 weeks and up to 6 months **Intervention group 1** • Compression hip screw (manufacturer not reported) • Number randomised to group = 42; analysed = 42 **Intervention group 2:** • Harris condylocephalic nailing • Number randomised to group = 42; analysed = 42
Outcomes	**Outcomes measured/reported by study authors:** operation time; fraction reduction; nail placement; fixation failure; osteoporosis; unstable fractures; varus reduction; re-operations (available at 6 weeks); blood replacement; infection rate; mortality (available at 6 months) **Outcomes relevant to the review:** unplanned return to theatre (reported at 6 weeks); mortality (reported at 6 months) **Note:** • study reports an additional 2 more participants in the Harris group needing re-operation. We did not include these 2 participants in analysis for unplanned return to theatre because it is not clear from the short report whether there were any additional re-operations in the CHS group.
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported **Notes:** • trial was terminated early because the third annual review demonstrated a significantly higher rate of fixation failure in the Harris group, with no evidence of compensatory benefit • study only available as abstract

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomisation not reported
Allocation concealment (selection bias)	Unclear risk	Method of allocation not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report the experience and skills of the surgeons

Trafton 1984 *(Continued)*

Other performance bias: surgeon experience of both implants	Unclear risk	It is uncertain whether surgeons are equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Because of limited information in the abstract, study flow is unclear. For the purpose of reporting the review outcomes, we assumed that there were no losses.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	High risk	Study report was available only as an abstract which we expected was not peer-reviewed. In addition, because of limited detail in the abstract, we could not be certain of other risks of bias.

Utrilla 1998

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: CSP versus fixed nail plate (RAB monoblock nail plate)
Participants	**Total number of randomised participants:** 200 **Inclusion criteria:** > 60 years of age; trochanteric fracture of the femur **Exclusion criteria:** not reported **Setting:** single centre; hospital; Spain **Baseline characteristics** **Intervention group 1** (CSP) • Age, mean: 80 years • Gender, M/F: 25/59 • Mental test: 8.02 • ASA status, I/II/III/IV: 9/22/43/10 • Preoperative waiting time: 4.2 days • Fracture classification, stable/unstable, n: 20/64 **Intervention group 2** (RAB) • Age, mean: 80 years • Gender, M/F: 15/67 • Mental test: 8.03

Utrilla 1998 *(Continued)*

- ASA status, I/II/III/IV: 12/31/30/9
- Preoperative waiting time: 4.8 days
- Fracture classification, stable/unstable, n: 16/66

Note:

- study authors reported baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence

Interventions	**General details:** all participants were treated by the same group of 4 surgeons, who had the same degree of experience; postoperative activities were programmed as follows: sitting down at 24 hours, and a trial deambulation at 48 hours, if tolerable; the participants were reviewed, clinically and radiologically, at 6 weeks, 3 months, 6 months and 12 months postoperatively **Intervention group 1** • Compression hip screw (IQL, Valencia) • Number randomised = 100; losses = 2 (lost to follow-up) 14 (died), analysed = 100 **Intervention group 2** • Rigidity Augmentation Baixauli (RAB) plate (IQL, Valencia); monoblock nail-plate; 120° angle blade is rectangular in cross-section; 6 mm buttress rod engages a groove on the underside of the blade • Number randomised = 100; losses = 6 (lost to follow-up) 12 (died), analysed = 100 **Note:** • study authors do not report data on the anaesthetic used • first 10 cases treated with RAB were not included whilst surgeons familiarised themselves with this implant
Outcomes	**Outcomes measured/reported by study authors:** duration of procedure; surgical difficulty; complications; blood loss; mortality (available at 1 month, 3 months and 6 months); re-operations (available at 12 months); shortening of limb; able to sit up; hospital stay; ambulation; hip tenderness; hip flexion; external rotation; shortening of limb; complications **Outcomes relevant to the review:** mortality (reported at 3 months and 6 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomisation not reported
Allocation concealment (selection bias)	Unclear risk	Method of allocation not reported
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to treatment groups. Study authors report that interventions were performed by surgeons who were equally experienced in using both types of study implants.

Utrilla 1998 *(Continued)*

Other performance bias: surgeon experience of both implants	Low risk	Experienced surgeons and we expected that they experienced with both types of implants
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect lack of blinding to influence detection bias for this outcome.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of intervention could influence judgments made by surgeons when assessing this subjective outcome.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few participants were lost, these losses were balanced between groups, and reasons for loss were clearly explained.
Selective reporting (reporting bias)	Unclear risk	Study authors did not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Utrilla 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** TGN versus CHS
Participants	**Total number of randomised participants:** 210 **Inclusion criteria:** trochanteric proximal femoral fractures; ≥ 65 years of age **Exclusion criteria:** subtrochanteric fractures; pathologic fractures; history of a previous lower limb injury; severe concomitant medical condition (ASA score of V) **Setting:** single centre; orthopaedic hospital; Spain **Baseline characteristics** **Intervention group 1** (TGN) • Age, mean (SD): 80.6 (± 7.5) years • Gender, M/F: 38/66 • Mobility assessment, mobility score (0–9 points, where 9 equates to maximum mobility; Parker 1993), mean (SD): 7.7 (± 1.8) • Place of residence, n: own home, 98; institution, 6 • Cognitive status, mental test score (0–10 points, where 10 equates to good cognitive status; Qureshi 1974), mean (SD): 9.4 (± 1.4) • ASA status, I/II/III/IV: 13/39/41/11 • Fracture classification, stable/unstable, n: 81/23 **Intervention group 2** (CHS) • Age, mean (SD): 79.8 (± 7.3) years

Utrilla 2005 *(Continued)*

- Gender, M/F: 28/78
- Mobility assessment, mobility score, mean (SD): 7.4 (± 1.9)
- Place of residence, n: own home, 105; institution, 1
- Cognitive status, mental test score (0–10 points, where 10 equates to good cognitive status; Qureshi 1974), mean (SD): 9.3 (± 1.9)
- ASA status, I/II/III/IV: 14/35/54/3
- Fracture classification, stable/unstable, n: 75/31

Overall

- Age, mean (range): 80 (65 to 104) years
- Gender, M/F: 68/144
- Place of residence, own home, n: 203
- Mobility assessment, walk without aids, n: 132

Note:

- study authors did not report: smoking history, medication, BMI, cognitive status/dementia, preoperative waiting time

Interventions	**General details:** fracture fixation was performed within 4 days; 4 surgeons experienced with Gamma nails; first 3 TGN operations performed by each surgeon were not included in the study and served as the learning curve; spinal anaesthesia (all but 3 participants); traction table with fluoroscopic control; suction drains for 48 hours; antibiotic and thromboembolic prophylaxis; clinical examination at 1, 3, 6 and 12 months **Intervention group 1** • TGN (Stryker Howmedica); implant length 180 mm; proximal and distal diameters of 17 mm and 11 mm; neck shaft angle 130; distal locking was performed with a single screw for rotationally unstable fractures • Randomised = 104; 3 lost at 12 months; 19 died; analysed for all 12-month outcomes = 82 **Intervention group 2** • CHS (Stryker Howmedica) • Randomised = 106; 4 lost at 12 months; 21 died; analysed for all 12-month outcomes = 81
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood transfusion; radiographic screening time; operative fracture of the femur; later fracture of the femur; cut-out of implant; re-operation; deep wound sepsis; local wound healing complications; DVT; shortening; hip flexion; mobility; pain (hip and thigh pain); mortality (available at 1, 3, 6 and 12 months); length of follow-up: 12 months **Outcomes relevant to the review:** mortality (at 3 months and at 12 months); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** quote: "No financial support of this project occurred. None of the authors received anything of value" **Study dates:** October 1998 to December 2000

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The patients were randomized for treatment into 2 groups based on sequence of admission, sealed envelopes were opened before the surgeon attempted a closed reduction of the fracture." Comment: no additional details

Utrilla 2005 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Study authors do not report whether envelopes are opaque and sequentially numbered
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Quote: "Four surgeons experienced in the standard Gamma nail did all the operations; however, the first 3 TGN operations performed by the surgeons were not included in the study and served as the learning curve for the new instrumentation."
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced between groups and were mostly explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Vaquero 2012

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus Gamma 3
Participants	**Total number of randomised participants:** 64 **Inclusion criteria:** isolated, unstable, closed or type I open trochanteric fractures treated with intramedullary fixation; ≥ 55 years of age; written and informed consent; agreed to attend all planned follow-up evaluations **Exclusion criteria:** pathological fractures of any origin other than osteoporosis; type II and type II open fractures; rheumatoid arthritis; existing neurological and psychiatric disorder (e.g. Parkinson's disease, multiple sclerosis, severe depression or dementia) that would preclude reliable assessment; active malignancy; wound and/or bone healing disorders of any cause other than diabetes mellitus or smoking; polytrauma; people with a life expectancy of < 3 months; refusal to sign the informed consent form; those unable to walk independently (excluding use of one stick) prior to injury **Setting:** multicentre; 6 hospitals; Spain **Baseline characteristics (for analysed participants only)** **Intervention group 1** (PFNA)

Vaquero 2012 *(Continued)*

- Age, mean (SD): 83.6 (± 7.5) years
- Gender, M/F: 3/28
- Smoking status, yes/stopped/no, n: 0/2/29
- Medication:
  - Oral anticoagulants: 0
  - Oral antidiabetics: 5
  - Aspirin: 4
  - Insulin: 2
  - Corticosteroids: 1
  - Long-term non-steroidal anti-inflammatory drugs (NSAIDs): 1
  - Osteoporosis therapy: 4
- BMI, mean (SD): 24.9 (± 4.4) kg/m^2
- Comorbidities, yes/no, n: 19/12
  - Sangha score, mean (SD): 5.0 (2.9)
  - Osteoporosis, yes/no, n: 12/29
  - Hyperparathyroidism, yes/no, n: 0/31
- Mobility assessment/use of walking aides: NR
- Place of residence:
  - At home without support: 18
  - At home with caregiver support: 10
  - Geriatric institution: 3
- Cognitive status/dementia: NR
- ASA classification, I/II/III/IV/V: 1/14/14/1/0
- Preoperative waiting time, mean (SD): (±) hours
- AO classification, A2.1/A2.2/A2.3/A3.1/A3.3, n: 18/4/3/4/2
- Tscherne classification, Closed Type 0/Closed Type 1, n: 28/2
- Pre-injury SF-36, physical/mental, mean (SD): 42.0 (8.1)/46.9 (11.2)

Intervention group 2 (Gamma)

- Age, mean (SD): 83.5 (± 7.4) years
- Gender, M/F: 5/25
- Smoking status, yes/stopped/no, n: 0/3/24
- Medication:
  - Oral anticoagulants: 0
  - Oral antidiabetics: 5
  - Aspirin: 4
  - Insulin: 2
  - Corticosteroids: 1
  - Long-term non-steroidal anti-inflammatory drugs (NSAIDs): 1
  - Osteoporosis therapy: 4
- BMI, mean (SD): 25.5 (± 2.9) kg/m^2
- Comorbidities, yes/no, n: 17/13
  - Sangha score, mean (SD): 4.1 (2,6)
  - Osteoporosis, yes/no, n: 10/20
  - Hyperparathyroidism, yes/no, n: 0/30
- Mobility assessment/use of walking aides: NR
- Place of residence:
  - At home without support: 16
  - At home with caregiver support: 10
  - Geriatric institution: 4
- Cognitive status/dementia: NR
- ASA classification, I/II/III/IV/V: 0/18/10/1/0

Vaquero 2012 *(Continued)*

- Preoperative waiting time, mean (SD): (±) hours
- AO classification, A2.1/A2.2/A2.3/A3.1/A3.3, n: 17/4/6/2/1
- Tscherne classification, Closed Type 0/Closed Type 1, n: 29/1
- Pre-injury SF-36, physical/mental, mean (SD): 39.7 (7.9)/51.7 (9.8)

Note:

- study authors do not report any baseline characteristics for mobility assessment or cognitive status/dementia

Interventions	**General details:** all participants received similar preoperative treatment including a combination of skin traction, prophylactic medication for DVT and surgical infection and adequate pain relief; surgery was performed on a traction table under spinal anaesthesia, except for 1 Gamma 3 participant who received general anaesthesia; participants were encouraged to partially weight-bear, starting as soon as possible; participants were discharged to their previous residence or a rehabilitation facility as soon as their health status allowed **Intervention group 1:** • Proximal femoral nail antirotation (Synthes, Switzerland); length 200 mm; diameter 11 mm; neck-shaft angle of 125° or 130°; femoral head fixation with a helical blade • Number randomised = 33 **Intervention group 2:** • Gamma third-generation (Stryker, Mahwah, NJ, USA); length 180 mm; diameter 11 mm; neck-shaft angle of 125° or 130°; femoral head fixation with a single screw • Number randomised = 31 **Note:** • study authors do not report the number of surgeons or their skills and experience
Outcomes	**Outcomes measured/reported by study authors:** HRQoL (available at 6 months and 12 months); HHS; baseline pain; mortality (available at 3 months, 6 months and 12 months); fracture fixation; fracture healing; fluoroscopy time; surgery duration; implant/surgery complications (breakage; loosening, and/or migration of hardware components, loss of reduction, fracture or difficulty with nail insertion, difficulty with distal screw locking, blade/screw measurement; guide wires); bone/fracture complications (loss of reduction; delayed healing; malunion; non-union; fracture impaction; refracture; avascular head necrosis); soft tissue/wound complications (superficial or deep infection; wound haematoma or seroma; trochanteric bursitis; tendinitis of the gluteus medius or minimus; local pain; neurological injury); general complications (pressure sores; thromboembolic complications; pneumonia; sepsis); time of hospital stay; TAD **Outcomes relevant to the review:** HRQoL (in SF-36 with PCS, and EQ-5D; reported at 12 months); mortality (reported at 3 months, and 12 months) **Notes:** • study authors do not report any data for unplanned return to theatre • although data for EQ-5D was collected, it is not clearly reported in the study
Notes	**Funding/sponsor/declarations of interest:** study authors report "data collection and data analysis was supported by the AO Foundation and a financial grant from Synthes, GmbH, Switzerland." The authors also state no conflicts of interest that could inappropriately influence their work **Study dates:** January 2008 to October 2009 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Varela-Egocheaga 2009

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** Gamma nail versus PCCP

Participants	**Total number of randomised participants:** 80
	
	Inclusion criteria: > 60 years; stable intertrochanteric fracture (AO/OTA 31.A1–31.A2.1)
	
	Exclusion criteria: open reduction; reverse obliquity fractures (AO/OTA 31.A3); unstable intertrochanteric fractures; pathological fracture; presence of metastatic malignant disease; ipsilateral lower limb surgery; contralateral hip fracture within the past 12 months
	
	Setting: single centre; orthopaedic hospital; Spain
	
	Baseline characteristics
	
	Intervention group 1 (Gamma 3)
	
	• Age, mean: 82.5 years
	• Gender, M/F: 6/34
	• Comorbidities, type, n:
	  ◦ arterial hypertension, 9
	  ◦ diabetes, 6
	  ◦ dementia senile, 5
	  ◦ transient ischaemic accident, 4
	  ◦ Parkinson's, 0
	  ◦ contralateral fracture of the hip, 2
	• Mobility assessment/use of walking aides: 15 without help; 20 cane; 5 walker
	• ASA status, I/II/III/IV: 0/12/18/2; 8 no class
	• Fracture types, AO/ASIF, n:
	  ◦ 31 A1.1, 10
	  ◦ 31 A1.2, 16
	  ◦ 31 A1.3, 1
	  ◦ 31 A2.1, 7
	  ◦ 31 A2.2, 5
	  ◦ 31 A2.3, 1
	• Additional information:
	  ◦ 1 high-energy fall
	
	Intervention group 2 (PCCP)
	
	• Age, mean: 81.6 years
	• Gender, M/F: 11/29
	• Comorbidities, type, n:
	  ◦ arterial hypertension, 16
	  ◦ diabetes, 4
	  ◦ dementia senile, 3
	  ◦ transient ischaemic accident, 3
	  ◦ Parkinson's, 2
	  ◦ contralateral fracture of the hip, 3
	• Mobility assessment/use of walking aides: 18 without help; 15 cane; 7 walker
	• ASA status, I/II/III/IV: 0/10/15/5; 10 no class

Varela-Egocheaga 2009 *(Continued)*

- Fracture types, AO/ASIF, n:
  - 31 A1.1, 15
  - 31 A1.2, 7
  - 31 A1.3, 2
  - 31 A2.1, 11
  - 31 A2.2, 4
  - 31 A2.3, 1
- Additional information:
  - 2 high-energy fall

Note:

- study authors did not report: smoking history, medication, BMI, place of residence, cognitive status/dementia, preoperative waiting time

Interventions	**General details:** fracture table; immediate postoperative full weight bearing; prophylactic antibiotics and prophylactic low-molecular-weight heparin (6 weeks postoperatively); 1-year period prior to study as 'learning curve' period for surgeons **Intervention group 1** • Gamma 3 nail (Stryker); nail length was not reported but it is highly probable that all nails were short; the cephalic screw was locked dynamically; distal locking was performed in all cases and was either static or dynamic • Randomised = 40; loss to follow-up not reported; analysed = 40 **Intervention group 2** • PCCP; two dynamic neck screws and three plate-shaft screws • Randomised = 40; loss to follow-up not reported; analysed = 40
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood transfusion; fall in haemoglobin; cut-out of implant; confusion; stroke; congestive cardiac failure; pneumonia; genitourinary infection; LOS; mortality; discharge to intermediate care; postoperative analgesia (duration and dose of metamizole); failure to regain mobility; length of follow-up: 12 months **Outcomes relevant to the review:** mortality (during hospital stay and 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** June 2006 and March 2007

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "randomized using a table of randomized numbers"
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.

Varela-Egocheaga 2009 *(Continued)*

Other performance bias: surgeon experience of both implants	Low risk	Study authors described prior 'learning curve' period before start of the trial, and we judged that surgeons were therefore likely to have experience with both implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few losses, which were balanced between groups
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Verettas 2010

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group:** intramedullary nail versus DHS

Participants	**Total number of randomised participants:** 120
	
	Inclusion criteria: unstable trochanteric proximal femoral fractures (AO/OTA type 31-A2 and Evans type III or IV); > 70 years of age; walk independently with or without aid; low-energy injury within 24 hours of admission
	
	Exclusion criteria: rheumatoid arthritis; pathological fracture
	
	Setting: single centre; orthopaedic hospital; Greece
	
	Baseline characteristics
	
	Intervention group 1 (Intramedullary nail)
	
	• Age, mean (SD): 79.22 (± 7.99) years
	• Gender, M/F: 20/40
	• Comorbidities, according to Ceder C, n: 55
	  ◦ None, 4
	  ◦ One, 14
	  ◦ Two, 18
	  ◦ More than two, 23
	• ASA status, mean (SD): 1.9 (± 0.6)
	• Additional information:
	  ◦ ADL Katz scale: 7.7 (± 1.8)
	
	Intervention group 2 (DHS)
	
	• Age, mean (SD): 81.03 (± 6.38) years
	• Gender, M/F: 15/45

Verettas 2010 *(Continued)*

- Comorbidities, according to Ceder C, n: 51
  - None, 8
  - One, 10
  - Two, 26
  - More than two, 15
- ASA status, mean (SD): 1.8 (± 0.6)
- Additional information:
  - ADL Katz scale: 7.6 (± 1.9)

Note:

- study authors did not report: smoking history, medication, BMI, place of residence, cognitive status/dementia, preoperative waiting time, mobility

Interventions	**General details:** operated as soon as possible after their admission and in no case later than 24 hours; general parenteral opiate or spinal analgesia dependent on the anaesthetist's assessment; reduced by closed methods; prophylactic antibiotics (cephalosporin) for 48 hours; prophylactic low-molecular-weight heparin for a total of 3 weeks; postoperative analgesia included a non-steroid anti-inflammatory medication; surgeons had previous experience of the use of these implants **Intervention group 1** • Gamma nail (n = 38) (Stryker) or Endovis BA nail (n = 22) (Citieffe, Bologna, Italy); in the case of the Gamma nail proximal locking is performed with a single screw whereas the Endovis BA nail utilises 2 cephalic screws; details of distal locking and length of nails was not reported in the study report. However, it is highly probable that all nails were short. • Randomised = 60; 1 lost to follow-up due to death; analysed = 60 **Intervention group 2** • DHS (Synthes) • Randomised = 60; 1 lost to follow-up due to death; analysed= 60
Outcomes	**Outcomes measured/reported by study authors:** length of surgery; blood loss; radiographic screening time; number of participants transfused; superficial wound infection; DVT ("immediate post-operative"); cardiovascular complication ("immediate post-operative"); neurologic complication/ delirium ("immediate post-operative"); respiratory complication ("immediate post-operative"); haematocrit; oxygen saturation and pressure; mental test score; LOS; days to being able to walk with a walker; mortality (in hospital); pain score; length of follow-up: duration of hospital stay (mean 10 days) **Outcomes relevant to the review:** mortality (during hospital stay)
Notes	**Funding/sponsor/declarations of interest:** funding not reported; study authors declare no conflicts of interests **Study dates:** not reported **Note:** • study author explained that the change in intramedullary nail was the result of a supplies policy at the hospital

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "The patients were allocated to each group alternatively on their admission."

Verettas 2010 *(Continued)*

Allocation concealment (selection bias)	High risk	It was not possible to conceal allocation with this method of randomisation
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Quote: "In our study the operating time was similar in both groups, possibly because the surgeons had previous experience of the use of these implants." However, there was a change in the type of nail used during the study period, and we could not be certain whether all surgeons were equally experienced with the newer implant.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few losses which are explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Vidyadhara 2007

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: Gamma nail (one femoral neck screw) versus Ace nail (two femoral neck screws)
Participants	**Total number of randomised participants:** 73 **Inclusion criteria:** > 60 years of age; unstable trochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre; hospital; India **Baseline characteristics** **Intervention group 1** (Gamma nail) • Age, mean (SD) (range): 68.6 (± 5.6) (61 to 82) years • Gender, M/F: 19/18

Vidyadhara 2007 *(Continued)*

- Comorbidities, n:
  - Osteoporosis, Singh's index grade 2/3/4, n: 7/24/6
  - Diabetes mellitus: 11
  - Hypertension: 11
  - Bronchial asthma: 3
  - Delirium:4
  - Parkinsonism: 3
  - Electrolyte imbalance: 0
  - Stroke: 0
- Mobility ability, no aids needed/need of aids but independent, n: 28/9
- ASA class, I/II/III: 2/12/23
- Preoperative waiting time, mean (SD): 2.6 (± 1.1) days
- AO classification, A2.2/A2.3/A3.1/A3.2/A3.3, n: 3/13/7/11/3

Intervention group 2 (Ace nail)

- Age, mean (SD) (range): 69.4(± 4.6) (62 to 89) years
- Gender, M/F: 18/18
- Comorbidities, n:
  - Osteoporosis, Singh's index grade 2/3/4, n: 10/22/4
  - Diabetes mellitus: 12
  - Hypertension: 8
  - Bronchial asthma: 6
  - Delirium: 3
  - Parkinsonism: 1
  - Electrolyte imbalance: 2
  - Stroke: 1
- Mobility ability, no aids needed/need of aids but independent: 28/8
- ASA class, I/II/III: 5/15/16
- Preoperative waiting time, mean (SD): 2.1 (± 1.4) days
- AO classification, A2.2/A2.3/A3.1/A3.2/A3.3, n: 2/11/9/12/2

Overall:

- Age, mean (SD) (range): 69 (± 6.4) (61 to 89) years
- Gender, M/F: 37/36
- Comorbidities, n:
  - Osteoporosis, Singh's index grade 2/3/4, n: 17/46/10
  - Diabetes mellitus: 23
  - Hypertension: 19
  - Bronchial asthma: 9
  - Delirium: 7
  - Parkinsonism: 4
  - Electrolyte imbalance: 2
  - Stroke: 1
- Mobility ability, no aids needed/need of aids but independent: 56/14
- ASA class, I/II/III: 7/27/39
- Preoperative waiting time, mean (SD): 2.3 (± 1.2) hours
- AO classification, A2.2/A2.3/A3.1/A3.2/A3.3, n: 5/24/16/23/5

Note:

- study authors do not report: smoking history; medication; BMI; place of residence; cognitive status/dementia

Vidyadhara 2007 *(Continued)*

Interventions	**General details:** surgery was performed in all cases by the same senior surgeon; participants received a prophylactic dose of an intravenous antibiotic; weight bearing within the limits of pain was allowed with walking frame or crutches as soon as possible in all participants; participants were discharged when comfortably walking; all participants were strictly advised to start full weight bearing without walking aids after the 4th week postoperatively; a standardised uniform rehabilitation protocol was followed in all participants regardless of the method of fixation used or the progress of fracture union; participants were reviewed with clinico-radiological assessment at 4 months, 12 months and 24 months after operation; 7 participants had general anaesthesia and the other 66 had spinal anaesthesia **Intervention group 1** • Gamma nail (Stryker); nail length 200 mm; femoral neck fixation with single screw; neck-shaft angle 130 degrees; all nails were locked distally • Number randomised to group = 37 **Intervention group 2** • Ace nail (DePuy); nail length 200 mm; femoral neck fixation with two screws; neck-shaft angle 130 degrees; all nails were locked distally • Number randomised to group = 36
Outcomes	**Outcomes measured/reported by study authors:** operating time; blood loss; bent guide wires; broken drill bit; mean fracture reduction time; difficult lag screw insertions; ideal implant position; fracture reduction; TAD; sliding of the lag screw; HHS; shortening; delay in walking; hip pain at 1 month; thigh pain at one month; limp; difficulty in squatting and sitting crossed legged; time to weight bearing **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2001 to May 2003 **Note:** • we did not complete risk of bias assessment because study authors reported no review-relevant outcomes.

Vossinakis 2002

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: SHS versus external fixation
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** pertrochanteric fractures **Exclusion criteria:** participants with dementia, basicervical fractures, pathological fractures, presenting more than one week after injury, subtrochanteric extension or reverse obliquity, people with associated fractures which could interfere with rehabilitation, people at high surgical risk (ASA > 4) **Setting:** hospital, single centre, Greece **Baseline characteristics** **Intervention group 1** (SHS)

Vossinakis 2002 *(Continued)*

- Age, mean (SD): 76.6 (± 8) years
- Gender, M/F: 12/38
- ASA status, I/II/III/IV: 6/21/23/0
- Fracture classification, Evans 1/2/3/4/5, n: 7/8/10/14/11
- Additional information:
  - weight, mean (SD): 71.1 (± 9.4) kg
  - low-energy/high-energy injury, n: 47/3

Intervention group 2 (external fixation)

- Age, mean (SD): 77.6 (± 6) years
- Gender, M/F: 14/36
- ASA status, I/II/III/IV: 4/24/23/0
- Fracture classification, Evans 1/2/3/4/5, n: 6/7/9/15/13
- Additional information:
  - weight, mean (SD): 72.8 (± 10.5) kg
  - low-energy/high-energy injury, n: 46/4

Notes:

- study authors do not report: smoking history; medication; BMI; place of residence; cognitive status/dementia

Interventions	**General details:** 4 surgeons; perioperative chemoprophylaxis (cefuroxime, 750 mg), thromboprophylaxis with low-molecular-weight heparin (enoxaparin), wearing of graduated compression stockings for 2 weeks; mobilisation using a walking frame, allowing full weight bearing, attempted from the second postoperative day; followed up for 6 months **Intervention group 1** • Sliding hip screw (manufacturer not reported) • Number randomised = 50; analysed = 50 **Intervention group 2** • Pertrochanteric external fixation (Orthofix, Srl, Verona, Italy) • Number randomised = 50; analysed = 50
Outcomes	**Outcomes measured/reported by study authors:** operating time; intraoperative complications; blood loss; blood transfusions; pain; mobility; LOS; place of residence; mortality, shortening; deep infection; re-operations **Outcomes relevant to the review:** mortality (in hospital, and at 6 months); unplanned return to theatre **Note:** • we did not include data for re-operations because these data were only relevant to the SHS group.
Notes	**Funding/sponsor/declarations of interest:** study authors report "no benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article" **Study dates:** 1997 to 1998

Risk of bias

Bias	Authors' judgement	Support for judgement

Vossinakis 2002 *(Continued)*

Random sequence generation (selection bias)	Low risk	"sealed envelopes containing cards, indicating the treatment for each patient"
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	It is not possible to blind surgeons to treatment groups. Study authors do not report surgeons' experience levels
Other performance bias: surgeon experience of both implants	Unclear risk	It is uncertain whether surgeons were equally experienced with both types of implants.
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of assessors of objective measures would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We expected surgeons were likely to assess this outcome, and decisions to re-operate could be subjective.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Participant loss was because of death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report pre-published protocol or clinical trial registration. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Wang 2011

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: expandable intramedullary nail versus PFN
Participants	**Total number of randomised participants:** 46 **Inclusion criteria:** intertrochanteric fractures **Exclusion criteria:** unknown **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (expandable intramedullary nail) • Age, mean (SD): 72.52 (± 15.50) years • Gender, M/F: 15/9 • Evans classification, I/II/III/IV/V, n: 2/5/8/6/2

Wang 2011 *(Continued)*

	Intervention group 2 (PFN) • Age, mean (SD): 71.30 (± 14.50) years • Gender, M/F: 14/8 • Evans classification, I/II/III/IV/V, n: 4/4/10/4/1 **Note:** • study authors do not report data for other baseline characteristics
Interventions	**General details:** not reported **Intervention group 1** • Fixion proximal femoral (PF) nail (DicO-Tech); expandable intramedullary nail system; femoral head fixation with a single screw • Number randomised = 24 **Intervention group 2** • Proximal femoral nail (PFN) (manufacturer not reported but most probably Synthes); femoral head fixation with two screws • Number randomised = 22
Outcomes	**Outcomes measured/reported by study authors:** operation time; intraoperative blood loss; length of incision; X-ray exposure; duration of inpatient stay; time to bone union; HHS **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** study authors state that they received no financial or other benefits and have no conflicts of interest **Study dates:** August 2005 to June 2009 **Notes:** • study reported in Chinese. We did not seek translation and only used data reported in English abstract. • we did not complete risk of bias assessments because study reported no review-relevant outcomes.

Wang 2019

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA vs DHS
Participants	**Total number of randomised participants:** 114 **Inclusion criteria:** diagnosed with intertrochanteric fractures on X-ray; no cardiac accidents before admission; no cognitive disorder; preoperative BP and blood sugar (and other common diseases) controlled in a normal state **Exclusion criteria:** severe cardiovascular and cerebrovascular disease; combined with other fractures; pathological fracture; mental illness before fracture; surgical contraindications **Setting:** hospital; single centre; China **Baseline characteristics (overall)**

Wang 2019 *(Continued)*

	• Age, mean (SD): 73.16 (± 3.47) years • Gender, M/F: 43/71 • Comorbidities, type, n: 50 had hypertension; 41 had diabetes • Preoperative waiting time, mean (SD): 4.18 (± 0.72) days • Fracture classification, n: Evans-Jensen type 1: 33; type II: 32; type III: 32, and type IV: 8. All closed fractures **Note:** • study authors reported only overall baseline characteristics. No data reported for: smoking history, medication, BMI, mobility assessment, place of residence; cognitive status, ASA status
Interventions	**General details:** all given antibiotics; epidural anaesthesia; on POD2, allowed to sit, half-squat, sit up, turn over, and perform contractile functional exercises of active and passive muscle, as well as knee flexion and extension exercises **Intervention group 1:** • PFNA; proximal locking was performed using a spiral blade which was locked statically; distal locking was performed through an aiming arm. Although the study report did not specifically report the length of nails, it is highly probable that all were short nails. • Randomised = 57 **Intervention group 2:** • DHS • Randomised = 57
Outcomes	**Outcomes measured/reported by study authors:** operation time; volume of intraoperative blood loss; postoperative drainage volume; time to weight bearing; serum inflammatory markers; serum levels of MI markers and heart failure markers **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2016 to February 2018 **Note:** • we did not conduct risk of bias assessment because study reported no review-relevant outcomes.

Watson 1998

Study characteristics	
Methods	Quasi-RCT; parallel design **Review comparison group**: DHS versus Medoff
Participants	**Total number of randomised participants:** 178 participants, 182 hips **Inclusion criteria:** intertrochanteric hip fracture **Exclusion criteria:** previous hip fracture or surgery; pathological fractures **Setting:** hospital, single centre, USA **Baseline characteristics (data only reported for participants followed up at 6 months)**

Watson 1998 *(Continued)*

	Intervention group 1 (DHS) • Fracture classification, stable/unstable, n: 29/62; 4 of unstable classed as reverse oblique **Intervention group 1 (Medoff)** • Fracture classification, stable/unstable, n: 17/69; 4 of unstable classed as reverse oblique **Overall:** • Age, mean (SD): 76 (25 to 99) years • Gender, M/F: 61/117 **Note:** • study authors do not report baseline characteristics by group; and do not provide: smoking history, medication, BMI, comorbidities, mobility assessment/use of walking aides, place of residence, cognitive status/dementia, ASA status, preoperative waiting time
Interventions	**General details:** surgery within 48 hours; performed by resident staff supervised by 1 of 4 attending staff; prophylactic antibiotics for 48 hours; closed suction drainage for 36 hours; compression stockings; subcutaneous heparin; mobilised on second day; weight bearing where appropriate; follow-up at 2 and 6 weeks, 3, 6 and 12 months **Intervention group 1:** • Dynamic hip screw (Synthes, Paoli, PA); four-hole plate • Number randomised = unclear; 91 available at follow-up **Intervention group 2:** • Medoff sliding plate (Wright Medical, Arlington TN); femoral head fixation with a single screw; four-hole plate if stable fracture pattern, six-hole if unstable • Number randomised = unclear; 69 available at follow-up **Note:** • 10 died during hospital stay, 12 lost to follow-up at 6 months • 160 followed up at 6 (range 6 to 26) months
Outcomes	**Outcomes measured/reported by study authors:** blood loss, ambulatory function; living status; pain; time to union; LOS; fixation failure; mortality **Outcomes relevant to the review:** mortality (in hospital) **Note:** • study authors report overall hospital mortality, but not reported by group and therefore we could not use these data.
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** November 1994 to December 1996 **Note:** • we did not complete risk of bias assessment because we were unable to use any outcome data in the review.

Weisbrot 2005

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PCCP versus DHS
Participants	**Total number of randomised participants:** 110 **Inclusion criteria:** trochanteric fractures **Exclusion criteria:** not reported **Setting:** single centre; hospital; country is not specified **Baseline characteristics not reported**
Interventions	**General details:** no details **Intervention group 1** • Percutaneous compression plate (manufacturer not reported) • Number randomised = 55 **Intervention group 2** • Dynamic hip screw (manufacturer not reported) • Number randomised = 55
Outcomes	**Outcomes measured/reported by study authors:** DVT; cardiac complication; chest infection; pressure sores; implant failure; deep wound infection **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** 2001 to 2003 **Notes:** • study is reported only as abstract with limited data • we did not complete risk of bias assessment because study reported no review-relevant outcomes.

Wild 2010

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus Targon PF
Participants	**Total number of randomised participants:** 80 **Inclusion criteria:** pertrochanteric femoral fractures (AO type 31.A2) **Exclusion criteria:** not reported **Setting:** single centre; hospital; Germany **Baseline characteristics**

Wild 2010 *(Continued)*

	Intervention group 1 (PFNA) • Age, mean (range): 81.6 (67 to 101) years • Fracture classification, stable/unstable, n: A2.1, 14; A2.2, 18; A2.3, 8 **Intervention group 2** (Targon PF) • Age, mean (range): 83.1(51 to 98) years • Fracture classification, stable/unstable, n: A2.1, 13; A2.2, 22; A2.3, 5 **Overall:** • Age, average: 82.5 years • Gender, M/F: 24/56 • Preoperative waiting time, mean (SD): 1.2 (± 0.4) days • Fracture classification, undisplaced/displaced, n: A2.2, 40; A2.1, 27; A2.3, 13
Interventions	**General details:** surgery completed on average 1.2 days post-injury; implantation was performed by the same two experienced surgeons who were familiar with the implants and had already been using them for many years; participants were examined clinically and radiologically at 2 weeks, 6 weeks, 3 months, 6 months and 12 months postoperatively **Intervention group 1** • Proximal femoral nail antirotation (Synthes, Oberdorf, Switzerland); femoral head fixation with a helical blade • Number randomised = 40 **Intervention group 2** • Targon PF (Aesculsp, Tuttingsn, Germany); femoral head fixation with a screw and a derotation pin • Number randomised = 40 **Note:** • 15 died, 4 left study (at 12 months)
Outcomes	**Outcomes measured/reported by study authors:** functional status (HHS); operative time; fluoroscopy time; mortality; hip motion; superficial infection; postoperative fractures; non-union; cut-out **Outcomes relevant to the review:** mortality (perioperative) **Note:** • mortality at follow-up not reported by group
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2006 to December 2007 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Wu 2020

Study characteristics	
Methods	RCT; parallel design

Wu 2020 *(Continued)*

Review comparison group: Gamma 3 versus PFNA-II

Participants	**Total number of randomised participants:** 415
	
	Inclusion criteria: informed consent; trochanteric fractures
	
	Exclusion criteria: < 60 years of age; not available for examination in outpatient clinic because of residing in other provinces or countries; previous hip fracture on the affected site; multiple fractures; confinement to a bed; pathological fractures; subtrochanteric fracture; limited life expectancy because of significant medical comorbidities (ASA grads IV and V); reverse obliquity fracture
	
	Setting: multicentre; 3 hospitals; China
	
	Baseline characteristics
	
	Intervention group 1 (Gamma 3)
	
	• Age, mean (SD): 77.47 (± 7.33) years
	• Gender, M/F: 74/95
	• BMI, mean (SD): 20.68 (± 2.76) kg/m^2
	• Comorbidities, n:
	  ○ Hypertension and cardiovascular diseases: 87
	  ○ Sequelae of cerebral infarction: 27
	  ○ Diabetes mellitus: 41
	  ○ Chronic renal insufficiency: 11
	• ASA score, mean (SD): 2.21 (± 0.43)
	• AO classification, A1/A2, n: 64/105
	
	Intervention group 2 (PFNA-II)
	
	• Age, mean (SD): 77.19 (± 8.45) years
	• Gender, M/F: 78/103
	• BMI, mean (SD): 20.77 (± 2.77) kg/m^2
	• Comorbidities, n:
	  ○ Hypertension and cardiovascular diseases: 101
	  ○ Sequelae of cerebral infarction: 23
	  ○ Diabetes mellitus: 38
	  ○ Chronic renal insufficiency: 15
	• ASA score, mean (SD): 2.26 (± 0.45)
	• AO classification, A1/A2, n: 80/101
	
	Note:
	
	• study authors report no baseline characteristics for: smoking history; medication; BMI; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time

Interventions	**General details:** all surgeries were performed by 32 orthopaedic trauma fellows who - although familiar with both implants - were defined as beginners because they had previously not performed the operations independently; general and spinal anaesthesia were used in both groups; all participants were operated on in the supine position on traction table; participants received prophylactic intravenous antibiotics starting 1 hour before operation; postoperatively, chemical venous thromboembolism prophylaxis (weight-adjusted doses of Fraxiparine) was adopted; regardless of any fracture type and different internal fixation, all participants complied with the same rehabilitation protocol; the active part or full weight bearing should be performed gradually as tolerated thereafter; follow-up occurred at 1, 3, 6 and 12 months postoperatively (mean 27.2 months (range 14 to 42 months)) **Intervention group 1**

Wu 2020 *(Continued)*

- Gamma third-generation (Stryker); available in various lengths: 170, 240, 260 mm long, mixed lengths were used (129 ≤ 180 mm; 40 ≥ 200 mm); femoral head fixation with a single screw; all nails were locked distally with a single screw
- Number randomised = 201

Intervention group 2

- Proximal femoral nail anti-rotation-II (Synthes); available in different lengths: 170, 200, 240 mm long, mixed lengths were used (132 ≤ 180 mm; 49 ≥ 200 mm); femoral head fixation with a helical blade; all nails were locked distally with a single screw
- Number randomised = 214

Outcomes	**Outcomes measured/reported by study authors:** quality of reduction; fracture gap; lateral wall fragment; closed/open reduction; nail length; TAD; operation time; fluoroscopy time; time to mobilisation; blood units transfused; hospital stay; functional status (HHS); hip and thigh pain; non-union; re-operations (available at 12 months); mortality (in hospital and at 12 months); complications related to fixation (cut-out, implant breakage, implant loosening, periprosthetic fracture, redisplacement, tractus irritation) **Outcomes relevant to the review:** unplanned return to theatre (reported at 12 months); mortality (reported during hospital stay and at 12 months)
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflicts of interest to disclose and that the research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors. **Study dates:** January 2011 to February 2017 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Xin 2014

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: DHS versus DHS with antirotation
Participants	**Total number of randomised participants:** 96 **Inclusion criteria:** unstable intertrochanteric fractures **Exclusion criteria:** **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (DHS) • Age, mean (SD): 78.9 (± 9) years • Gender, M/F: 24/20 **Intervention group 2** (DHS with antirotation screw) • Age, mean (SD): 76.8 (± 7.3) years • Gender, M/F: 25/22

Xin 2014 *(Continued)*

	Note: • study authors report no baseline data for: smoking history, medication, BMI, comorbidities, mobility assessment, place of residence, cognitive status, ASA status, preoperative waiting times, fracture classification
Interventions	**General details:** unknown **Intervention group 1:** • Dynamic hip screw (manufacturer not reported) • Number randomised = 48 **Intervention group 2:** • Dynamic hip screw with antirotation screw (manufacturer not reported) • Number randomised = 48
Outcomes	**Outcomes measured/reported by study authors:** surgical time; intraoperative blood loss; exposure time of X-ray; fracture healing time; postoperative HHS; postoperative complications **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** study authors declare no conflicts of interest **Study dates:** June 2005 to June 2012 **Note:** • study reported in Chinese. We did not seek translation, and have used information from the English abstract and use of Google Translate for limited data extraction. • we did not complete risk of bias assessment because the study reported no review-relevant outcomes.

Xu 2010a

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus Gamma 3
Participants	**Total number of randomised participants:** 136 **Inclusion criteria:** unstable proximal femoral fracture; ASA score of I to IV; signed informed consent; > 60 years of age **Exclusion criteria:** Pathological fractures; inability to walk prior to injury; severe concomitant medical condition **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD): 76 (± 1.2) years • Gender, M/F: 27/39 • Walking ability score, mean (SD): 6.95 (± 0.27) • ASA status, I/II/III/IV: 20/27/10/9 • Fracture type, A2/A3, n: 57/8

Xu 2010a *(Continued)*

Intervention group 2 (Gamma 3)

- Age, mean (SD): 75.4 (± 1.0) years
- Gender, M/F: 37/43
- Walking ability score, mean (SD): 6.80 (± 0.25)
- ASA status, I/II/III/IV: 25/21/13/11
- Fracture type, A2/A3, n: 59/11

Note:

- study authors do not report any baseline characteristics for: smoking history; medication; BMI; co-morbidities; place of residence; cognitive status/dementia; preoperative waiting time

Interventions	**General details:** operations were performed by surgeons who had experience with at least 5 procedures using the PFNA and the Gamma 3; each participant was given antibiotics with ceftriaxone preoperatively; either spinal or general anaesthesia was used; participants underwent surgery on a traction table **Intervention group 1** • Proximal femoral nail antirotation (Synthes); the PFNA used in study was a solid titanium nail of 170 or 240 mm in length and 10 mm in diameter; neck-shaft angle 130° • Number randomised = 66 **Intervention group 2:** • Gamma third-generation (Stryker); 170 mm cannulated steel nail; diameter of 11 mm; neck-shaft angle 130° • Number randomised = 70 **Note:** • study authors do not provide details on the pre-/postoperative care • a total of 15 died, 21 did not attend final follow-up because they were too ill, 7 were lost to follow-up but it is not specified to which groups these losses belonged
Outcomes	**Outcomes measured/reported by study authors:** operation time; fluoroscopy time; blood loss; intraoperative complications; result of fracture reduction; time till hospital discharge; number of transfusions; number of open reductions; time to fracture healing; complications (femoral shaft fracture, superficial wound infection, haematoma, lateral migration, decubitus ulcer, chest infection, UTI); pain; mobility **Outcomes relevant to the review:** none • total deaths are reported but it is not reported to which groups these deaths belonged; therefore, we have not included these data in analysis
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** January 2006 to August 2008 **Note:** • we did not complete risk of bias assessment because we included no outcome data in analysis.

Xu 2010b

Study characteristics

Xu 2010b *(Continued)*

Methods	RCT; parallel design **Review comparison group:** PFNA versus DHS
Participants	**Total number of randomised participants:** 106 **Inclusion criteria:** unstable proximal femoral fracture (AO category 31-A2) **Exclusion criteria:** < 65 years of age; pathological fractures; fractures associated with polytrauma; previous surgery on the ipsilateral hip or femur; inability to work before injury; severe concomitant medical condition (ASA status V) **Setting:** single centre; orthopaedic hospital; China **Intervention group 1** (PFNA) • Age, mean (SD): 78.5 (± 7.97) years • Gender, M/F: 15/36 • Mobility score, Parker scale (Parker 1993), mean (SD): 6.71 (± 1.89) • ASA status, I/II/III/IV: 12/22/10/7 **Intervention group 2** (DHS) • Age, mean (SD): 77.9 (± 7.82) years • Gender, M/F: 16/39 • Mobility score, Parker scale (Parker 1993), mean (SD): 6.18 (± 1.83) • ASA status, I/II/III/IV: 14/21/11/9 **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, place of residence, cognitive status/dementia, preoperative waiting time
Interventions	**General details:** performed through an open approach with direct exposure of the fracture; all operations were performed by surgeons who had performed ≥ 3 procedures with both interventions; preoperative ceftriaxone (2 g); general or spinal anaesthesia; prophylactic antibiotics for 3 to 5 days; movement of hip, knee and ankle joints on POD1; continuous passive motion rehabilitation devices used twice daily; clinical examination at 1, 3, 6 and 12 months **Intervention group 1** • PFNA; solid titanium nail 170 mm or 240 mm in length and 10 mm or 11 mm in diameter; spiral blade for cephalic fixation. Configuration of distal locking for the nail group was not clearly reported • Randomised = 51; 3 months: 2 lost to follow-up, 1 died; 12 months: 4 lost to follow-up, 2 died, 2 excluded; analysed = 51 **Intervention group 2** • DHS; 3 or 4 holes and a 135° plate with a screw of appropriate size • Randomised = 55; 3 months: 2 lost to follow-up, 2 died, 1 excluded; 12 months: 3 lost to follow-up, 3 died, 1 excluded; analysed = 55
Outcomes	**Outcomes measured/reported by study authors:** mortality (at 3 and 12 months); operation time; fluoroscopy time; blood loss; blood transfusion; cut-out; union; fixation failure; wound infection; lower respiratory tract infection; decubital ulcer; UTI; cerebral infarction; LOS; mobility score (Parker scale at 3 and 12 months); time to mobilise with frame; tIme to achieve preoperative mobility; return to preoperative mobility at 12 months; shortening of the femur on radiograph at 12 months **Outcomes relevant to the review:** unplanned return to theatre (12 months); mortality (at 3 and 12 months)

Xu 2010b *(Continued)*

Notes	**Funding/sponsor/declarations of interest:** funding not reported, authors declare no conflicts of interest **Study dates:** August 2006 and June 2008

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "consecutive numbered and sealed envelopes based on a computer generated list"
Allocation concealment (selection bias)	Unclear risk	Quote: "sealed envelopes were opened before the surgeon performed the operation" Comment: study authors do not report whether envelopes are opaque or sequentially numbered
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Low risk	Quote: "All operations were performed by surgeons who had performed at least three procedures with both the PFNA and the DHS".
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the type of implant could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses were balanced between groups, and mostly explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Xu 2018

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus DHS
Participants	**Total number of randomised participants:** 100

Xu 2018 *(Continued)*

Inclusion criteria: ≥ 65 years of age; femoral neck bone density score ≤ 2.5 standard deviations; primary femoral intertrochanteric fracture

Exclusion criteria: femoral head necrosis; Evans type II fracture or other serious complications detected in imaging examinations; surgical indications

Setting: hospital; single centre; China

Baseline characteristics

Intervention group 1 (intramedullary)

- Age, mean (SD): 68.2 (± 7.4) years
- Gender, M/F: 23/27
- Comorbidities, complications (not defined), n: 33
- Fracture classification, n: Evans type Ia: 13; Ib: 16; Ic: 14; Id: 7

Intervention group 2 (extramedullary)

- Age, mean (SD): 70.3 (± 6.2) years
- Gender, M/F: 22/28
- Comorbidities, complications (not defined), n: 33
- Fracture classification, n: Evans type Ia: 15; Ib: 14; Ic: 16; Id: 5

Note:

- study authors report no baseline characteristics for: smoking history, medication history, BMI, mobility assessment, place of residence; cognitive status, ASA status, preoperative waiting time

Interventions	**General details:** prophylactic preoperative antibiotics; prophylactic anti-inflammatory therapy, subcutaneous injection of low-molecular-weight heparin calcium, and anti-osteoporosis drugs. Lower limb muscle contraction exercises on POD1. Time to weight bearing was determined according to X-ray examinations (1, 4, 6, and 12 weeks after surgery) **Intervention group 1:** • PFNA; the length of nails used was not reported in the study report; however, it is highly probable that all nails were short nails; details regarding proximal and distal locking of the nails were not reported • Randomised = 50 **Intervention group 2:** • DHS • Randomised = 50
Outcomes	**Outcomes measured/reported by study authors:** operation time, LOS, volume of blood loss, time to postoperative weight bearing, callusing time, swelling reduction time, transforming growth factor (TGF)-beta2 expression; hip function scores; complications (hip varus, femoral shaft fracture, cut-out of femoral head, fracture site infection, internal fixation breakage) **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** supported by the Research Project of the Jiangsu Health and Family Planning Commission; study authors declare no competing interests **Study dates:** January 2016 to January 2017 **Note:** • we did not complete risk of bias assessment because we included no outcome data in analysis.

Yamauchi 2014

Study characteristics	
Methods	Quasi-randomised; parallel design **Review comparison group**: extra small PFN vs DHS
Participants	**Total number of randomised participants:** 19 **Inclusion criteria:** simple intertrochanteric fractures, 31-A1.1 and A1.2. All participants selected for this study reported walking independently without the use of walking aids such as walking frames or canes before sustaining their initial fracture (i.e. they had equivalent ADL) **Exclusion criteria:** simple fractures such as femoral basal neck fracture, minor trochanter as fracture fragment, comminuted greater trochanteric fractures; pathological fractures, high-energy injuries or other multiple injuries. Participants with apparent dementia or other psychological problems and severe perioperative or postoperative complications that would result in delayed postoperative rehabilitation **Setting:** single centre; hospital; Japan **Baseline characteristics** **Intervention group 1** (intramedullary; baseline data for only 10 participants) • Age, mean (range): 79.7 (70 to 90) years • Gender, M/F: 4/6 • BMI, mean (SD): 21.38 (± 3.80) kg/m^2 • Mobility assessment: all walking independently without any aids before injury • Cognitive status/dementia: none had dementia or cognitive impairment • Preoperative waiting time, mean (SD): 5.60 (± 2.41) days • Fracture classification: all 31 A1.1 and A1.2 **Intervention group 2** (extramedullary; baseline data for only 8 participants) • Age, mean (range): 73.75 (65 to 89) years • Gender, M/F: 2/6 • BMI, mean (SD): 21.06 (± 2.74) kg/m^2 • Mobility assessment: all walking independently without any aids before injury • Cognitive status/dementia: none had dementia or cognitive impairment • Preoperative waiting time, mean (SD): 5.25 (± 2.19) days • Fracture classification: all 31 A1.1 and A1.2 **Note:** • study authors reported no baseline data for: smoking history, medication, comorbidities, place of residence, ASA status
Interventions	**General details:** a physiotherapist supervised full weight bearing and walking exercises that were performed on POD1. Plain anteroposterior and lateral radiographs were also obtained for each participant to confirm complete union of the bone. **Intervention group 1:** • PFN; short nails were used in all cases; distal locking was performed with a single screw • Randomised = 10 **Intervention group 2:** • DHS; plate fixation was performed with two screws

Yamauchi 2014 *(Continued)*

	• Randomised = 9 **Note:** • study authors do not report number of surgeons (or their skills or experience), type of anaesthesia, perioperative use of antibiotics or antithromboembolics
Outcomes	**Outcomes measured/reported by study authors:** surgical variables (duration of surgery, intraoperative blood loss, haemoglobin). Pain and ADL scores (measured at 1, 2, 3 and 4 weeks after surgery), active ROM, angle of hip flexion, and abduction, time to achieve straight leg raise, time to achieve independent standing on the surgical leg **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** no funding. Study authors declared no conflicts of interest **Study dates:** 2009 to 2012 **Note:** • we did not conduct risk of bias assessment because this study reported no review-relevant outcomes.

Yang 2011a

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus IHS
Participants	**Total number of randomised participants:** 215 **Inclusion criteria:** intertrochanteric fractures from low-energy trauma, 60 to 90 years of age, ASA status ≤ III; informed consent **Exclusion criteria:** high-energy trauma; < 60 years of age; hip joint tumours; tuberculosis, arthritis in hip, conditions not conducive to surgery **Setting:** single centre, hospital, China **Baseline characteristics** **Intervention group 1** (PFN) • Age, mean (range): 83.9 (71 to 86) years • Gender, M/F: 33/72 • Mobility assessment, independent walking/assisted walking, n: 64/37 • Fracture classification, stable/unstable, n: 39/66 **Intervention group 2** (IHS) • Age, mean (range): 83.5 (69 to 87) years • Gender, M/F: 34/76 • Mobility assessment, independent walking/assisted walking, n: 62/45 • Fracture classification, stable/unstable, n: 37/73
Interventions	**General details:** preoperative antibiotics, prophylactic anticoagulation therapy, active within 24 hours of surgery; clinical follow-up at 1, 3, 6 and 12 months **Intervention group 1**

Yang 2011a *(Continued)*

- Proximal femoral nail (manufacturer not reported); femoral head fixation with two screws
- Number randomised = 105

Intervention group 2

- Intramedullary hip screw (manufacturer not reported); femoral head fixation with a single screw
- Number randomised = 110

Outcomes	**Outcomes measured/reported by study authors:** blood loss and transfusion; mortality; postoperative complications (dislocation, fixation failure, postoperative fracture, cut-out, infection); walking ability **Outcomes relevant to the review:** mortality (12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** July 2008 to June 2010 **Note:** • study reported in Chinese with an English abstract. We used Google Translate to extract key data, including data for mortality. • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Yang 2011b

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PCCP compared with SHS
Participants	**Total number of randomised participants:** 66 **Inclusion criteria:** ≥ 18 years of age; A1 or A2 AO/OTA intertrochanteric proximal femoral fracture **Exclusion criteria:** existing or previous fractures of the same or contralateral hip; other fractures or injuries that could confound the outcome measure of interest; an inability to appear for follow-up for any reason one year after surgery; inability to understand the purpose of the study and/or an inability to give informed consent for inclusion **Setting:** single centre; hospital; USA **Baseline characteristics** **Note:** • study authors do not report any baseline characteristics
Interventions	**General details:** all participants began weight bearing as tolerated after surgery and were out of bed on the first or second postoperative day; physical therapy was initiated within 4 days of the procedure, depending on a variety of factors; mean follow-up time was 36 months **Intervention group 1** • Gotfried percutaneous compression plate (Orthofix); femoral head fixation with 2 telescoping compression and three shaft screws for distal fixation • Number randomised = 33

Yang 2011b *(Continued)*

	Intervention group 2 • Sliding hip screw (manufacturer not reported) • Number randomised = 33 **Note:** • study authors do not report the number or the skills and experience of the surgeons or any details on the anaesthetics or other medications used
Outcomes	**Outcomes measured/reported by study authors:** functional status; VAS; HRQoL (available at 2 weeks, 4 weeks and 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 months); mortality (available at 12 months); surgical time; incision length; blood loss; transfusions **Outcomes relevant to the review:** HRQoL (in SF-36, at 4 months and 12 months); mortality (reported at 12 months) **Note:** • scores for SF-36 not clearly reported and we were therefore unable to use these data
Notes	**Funding/sponsor/declarations of interest:** study authors declare that there was no external funding for this study. Study authors declare that some authors received fees or benefits of < $10,000 from commercial entities (Synthes, Orhofix, Smeith & Nephew, and Stryker) **Study dates:** July 2004 to September 2007 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Yaozeng 2010

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus Gamma 3
Participants	**Total number of randomised participants:** 107 (143 initially recruited) **Inclusion criteria:** trochanteric fracture of the femur; informed consent **Exclusion criteria:** < 60 years of age; ASA score of V; unable to walk before injury; refusal to participate **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD): 76.8 (± 9.6) years • Gender, M/F: 23/32 • Walking ability, mean (SD): 7.2 (± 2.1) • ASA status, I/II/III/IV: 9/17/21/8 • Fracture classification, stable/unstable, n: 19/36 **Intervention group 2** (Gamma 3) • Age, mean (SD): 76.6 (± 8.2) years

Yaozeng 2010 *(Continued)*

- Gender, M/F: 15/37
- Walking ability, mean (SD): 7.4 (± 1.8)
- ASA status, I/II/III/IV: 11/13/25/3
- Fracture classification, stable/unstable, n: 21/31

Note:

- study authors do not report any baseline characteristics for: smoking history; medication; BMI; co-morbidities; place of residence; cognitive status/dementia; preoperative waiting time

Interventions	**General details:** all operations were performed by surgeons who had experience with at least 5 procedures with both implants; preoperative intravenous antibiotics with 2 g of ceftriaxone; general and spinal anaesthesia were used in both groups; operated on a traction table in a supine position; suction drains for 2 days; prophylactic antibiotics for 3 days; movement of hip, knee and ankle joints from the first postoperative day; encouraged full weight bearing as soon as possible; follow-up was undertaken at 3, 6 and 12 postoperative months, and yearly thereafter **Intervention group 1:** • Proximal femoral nail antirotation (Synthes); solid titanium nail of 170 or 240 mm in length and 10 or 11 mm in diameter; neck-shaft angle is 130°; femoral head fixation with a single helical blade • Number randomised = 55 **Intervention group 2:** • Gamma third-generation (Stryker); length 170 mm; cannulated steel nail; diameter of 11 mm; neck-shaft angle is 130°; femoral head fixation with a single screw • Number randomised = 52
Outcomes	**Outcomes measured/reported by study authors:** operative time; fluoroscopy time; blood loss; intra-operative complications (femoral shaft fracture, locking difficulties, inappropriate length of screws); motion range of hip; hip pain; thigh pain; walking ability score; open reductions; hospital stay; mortality (available at 12 months); complications (lateral blade migration, delayed union, superficial wound infection, haematoma, decubital ulcer, pneumonia, UTI, cerebral infarction), re-operations (available at 12 months) **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** not reported **Study dates:** April 2007 to May 2008 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Yu 2015

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFN versus PFNA
Participants	**Total number of randomised participants:** 70 **Inclusion criteria:** osteoporotic intertrochanteric fracture

Yu 2015 *(Continued)*

Exclusion criteria: not specified in English abstract

Setting: single centre; hospital; China

Baseline characteristics

Intervention group 1 (PFN)

- Age, mean (SD): 67.9 (± 2.3) years
- Gender, M/F: 20/15
- Fracture classification, Evans-Jenson I/II/III/IV/V, n: 6/8/10/7/4

Intervention group 2 (PFNA)

- Age, mean (SD): 70.2 (± 3.1) years
- Gender, M/F: 22/13
- Fracture classification, Evans-Jenson I/II/III/IV/V, n: 8/9/9/6/3

Note:

- study authors do not report baseline data for: smoking history, medication, BMI, mobility assessment, place of residence, cognitive assessment, ASA status, preoperative waiting time

Interventions	**General details:** unknown **Intervention group 1** • Proximal femoral nail (manufacturer not reported); femoral head fixation with two screws • Number randomised = 35 **Intervention group 2** • Proximal femoral nail antirotation (manufacturer not reported); femoral head fixation with a helical blade • Number randomised = 35
Outcomes	**Outcomes measured/reported by study authors:** operation time; intraoperative blood loss; fracture healing time; postoperative complications; HHS; mortality **Outcomes relevant to the review:** mortality
Notes	**Funding/sponsor/declarations of interest:** funding not reported; study authors declare no conflicts of interest **Study dates:** June 2012 to June 2014 **Note:** • study reported in Chinese with English abstract. We used Google Translate to extract key information. We could not be certain whether data were available for mortality or reported as lost to follow-up, and therefore we did not include mortality data in the review. • we did not complete risk of bias assessments because we included no data for review outcomes.

Zehir 2015

Study characteristics	
Methods	RCT; parallel design

Zehir 2015 *(Continued)*

	Review comparison group: PFNA vs DHS
Participants	**Total number of randomised participants:** 198 **Inclusion criteria:** unstable trochanteric fractures (31 A2), > 65 years of age **Exclusion criteria:** multiple ipsilateral or contralateral fragmented or pathological fractures, intracapsular fractures, stable fractures; unable to walk or bedridden or wheelchair-bound; history of previous hip surgery at either side **Setting:** single centre; tertiary university hospital; Turkey **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD): 77.22 (± 6.82) years • Gender, M/F: 37/59 • Comorbidities, type, n: diabetes: 8; hypertension: 18; chronic pulmonary disease: 6; heart failure: 12; CAD: 1; multiple disease: 23 • Mobility assessment/use of walking aides: all able to walk prior to injury • ASA status, I/II/III/IV/V: 0/14/39/43/0 • Preoperative waiting time, mean (SD): 3.29 (± 1.8) weeks • Fracture classification, n: A2.1: 26; A2.2 41; A2.3: 29 **Intervention group 2** (DHS) • Age, mean (SD): 76.86 (± 6.74) years • Gender, M/F: 39/63 • Comorbidities, type, n: diabetes: 7; hypertension: 22; chronic pulmonary disease: 3; heart failure: 7; CAD: 5; multiple disease: 22 • Mobility assessment/use of walking aides: all able to walk prior to injury • ASA status, I/II/III/IV/V: 0/14/54/34/0 • Preoperative waiting time, mean (SD): 3.35 (± 2.0) weeks • Fracture classification, n: A2.1: 23; A2.2: 46; A2.3: 33 **Note:** • study authors report no baseline characteristics for: smoking history, medication, BMI, place of residence, cognitive status
Interventions	**General details:** 1 of 2 surgeons experienced in hip surgery; prophylactic antibiotics; under spinal, epidural, general anaesthesia, or regional; all participants mobilised out of bed and allowed weight bearing on POD1 or POD2 **Intervention group 1** • PFNA (Synthes-Stratec); nail length from 200 mm to 240 mm; diameter 9 mm or 10mm; cephalic fixation was performed with a spiral blade • Randomised = 96; no losses (except for death); analysed = 96 **Intervention group 2** • DHS (Synthes-Stratec); including 25 or 38 mm barrels and 3 to 12 holes within the shaft with the shaft length ranging from 62 mm to 206 mm • Randomised = 102; no losses (except for death); analysed = 102 **Note:** • details regarding distal locking were not reported for the nail

Zehir 2015 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** length of surgery; fluoroscopy times, volume of blood loss, mortality (in hospital, and at end of follow-up); LOS; superficial infection; deep infection; haematoma; cut-out; screw migration; pain (hip and thigh); re-operation; DVT; PE; decompensated heart failure; UTI; pneumonia; pressure ulcer; time to healing; recovery of walking ability and independent mobility; discharged to home; mean tip-apex distance **Outcomes relevant to the review:** mortality (in hospital and at end of follow-up, median follow-up is 15.95); unplanned return to theatre (12 months)
Notes	**Funding/sponsor/declarations of interest:** funding not reported. Study authors declared no conflicts of interest **Study dates:** January 2010 and March 2013

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Using a computer-based random number generator, patients were randomly allocated"
Allocation concealment (selection bias)	Unclear risk	Although sealed envelopes were used, study authors do not report if envelopes were opaque or sequentially numbered.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Experienced hip surgeons, but study authors do not report if surgeons are experienced with using both types of implants in this study
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	Clinically-reported subjective measures were assessed by independent radiographers. However, we assume that no attempts were made to conceal types of interventions, in which case there is a lack of blinding for these subjective measures.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Losses explained by death, which is expected in this population.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Zhang 2013

Study characteristics

Zhang 2013 *(Continued)*

Methods	RCT; parallel design **Review comparison group**: InterTAN nail versus PFNA-II
Participants	**Total number of randomised participants:** 113 **Inclusion criteria:** unstable trochanteric fractures of the femur; informed consent; low-energy trauma **Exclusion criteria:** high-energy trauma; pathological fractures; open fractures; multiple fractures; ASA score of V; inability to walk before injury; presence of degenerative osteoarthritis/arthritis in the injured hip **Setting:** single centre, hospital, China **Baseline characteristics** **Intervention group 1** (PFNA II) • Age, mean (SD): 72.4 (± 8.7) years • Gender, M/F: 19/37 • ASA status, I/II/III/IV: 8/16/24/8 • AO classification, A2.1/A2.2/A2.3/A3.1/A3.2/A3.3, n: 11/19/15/5/3/3 • HHS, mean (SD): 58.7 (± 9.8) **Intervention group 2** (InterTAN) • Age, mean (SD): 72.9 (± 7.6) years • Gender, M/F: 23/34 • ASA status, I/II/III/IV: 10/17/23/7 • AO classification, A2.1/A2.2/A2.3/A3.1/A3.2/A3.3, n: 9/21/15/4/3/5 • HHS, mean (SD): 56.3 (± 7.6) **Note:** • study authors do not report baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; preoperative waiting time
Interventions	**General details:** all surgeries were performed by surgeons who had performed at least 5 procedures independently with each implant; general or spinal anaesthesia were used; participants underwent prophylaxis for thrombosis perioperatively and received prophylactic antibiotics 30 minutes preoperatively; participants were operated on while in a supine position on a traction table; postoperatively, all participants had suction drains placed for 48 hours and were given prophylactic antibiotics for 24 hours; all participants were encouraged to walk with full weight bearing, while assisted by a physiotherapist, as soon as possible postoperatively; follow-up occurred at 1, 3, 6 and 12 months postoperatively and yearly thereafter **Intervention group 1** • Trigen InterTAN (Smith and Nephew); trapezoidal proximal end; 180 mm long and a diameter decreasing from 15.25 X 16.25 mm at the proximal end to 11 mm at the distal end; the proximal end of the nail will accept two cephalocervical screws: a larger superior 11 mm lag screw and a smaller 7 mm compression screw • Number randomised = 57 **Intervention group 2** • Proximal femoral nail anti-rotation-II (Synthes); solid titanium nail; length 170 or 200 mm; 9, 10 or 11 mm in diameter; femoral head fixation with a helical blade • Number randomised = 56

Zhang 2013 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** intraoperative time; fluoroscopy time; intraoperative blood loss; length of hospital stay; complications (superficial wound infection, deep infection, haematoma, cut-out, lateral hip migration screw, femoral shaft fracture, DVT, pulmonary embolism, pressure sores, UTI); fixation failures; hip range of motion; pain in the hip and thigh; walking ability score; postoperative complications (wound infection and pulmonary, cardiovascular, thromboembolic, renal and gastrointestinal disorders); fracture complications (cut-out, implant breakage, revision surgery); HHS; TAD; mortality (reported at 12 months); mean time to bone healing; re-operations (available at 12 months); walking **Outcomes relevant to the review:** mortality (reported at 12 months); unplanned return to theatre (reported at 12 months)
Notes	**Funding/sponsor/declarations of interest:** the study authors have no relevant financial relationships to disclose **Study dates:** July 2009 to September 2010 **Note:** • we did not conduct risk of bias assessment for this study because we were unable to include any data in the networks.

Zhang 2018

Study characteristics	
Methods	RCT; parallel design **Review comparison group**: PFNA versus hip arthroplasty
Participants	**Total number of randomised participants:** 100 **Inclusion criteria:** > 18 years of age; no history of bone fractures; clinically diagnosed unstable osteoporotic femoral intertrochanteric fracture; decision to receive surgery **Exclusion criteria:** severe dysfunction of liver and kidney; open fracture; pathological fracture; complicated with coagulation disorders, manifested surgical contraindication, inability to co-operate **Setting:** single centre; hospital; China **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (SD): 66.5 (± 2.9) years • Gender, M/F: 31/19 • AO classification, A1/A2/A3, n: 7/23/20 **Intervention group 2** (hip arthroplasty) • Age, mean (SD): 67.0 (± 2.6) years • Gender, M/F: 34/16 • AO classification, A1/A2/A3, n: 10/26/14 **Note:** • study authors do not report any baseline characteristics for: smoking history; medication; BMI; comorbidities; mobility assessment; place of residence; cognitive status/dementia; ASA status; preoperative waiting time

Zhang 2018 *(Continued)*

Interventions	**General details:** general anaesthesia was used for all surgeries **Intervention group 1** • Proximal femoral nail antirotation (manufacturer not reported); femoral head fixation with a single helical blade; nails were locked distally • Number randomised = 50 **Intervention group 2** • Hip arthroplasty (manufacturer not reported); no further implant details reported • Number randomised = 50 **Note:** • study authors do not report; any general details; the number of surgeons or their skills and experience; any details on the pre-/postoperative care
Outcomes	**Outcomes measured/reported by study authors:** duration of surgery, intraoperative blood loss, length of hospital stay; DVT; pulmonary infection; joint dislocation; prosthetic loosening; HHS **Outcomes relevant to the review:** none
Notes	**Funding/sponsor/declarations of interest:** study authors report no conflict of interest with no detail of funding reported **Study dates:** January 2015 to December 2017 **Note:** • we did not complete risk of bias assessment because the study reported no review-relevant outcomes.

Zhou 2012

Study characteristics	
Methods	RCT; parallel design **Review comparison group:** PNFA versus LISS (less-invasive stabilisation system)
Participants	**Total number of randomised participants:** 68 **Inclusion criteria:** OTA Type 31A proximal femoral fracture; closed fractures; treated within 3 weeks of injury **Exclusion criteria:** open fractures; pathologic fractures; delayed fractures; multiple fractures; periprosthetic fractures **Setting:** single centre; orthopaedic hospital; China **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (range): 76.19 (42 to 103) years • Gender, M/F: 17/19 • ASA status, I/II/III/IV: 1/21/14/0

Zhou 2012 *(Continued)*

- Fracture classification, OTA group, n:
  - 31A1.1, 3
  - 31A1.2, 3
  - 31A1.3, 2
  - 31A2.1, 7
  - 31A2.2, 11
  - 31A2.3, 10
  - 31A3.1, 0
  - 31A3.2, 0
  - 31A3.3, 0

Intervention group 2 (LISS)

- Age, mean (range): 67.75 (24 to 87) years
- Gender, M/F: 13/15
- ASA status, I/II/III/IV: 2/15/10/1
- Fracture classification, OTA group, n:
  - 31A1.1, 2
  - 31A1.2, 1
  - 31A1.3, 0
  - 31A2.1, 4
  - 31A2.2, 6
  - 31A2.3, 8
  - 31A3.1, 2
  - 31A3.2, 4
  - 31A3.3, 1

Note:

- study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment/use of walking aides, place of residence, cognitive status/dementia, preoperative waiting time

Interventions	**General details:** fracture table and image intensifier were used; performed by 3 senior surgeons; preoperative intravenous antibiotics with 1.5 g cefuroxime; spinal or general anaesthesia; low-molecular-weight heparin was used as thromboembolic prophylaxis for 5 days; postoperative prophylactic antibiotics (1.5 g cefuroxime, 3 doses); weight bearing dependent on radiographs and partial healing; clinical examination at 1, 3, 6 and 12 months **Intervention group 1** • PFNA (Synthes); nail diameter 12 mm; cephalic fixation was performed using the helical blade. Nail lengths were not reported but it is highly probable that all nails used in the study were short nails; details regarding distal locking of the nails were not reported • Randomised = 40; 4 excluded after randomisation (because surgeon thought a nail should not be used with Type A3 fracture); analysed = 36 **Intervention group 2** • LISS (Synthes); the plates were secured with three or four screws in the proximal and four screws in the femoral shaft • Randomised = 28; 1 lost to follow-up; analysed = 28 **Note:** • some discrepancies between text and tables in the study report. For mortality, we used data for deaths as reported in the table of the study report

Zhou 2012 *(Continued)*

Outcomes	**Outcomes measured/reported by study authors:** mortality; postoperative complications; unplanned return to theatre; intraoperative time; intraoperative blood loss; LOS; hip function (HHS); radiograph evaluation; length of follow-up: mean 26.8 months (range 21 to 36 months) **Outcomes relevant to the review:** mortality (at 1 months and 6 months); unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** quote: "no financial support was received for the work on this project" **Study dates:** December 2006 to March 2008

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: “the patients were randomised by a computer generated list”
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	High risk	Quotes: “Surgery was performed by three senior surgeons” and “The longer operative time in the LISS group compared with the PFNA group in the study may be the result of the learning curve" Comment: we judged that surgeons were not equally experienced with both implants
Blinding of outcome assessment: mortality (detection bias)	Low risk	We did not expect that lack of blinding of outcome assessors would influence objective outcome data.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the intervention could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Data were reported for all outcomes. We noted some discrepancies between text and tables in the study report, but these were for a small number of participants and we did not expect that they would influence the data.
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or pre-published protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

Zou 2009

Study characteristics

Methods	RCT; parallel design

Zou 2009 *(Continued)*

	Review comparison group: PFNA versus DHS
Participants	**Total number of randomised participants:** 121 **Inclusion criteria:** low-energy trochanteric proximal femoral fractures. **Exclusion criteria:** pathological fracture or multiple injuries **Setting:** single centre; orthopaedic hospital; China **Baseline characteristics** **Intervention group 1** (PFNA) • Age, mean (range): 65 (37 to 91) years • Gender, M/F: 12/46 • Fracture classification, n: described as (31-A1) stable, 42; and (31-A2/31-A3) unstable 16 **Intervention group 2** (DHS) • Age, mean (range): 65 (34 to 89) years • Gender, M/F: 15/48 • Fracture classification, n: described as (31-A1) stable, 52; and (31-A2/31-A3) unstable 11 **Note:** • study authors did not report: smoking history, medication, BMI, comorbidities, mobility assessment/use of walking aides, place of residence, cognitive status/dementia, preoperative waiting time
Interventions	**General details:** supine position on a fracture table; participants were mobilised and given standard rehabilitation instructions; prophylactic intravenous antibiotic; clinical examinations at 6 weeks, 3, 6 and 9 months, and then annually; no details on surgeons' experience **Intervention group 1** • PFNA; nail lengths 170 mm, 200 mm or 240 mm; nail diameter 10 mm, 11 mm or 12mm; cephalic fixation was performed with the helical blade. Details regarding distal locking of nails were not reported in the study report. • Randomised = 58; no reported loss to follow-up, analysed = 58 **Intervention group 2** • DHS; no further details on implant types • Randomised = 63; no reported loss to follow-up, analysed = 63
Outcomes	**Outcomes measured/reported by study authors:** functional outcome at 12 months using the Salvati and Wilson (Salvati 1973) scoring system: categorised as excellent (≥ 32), good (24 to 31), fair (16 to 23) or poor (≤ 15); length of surgery; operative blood loss; radiographic screening time; cut-out of the implant; fracture; non-union; implant breakage; re-operation; superficial and deep wound infection; DVT; LOS; time point unclear, assumed to be 12 months unless reporting operative data **Outcomes relevant to the review:** unplanned return to theatre
Notes	**Funding/sponsor/declarations of interest:** funding not reported; study authors declared no conflicts of interest **Study dates:** January 2006 and December 2007

Risk of bias

Bias	Authors' judgement	Support for judgement

Zou 2009 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	No details
Allocation concealment (selection bias)	Unclear risk	No details
Blinding of participants and personnel (performance bias) All outcomes	Low risk	It is not possible to blind surgeons to the type of intervention. We did not, however, expect that this would influence surgeon performance.
Other performance bias: surgeon experience of both implants	Unclear risk	Study authors did not describe how many surgeons were involved in the study and whether they were equally experienced with the types of implants used in this study.
Blinding of outcome assessment: unplanned return to theatre (detection bias)	High risk	It is not possible to blind surgeons to treatment groups. We judged that knowledge of the intervention could influence judgments made by surgeons when assessing subjective outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No apparent losses
Selective reporting (reporting bias)	Unclear risk	Study authors do not report registration with a clinical trials register or prepublished protocol. It is not feasible to effectively assess risk of selective reporting bias without these documents.
Other bias	Low risk	We identified no other sources of bias.

ADL: activities of daily living; **AF:** atrial fibrillation; **AO/OTA:** Arbeitsgemeinschaft für Osteosynthesefragen (German for "Association for the Study of Internal Fixation")/Orthopaedic Trauma Association; **AP**: angled blade plate;**AMTS:** abbreviated mental test score; **ASA:** American Society of Anesthesiologists; **AVN**: avascular necrosis; **BMD**: bone mineral density; **BMI**: body mass index; **CAD:** coronary artery disease; **CaP**: calcium phosphate; **CCD**: caput-collum-diaphyseal; **CHF:** chronic heart failure; **CHS**: compression hip screw; **COPD**: chronic obstructive pulmonary disease; **CRF**: chronic renal failure; **CSP**: compression screw-plate; **CVA**: cerebrovascular accident; **DCS**: dynamic compression screw; **DHS**: dynamic hip screw; **DHHS**: dynamic helical hip system; **DHPS**: dynamic hip plating system; **DVT:** deep vein thrombosis; **EQ-5D (-3L/-5L):** EuroQol 5 dimensions (3 levels/5 levels); **FIM:** Functional Independence Measure; **FRS**: functional recovery score; **G3**: Gamma 3; **HA**: hemiarthroplasty; **HHS**: Harris hip score; **HIV:** human immunodeficiency virus; **HRQoL**: health related quality of life; **ICECAP-O:** ICEpop capability measure for older people; **ICU**: intensive care unit; **IHS**: intramedullary hip screw; **IM:** intramedullary; **IMHS**: intramedullary hip screw; **IQR:** interquartile range; **IT**: InterTan; **ITST**: type of nail (not defined in study report); **ITT:** intention-to-treat; **IU:** international units; **IV:** intravenous(ly); **LEM:** Lower Extremity Measure; **LISS:** less-invasive stabilisation system; **LOS:** length of stay; **MCL**: McLaughlin nail-plate; **MI**: myocardial infarction; **MIDHS**: minimally invasive dynamic hip screw; **MMS**: mean mobility score; **MMSE:** mini-mental state examination; **MSP**: Medoff sliding plate; **NR:** not reported; **OPF**: Orthofix pertrochanteric fixator; **PC(C)P**: percutaneous compression plate; **PE:** pulmonary embolism; **PFLP**: proximal femoral locking plate; **PFLCP**: proximal femur locking compression plate; **PFN**: proximal femoral nail; **PFNA**: proximal femoral nail antirotation; **POD**: postoperative day; **RAB**: Rigidity Augmentation Baixauli; **RCT:** randomised controlled trial; **ROM:** range of motion; **RSA:** radiostereometry; **TSD:** standard deviation; **SEM:** standard error of the mean; **SF-12 (PCS; MCS):** Short Form 12-item questionnaire (Physical component score; Mental component score);**SF-36:** Short Form 36-item questionnaire; **SHS**: sliding hip screw; **SPMSQ**: short portable mental status questionnaire; **SSP**: sliding screw plate; **TAD**: tip-apex distance; **TGN:** trochanteric Gamma nail; **THA:** total hip arthroplasty; **TIA:** transient ischaemic attack; **TSP**: trochanteric support plate; **TUG:** timed up-and-go test; **2MWT:** Two-Minute Walk Test; **WOMAC**: Western Ontario and McMaster Universities Arthritis Index; **UTI**: urinary tract infection; **VAS**: visual analogue scale; **VDP**: Vandeputte; **yr:** year

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
ACTRN12608000162314	Study comparing Gamma nail versus DHS. We received communication from the study contact (Rob Molnar; on 3 August 2015) to explain that the study was abandoned early because of poor recruitment. We excluded this study because no outcome data are available.
Ahmad 2011	RCT comparing intramedullary hip screw versus compression hip screw. Published only as abstracts which contain insufficient information to justify inclusion in the review.
Alobaid 2004	Quasi-RCT comparing minimally-invasive surgical technique with a conventional surgical technique using a DHS in both groups. We excluded this study because it did not compare interventions from our review criteria.
Bong 1981	RCT comparing skeletal traction with tibial pin versus medial displacement osteotomy versus valgus osteotomy. We excluded this study because the comparisons were not consistent with our review criteria.
El-Desouky 2016	RCT comparing proximal femoral locking plate versus anatomical reduction. We excluded this study because it included mostly younger participants with high-energy trauma.
Emami 2013	Quasi-RCT comparing DHS with bipolar HA. We excluded this study because the participants were aged between 45 and 65 years of age, and therefore did not meet our review criterion of older participants.
Gupta 2012	RCT comparing condylocephalic nail versus compression hip screw. We excluded this study because it was reported as an abstract with insufficient information.
Kumar 1996	RCT comparing anatomical reduction with medialisation osteotomy using a DHS in both groups. We excluded this study because it did not compare interventions from our review criteria.
Kumar 2006	RCT comparing DHS versus DHS with modular TSP fixation in unstable intertrochanteric fractures. We excluded this study because it was reported as an abstract with insufficient information.
Lee 2007a	RCT comparing minimally-invasive surgical technique with a conventional surgical technique using a DHS in both groups. We excluded this study because it did not compare interventions from our review criteria.
Lee 2007b	Quasi-RCT comparing Russell-Taylor reconstruction intramedullary nail versus dynamic condylar screw. We excluded this study which evaluates hip fractures in younger adults < 55 years of age.
Li 2015a	RCT comparing traditional Chinese medicine with conventional treatment using a DHS in both groups. We excluded this study because it did not compare interventions from our review criteria.
NCT00323232	RCT comparing DHS as either a 2-hole or 4-hole device. Study is registered as completed in the clinical trials register in 2011. We have not sourced a full-text report for this study and we do not expect the results of this study will be published.
NCT00686023	RCT comparing inflatable PFN versus DHS. Clinical trials register states that expected study completion was in 2012. The trial register has not been updated. We excluded this study because we presume that this study has not been, or is unlikely to be, completed.
NCT00736684	RCT comparing Gamma nail versus PFNA. Clinical trials register states that study completion was in 2009. The trial register has not been updated. We excluded this study because we presume that this study has not been, or is unlikely to be, completed.
NCT01173744	RCT comparing Gamma nails with DHS. Clinical trials register states that expected study completion was in 2012. The trial register has not been updated. We excluded this study because we presume that this study has not been, or is unlikely to be, completed.

Study	Reason for exclusion
NCT01238068	RCT comparing Gamma nail with DHS. Clinical trials register states that expected study completion was in 2011. The trial register has not been updated. We excluded this study because we presume that this study has not been, or is unlikely to be, completed.
NCT03065101	RCT comparing Trigen Intertan nail with SHS. Clinical trials register states that the study was terminated because of low recruitment. We excluded this study because we did not have contact details for the principal investigator to confirm study status/recruitment, and we presume that the results of this study are unavailable.
Savadhkoohi 2016	RCT comparing intramedullary nail with dynamic compression screw in subtrochanteric fractures. We excluded this study because it was reported as an abstract with insufficient information.
Sher 1985	Oral presentation of RCT comparing SHS with Küntscher Y nail. We excluded this study because the short report/abstract contained insufficient information.
Wong 2009	RCT comparing minimally-invasive surgical technique with a conventional surgical technique using a DHS in both groups. We excluded this study because it did not compare interventions from our review criteria.

DHS: dynamic hip screw; **HA:** hemiarthroplasty; **PFN(A):** proximal femoral nail (antirotation); **RCT:** randomised controlled trial; **TSP:** trochanteric support plate

Characteristics of studies awaiting classification *[ordered by study ID]*

ISRCTN32393360

Methods	RCT; parallel design
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** people with extracapsular fractures
Interventions	Compression hip screw versus intramedullary hip screw
Outcomes	Stroke volume, cardiac output, mean arterial pressure; oxygen saturation; length of hospital stay; pulmonary embolism; mortality
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was unavailable. We have used limited information available in the Cochrane Central Register of Controlled Trials. The year of publication is reported as 2005, and we therefore expect that this study is completed. We do not have contact details and have not been able to determine if this study is already published.

ISRCTN48618754

Methods	RCT; parallel design
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** people presenting with an extracapsular hip fracture at Huddersfield Royal Infirmary
Interventions	Hansson Twin Hook versus lag screw

ISRCTN48618754 *(Continued)*

Outcomes	General and local complications, length of hospital stay, pain, mobility, hip characteristics, hip function, surgical/radiological evaluations
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was unavailable. We have used limited information available in the Cochrane Central Register of Controlled Trials. The year of publication is reported as 2004, and we therefore expect that this study is completed. We do not have contact details and have not been able to determine if this study is already published.

JPRN-UMIN000018307

Methods	RCT; parallel design
Participants	**Estimated participant enrolment:** 195 **Inclusion criteria:** femoral trochanteric fracture (candidate for short femoral nail fixation); AO classification A1 and A2; written consent was obtained to participate in the study **Exclusion criteria:** adolescent who needed informed consent; individual who may present difficulties for CT analysis due to metal artefacts by metal implantation at proximal femur or other factors; ruled unfit for the study by a surgeon
Interventions	Short femoral nail with an integrated lag screw versus short femoral nail with a single lag screw
Outcomes	Rotational angle of proximal fragment; cut out; position of implant
Notes	Study described in clinical trials register as completed in March 2019. Some brief data reported in the clinical trials register. We await publication of the full study report.

NCT01380444

Methods	RCT; parallel design
Participants	**Estimated number of participants**: 736 participants **Inclusion criteria** • Adult men or women aged 18 years and older (with no upper age limit) • An intertrochanteric fracture (stable or unstable), AO Type 31-A1 or 31-A2, confirmed with antero-posterior and lateral hip radiographs, computed tomography, or magnetic resonance imaging • Low-energy fracture (defined as a fall from standing height) • No other major trauma. Individual was ambulatory prior to fracture, though they may have used an aid such as a cane or a walker • Anticipated medical optimisation of the patient for operative fixation of the proximal femur • Operative treatment within 7 days after the trauma. (Operative treatment should take place as soon as possible as permitted by each institution's standard of care.) • Provision of informed consent by patient or proxy **Exclusion criteria** • Associated major injuries of the lower extremity (i.e. ipsilateral or contralateral fractures (or both) of the foot, ankle, tibia, fibula, or knee; dislocations of the ankle, knee, or hip). • Retained hardware around the affected proximal femur. Infection around the proximal femur (i.e. soft tissue or bone)

NCT01380444 *(Continued)*

	• People with disorders of bone metabolism other than osteoporosis (i.e. Paget's disease, renal osteodystrophy, or osteomalacia) • People with Parkinson's disease severe enough to increase the likelihood of falling or severe enough to compromise rehabilitation • People with a subtrochanteric fracture • People with a pathologic fracture • People with a reverse oblique fracture pattern, fracture AO Type 31-A3 • Obesity in the judgment of the attending surgeon • Off-label use of the implant • People with a previous history of frank dementia that would interfere with assessment of the primary outcome (i.e. EQ-5D at 1 year) • Likely problems, in the judgment of the Site Investigators, with maintaining follow-up. "We will, for example, exclude patients with no fixed address, those who report a plan to move out of town in the next year, or intellectually challenged patients without adequate family support." • Individual is enrolled in another ongoing drug or surgical intervention trial • If the attending surgeon believes that there is another reason to exclude this individual from INSITE. This reason will be documented on the case report forms.
Interventions	Gamma 3 nail (Stryker) versus the Sliding Hip Screw
Outcomes	Length of follow-up: 2 years • HQRoL (EQ-5D, Parker mobility score); time frame: hospital admission, post-surgery, 13 weeks, 26 weeks, 52 weeks, and 104 week • Fracture healing rates; time frame: up to 104 weeks • Fracture-related adverse events; time frame: up to 104 weeks • Revision surgery rates including unplanned surgery after the initial fixation to promote fracture healing (non-union), relieve pain (avascular necrosis, early or late implant failure), treat infection, or improve function will be considered a study event; time frame: up to 104 weeks
Notes	Expected completion date: March 2017 Sponsor: Stryker Trauma GmbH This trial is being conducted at 26 centres in 12 countries. It is likely that the REGAIN 2008 study has acted as a pilot for this trial. Study authors contacted in April 2021. They confirmed that a publication was imminent but it was not possible to obtain preprint data.

NCT02171897

Methods	RCT; parallel design
Participants	**Expected number of participants:** 70 **Inclusion criteria:** • provided written informed consent • > 18 years of age • < 70 years of age • presenting with a fracture of the trochanter (type 1 to 6 according to the Ender classification, and A1 and A2 according to the AO classification **Exclusion criteria:**

NCT02171897 *(Continued)*

- adult under guardianship
- not covered by national health insurance
- pregnant or breastfeeding women
- unable to walk independently before the trauma
- with dementia

Interventions	Fixation with nail, plate, or screw versus THA
Outcomes	HHS; functional score; time to weight bearing; subjective satisfaction score (EQ-5D, and VAS score for pain at rest); Parker score; complications (loosening, fractures, infections, phlebitis pulmonary embolism), mortality (12 months)
Notes	Study listed as completed in the clinical trials register. We await publication of the full study results.

NCT02294747

Methods	RCT; parallel design
Participants	**Expected number of participants:** 31 **Inclusion criteria:** • AO 31-A2 • able to walk independently, aids such as crutches or walker allowed • able to consent • fit for surgery with SHS with or without trochanteric support plate **Exclusion criteria:** • not willing or able to attain follow-up • previous fracture or surgery with retained metal work in the same hip • concomitant disease that will shorten life expectancy
Interventions	SHS with and without trochanteric support plate
Outcomes	Fracture displacement healing; perioperative blood loss; time of surgery; EQ-5D; time to union; HHS; pain; TUG; satisfaction with operated hip motion during healing
Notes	Study listed as complete in the clinical trials register. We await publication of full study results.

NCT02788994

Methods	RCT, parallel design
Participants	**Expected number of participants:** 60 **Inclusion criteria** • 55 to 95 years • fresh unstable (AO/OTA type A2) pertrochanteric fracture • if medically fit, participant will undergo surgical fixation within 48 hours of admission. Otherwise, all participants must undergo surgery within 7 days of admission. • informed consent/assent to participate in the study

NCT02788994 *(Continued)*

	• in the opinion of investigating team, participant able to complete the study assessment and visit schedule
Interventions	Endovis BA2 nail versus DHS
Outcomes	Mobility (TUG); length of hospital stay
Notes	We contacted trialists (Peter Giannoudis) in April 2021. Trialists confirmed that publication is in process but were unable to share data at this point.

NCT03000972

Methods	RCT; parallel design
Participants	**Expected number of participants:** 20 **Inclusion criteria:** • intertrochanteric hip fracture AO 31-A1 or AO 31-A2 • healthy contralateral hip • ASA status class I or II **Exclusion criteria:** • dementia
Interventions	PFNA with and without cement augmentation
Outcomes	Fluoride uptake; HHS
Notes	Study listed as completed in clinical trials register. We await publication of the full study results.

NCT03635320

Methods	RCT; parallel design
Participants	**Expected number of participants:** 188 **Inclusion criteria:** • ≥ 18 years of age • with unilateral proximal femur fractures that will be treated with intramedullary nail internal fixation According to AO fracture classification, subjects with following fracture type: • pertrochanteric (31-A1 and 31-A2) • intertrochanteric (31-A3) • trochanteric area (31-A1/A2/A3) with diaphyseal extension • participant must be comfortable with speaking and understanding questions and responses in an available translated language for patient-reported outcomes **Exclusion criteria:** • participant does not provide voluntary consent to participate in the study

NCT03635320 *(Continued)*

- women who are pregnant or lactating
- fractures where the operative treatment will occur > 3 weeks after the primary injury
- people with femoral head fractures and femoral neck fractures (AO classification 31-B and 31-C)
- pathological fracture (e.g. primary or metastatic tumour)
- serious soft tissue injury, judged by the investigator, that will impact the union of the fracture, combined vascular injury, and combined osteofascial compartment syndrome
- multiple systemic injuries judged by researchers not suitable for enrolment, or orthopaedic fractures in other bones at three or more sites
- revision surgeries (for example, due to malunion, non-union or infection)
- concurrent medical conditions judged by researchers not suitable for enrolment, such as: diabetes, metabolic bone disease, post-polio syndrome, poor bone quality, prior history of poor fracture healing, etc.
- people with anaesthetic and surgical contraindications
- people known to be allergic to implant components
- people who are currently using chemotherapeutics or accepting radiotherapy, use systematically corticosteroid hormone or growth factor, or long-term use sedative hypnotics (continuous use over 3 months) or non-steroidal anti-inflammatory drugs (continuous use over 3 months)
- intemperance judged by researchers, not suitable for enrolment (e.g. excessive daily drinking or smoking, drug abuse)
- people who have participated in other clinical trial in the previous 3 months
- people with poor compliance judged by researchers, and cannot complete the test according to test scheme, such as schizophrenia and dementia

Interventions	TFNA vs PFNA-II
Outcomes	Fracture union; adverse events; revision; re-operation; HRQoL (SF-12; EQ-5D); HHS
Notes	Study listed as completed in clinical trials register. We await publication of the full study report.

NCT03849014

Methods	RCT; parallel design
Participants	**Expected number of participants:** 52 **Inclusion criteria:** • trochanteric region fractures AO/OTA 31.A1 and 31.A2 • time from fracture until surgery up to 1 week • ASA I to III • willing to participate **Exclusion criteria:** • polytrauma patients • open fractures • existing local or systemic infection • pre-existing coagulatory disorder • existing malignancy • corticosteroid use • systemic inflammatory disease • voluntary withdrawal of the individual
Interventions	PFN versus DHS

NCT03849014 *(Continued)*

Outcomes	Mortality and complications
Notes	Study listed as completed in clinical trials register. We await publication of the full study report.

NCT04240743

Methods	RCT; parallel design
Participants	**Expected number of participants:** 64 **Inclusion criteria:** • basicervical fracture • ≥ 65 years of age • an isolated fracture • the ability to walk independently (with or without an aid) prior to fracture • a fracture that had occurred < 1 week prior to admission **Exclusion criteria:** • history of ipsilateral femoral fracture • a fracture due to malignancy • limited life expectancy due to medical comorbidities • any contraindication to surgery • diagnosed dementia • any other traumatic fracture on admission
Interventions	Cephalomedullary nail vs SHS
Outcomes	Mobility; HHS; BI: TAP; fracture settling
Notes	Study listed as completed in clinical trials register. We await publication of the full study report.

REGAIN 2008

Methods	RCT; parallel design
Participants	**Estimated number of participants**: 90 participants; 85 participants reported in a conference abstract (see Notes) **Inclusion criteria** • adult men or women aged 50 years and older (with no upper age limit) • intertrochanteric fracture (stable or unstable) confirmed with anterior and posterior lateral hip radiographs, computed tomography, or magnetic resonance imaging • operative treatment within 3 days after the trauma • ambulatory prior to fracture, though they may have used an aid such as a cane or a walker • anticipated medical optimalisation of the participant for operative fixation of the hip • provision of informed consent by participant or proxy • low-energy fracture (defined as a fall from standing height) • no other major trauma **Exclusion criteria**

REGAIN 2008 *(Continued)*

- associated major injuries of the lower extremity (i.e. ipsilateral or contralateral fractures of the foot, ankle, tibia, fibula, knee, or femur; dislocations of the ankle, knee, or hip; or femoral head defects or fracture)
- retained hardware around the affected hip
- infection around the hip (i.e. soft tissue or bone)
- people with disorders of bone metabolism other than osteoporosis (i.e. Paget's disease, renal osteodystrophy, or osteomalacia)
- moderate or severe cognitively impaired people (i.e. 6-Item Screener with ≥ 3 errors)
- Parkinson's disease (or dementia) severe enough to increase the likelihood of falling or severe enough to compromise rehabilitation
- likely problems, in the judgment of the investigators, with maintaining follow-up. The investigators will, for example, exclude people with no fixed address, those who report a plan to move out of town in the next year, or intellectually challenged people without adequate family support
- if the attending surgeon believes that a person should be excluded from REGAIN because they are enrolled in another ongoing drug or surgical intervention trial
- if the attending surgeon believes that there is another reason to exclude the individual from the study. This reason will be documented on the case report forms.

Interventions	Gamma 3 intramedullary nail (Stryker) versus the sliding hip screw
Outcomes	Length of follow-up: 2 years • Rates of revision surgery • HRQoL (SF-12, WOMAC, EQ-5D, Merle d'Aubigne, Parker Mobility score); time frame: hospital admission, 1 and 2 weeks, 3, 6, 9,12, 18 and 24 months • Fracture healing rates; time frame: 3, 6, 9,12, 18 and 24 months • Complications (mortality, femoral shaft fracture, avascular necrosis, non-union, malunion, implant breakage/failure, infection); time frame: hospital admission, 1 and 2 weeks, 3, 6, 9,12, 18 and 24 months
Notes	On WHO International Clinical Trials Registry (ICTR) platform, the trial (NCT00555945) is documented as recruitment complete with no results posted. No response was received from Dr Sprague who was emailed on 1 August 2015 requesting a further update on the trial regarding publication. This trial, which was conducted at three centres in Canada, Denmark and Sweden, was reported in a conference abstract (Bhandari 2011). It is termed a pilot study and thus it is very likely to be the pilot for NCT01380444.

ASA: American Society of Anesthesiologists; **BI:** Barthel Index; **DHS:** dynamic hip screw; **EQ-5D:** EuroQol 5-dimension quality of life questionnaire; **HHS:** Harris Hip Score; **HRQoL:** health-related quality of life; **PFN:** proximal femoral nail; **PFNA:** proximal femoral nail antirotation; **RCT:** randomised controlled trial; **SF-12:** Short Form 12-item questionnaire; **SHS:** sliding hip screw; **TAP:** tip-apex distance; **TFNA:** trochanteric fixation nail advanced; **THA:** total hip arthroplasty; **TUG:** timed up and go test;**VAS:** visual analogue scale; **WHO:** World Health Organization; **WOMAC:** Western Ontario and McMaster Universities Osteoarthritis Index

Characteristics of ongoing studies *[ordered by study ID]*

ACTRN12610000992000

Study name	Locking plate for treatment of intertrochanteric hip fractures
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 100 **Inclusion criteria:** primary intertrochanteric hip fracture; BMI < 30 kg/m^2; no other diseases likely to affect outcome of fracture healing; no other previous surgical treatments

ACTRN12610000992000 *(Continued)*

	Exclusion criteria: BMI > 30 kg/m^2; other surgical treatment; health condition is not stable; other diseases affecting bone healing (such as cancer, kidney disease, needing corticosteroids)
Interventions	Locking plate versus Gamma nail
Outcomes	Incision length; transfusion volume; healing of fracture; functional scores (HHS); range of movement
Starting date	November 2010; register describes study as still recruiting
Contact information	Zhao Xiang; dr.zhaoxiang@gmail.com
Notes	

ACTRN12618001431213

Study name	Evaluating the treatment methods of proximal femur fractures in elderly trauma patients
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 900 **Inclusion criteria:** traumatic extracapsular hip fracture; closed injury; aged over 60 years; ability to be followed for up to 6 months; presentation to hospital within 14 days of injury **Exclusion criteria:** concomitant injuries affecting treatment and rehabilitation of the affected limb; associated neurovascular injuries requiring immediate surgery; consent is refused; limited English proficiency including family members
Interventions	InterTAN (locked and unlocked) versus Gamma nail (unlocked)
Outcomes	Device failure; injury-specific complications (perioperative technical complications, surgical site infection, unplanned surgery, mortality); functional independence measure (FIM); TUG; re-operation; general medical complications; return to mobility circumstances; gross motor activity; duration of operation; fluoroscopy time; TAD; range of motion; hip join contact forces and moments; hip muscle function; hip muscle asymmetry; nail and screw sizes used by operating team; HHS; pain (VAS)
Starting date	August 2018
Contact information	A/Prof Mark Rickman; mark.rickman@sa.gov.au
Notes	

ChiCTR1900025588

Study name	A randomized control trial for combined proximal femur intramedullary nail and lateral wall plate for the treatment of pantrochanteric fracture
Methods	Unknown
Participants	**Estimated participant enrolment:** unknown

ChiCTR1900025588 *(Continued)*

	Inclusion criteria: at least 60 years of age; male and female; diagnosis of internal and external unstable femoral intertrochanteric fractures (Babhulkar modified type B and C fractures); undergoing surgery in the hospital; informed consent
Interventions	Intramedullary nail versus intramedullary nail with lateral plate
Outcomes	Failure rate; fracture-associated complications; operative time; blood loss during surgery; length of hospital stay; medical complications; VAS; HHS
Starting date	Unknown
Contact information	Unknown
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was not available. We have used limited information available in the Cochrane Central Register of Controlled Trials.

ChiCTR-INR-17011841

Study name	Intertrochanteric fracture in the elderly: a randomized comparison of reduction and fixation and total hip arthroplasty
Methods	Unknown
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** > 65 years of age; intertrochanteric fracture; informed consent
Interventions	Femoral head replacement or THA
Outcomes	Radiological evaluation; routine blood text; HHS; blood transfusion rate; DVT
Starting date	Unknown
Contact information	Unknown
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was not available. We have used limited information available in the Cochrane Central Register of Controlled Trials.

ChiCTR-TRC-11001642

Study name	Minimally invasive percutaneous compression plating versus dynamic hip screw for intertrochanteric fractures
Methods	Unknown
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** > 60 years of age; intertrochanteric fracture amenable to satisfactory reduction (type AO/OTA 31.A1-A2, Evans type1); ability to ambulate independently prior to the fracture with or without assistive devices
Interventions	PCCP versus DHS

ChiCTR-TRC-11001642 *(Continued)*

Outcomes	Blood loss; postoperative complications; VAS; HHS
Starting date	Unknown
Contact information	Unknown
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was not available. We have used limited information available in the Cochrane Central Register of Controlled Trials.

CTRI/2019/02/017733

Study name	A clinical study to evaluate the outcomes of singe lag screw and helical blade nailing in treatment of intertrochanteric femur fractures
Methods	Unknown
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** people with intertrochanteric fracture presenting to the institution during this period; low-energy trauma; fracture < 3 weeks old
Interventions	Single lag screw nailing versus helical blade nailing
Outcomes	Functional outcomes (modified HHS); comorbidities; pullout rate; neck shaft angle; implant position and cut-out rate; union rate; neck length
Starting date	Unknown
Contact information	Unknown
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was not available. We have used limited information available in the Cochrane Central Register of Controlled Trials.

CTRI/2019/11/022097

Study name	A study to compare the results using dynamic hip screw and modified proximal femoral locking compression plate in fractures around the hip
Methods	Unknown
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** people with post-traumatic intertrochanteric fractures; adults > 18 years of either sex; intertrochanteric fractures with subtrochanteric extension; fractures included in 31A1 and 31A2 AO classification
Interventions	Modified proximal femoral locking compression plate versus DHS
Outcomes	Functional and radiological outcomes; complications
Starting date	Unknown

CTRI/2019/11/022097 *(Continued)*

Contact information	Unknown
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was not available. We have used limited information available in the Cochrane Central Register of Controlled Trials.

IRCT20141209020258N80

Study name	Comparison proximal femoral nailing (PFN) versus dynamic hip screw (DHS) in intertrochanteric fracture
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 36 **Inclusion criteria:** intertrochanteric fracture, ≥ 18 years of age, either gender, fracture < 2 weeks old, lack of multiple fractures, absence of pathologic fracture, lack of background bone disease
Interventions	PFN versus DHS
Outcomes	Wound healing; clinical improvement of fracture by radiological examination
Starting date	March 2018
Contact information	Fariba Farokhi; f.farokhi@arakmu.ac.ir; Arak University of Medical Sciences; Iran
Notes	

IRCT20170621034689N2

Study name	Results of intertrochanteric fractures treated with dynamic hip screw (DHS) with or without use of static screw
Methods	Unknown
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** intertrochanteric fractures
Interventions	DHS (conventional use) versus DHS with an additional static screw superior to the DHS
Outcomes	Failure of treatment; HHS; VAS; fracture union
Starting date	Unknown
Contact information	Unknown
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was not available. We have used limited information available in the Cochrane Central Register of Controlled Trials.

IRCT20181015041344N1

Study name	Comparison of dynamic hip screw and dynamic external fixator in intertochanteric fractures
Methods	RCT
Participants	**Estimated participant enrolment:** unknown **Inclusion criteria:** intertrochanteric fracture of type A1 or A2; > 65 years of age; bone density less than 2.5 in T score; able to walk without help before the fracture; participant should be at high anaesthetic risk
Interventions	DHS versus dynamic external fixator
Outcomes	Pain; length of hospital stay; haematocrit
Starting date	Unknown
Contact information	Unknown
Notes	At the time of adding this study to the Review Manager file, the WHO search trial portal was unavailable. We have used limited information available in the Cochrane Central Register of Controlled Trial.

JPRN-UMIN000019523

Study name	Prospective study for treatment of femoral intertrochanteric fracture - ORIF vs bipolar prosthesis
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 40 **Inclusion criteria:** < 80 years of age; with femoral intertrochanteric fracture **Exclusion criteria:** bilateral cases; severe dementia; neurological impairment
Interventions	Open reduction and internal fixation (ORIF) versus bipolar hip prosthesis
Outcomes	Muscle strength; functional evaluation using Barthel Index for walking or stair climbing
Starting date	August 2015
Contact information	Mitsuaki Noda; m-noda@muf.biglobe.ne.jp
Notes	

NCT01437176

Study name	Treatment of intertrochanteric fracture with new type of intramedullary nail
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 36 **Inclusion criteria**

NCT01437176 *(Continued)*

- adult men or women aged 18 years and older (with no upper age limit)
- intertrochanteric fracture confirmed with either anteroposterior and lateral hip radiographs, computed tomography or MRI
- operative treatment of fractures within 14 days of presenting to the emergency room
- ambulatory prior to fracture, though they may have used an aid such as a cane or a walker
- anticipated medical optimisation for operative fixation of the hip
- provision of informed consent by participant or legal guardian
- no other major trauma

Exclusion criteria

- not suitable for internal fixation (i.e. severe osteoarthritis, rheumatoid arthritis or pathologic fracture)
- associated major injuries of the lower extremity (i.e. ipsilateral or contralateral fractures of the foot, ankle, tibia, fibula, knee or femur; dislocations of the ankle, knee or hip; or femoral head defects or fracture)
- retained hardware around the affected hip
- infection around the hip (i.e. soft tissue or bone)
- disorders of bone metabolism except osteoporosis (i.e. Paget's disease, renal osteodystrophy, osteomalacia)
- moderate or severe cognitively impaired patients (i.e. Six Item Screener with 3 or more errors)
- Parkinson's disease (or dementia) severe enough to increase the likelihood of falling or severe enough to compromise rehabilitation
- likely problems, in the judgment of the investigators, with maintaining follow-up. We will, for example, exclude people with no fixed address, those who report a plan to move out of town in the next year, or intellectually challenged individuals without adequate family support

Interventions	PFNA versus new type of intramedullary nail (Weigao Orthopaedic Device Co. Ltd)
Outcomes	Bone healing; rates of revision surgery; quality of life (SF-36, ADL, FIM); complications (mortality, non-union, implant breakage/failure, infection, DVT)
Starting date	September 2011; clinical trials register states that study is still recruiting
Contact information	Tang Peifu; Chinese PLA General Hospital
Notes	

NCT01509859

Study name	Comparing weight bearing after intramedullary fixation devices for the proximal femur fracture
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 100 **Inclusion criteria** • pertrochanteric fracture AO 2.2 and above • ambulatory participant, without support prior to the fall • minor trauma mechanism • without other injuries • operated 3 days from the injury **Exclusion criteria**

NCT01509859 *(Continued)*

	• dementia • previous hip or knee arthroplasty • known osteoarthritis
Interventions	PFNA versus InterTan nail
Outcomes	Not reported in clinical trials register
Starting date	September 2012; status in clinical trials register states that study is recruiting
Contact information	Yona Kosashvili, MD; Rabin Medical Center
Notes	

NCT01797237

Study name	Outcome comparison between PFNA and InterTAN
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 60 **Inclusion criteria** • adult men or women aged 18 years and older (with no upper age limit) • fracture of the intertrochanteric fracture confirmed with either anteroposterior and lateral hip radiographs, computed tomography, or MRI • operative treatment of fractures within 14 days of presenting to the emergency room • ambulatory prior to fracture, though they may have used an aid such as a cane or a walker • anticipated medical optimisation for operative fixation of the hip • provision of informed consent by participant or legal guardian • no other major trauma **Exclusion criteria** • not suitable for internal fixation (i.e. severe osteoarthritis, rheumatoid arthritis, or pathologic fracture) • associated major injuries of the lower extremity (i.e. ipsilateral or contralateral fractures of the foot, ankle, tibia, fibula, knee, or femur; dislocations of the ankle, knee or hip; or femoral head defects or fracture) • retained hardware around the affected hip • infection around the hip (i.e. soft tissue or bone) • disorders of bone metabolism except osteoporosis (i.e. Paget's disease, renal osteodystrophy, osteomalacia) • moderate or severe cognitively impaired patients (i.e. Six Item Screener with 3 or more errors) • Parkinson's disease (or dementia) severe enough to increase the likelihood of falling or severe enough to compromise rehabilitation. Likely problems, in the judgment of the investigators, with maintaining follow-up. We will, for example, exclude people with no fixed address, those who report a plan to move out of town in the next year, or intellectually challenged people without adequate family support
Interventions	PFNA vs InterTan
Outcomes	Quality of life (SF-36, ADL, FIM); bone healing

NCT01797237 *(Continued)*

Starting date	October 2012; status in clinical trials register states that study is recruiting
Contact information	Peifu Tang; Chinese PLA General Hospital
Notes	

NCT02627040

Study name	Intertrochanteric femoral fracture fixation trial
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 95 **Inclusion criteria** • people surgically treated for an intertrochanteric femur fracture at Tampa General Hospital • skeletally-mature individuals over the age of 60 years; both genders • community ambulators **Exclusion criteria** • ipsilateral lower extremity injury • under age 60 • co-existent, severe knee or back problems • muscle contracture around the knee or hip joint • individuals who have had TKA within 6 months • BMI > 40 kg/m^2 • suspicious of pathologic fracture (tumour in origin) • preoperative mobility: non ambulatory; ambulatory indoors with living support • cognitive impairment or dementia • prisoners or impending incarceration • homeless or no stable address
Interventions	Gamma 3 nail versus InterTan
Outcomes	Hip function (HHS); functional outcome; walking ability; hip range of motion; pain
Starting date	November 2015
Contact information	Hassan R Mir, MD, MBA; Florida Orthopaedic Institute
Notes	

NCT03407131

Study name	Internal fixation or joint replacement therapy for aged hip fracture patients
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 100

NCT03407131 *(Continued)*

	Inclusion criteria • intertrochanteric fractures of the femur need surgery • male and female, age more than 75 years old • combined with more than one medical complication, including hypertension, cerebral infarction, respiratory failure, renal insufficiency, coronary heart disease, diabetes, heart failure, pulmonary infection, heart rate, water and electrolyte disorders • still able to tolerate surgery through the anaesthesia and related department assessment • signed written informed consent **Exclusion criteria** • no complications associated with internal medicine • mild fracture displacement and conservative treatment required • multiple trauma involving more than one organ system • known to have progressive malignant neoplasms • not possible for the subjects to follow the test scheme, such as uncooperative attitudes, inability to return to the research centre for follow-up visits and inability to complete the study
Interventions	Joint replacement versus intramedullary nail fixation
Outcomes	Postoperative drainage volume and bleeding volume during surgery; joint rehabilitation index, complication rate, functional rehabilitation index, surgical related index
Starting date	February 2018
Contact information	Baoguo Jiang; Peking University People's Hospital
Notes	

NCT03906032

Study name	Comparison of sliding hip screw to intramedullary nailing in the treatment of intertrochanteric hip fracture
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 352 **Inclusion criteria** • OTA A1 and A2 fractures • ≥ 60 years of age **Exclusion criteria** • Polytrauma, high-energy hip fractures, pathological fractures • Reverse oblique and subtrochanteric femoral fractures • < 60 years of age
Interventions	TFNA IM Nail versus SHS
Outcomes	Blood loss; mortality, analgesia use; mobility (TUG), function (HHS), kinematic gait parameters at hip; length of hospital stay
Starting date	April 2019

NCT03906032 *(Continued)*

Contact information	May Cleary; may.cleary@hse.ie
Notes	Estimated completion date April 2023

NCT04306198

Study name	Helical blade vs lag screw fixation for cephalomedullary nailing of low energy intertrochanteric hip fractures
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 200 **Inclusion criteria** • low-energy trauma • hip fracture classified as 31.A1.2 - 31 A1.3 and 31.A2 in the AO classification (year 2018) **Exclusion criteria** • medical contraindication to surgery • a fracture due to malignancy • peri-implant fractures • inability to walk before the fracture • an inability to comply with rehabilitation • non-ambulatory pre-fracture
Interventions	Trochanteric fixation nail, using a lag screw versus a helical blade as proximal fixation
Outcomes	Cut-out; complications (infection and non-union); Parker Mobility Score
Starting date	March 2020
Contact information	Tomas Amenabar MD; Instituto Traumatologico
Notes	

NCT04441723

Study name	Comparison of dynamic versus static lag screw modes for cephalomedullary nails used to fix intertrochanteric fragility fractures
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 150 **Inclusion criteria:** • low-energy trauma • hip fracture classified as 31.A1.2 - 31 A1.3 and 31.A2 in the AO classification (year 2018) **Exclusion criteria:** • fracture due to malignancy

NCT04441723 *(Continued)*

	• previous contralateral fracture • inability to walk before the fracture • inability to comply with rehabilitation • follow-up of less than 6 months
Interventions	Gamma 3 nail using static versus dynamic lage screw as a proximal fixation
Outcomes	Cut-out; complications (infection and non-union); offset
Starting date	January 2020
Contact information	Dr Teodoro Gebauer Weisser; Instituto Traumatologico
Notes	

NTR1133

Study name	Intramedullary nailing of proximal femur fractures: Gamma 3 Nail versus Fixion Proximal Femur Nailing System
Methods	RCT, parallel design
Participants	**Estimated participant enrolment:** 244 **Inclusion criteria:** proximal femur fractures with AO-classification 31 A1.1 - A3.3; > 18 years; admitted to hospital **Exclusion criteria:** primary bone disease; life expectancy < 1 year; unable to speak Dutch
Interventions	Gamma 3 nail versus Fixion Proximal Femur Nailing System
Outcomes	Major and minor implant-related complications; procedure time; per-operative fluoroscopic time; number of infections; resumption of full activities; mortality
Starting date	January 2008
Contact information	AM Bek; A.bek@student.unimaas.nl
Notes	

ADL: activities of daily living; **BMI:** body mass index; **DHS:** dynamic hip screw; **DVT:** deep vein thrombosis; **FIM:** functional independence measure; **HHS:** Harris Hip Score:**MRI:** magnetic resonance imaging; **ORIF:** open reduction and internal fixation; **OTA:** Orthopaedic Trauma Association; **PCCP:** percutaneous compression plate; **PFN:** proximal femoral nail; **PLA:** People's Liberation Army; **RCT:** randomised controlled trial; **SF-36:** Short Form 36-item questionnaire; **SHS:** sliding hip screw; **TFNA IM:** TFN-Advanced® proximal femoral nailing system - intramedullary nail; **TAD:** tip apex distance; **THA**: total hip arthroplasty; **TKA:** total knee arthroplasty; **TUG:** timed up and go test; **VAS:** visual analogue scale; **WHO:** World Health Organization

ADDITIONAL TABLES

Table 1. Trochanteric region fractures: type and surgical management (Revised AO/OTA classification, January 2018)

Type	Features	Stability	Description

Table 1. Trochanteric region fractures: type and surgical management (Revised AO/OTA classification, January 2018) *(Continued)*

Simple, pertrochanteric fractures (A1)	• Isolated pertrochanteric fracture • Two-part fracture • Lateral wall intact	Stable	The fracture line can begin anywhere on the greater trochanter and end either above or below the lesser trochanter. The medial cortex is interrupted in only one place.
Multifragmentary pertrochanteric fractures (A2)	• With one or more intermediate fragments • Lateral wall may be incompetent	Unstable	The fracture line can start laterally anywhere on the greater trochanter and runs towards the medial cortex, which is typically broken in two places. This can result in the detachment of a third fragment which may include the lesser trochanter.
Intertrochanteric fractures (A3)	• Simple oblique fracture • Simple transverse fracture • Wedge or multifragmentary fracture	Unstable	The fracture line passes between the two trochanters, above the lesser trochanter medially and below the crest of the vastus lateralis laterally.

AO/OTA: Arbeitsgemeinschaft für Osteosynthesefragen (German for "Association for the Study of Internal Fixation")/Orthopaedic Trauma Association

Table 2. Categorisation of internal and external fixation interventions for extracapsular hip fractures

Implant category	Grouping variable	Implant subcategory (entry point/static or dynamic)	Examples[a]	Description
Extracapsular fractures				
External fixation				
External fixator	n/a	n/a	• Hoffman (Stryker) • Large External Fixator (DePuy Synthes) • Lower Extremity Fixator (Orthofix)	Threaded pins are passed into the bone proximal and distal to the fracture. These pins are attached to external bars which may be arranged in numerous configurations to bridge the fracture.
Internal fixation				
Intramedullary nails	n/a	Cephalomedullary nails	• Y-nail (Küntscher 1967) • Zickel nail (Zicker 1976) • Gamma nail (first generation, Howmedica) • Gamma nail (second gen-	A nail is inserted antegrade into the intramedullary canal of the femur. Once the nail is in place, a pin, nail or screw is passed from the lateral cortex of the femur across the fracture and through the nail into the femoral head. The pin or screw can be fixed to the nail in various ways to allow or prevent sliding as well as provide rotational stability about the axis of the femoral neck.

Table 2. Categorisation of internal and external fixation interventions for extracapsular hip fractures *(Continued)*

eration, Stryker)
• Gamma3 nail (Stryker)
  ○ Gamma3 Trochanteric Nail
  ○ Gamma3 Long Nail
  ○ Gamma3 RC Lag Screw
  ○ Gamma3 Distal Targeting System
• Gamma3 sliding lag screw (Stryker)
• Gamma3 non-sliding lag screw (Stryker)
	Küntscher Y-nail: an early intramedullary nail based on the principles of stable fixation and closed nailing.
	
	Zickel nail: similar to the Küntscher Y-nail. The Küntscher Y-nail was considered to be more difficult to insert than the Zickel nail. The major complication of the Küntscher Y-nail was distal migration of the intramedullary nail, although this may be prevented by the insertion of a bolt through the upper end of the nail. Zickel developed his device to address the difficulties with the former.
	
	Gamma nail (first generation, 1980s) or Standard Gamma Nail (SGN): a prototype intramedullary nailing system which became the most widely used for trochanteric fractures worldwide. Complications such as cut-out, implant breakage, femoral shaft fractures, and reduction loss were reported with its use.

• Proximal femoral nail (PFN)
• Expandable PFN (Fixion)
• Proximal femoral nail antirotation (PFNA) (DePuy Synthes)
  ○ PFNA nail long
  ○ PFNA nail standard
• PFNA II
• TFNA (Synthes)
• ACE Trochanteric nail System (ATN) (DePuy)
• Russel-Taylor Recon nail
• Intramedullary hip screw clinically proven (IMHS CP) (Smith & Nephew)
• Targon proximal femoral nail (Aesculap)
	Long Gamma Nail (LGN) (1992): used for subtrochanteric hip fractures, femoral shaft fractures and combined trochanter-diaphyseal fractures of the femur.
	
	Trochanteric Gamma Nail (TGN) (1997): a modified SGN, replaced the SGN.
	
	Gamma3 Nailing System: third generation of intramedullary short and long Gamma fixation nails. Four locking grooves allow for quarter-turn advancement of 0.8 mm to allow for precise lag screw positioning.
	
	PFN (Synthes, Solothurn, Switzerland) and ATN (DePuy, Warsaw, IN, USA): developed to address the mechanical complications of the standard gamma nail. These intramedullary implants provide sliding head-neck screws. However, complications still occurred, such as lateral migration of head-neck screw, cut-out from head-neck fragment and cut-through of the antirotation screw into the joint. The expandable PFN was a development of this nail with a hydraulic expansion mechanism in the head reducing the need for reaming for the lag screw.
	
	PFNA (Synthes, Solothurn, Switzerland) was designed by the AO/ASIF group for improving the ro-

Table 2. Categorisation of internal and external fixation interventions for extracapsular hip fractures *(Continued)*

• Zimmer® Natural Nail® System (Zimmer) • Holland Nail™ System • Endovis Cephomedullary nail (Citieffe) • Trigen InterTAN nail • Elos Intramedullary nail • Affixus Hip Fracture Nail System	tational stability. It used a single head-neck fixation device called a 'helical blade'. The TFN and TFNA are the first- and second-generation trochanteric entry point cephalomedullary nails made by Synthes (Switzerland) using lag screws or blades. ACE Trochanteric nail System (ATN) (DePuy): intended to treat stable and unstable proximal fractures of the femur including pertrochanteric fractures, intertrochanteric fractures, high subtrochanteric fractures and combinations of these fractures. Trochanteric Long Nail System: additionally indicated to treat pertrochanteric fractures associated with shaft fractures, pathologic fractures in osteoporotic bone of the trochanteric and diaphyseal areas, long subtrochanteric fractures, ipsilateral femoral fractures, proximal or distal nonunions and malunions and revision procedures. Russel-Taylor Recon nail: a second-generation locking femoral nail. Intramedullary hip screw (IMHS): a short intramedullary nail with interlocking screws that can be used to treat subtrochanteric and intertrochanteric femur fractures. This nail, which has the biomechanical advantage of being an intramedullary appliance but can be placed percutaneously, is inserted under fluoroscopic control with the patient on a fracture table. Reaming is not usually necessary. Intramedullary Hip Screw Clinically Proven (IMHS™ CP): intramedullary hip screw device that provides a barrel through which a lag screw can slide. Introduced in 1991 with its design, the IMHS system provided a more minimally invasive technique than the traditional Compression Hip Screw. By featuring a centering sleeve to enhance lag screw sliding and medialising the implant to reduce the moment arm, this design improved implant biomechanics for the treatment of hip fractures. Targon® PFT nailing system: targeting device is suitable for all caput collum diaphyseal (CCD) angles and permits shorter and less invasive incisions thanks to an optimised geometry.

Table 2. Categorisation of internal and external fixation interventions for extracapsular hip fractures *(Continued)*

			Zimmer Natural Nail System: intramedullary nails, screws, instruments and other associated implants. Holland Nail™ System includes a short, universal nail in diameters of 9, 11 and 13 mm x 24 cm length and long, anatomic (L & R) nails in diameters of 9 mm and 12 mm in various lengths. A 7 mm cannulated, partially threaded screw is used for proximal reconstructive interlocking. A unique pilot thread screw is used for proximal and distal interlocking. Distal screw options offer shaft fracture compression while controlling rotation by a distal slot, or the option of static interlocking. Endovis cephalomedullary nail (Citieffe, Italy) is implanted without reaming and has two lag screws placed in the femoral head. The Trigen Intertan (Smith and Nephew) intramedullary nail was designed as a trochanteric entry nail especially shaped for fractures of the proximal femur. It offers an integrated interlocking screw option to increase stability and resistance to intraoperative and postoperative femoral head rotation, thus eliminating excessive sliding and the possibility of Z-effect. Femoral intramedullary nail (Elos) is a trapezoidal section piriformis fossa entry point nail with cannulated cephalic lag screw. Affixus Hip Fracture Nail System (ZimmerBiomet) is a cephalomedullary nail with double cephalic lag screws.
n/a	Condylocephallic nails	• Ender nail (Pankoich and Tarabishy) • Harris nail	Condylocephalic nails are intramedullary nails which are inserted retrograde through the femoral canal across the fracture and into the femoral head. Ender nails are pre-bent flexible rods. Three to five of these of appropriate length are inserted into the femoral canal. The femoral canal is thus 'stacked' with nails, whilst their tips should radiate out to produce a secure fixation within the femoral head. Harris nail is a larger nail used as a single nail.

Table 2. Categorisation of internal and external fixation interventions for extracapsular hip fractures *(Continued)*

Fixed angle plates	Sliding	Static	• Holt nail plate • Jewett nail plate • McLaughlin nail plate • Thornton nail plate • LCP (Locking Compression Plate) • Dynamic Helical Hip System (DHHS) • Contralateral reverse distal femoral locking compression plate (DFLCP) (Green Surgicals) • AO Angle Blade Plate • Baixauli (IQL) • Less-Invasive Stabilisation System (LISS) (Synthes)	Static device consisting of a nail, pin or screw which is passed across the fracture into the femoral head and connected to a plate on the lateral femur. These implants have no capacity for 'sliding' between the plate and pin or screw components and hence are termed static implants. Holt nail plate: a four-flanged nail connected to a plate at the time of surgery. Jewett nail: the nail is fixed to the plate at manufacture. Thornton and McLaughlin nail plates: the nail is connected to the plate at the time of surgery with a locking bolt. RAB plate: similar to a Jewett fixed nail plate but has an additional oblique strut to connect the nail and the side plate. AO Angle Blade Plate (Synthes) is a well-used fixed angle static implant where the cephalic placed blade is angled at various degrees from 90 to 150 with a plate attached to the lateral side of the femur. Less-Invasive Stabilisation System (LISS) (Synthes) is a fixed angle plating system where screws fix into the plate but are statically locked.
		Dynamic	• Dynamic hip screw • Precimed Hip Screw System • AMBI/Classic Hip Screw System (Smith & Nephew Richards) • HDS/DCS Dynamic Hip & Condylar Screw System • Pugh nail • Medoff plate • Resistance Augmented or	Dynamic device consisting of a nail, pin or screw which is passed across the fracture into the femoral head and connected to a plate on the lateral femur. These implants allow 'sliding' between the plate and pin or screw components and hence are termed dynamic implants. Weight bearing or translation during surgery causes the femoral head to become impacted on the femoral neck, leading to compression of the fracture. Precimed Hip Screw System: compression fixation system used for the treatment of femoral neck and distal femoral fractures. It consists of compression plates, lag screws, compression screws, bone screws and angled blade plates. The system functions to provide immediate stability and temporary fixation during the natural healing process following fractures of the femoral neck or distal femur.

Table 2. Categorisation of internal and external fixation interventions for extracapsular hip fractures *(Continued)*

	Rigidity Augmentation Baixauli (RAB) plate • Gotfried percutaneous compression plate (PCCP) • Dynamic condylar screw (DCS) • X-BOLT Hip System (XHS™) • Compression hip screw (Smith & Nephew) • Richards sliding hip screw	AMBI/Classic Hip Screw System: compression fixation system consisting of hip screw plates and nails. AMBI plates have a barrel design which is keyless but can be converted to keyed with the insertion of a small keying clip; Classic plates have a keyed barrel design only. AMBI/Classic Lag Screws: 18 lengths: 55 mm to 140 mm; nonself-tapping for cancellous bone. Pugh nail: similar to SHS except instead of a lag screw being passed up the femoral neck, a nail with a trifin or three-flanged terminus is inserted by a punching mechanism. This is then connected to the side plate in the same manner as for a SHS. Medoff plate: a modification of SHS, where a lag screw is passed up the femoral neck and attached to a plate on the side of the femur. The difference is that the plate has an inner and outer sleeve, which can slide between each other. This creates an additional capacity for sliding to occur at the level of the lesser trochanter as well as at the lag screw. An additional variant of the Medoff plate is the capability of compressing the fracture distally using the two interlocking plates and a compression screw. In addition, sliding at the lag screw can be prevented with a locking screw to create a 'one way' sliding Medoff instead of a 'two way' sliding Medoff. At a later date, the locking device on the lag screw can be removed to 'dynamise' the fracture. Gotfried PCCP has a side plate that is inserted via a small incision level to the lesser trochanter by use of a connecting jig. Using the latter, two sliding proximal screws are passed up the femoral neck and the plate is fixed to the femur shaft with three screws. DCS is an implant assembly that consists of a lag screw, angled barrel plate fixed to the bone (usually distal femur) by 4.5 cortical screws. DCS and DHS work on the same principle of the sliding nail that allows impaction of the fracture. This is due to insertion of wide diameter into the condyle (or femoral head). A side plate, which has a barrel at a fixed angle, is slid over the screw and fixed to the femoral shaft. DCS has all other components the same as DHS; only the side plate is different. The plate barrel angle is 95 degrees and the plate is shaped to accommodate the lateral aspect of lateral condyle. DCS was mainly developed for fractures of distal femoral condyles. It is also used in fixation of subtrochanteric fractures of femur. Sometimes,

Table 2. Categorisation of internal and external fixation interventions for extracapsular hip fractures *(Continued)*

				it can be used in revision surgeries of selected intertrochanteric fractures.
				Compression hip screw (Smith & Nephew) is similar to other types of sliding hip screw with an angled barrel, sliding lag screw and plate attached to the side of the femur.
				Richards sliding hip screw is similar to other types of sliding hip screw with an angled barrel, sliding lag screw and plate attached to the side of the femur.
				X-BOLT®: an expanding bolt akin to a Chinese lantern with a central drive shaft. The opposing threads compress the expandable section from both ends to expand the wings perpendicularly to the shaft, without spinning, pushing or pulling the femoral head.
External fixation				
	n/a	Pertrochanteric external fixator		Pertrochanteric external fixator: held outside the thigh by two pairs of pins. One pair is passed up the femoral neck under X-ray control. The other pair is placed in the femur. The fixator is left in place until the fracture has healed, which usually takes about three months. It is then removed under local anaesthesia, generally as an outpatient procedure.

[a]This list is not exhaustive. **n/a:** not applicable

Table 3. Categorisation of arthroplasty interventions for extracapsular hip fractures

Implant	Grouping variable	Implant subcategory	Examples[a]	Description
Extracapsular fractures				
Arthroplasty				
Total hip arthroplasty	Articulation	Femoral head and acetabular bearing surface materials	• Metal-on-polyethylene (MoP) • Ceramic-on-polyethylene (CoP) • Ceramic-on-ceramic (CoC) • Metal-on-metal (MoM)	Bearing surfaces may be grouped into hard (ceramic and metal) and soft (polyethylene variants). Arthroplasties exist with many of the possible combinations of these bearing surfaces.

Table 3. Categorisation of arthroplasty interventions for extracapsular hip fractures *(Continued)*

			• Polyethylene material • Highly cross linked (HCL) • Not HCL	
		Femoral head size	• Large head ≥ 36 mm • Standard small head < 36 mm	Over the development of hip arthroplasty, different sizes of femoral head have been used, from 22 mm to very large diameters approximating that of the native femoral head. The size of the head represents a compromise between stability and linear and volumetric wear at the articulation. The optimum size varies by indication and bearing materials. 36 mm is considered as a cut-off between standard and large sizes.
		Acetabular cup mobility	• Single • Dual	A standard total hip arthroplasty has a single articulating surface between the femoral head and acetabulum bearing surface. Alternative designs incorporate two further articulations within the structure of the femoral head.
	Fixation technique	Cemented	• Exeter Hip System • CPT Hip System	Both components are cemented with poly(methyl methacrylate) bone cement that is inserted at the time of surgery. It sets hard and acts as grout between the prosthesis and the bone.
		Modern uncemented	• Corail Hip System • Avenir Hip System • Taperloc Hip System	Neither component is cemented but rely on osseous integration forming a direct mechanical linkage between the bone and the implant. The femoral prosthesis may be coated with a substance such as hydroxyapatite which promotes bone growth into the prosthesis. Alternatively, the surface of the prosthesis may be macroscopically and microscopically roughened so that bone grows onto the surface of the implant. The acetabular component may be prepared similarly and may or may not be augmented with screws fixed into the pelvis.
		Hybrid	Combinations	The femoral stem is cemented and the acetabular cup is uncemented.
		Reverse hybrid	Combinations	The acetabular cup is cemented and the femoral stem is uncemented.
Hemiarthroplasty	Articulation	Unipolar	• Thompson • Austin-Moore • Exeter Trauma Stem • Exeter Unitrax	A single articulation between the femoral head and the native acetabulum. The femoral component can be a single 'monoblock' of alloy or be modular, assembled from component parts during surgery.

Table 3. Categorisation of arthroplasty interventions for extracapsular hip fractures *(Continued)*

		Bipolar	• CPT modular bipolar • Exeter modular bipolar • Bateman • Monk	The object of the second joint is to reduce acetabular wear. This type of prosthesis has a spherical inner metal head with a size between 22 and 36 mm in diameter. This fits into a polyethylene shell, which in turn is enclosed by a metal cap. There are a number of different types of prostheses with different stem designs.
	Fixation technique	First generation uncemented	• Thompson • Austin Moore	These prostheses were designed before the development of poly(methyl methacrylate) bone cement and were therefore originally inserted as a 'press fit'. Long-term stability through osseus integration was not part of the design concept.
		Cemented	• Thompson • Exeter Trauma Stem • Exeter Hip System • CPT Hip System	The femoral stem is cemented with poly(methyl methacrylate) bone cement that is inserted at the time of surgery. It sets hard and acts as grout between the prosthesis and the bone.
		Modern uncemented	• Corail • Furlong • Avenir	The femoral stem relies on osseous integration forming a direct mechanical linkage between the bone and the implant. A prosthesis may be coated with a substance such as hydroxyapatite which promotes bone growth into the prosthesis. Alternatively, the surface of the prosthesis may be macroscopically and microscopically roughened so that bone grows onto the surface of the implant.

[a]This list is not exhaustive.

Table 4. Early mortality: network estimates, direct estimates and indirect estimates

Dynamic fixed angle plate	D: 0.91 (0.36 to 2.32) I: 0.71 (0.28 to 1.79)	D: 1.80 (1.02 to 3.18) I: 0.53 (0.28 to 1.01)	D: 0.94 (0.75 to 1.19) I: 2.92 (1.34 to 6.39)	D: 0.93 (0.48 to 1.80) I: 1.12 (0.36 to 3.53)	D: 0.62 (0.23 to 1.68) I: too imprecise
0.81 (0.42 to 1.54)	**Static fixed angle plate**		D: 1.56 (0.14 to 16.97) I: 1.28 (0.62 to 2.64)	D: 1.29 (0.61 to 2.70) I: 1.06 (0.35 to 3.16)	
1.09 (0.65 to 1.80)	1.35 (0.59 to 3.06)	**Long cephalomedullary nails**	D: 1.79 (0.98 to 3.25) I: 0.53 (0.28 to 0.97)		
1.05 (0.81 to 1.36)	1.30 (0.65 to 2.60)	0.97 (0.58 to 1.61)	**Short cephalomedullary nails**		D: 0.87 (0.20 to 3.86)

Table 4. Early mortality: network estimates, direct estimates and indirect estimates *(Continued)*

						I: too imprecise
0.97 (0.55 to 1.71)	1.21 (0.66 to 2.21)	0.90 (0.42 to 1.92)	0.93 (0.50 to 1.72)	**Condylocephalic nails**		
0.62 (0.23 to 1.68)	0.76 (0.23 to 2.52)	0.57 (0.18 to 1.75)	0.59 (0.21 to 1.66)	0.63 (0.20 to 2.00)	**External fixation**	
0.91 (0.20 to 4.14)	1.14 (0.22 to 5.86)	0.84 (0.18 to 4.06)	0.87 (0.20 to 3.86)	0.94 (0.19 to 4.71)	1.49 (0.24 to 9.11)	**Hemiarthroplasty**

Intervention effects, measured as risk ratios (with 95% confidence intervals), for early mortality (≤ 4 months). In the lower triangle (network estimates), the column-defining intervention is the reference group; a risk ratio lower than 1 favours the row-defining intervention for the network meta-analysis results (network estimates). In the upper triangle (direct estimates (D) and indirect estimates (I)), the row-defining intervention is the reference group; a risk ratio lower than 1 favours the column-defining intervention for the pairwise meta-analysis. Blank spaces indicate that no direct estimates were available and the network estimate was derived from indirect evidence only.

Table 5. Early mortality: estimated probabilities of rankings

Rank	F	B	G	E	A	D	C
Best	47.8	17.6	26.3	4	0.7	0.8	2.9
2nd	21.6	29.9	15.7	14	6.3	4.3	8.3
3rd	9.1	20.6	7.8	20.6	16.9	12.3	12.6
4th	5.2	10.2	5.1	16.8	29.7	19.6	13.4
5th	4.4	7.9	4.7	12.7	27.6	27.3	15.4
6th	5.6	8.4	7.4	16.6	14.6	25	22.4
Worst	6.3	5.4	33	15.3	4.3	10.8	24.9
MEAN RANK	**2.4**	**3.1**	**4**	**4.3**	**4.4**	**4.9**	**5**
SUCRA	**0.8**	**0.7**	**0.5**	**0.4**	**0.4**	**0.4**	**0.3**

Estimated probabilities of rankings, mean rank and SUCRA (surface under the cumulative ranking curve) for each treatment in the early mortality network based on random-effects consistency network meta-analysis (sorted by mean rank from left to right). **Treatment nodes** - **A:** dynamic fixed angle plate;**B:** static fixed angle plate; **C:** long cephalomedullary nail; **D:** short cephalomedullary nail; **E:** condylocephalic nail;**F:** external fixation; **G:** hemiarthroplasty

Table 6. Mortality at 12 months: network estimates, direct estimates and indirect estimates

Dynamic fixed angle plate	D: 1.03 (0.74 to 1.42) I: 1.01 (0.57 to 1.79)	D: 1.28 (0.89 to 1.85) I: 1.05 (0.27 to 4.12)	D: 0.97 (0.87 to 1.07) I: 0.98 (0.40 to 2.38)	D: 0.92 (0.73 to 1.16) I: 0.98 (0.49 to 1.97)	D: 0.88 (0.34 to 2.23) I: 0.57 (0.17 to 1.93)	D: 0.91 (0.45 to 1.85) I: 1.40 (0.36 to 5.49)	D: 0.69 (0.12 to 4.03) I: too imprecise
1.02 (0.77 to 1.36)	**Static fixed angle plate**		D: 0.86 (0.28 to 2.59) I: 0.95 (0.70 to 1.30)	D: 0.95 (0.51 to 1.78) I: 0.89 (0.60 to 1.32)			
1.27 (0.89 to 1.81)	1.24 (0.79 to 1.95)	**Long cephalomedullary nail**	D: 0.92 (0.23 to 3.58) I: 0.75 (0.51 to 1.10)				

Table 6. Mortality at 12 months: network estimates, direct estimates and indirect estimates *(Continued)*

0.97 (0.87 to 1.07)	0.95 (0.70 to 1.28)	0.76 (0.53 to 1.10)	**Short cephalomedullary nail**			D: 1.41 (0.77 to 2.61) I: too imprecise		
0.93 (0.74 to 1.16)	0.91 (0.65 to 1.26)	0.73 (0.48 to 1.11)	0.96 (0.75 to 1.23)	**Condylocephalic nail**				
0.75 (0.36 to 1.57)	0.73 (0.33 to 1.62)	0.59 (0.26 to 1.34)	0.77 (0.37 to 1.64)	0.81 (0.37 to 1.75)	**External fixation**		1.60 (0.59 to 4.33) I: 1.04 (0.32 to 3.37)	
1.36 (0.73 to 2.54)	1.34 (0.68 to 2.64)	1.08 (0.53 to 2.20)	1.41 (0.77 to 2.61)	1.47 (0.76 to 2.85)	1.83 (0.69 to 4.81)	**Hemiarthroplasty**		
1.00 (0.53 to 1.87)	0.98 (0.49 to 1.95)	0.79 (0.38 to 1.62)	1.03 (0.55 to 1.95)	1.08 (0.55 to 2.10)	1.34 (0.63 to 2.86)	0.73 (0.30 to 1.77)	**Non-operative treatment**	
0.69 (0.12 to 4.03)	0.68 (0.11 to 4.04)	0.55 (0.09 to 3.30)	0.72 (0.12 to 4.19)	0.75 (0.13 to 4.41)	0.93 (0.14 to 6.27)	0.51 (0.08 to 3.29)	0.69 (0.11 to 4.50)	**Total hip arthroplasty**

Intervention effects, measured as risk ratios (with 95% confidence intervals), for unplanned return to theatre. In the lower triangle (network estimates), the column-defining intervention is the reference group; a risk ratio lower than 1 favours the row-defining intervention for the network meta-analysis results (network estimates). In the upper triangle (direct estimates (D) and indirect estimates (I)), the row-defining intervention is the reference group; a risk ratio lower than 1 favours the column-defining intervention for the pairwise meta-analysis. Blank spaces indicate that no direct estimates were available and the network estimate was derived from indirect evidence only.

Table 7. Mortality at 12 months: estimated probabilities of ranking

Rank	F	I	E	D	H	A	B	C	G
Best	33.5	48.7	5.6	1.5	6.1	0.3	2.2	0.3	1.7
2nd	31.4	9.6	18.1	9	16.8	1.9	8.1	1.3	3.7
3rd	8.7	3.9	23.8	20	16.2	8.7	12.9	2.2	3.7
4th	4	2	20.1	26.5	7.4	20.4	12.9	2.8	3.8

Table 7. Mortality at 12 months: estimated probabilities of ranking *(Continued)*

5th	4.1	2.2	13.3	22.2	6.8	30.2	13.9	4.1	3.2
6th	5.3	3.2	10.4	14.2	9.6	24.7	17.6	9.5	5.6
7th	5.9	4.8	6.2	5.2	14	11.6	19	21.1	12.2
8th	4.4	6.8	2.2	1.3	13.4	2	10.8	35.1	23.9
Worst	2.6	18.8	0.3	0.1	9.7	0.2	2.6	23.5	42.3
MEAN RANK	**2.9**	**3.7**	**3.9**	**4.3**	**5**	**5.1**	**5.3**	**7.4**	**7.4**
SUCRA	**0.8**	**0.7**	**0.6**	**0.6**	**0.5**	**0.5**	**0.5**	**0.2**	**0.2**

Estimated probabilities of rankings, mean rank and SUCRA for each treatment in the 12-month mortality network based on random-effects consistency network meta-analysis (sorted by mean rank from left to right). **Treatment nodes** - **A:** dynamic fixed angle plate;**B:** static fixed angle plate; **C:** long cephalomedullary nail; **D:** short cephalomedullary nail; **E:** condylocephalic nail; **F:** external fixation; **G:** hemiarthroplasty; **H:** non-operative treatment; **I:** total hip arthroplasty

Table 8. Unplanned return to theatre: network estimates, direct estimates and indirect estimates

Dynamic fixed angle plate	D: 2.19 (0.97 to 4.92) I: 2.91 (1.17 to 7.22)	D: 1.09 (0.19 to 6.15) I: 1.98 (0.51 to 7.70)	D: 1.13 (0.81 to 1.59) I: 0.74 (0.14 to 3.95)	D: 3.57 (1.91 to 6.66) I: 2.74 (0.93 to 8.05)	D: 0.09 (0.00 to 1.87) I: too imprecise	
2.48 (1.36 to 4.50)	**Static fixed angle plate**		D: 0.39 (0.03 to 4.93) I: 0.45 (0.22 to 0.92)	D: 1.22 (0.58 to 2.59) I: 1.59 (0.59 to 4.30)		
1.58 (0.55 to 4.56)	0.64 (0.19 to 2.15)	**Long cephalomedullary nail**	D: 0.57 (0.15 to 2.14) I: 1.03 (0.18 to 6.01)			
1.12 (0.80 to 1.56)	0.45 (0.23 to 0.88)	0.71 (0.25 to 2.01)	**Short cephalomedullary nail**			D: 0.33 (0.01 to 9.05) I: too imprecise
3.33 (1.95 to 5.68)	1.34 (0.75 to 2.42)	2.11 (0.64 to 6.93)	2.98 (1.59 to 5.60)	**Condylocephalic nail**		
0.09 (0.00 to 1.87)	0.04 (0.00 to 0.80)	0.06 (0.00 to 1.42)	0.08 (0.00 to 1.71)	0.03 (0.00 to 0.59)	**External fixation**	
0.37 (0.01 to 10.26)	0.15 (0.01 to 4.36)	0.24 (0.01 to 7.53)	0.33 (0.01 to 9.05)	0.11 (0.00 to 3.22)	3.98 (0.05 to 350.47)	**Hemiarthroplasty**

Intervention effects, measured as risk ratios (with 95% confidence intervals), for unplanned return to theatre. In the lower triangle (network estimates), the column-defining intervention is the reference group; a risk ratio lower than 1 favours the row-defining intervention for the network meta-analysis results (network estimates). In the upper triangle (direct estimates (D) and indirect estimates (I)), the row-defining intervention is the reference group; a risk ratio lower than 1 favours the column-defining intervention for the pairwise meta-analysis. Blank spaces indicate that no direct estimates were available and the network estimate was derived from indirect evidence only.

Table 9. Unplanned return to theatre: estimated probabilities of ranking

Rank	F	G	A	D	C	B	E
Best	71.1	26.4	1.5	0.4	0.7	0	0
2nd	22.1	43.9	20.3	6.8	6.8	0.1	0
3rd	1.7	3.7	49.3	30.8	13.9	0.6	0
4th	2	5.9	23.7	47.2	16	4.6	0.6
5th	1.5	6.5	5.3	14.6	41	26	5.2
6th	0.7	3.6	0	0.2	13	56.1	26.5
Worst	0.9	9.9	0	0	8.6	12.7	67.8
MEAN RANK	**1.5**	**2.7**	**3.1**	**3.7**	**4.6**	**5.8**	**6.6**
SUCRA	**0.9**	**0.7**	**0.6**	**0.6**	**0.4**	**0.2**	**0.1**

Estimated probabilities of rankings, mean rank and SUCRA for each treatment in the unplanned return to theatre network based on random-effects consistency network meta-analysis (sorted by mean rank from left to right). **Treatment nodes** - **A:** dynamic fixed angle plate; **B:** static fixed angle plate; **C:** long cephalomedullary nail; **D:** short cephalomedullary nail; **E:** condylocephalic nail; **F:** external fixation; **G:** hemiarthroplasty

APPENDICES

Appendix 1. Search strategies

CENTRAL (CRS-Web)

#1 MESH DESCRIPTOR Femoral Fractures EXPLODE ALL AND CENTRAL:TARGET
#2 ((hip or hips or cervical) NEAR5 (fracture* or break* or broke*)) AND CENTRAL:TARGET
#3 ((femoral* or femur* or acetabul*) NEAR5 (fracture* or break* or broke*)) AND CENTRAL:TARGET
#4 ((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical) NEAR5 (fracture* or break* or broke*)) AND CENTRAL:TARGET
#5 ((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) NEAR5 (fracture* or break* or broke*)) AND CENTRAL:TARGET
#6 ((head or neck or proximal) NEAR5 (fracture* or break* or broke*)) and (femoral* or femur*) AND CENTRAL:TARGET
#7 #1 OR #2 OR #3 OR #4 OR #5 OR #6 AND CENTRAL:TARGET
#8 MESH DESCRIPTOR Arthroplasty, Replacement, Hip AND CENTRAL:TARGET
#9 MESH DESCRIPTOR Hip Prosthesis AND CENTRAL:TARGET
#10 MESH DESCRIPTOR Arthroplasty, Replacement AND CENTRAL:TARGET
#11 MESH DESCRIPTOR Hemiarthroplasty AND CENTRAL:TARGET
#12 MESH DESCRIPTOR Joint Prosthesis AND CENTRAL:TARGET
#13 ((arthroplast* or hemiarthroplast*) NEAR5 (hip or hips or femur* or femoral* or acetabul*)) AND CENTRAL:TARGET
#14 ((hip or hips) NEAR5 (replac* or prosthes* or implant*)) AND CENTRAL:TARGET
#15 ((joint* NEAR5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*)) AND CENTRAL:TARGET
#16 #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 AND CENTRAL:TARGET
#17 MESH DESCRIPTOR Fractures, Bone AND CENTRAL:TARGET
#18 MESH DESCRIPTOR Fracture Dislocation EXPLODE ALL AND CENTRAL:TARGET
#19 MESH DESCRIPTOR Fractures, Closed AND CENTRAL:TARGET
#20 MESH DESCRIPTOR Fractures, Comminuted AND CENTRAL:TARGET
#21 MESH DESCRIPTOR Fractures, Compression AND CENTRAL:TARGET
#22 MESH DESCRIPTOR Fractures, Malunited AND CENTRAL:TARGET
#23 MESH DESCRIPTOR Fractures, Multiple AND CENTRAL:TARGET
#24 MESH DESCRIPTOR Fractures, Open AND CENTRAL:TARGET
#25 MESH DESCRIPTOR Fractures, Spontaneous AND CENTRAL:TARGET
#26 MESH DESCRIPTOR Fractures, Stress AND CENTRAL:TARGET
#27 MESH DESCRIPTOR Fractures, Ununited AND CENTRAL:TARGET
#28 MESH DESCRIPTOR Intra-Articular Fractures AND CENTRAL:TARGET
#29 MESH DESCRIPTOR Osteoporotic Fractures AND CENTRAL:TARGET
#30 MESH DESCRIPTOR Periprosthetic Fractures AND CENTRAL:TARGET
#31 fracture* AND CENTRAL:TARGET
#32 #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 AND CENTRAL:TARGET
#33 #32 AND #16 AND CENTRAL:TARGET
#34 (pin or pins or nail or nails or screw or screws or plate or plates) AND CENTRAL:TARGET
#35 MESH DESCRIPTOR Internal Fixators AND CENTRAL:TARGET
#36 MESH DESCRIPTOR Bone Nails AND CENTRAL:TARGET
#37 MESH DESCRIPTOR Bone Plates AND CENTRAL:TARGET
#38 MESH DESCRIPTOR Bone Screws EXPLODE ALL AND CENTRAL:TARGET
#39 (static NEXT (device* or implant*)) AND CENTRAL:TARGET
#40 (dynamic NEXT (device* or implant*)) AND CENTRAL:TARGET
#41 #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 AND CENTRAL:TARGET
#42 ((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*)) AND CENTRAL:TARGET
#43 (hip or hips or femur* or femoral* or acetabul*) AND CENTRAL:TARGET
#44 #43 AND (#17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30) AND CENTRAL:TARGET
#45 #42 OR #44 AND CENTRAL:TARGET
#46 #41 AND #45 AND CENTRAL:TARGET
#47 #7 OR #33 OR #46 AND CENTRAL:TARGET
#48 14/11/2018_TO_08/07/2020:CRSCREATED AND CENTRAL:TARGET
#49 #47 AND #48

MEDLINE (Ovid)

1 exp Femoral Fractures/
2 ((hip or hips or cervical) adj5 (fracture$ or break$ or broke$)).ti,ab,kf.

3 ((femoral$ or femur$ or acetabul$) adj5 (fracture$ or break$ or broke$)).ti,ab,kf.
4 ((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or transcervical or basicervical or basi-cervical) adj5 (fracture $ or break$ or broke$)).ti,ab,kf.
5 ((extracapsular or extra-capsular or trochant$ or subtrochant$ or pertrochant$ or intertrochant$) adj5 (fracture$ or break$ or broke $)).ti,ab,kf.
6 (((head or neck or proximal) adj5 (fracture$ or break$ or broke$)) and (femoral$ or femur$)).ti,ab,kf.
7 or/1-6
8 randomized controlled trial.pt.
9 controlled clinical trial.pt.
10 randomized.ab.
11 placebo.ab.
12 clinical trials as topic.sh.
13 randomly.ab.
14 trial.ti.
15 or/8-14
16 7 and 15
17 Arthroplasty, Replacement, Hip/ or Hip Prosthesis/
18 Arthroplasty, Replacement/ or Hemiarthroplasty/ or Joint Prosthesis/
19 ((arthroplast$ or hemiarthroplast$) adj5 (hip or hips or femur$ or femoral$ or acetabul$)).ti,ab,kf.
20 ((hip or hips) adj5 (replac$ or prosthes$ or implant$)).ti,ab,kf.
21 ((joint$1 adj5 (replac$ or prosthes$ or implant$)) and (hip or hips or femur$ or femoral$ or acetabul$)).ti,ab,kf.
22 or/17-21
23 fractures, bone/ or exp fracture dislocation/ or fractures, closed/ or fractures, comminuted/ or fractures, compression/ or fractures, malunited/ or fractures, multiple/ or fractures, open/ or fractures, spontaneous/ or exp fractures, stress/ or fractures, ununited/ or intra-articular fractures/ or osteoporotic fractures/ or periprosthetic fractures/
24 fracture$.ti,ab,kf.
25 23 or 24
26 22 and 25 and 15
27 (pin or pins or nail or nails or screw or screws or plate or plates).ti,ab,kf.
28 internal fixators/ or bone nails/ or bone plates/ or exp bone screws/
29 (static adj (device$1 or implant$1)).ti,ab,kf.
30 (dynamic adj (device$1 or implant$1)).ti,ab,kf.
31 or/27-30
32 ((hip or hips or femur$ or femoral$ or acetabul$) and (fracture$ or break$ or broke$)).ti,ab,kf.
33 (hip or hips or femur$ or femoral$ or acetabul$).ti,ab,kf. and (fractures, bone/ or exp fracture dislocation/ or fractures, closed/ or fractures, comminuted/ or fractures, compression/ or fractures, malunited/ or fractures, multiple/ or fractures, open/ or fractures, spontaneous/ or exp fractures, stress/ or fractures, ununited/ or intra-articular fractures/ or osteoporotic fractures/ or periprosthetic fractures/)
34 or/32-33
35 31 and 34 and 15
36 16 or 26 or 35
37 exp animals/ not humans/
38 36 not 37

Embase (Ovid)

1 exp Femur Fractures/ or exp hip fracture/
2 ((hip or hips or cervical) adj5 (fracture$ or break$ or broke$)).ti,ab,kw.
3 ((femoral$ or femur$ or acetabul$) adj5 (fracture$ or break$ or broke$)).ti,ab,kw.
4 ((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or transcervical or basicervical or basi-cervical) adj5 (fracture $ or break$ or broke$)).ti,ab,kw.
5 ((extracapsular or extra-capsular or trochant$ or subtrochant$ or pertrochant$ or intertrochant$) adj5 (fracture$ or break$ or broke $)).ti,ab,kw.
6 (((head or neck or proximal) adj5 (fracture$ or break$ or broke$)) and (femoral$ or femur$)).ti,ab,kw.
7 or/1-6
8 exp hip surgery/ or (joint surgery/ and exp hip/)
9 exp Hip Prosthesis/
10 joint prosthesis/ and exp hip/
11 Replacement Arthroplasty/ and exp hip/
12 exp Hip arthroplasty/
13 Arthroplasty/ and exp hip/
14 Hemiarthroplasty/ and exp hip/

15 Hip hemiarthroplasty/
16 ((arthroplast$ or hemiarthroplast$) adj5 (hip or hips or femur$ or femoral$ or acetabul$)).ti,ab,kw.
17 ((hip or hips) adj5 (replac$ or prosthes$ or implant$)).ti,ab,kw.
18 ((joint$1 adj5 (replac$ or prosthes$ or implant$)) and (hip or hips or femur$ or femoral$ or acetabul$)).ti,ab,kw.
19 or/8-18
20 fracture/
21 Fracture dislocation/
22 Comminuted fracture/
23 Multiple fracture/
24 Open fracture/
25 Fragility fracture/
26 exp Fracture healing/
27 Stress fracture/
28 intraarticular fracture/
29 periprosthetic fracture/
30 fracture$.ti,ab,kw.
31 or/20-30
32 19 and 31
33 (pin or pins or nail or nails or screw or screws or plate or plates).ti,ab,kw.
34 internal fixator/ or exp bone nail/ or exp bone plate/ or exp bone pin/ or exp bone screw/ or exp femoral fixation device/
35 (static adj (device$1 or implant$1)).ti,ab,kw.
36 (dynamic adj (device$1 or implant$1)).ti,ab,kw.
37or/33-36
38 ((hip or hips or femur$ or femoral$ or acetabul$) and (fracture$ or break$ or broke$)).ti,ab,kw.
39 (hip or hips or femur$ or femoral$ or acetabul$).ti,ab,kw.
40 39 and 31
41 37 and (38 or 40)
42 7 or 32 or 41
43 Randomized controlled trial/
44 Controlled clinical study/
45 Random$.ti,ab.
46 randomization/
47 intermethod comparison/
48 placebo.ti,ab.
49 (compare or compared or comparison).ti.
50 ((evaluated or evaluate or evaluating or assessed or assess) and (compare or compared or comparing or comparison)).ab.
51 (open adj label).ti,ab.
52 ((double or single or doubly or singly) adj (blind or blinded or blindly)).ti,ab.
53 double blind procedure/
54 parallel group$1.ti,ab.
55 (crossover or cross over).ti,ab.
56 ((assign$ or match or matched or allocation) adj5 (alternate or group$1 or intervention$1 or patient$1 or subject$1 or participant $1)).ti,ab.
57 (assigned or allocated).ti,ab.
58 (controlled adj7 (study or design or trial)).ti,ab.
59 (volunteer or volunteers).ti,ab.
60 human experiment/
61 trial.ti.
62 or/43-61
63 (random$ adj sampl$ adj7 ("cross section$" or questionnaire$1 or survey$ or database$1)).ti,ab. not (comparative study/ or controlled study/ or randomi?ed controlled.ti,ab. or randomly assigned.ti,ab.)
64 Cross-sectional study/ not (randomized controlled trial/ or controlled clinical study/ or controlled study/ or randomi?ed controlled.ti,ab. or control group$1.ti,ab.)
65 (((case adj control$) and random$) not randomi?ed controlled).ti,ab.
66 (Systematic review not (trial or study)).ti.
67 (nonrandom$ not random$).ti,ab.
68 "Random field$".ti,ab.
69 (random cluster adj3 sampl$).ti,ab.
70 (review.ab. and review.pt.) not trial.ti.
71 "we searched".ab. and (review.ti. or review.pt.)
72 "update review".ab.
73 (databases adj4 searched).ab.

74 (rat or rats or mouse or mice or swine or porcine or murine or sheep or lambs or pigs or piglets or rabbit or rabbits or cat or cats or dog or dogs or cattle or bovine or monkey or monkeys or trout or marmoset$1).ti. and animal experiment/
75 Animal experiment/ not (human experiment/ or human/)
76 or/63-75
77 62 not 76
78 42 and 77

Web of Science

1 TOPIC: (((hip or hips or cervical) NEAR/5 (fracture* or break* or broke*))) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
2 TOPIC: (((femoral* or femur* or acetabul*) NEAR/5 (fracture* or break* or broke*))) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
3 TOPIC: (((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical) NEAR/5 (fracture* or break* or broke*))) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
4 TOPIC: (((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) NEAR/5 (fracture* or break* or broke*))) Indexes=SCIEXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
5 TOPIC: (((head or neck or proximal) NEAR/5 (fracture* or break* or broke*)) and (femoral* or femur*)) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
6 #5 OR #4 OR #3 OR #2 OR #1 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
7 TS=(((arthroplast* or hemiarthroplast*) NEAR/5 (hip or hips or femur* or femoral* or acetabul*)) and fracture*) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
8 TS=(((hip or hips) NEAR/5 (replac* or prosthes* or implant*)) and fracture*) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
9 TS=(((joint* NEAR/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*)) and fracture*) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
10 TS=((pin or pins or nail or nails or screw or screws or plate or plates or fixator*) and ((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
11 TS=((“static device*” OR “static implant*”) and ((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
12 TS=((“dynamic device*” or “dynamic implant*”) and ((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
13 #12 OR #11 OR #10 OR #9 OR #8 OR #7 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
14 #13 OR #6 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
15 TS=(random* or factorial* or crossover* or "cross-over*" or placebo* or "doubl* blind*" or "singl* blind*" or assign* or allocat* or volunteer* or "trial" or "groups" or "controlled") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
16 #15 AND #14 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
17 #16 Indexes=SCI-EXPANDED, CPCI-S Timespan=1900-2018
18 TI=(RAT OR RATS OR MOUSE OR MOUSE OR DOG OR DOGS OR RABBIT OR RABBITS OR PIG OR PIGS OR SWINE OR PORCINE) Indexes=SCIEXPANDED, CPCI-S Timespan=1900-2020
19 #17 NOT #18 Indexes=SCI-EXPANDED, CPCI-S Timespan=1900-2020

Cochrane Database of Systematic Reviews (CDSR)

#1 MeSH descriptor: [Femoral Fractures] explode all trees
#2 ((hip or hips or cervical) NEAR/5 (fracture* or break* or broke*))
#3 ((femoral* or femur* or acetabul*) NEAR/5 (fracture* or break* or broke*))
#4 ((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or transcervical or basicervical or basi-cervical) NEAR/5 (fracture* or break* or broke*))
#5 ((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) NEAR/5 (fracture* or break* or broke*))
#6 ((head or neck or proximal) NEAR/5 (fracture* or break* or broke*)) and (femoral* or femur*)
#7 #1 OR #2 OR #3 OR #4 OR #5 OR #6
#8 MeSH descriptor: [Arthroplasty, Replacement, Hip] this term only
#9 MeSH descriptor: [Hip Prosthesis] this term only
#10 MeSH descriptor: [Arthroplasty, Replacement] this term only
#11 MeSH descriptor: [Hemiarthroplasty] this term only
#12 MeSH descriptor: [Joint Prosthesis] this term only
#13 ((arthroplast* or hemiarthroplast*) NEAR/5 (hip or hips or femur* or femoral* or acetabul*))
#14 ((hip or hips) NEAR/5 (replac* or prosthes* or implant*))
#15 ((joint* NEAR/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))
#16 #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15
#17 MeSH descriptor: [Fractures, Bone] this term only
#18 MeSH descriptor: [Fracture Dislocation] explode all trees

#19 MeSH descriptor: [Fractures, Closed] this term only
#20 MeSH descriptor: [Fractures, Comminuted] this term only
#21 MeSH descriptor: [Fractures, Compression] this term only
#22 MeSH descriptor: [Fractures, Malunited] this term only
#23 MeSH descriptor: [Fractures, Multiple] this term only
#24 MeSH descriptor: [Fractures, Open] this term only
#25 MeSH descriptor: [Fractures, Spontaneous] this term only
#26 MeSH descriptor: [Fractures, Stress] explode all trees
#27 MeSH descriptor: [Fractures, Ununited] this term only
#28 MeSH descriptor: [Intra-Articular Fractures] this term only
#29 MeSH descriptor: [Osteoporotic Fractures] this term only
#30 MeSH descriptor: [Periprosthetic Fractures] this term only
#31 fracture*
#32 #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31
#33 #16 AND #32
#34 (pin or pins or nail or nails or screw or screws or plate or plates)
#35 MeSH descriptor: [Internal Fixators] this term only
#36 MeSH descriptor: [Bone Nails] this term only
#37 MeSH descriptor: [Bone Plates] this term only
#38 MeSH descriptor: [Bone Screws] explode all trees
#39 (static NEXT (device* or implant*))
#40 (dynamic NEXT (device* or implant*))
#41 #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40
#42 ((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))
#43 (hip or hips or femur* or femoral* or acetabul*)
#44 #43 AND (#17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30)
#45 #42 OR #44
#46 #41 AND #45
#47 #7 OR #33 OR #46 in Cochrane Reviews

Database of Abstracts of Reviews of Effects (DARE)

1 (MeSH DESCRIPTOR Femoral Fractures EXPLODE ALL TREES)
2 ((hip or hips or cervical) near5 (fracture* or break* or broke*))
3 ((fracture* or break* or broke*) near5 (hip or hips or cervical))
4 ((femoral* or femur* or acetabul*) near5 (fracture* or break* or broke*))
5 ((fracture* or break* or broke*) near5 (femoral* or femur* or acetabul*))
6 ((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or transcervical or basicervical or basi-cervical) near5 (fracture* or break* or broke*))
7 ((fracture* or break* or broke*) near5 (intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical))
8 ((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near5 (fracture* or break* or broke*))
9 ((fracture* or break* or broke*) near5 (extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*))
10 ((head or neck or proximal) near5 (fracture* or break* or broke*)) AND (femoral* or femur*)
11 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10
12 (MeSH DESCRIPTOR Arthroplasty, Replacement, Hip) OR (MeSH DESCRIPTOR Hip Prosthesis)
13 (MeSH DESCRIPTOR Arthroplasty, Replacement) OR (MeSH DESCRIPTOR Hemiarthroplasty) OR (MeSH DESCRIPTOR Joint Prosthesis)
14 ((arthroplast* or hemiarthroplast*) near5 (hip or hips or femur* or femoral* or acetabul*))
15 ((hip or hips or femur* or femoral* or acetabul*) near5 (arthroplast* or hemiarthroplast*))
16 ((hip or hips) near5 (replac* or prosthes* or implant*))
17 ((replac* or prosthes* or implant*) near5 (hip or hips))
18 (joint* near5 (replac* or prosthes* or implant*)) AND (hip or hips or femur* or femoral* or acetabul*)
19 #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18
20 (MeSH DESCRIPTOR fractures, bone)
21 (MeSH DESCRIPTOR fracture dislocation EXPLODE ALL TREES)
22 (MeSH DESCRIPTOR fractures, closed)
23 (MeSH DESCRIPTOR fractures, comminuted)
24 (MeSH DESCRIPTOR fractures, compression)
25 (MeSH DESCRIPTOR fractures, malunited)
26 (MeSH DESCRIPTOR fractures, open)
27 (MeSH DESCRIPTOR fractures, spontaneous)
28 (MeSH DESCRIPTOR fractures, stress EXPLODE ALL TREES)

29 (MeSH DESCRIPTOR fractures, ununited)
30 (MeSH DESCRIPTOR intra-articular fractures)
31 (MeSH DESCRIPTOR osteoporotic fractures)
32 (MeSH DESCRIPTOR periprosthetic fractures)
33 (MeSH DESCRIPTOR fractures, multiple)
34 (fracture*)
35 #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34
36 #19 AND #35
37 (pin or pins or nail or nails or screw or screws or plate or plates)
38 (MeSH DESCRIPTOR internal fixators)
39 (MeSH DESCRIPTOR bone nails)
40 (MeSH DESCRIPTOR bone plates)
41 (MeSH DESCRIPTOR bone screws EXPLODE ALL TREES)
42 (static near (device* or implant*))
43 ((device* or implant*) near static)
44 (dynamic near (device* or implant*))
45 ((device* or implant*) near dynamic)
46 #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45
47 ((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))
48 (hip or hips or femur* or femoral* or acetabul*)
49 (#20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33)
50 #48 AND #49
51 #47 OR #50
52 #46 AND #51
53 #11 OR #36 OR #52
54 * IN DARE
55 #53 AND #54

Health Technology Assessment (HTA)

1 (MeSH DESCRIPTOR Femoral Fractures EXPLODE ALL TREES)
2 ((hip or hips or cervical) near5 (fracture* or break* or broke*))
3 ((fracture* or break* or broke*) near5 (hip or hips or cervical))
4 ((femoral* or femur* or acetabul*) near5 (fracture* or break* or broke*))
5 ((fracture* or break* or broke*) near5 (femoral* or femur* or acetabul*))
6 ((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or transcervical or basicervical or basi-cervical) near5 (fracture* or break* or broke*))
7 ((fracture* or break* or broke*) near5 (intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical))
8 ((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near5 (fracture* or break* or broke*))
9 ((fracture* or break* or broke*) near5 (extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*))
10 ((head or neck or proximal) near5 (fracture* or break* or broke*)) AND (femoral* or femur*)
11 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10
12 (MeSH DESCRIPTOR Arthroplasty, Replacement, Hip) OR (MeSH DESCRIPTOR Hip Prosthesis)
13 (MeSH DESCRIPTOR Arthroplasty, Replacement) OR (MeSH DESCRIPTOR Hemiarthroplasty) OR (MeSH DESCRIPTOR Joint Prosthesis)
14 ((arthroplast* or hemiarthroplast*) near5 (hip or hips or femur* or femoral* or acetabul*))
15 ((hip or hips or femur* or femoral* or acetabul*) near5 (arthroplast* or hemiarthroplast*))
16 ((hip or hips) near5 (replac* or prosthes* or implant*))
17 ((replac* or prosthes* or implant*) near5 (hip or hips))
18 (joint* near5 (replac* or prosthes* or implant*)) AND (hip or hips or femur* or femoral* or acetabul*)
19 #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18
20 (MeSH DESCRIPTOR fractures, bone)
21 (MeSH DESCRIPTOR fracture dislocation EXPLODE ALL TREES)
22 (MeSH DESCRIPTOR fractures, closed)
23 (MeSH DESCRIPTOR fractures, comminuted)
24 (MeSH DESCRIPTOR fractures, compression)
25 (MeSH DESCRIPTOR fractures, malunited)
26 (MeSH DESCRIPTOR fractures, open)
27 (MeSH DESCRIPTOR fractures, spontaneous)
28 (MeSH DESCRIPTOR fractures, stress EXPLODE ALL TREES)
29 (MeSH DESCRIPTOR fractures, ununited)
30 (MeSH DESCRIPTOR intra-articular fractures)

31 (MeSH DESCRIPTOR osteoporotic fractures)
32 (MeSH DESCRIPTOR periprosthetic fractures)
33 (MeSH DESCRIPTOR fractures, multiple)
34 (fracture*)
35 #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34
36 #19 AND #35
37 (pin or pins or nail or nails or screw or screws or plate or plates)
38 (MeSH DESCRIPTOR internal fixators)
39 (MeSH DESCRIPTOR bone nails)
40 (MeSH DESCRIPTOR bone plates)
41 (MeSH DESCRIPTOR bone screws EXPLODE ALL TREES)
42 (static near (device* or implant*))
43 ((device* or implant*) near static)
44 (dynamic near (device* or implant*))
45 ((device* or implant*) near dynamic)
46 #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45
47 ((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))
48 (hip or hips or femur* or femoral* or acetabul*)
49 (#20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33)
50 #48 AND #49
51 #47 OR #50
52 #46 AND #51
53 #11 OR #36 OR #52
54 * IN HTA
55 #53 AND #54

Epistemonikos

Search 1:
Title/abstract (fracture* or break* or broke) AND Title/abstract (hip or hips or cervical or femoral* or femur* or acetabul* or intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical or extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*)

Search 2:
Title/abstract (hip or hips or femur* or femoral* or acetabul*) and (replac* or prosthes* or implant*) and fracture*
OR Title/abstract
(arthroplast* or hemiarthroplast*) and (hip or hips or femur* or femoral* or acetabul*) and fracture*

Search 3:
Title/abstract (pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators) AND Title/abstract (hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke)

Proquest DISSERTATIONS AND THESES

S1 ti(((hip or hips or cervical) near/5 (fracture* or break* or broke*))) OR ab(((hip or hips or cervical) near/5 (fracture* or break* or broke*)))
S2 ti(((femoral* or femur* or acetabul*) near/5 (fracture* or break* or broke*))) OR ab(((femoral* or femur* or acetabul*) near/5 (fracture* or break* or broke*)))
S3 ti(((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical) near/5 (fracture* or break* or broke*))) OR ab(((intracapsular or intracapsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical) near/5 (fracture* or break* or broke*)))
S4 ti(((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near/5 (fracture* or break* or broke*))) OR ab(((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near/5 (fracture* or break* or broke*)))
S5 ti((((head or neck or proximal) near/5 (fracture* or break* or broke*)) and (femoral* or femur*))) OR ab((((head or neck or proximal) near/5 (fracture* or break* or broke*)) and (femoral* or femur*)))
S6 (ti(((hip or hips or cervical) near/5 (fracture* or break* or broke*))) OR ab(((hip or hips or cervical) near/5 (fracture* or break* or broke*)))) OR (ti(((femoral* or femur* or acetabul*) near/5 (fracture* or break* or broke*))) OR ab(((femoral* or femur* or acetabul*) near/5 (fracture* or break* or broke*)))) OR (ti(((intracapsular or intracapsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical) near/5 (fracture* or break* or broke*))) OR ab(((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basicervical) near/5 (fracture* or break* or broke*)))) OR (ti(((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near/5 (fracture* or break* or broke*))) OR ab(((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near/5 (fracture* or break* or broke*)))) OR (ti((((head or neck or proximal) near/5

(fracture* or break* or broke*)) and (femoral* or femur*))) OR ab((((head or neck or proximal) near/5 (fracture* or break* or broke*)) and (femoral* or femur*))))
S7 ti((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*)) OR ab((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*))
S8 ti((hip or hips) near/5 (replac* or prosthes* or implant*)) OR ab((hip or hips) near/5 (replac* or prosthes* or implant*))
S9 ti(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))) OR ab(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*)))
S10 (ti((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*)) OR ab((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*))) OR (ti((hip or hips) near/5 (replac* or prosthes* or implant*)) OR ab((hip or hips) near/5 (replac* or prosthes* or implant*))) OR (ti(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))) OR ab(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))))
S11 ti(fracture*) OR ab(fracture*)
S12 ((ti((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*)) OR ab((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*))) OR (ti((hip or hips) near/5 (replac* or prosthes* or implant*)) OR ab((hip or hips) 183 near/5 (replac* or prosthes* or implant*))) OR (ti(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))) OR ab(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))))) AND (ti(fracture*) OR ab(fracture*))
S13 ti((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators)) OR ab((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators))
S14 ti(static near (device* or implant*)) OR ab(static near (device* or implant*))
S15 ti(dynamic near (device* or implant*)) OR ab(dynamic near (device* or implant*))
S16 (ti((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators)) OR ab((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators))) OR (ti(static near (device* or implant*)) OR ab(static near (device* or implant*))) OR (ti(dynamic near (device* or implant*)) OR ab(dynamic near (device* or implant*)))
S17 ti((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*)) OR ab((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))
S18 ((ti((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators)) OR ab((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators))) OR (ti(static near (device* or implant*)) OR ab(static near (device* or implant*))) OR (ti(dynamic near (device* or implant*)) OR ab(dynamic near (device* or implant*)))) AND (ti((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*)) OR ab((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*)))
S19 ((ti(((hip or hips or cervical) near/5 (fracture* or break* or broke*))) OR ab(((hip or hips or cervical) near/5 (fracture* or break* or broke*)))) OR (ti(((femoral* or femur* or acetabul*) near/5 (fracture* or break* or broke*))) OR ab(((femoral* or femur* or acetabul*) near/5 (fracture* or break* or broke*)))) OR (ti(((intracapsular or intracapsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basi-cervical) near/5 (fracture* or break* or broke*))) OR ab(((intracapsular or intra-capsular or subcapital or sub-capital or transcervical or trans-cervical or basicervical or basicervical) near/5 (fracture* or break* or broke*)))) OR (ti(((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near/5 (fracture* or break* or broke*))) OR ab(((extracapsular or extra-capsular or trochant* or subtrochant* or pertrochant* or intertrochant*) near/5 (fracture* or break* or broke*)))) OR (ti((((head or neck or proximal) near/5 (fracture* or break* or broke*)) and (femoral* or femur*))) OR ab((((head or neck or proximal) near/5 (fracture* or break* or broke*)) and (femoral* or femur*))))) OR (((ti((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*)) OR ab((arthroplast* or hemiarthroplast*) near/5 (hip or hips or femur* or femoral* or acetabul*))) OR (ti((hip or hips) near/5 (replac* or prosthes* or implant*)) OR ab((hip or hips) near/5 (replac* or prosthes* or implant*))) OR (ti(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))) OR ab(((joint* near/5 (replac* or prosthes* or implant*)) and (hip or hips or femur* or femoral* or acetabul*))))) AND (ti(fracture*) OR ab(fracture*))) OR (((ti((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators)) OR ab((pin or pins or nail or nails or screw or screws or plate or plates or fixator or fixators))) OR (ti(static near (device* or implant*)) OR ab(static near (device* or implant*))) OR (ti(dynamic near (device* or implant*)) OR ab(dynamic near (device* or implant*)))) AND (ti((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*)) OR ab((hip or hips or femur* or femoral* or acetabul*) and (fracture* or break* or broke*))))

National Technical Information Service (NTIS)

Title: hip fractures OR Keyword: hip fractures

Keyword: Hip AND Keyword: Bone fractures

ClinicalTrials.gov

Advanced search limited to intervention studies in Condition or disease

Interventional Studies | (fracture OR fractures OR break OR broke OR broken) AND (hip OR hips OR femoral OR femur OR acetabular OR intracapsular OR intra-capsular OR subcapital OR sub-capital OR transcervical OR trans-cervical OR basicervical OR basi-cervical)

Interventional Studies | (fracture OR fractures OR break OR broke OR broken) AND (extracapsular OR extracapsular OR trochanter OR trochanteric OR subtrochanter OR subtrochanteric OR pertrochanter OR pertochanteric OR intertrochanter OR intertochanteric)

Interventional Studies | (hip OR hips OR femur OR femoral OR acetabular) AND (replace OR replacement OR prosthesis OR prostheses OR implant OR implants) AND (fracture OR fractures OR break OR broke OR broken)

Interventional Studies | (arthroplasty OR hemiarthroplasty) AND (hip OR hips OR femur OR femoral OR acetabular) AND (fracture OR fractures OR break OR broke OR broken)

Appendix 2. Template data extraction form

Methods	*RCT or quasi-randomised; parallel design* **Review comparison group:**
Participants	**Total number of randomised participants:** **Inclusion criteria:** **Exclusion criteria:** **Setting:** *type of setting, how many sites & country* **Baseline characteristics** **Intervention group 1** (*specify by name*) • Age, mean (SD): (±) years • Gender, M/F: • Smoking history, n: • Medication, type, n: • BMI, mean (SD): (±) kg/m^2 • Comorbidities, type, n: • Mobility assessment/use of walking aides: • Place of residence: • Cognitive status/dementia: • ASA status, I/II/III/IV: • Preoperative waiting time, mean (SD): (±) hours • Fracture classification, stable/unstable, n: • Additional information: **Intervention group 2** (*specify by name*) • Age, mean (SD): (±) years • Gender, M/F: • Smoking history, n: • Medication, type, n: • BMI, mean (SD): (±) kg/m^2 • Comorbidities, type, n: • Mobility assessment/use of walking aides: • Place of residence: • Cognitive status/dementia: • ASA status, I/II/III/IV: • Preoperative waiting time, mean (SD): (±) hours • Fracture classification, stable/unstable, n: • Additional information: **Overall** • Age, mean (SD): (±) years

(Continued)

	• Gender, M/F: • Smoking history, n: • Medication, type, n: • BMI, mean (SD): (±) kg/m^2 • Comorbidities, type, n: • Mobility assessment/use of walking aides: • Place of residence: • Cognitive status/dementia: • ASA status, I/II/III/IV: • Preoperative waiting time, mean (SD): (±) hours • Fracture classification, stable/unstable, n: • Additional information: **Note:** • *specify outcomes for which baseline data are not specified* • *are prognostic variables comparable between groups?*
Interventions	**General details:** to include number of clinicians (and their skills and experience), type of anaesthesia, pre- and postoperative care (e.g. use of prophylactic antibiotics or antithromboembolics), rehabilitation (e.g. time to mobilisation or weight bearing) **Intervention group 1:** type of implant (with manufacturer details), description of use; number randomised to group, number of losses (for relevant outcomes, and with reasons for losses), number analysed by review authors for each review outcome **Intervention group 2:** type of implant (with manufacturer details), description of use; number randomised to group, number of losses (for relevant outcomes, and with reasons for losses), number analysed by review authors for each review outcome **Note:** • *specify general details for which information is not reported by study authors*
Outcomes	Outcomes measured/reported by study authors: *include all outcomes reported by study authors. For outcomes relevant to the review, specify all time points measured by study authors* Outcomes relevant to the review: *include measurement tools and time point of measure used in review analysis* **Note:** • *specify outcome data which are not included in the review and reasons for not including these data*
Notes	**Funding/sponsor/declarations of interest:** **Study dates:**

HISTORY

Protocol first published: Issue 8, 2019

CONTRIBUTIONS OF AUTHORS

SL (systematic reviewer): sifted and identified included studies, extracted study data, interpreted the findings and drafted the review.
RM (systematic reviewer): sifted and identified included studies, extracted study data, interpreted the findings and drafted the review.
JL (systematic reviewer): extracted study data and drafted the review.
JS (statistician): prepared estimates for the networks and conducted statistical analyses according to the protocol, interpreted the findings and approved the final draft of the review.

JG (content expert, Trauma and Orthopaedics): agreed network nodes, extracted data and approved the final draft of the review.
JC (statistician): prepared estimates for the networks and conducted statistical analyses according to the protocol, interpreted the findings and approved the final draft of the review.
WE (content expert, Trauma and Orthopaedics): agreed network nodes, and reviewed and approved the final review.
MP (content expert, Trauma and Orthopaedics): agreed network nodes, and reviewed and approved the final review.
XG (content expert, Trauma and Orthopaedics): interpreted the findings, drafted the review, approved the final review and is the guarantor of the content.

Editorial contributions

Faith Armitage (Copy Editor): copy-edited the review.
Liz Bickerdike (Acute and Emergency Care Network Associate Editor): advised on methodology and review content.
Mike Brown (Acute and Emergency Care Network Senior Editor): approved the final version for publication.
Maria Clarke (Information Specialist): ran literature searches and edited the search methods section.
Kerry Dwan (Statistical Editor): advised on methodology and review content.
Joanne Elliott (Managing Editor): co-ordinated the editorial process and edited the review.

Xavier Griffin and Sharon Lewis are members of the editorial base but were not involved in the editorial process or decision-making for this review.

DECLARATIONS OF INTEREST

SL: none known
RM: none known
JL: none known
JS: none known
JG: none known
JC: none known
WE has an advisory role on infection control with Orthofix, Bone Support and Stryker, but this is unrelated to this review. He has no known conflicts of interest.
MP has received and may continue to receive financial payment from manufacturing companies of orthopaedic implants for attending meetings organised by these companies and for advising on the design and use of hip fracture implants. He remained independent of study selection decisions, risk of bias assessment and any data extraction of any of the studies on which he is an author, co-applicant or has had an advisory role.
XG is funded by a National Institute for Health Research Clinician Scientist Grant. Further funding from industry and charitable grants are and have been made available to his institution. He has ongoing expert consultancy with several companies; none involve the development of any implant for use in hip fracture care. All decisions relating to the design, conduct, analysis, write-up and publication of research are independent of these funders. He remained independent of study selection decisions, risk of bias assessment and any data extraction of any of the studies on which he is an author, co-applicant or has had an advisory role.

SOURCES OF SUPPORT

Internal sources

- National Institute for Health Research Oxford Biomedical Research Centre, UK

External sources

- This project was supported by the National Institute for Health Research via Cochrane Infrastructure funding to the Cochrane Bone, Joint and Muscle Trauma Group, UK

  The views and opinions expressed herein are those of the authors and do not necessarily reflect those of the Systematic Reviews Programme, NIHR, NHS or the Department of Health.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Review information

- Title: we edited the title to better reflect the older adult population included in the review.
- Review authors: five new review authors joined the review team (SL, RM, JL, JG, JS) and four authors left the review author team (AS, AJ, HW, JMG).

Objectives

- We edited the objectives to reflect the restriction to older adult populations.

Methods

Criteria for considering studies for this review

- Types of participants: we edited the criteria to state the inclusion of older adults (at least 60 years of age). We excluded studies in which all study participants were not representative of the general hip fracture population, and in which we expected that most hip fractures were not caused by low-energy trauma. We reported these exclusions in Excluded studies.
- Types of outcomes: we edited the time points in the review to reflect the wider variation in data in the included studies. In addition to the early data at 4 months or earlier, we added collection of data at 12 months (prioritising 12-month data, but in its absence including data after 4 months and up to 24 months) and late (after 24 months) time points. We did not prioritise early time points when reporting results. Data for all three time points were reported, and in the summary of findings tables, abstract and PLS, we selected the time point which yielded the most data (i.e. 12 months after surgery).
- Types of interventions: we did not number the intervention groups in order to specify the direction of the comparisons. We ensured that the direction of effect was always reported within any cited effect estimate.

Search methods for identification of studies

- Electronic searches: we did not search the World Health Organization International Clinical Trials Registry Platform (www.who.int/ictrp/en/) because, at the time of searching, the platform was not available because of the COVID-19 pandemic. We believed that clinical trials register searches remained comprehensive because CENTRAL also includes studies from international trials registers.

Data collection and analysis

- Data extraction and management: we planned that data extraction would be completed independently by two reviewers. In practice, one author extracted data which was checked for accuracy by a second review author. We edited the data collected to describe the flow of study participants. Rather than collecting "study disposition (number randomised, number by protocol, number available for analysis)", we collected "number of randomised participants, losses (and reasons for losses), and number analysed for each outcome".
- Summary measures: we were able to extract dichotomous data from all studies as number of events per arm. We did not need to use other data such as P values. We did not use 'count data' in which studies reported more than one observation during the course of follow-up. We explained the method used to interpret any estimates reported with SMD.
- Relative treatment ranking: we presented SUCRA as a proportion rather than a percentage, and have edited the methods to reflect this. In addition, we also provided an estimation of mean rank for each treatment, and described this in the methods.
- Unit of analysis issues: we did not include any cluster-randomised trials in the review.
- Reports of outcomes at different time points: as described above ('types of outcomes'), we added an additional time point for collecting data. As we believed this approach best fit the data within the studies, as well as being most clinically appropriate, we did not consider alternative methods of grouping these time points.
- Dealing with missing data: we attempted to contact study authors of recently published studies (since 2012) when we noted data were missing or not clearly reported for critical review outcomes. Most studies in the review were published more than 20 years ago and we did not expect study authors of older studies to have access to study data. We specified that we used the Characteristics of included studies to note when study authors reported data that we were unable to use because of an unknown number of losses or because data were reported unclearly.
- Geometry of the network: we did not present network diagrams that were coloured according to the risk of bias.
- Local approaches for evaluating inconsistency/incoherence: we did not use 'loop-specific' approaches to evaluate incoherence. Instead, we only used the node-splitting (sidesplit) approach.
- Investigation of heterogeneity: we did not explore possible effect modifiers through network meta-regression as we found that there was insufficient variation between studies for these effect modifiers, and individual studies did not report subgroup data by these effect modifiers. Similarly, we did not attempt to run network meta-regression models to detect associations between study size and effect size as originally planned.
- Investigation of heterogeneity: in order to make the distinction between different types of statistical heterogeneity, we changed the term for statistical heterogeneity within pairwise comparisons to 'statistical inconsistency' and the term for statistical heterogeneity within the entire network (locally or globally) to 'statistical incoherence'. This terminology is used in the *Cochrane Handbook for Systematic Reviews of Interventions* (Chaimani 2018).
- Sensitivity analysis: we planned to explore the effect of excluding studies based on particular criteria. However, we did not conduct sensitivity analyses in this review. For studies at high risk of bias, we found that we had very few studies in most of the individual treatment arms such that sensitivity analysis would produce less meaningful results. Very few studies had substantial amounts of missing data, and we found insufficient variation in fracture classifications to warrant sensitivity analysis. We no longer believed that sensitivity analysis was necessary for the time points ('early' and 'late' time points) as we had addressed this by re-defining the time points. Finally, we judged that all interventions, or sufficiently similar variations of these interventions, were in clinical use in a worldwide setting.
- Credibility of the evidence: we presented tables of direct, indirect and network estimates for all outcomes but, given the number of possible direct and indirect estimates and the expected similarity in the GRADE judgements (low to very low), we did not also present GRADE judgements of certainty for each pairwise comparison. We removed this from this section of the methods.

- Summary of findings tables: we specified the outcomes (and time points) for which we prepared summary of findings tables, the inclusion of all available interventions (from our nodes), and the decision to choose a reference comparator to present network estimates against in the tables. We did not include ranking values in the summary of findings tables; we were advised to drop this information from the table by a Methodological Editor in the Cochrane Methods Support Unit.

NOTES

Additional figures and data are available on request from the review authors of the Cochrane Bone, Joint and Muscle Trauma Group. These include the following.

- Forest plots of direct comparisons of treatments (only studies in the networks).
- Netfunnel plots.
- Contribution matrix figures.
- Bar charts showing distribution of key baseline characteristics (gender, age, fracture displacement).
- Outcome data for all studies (included and not included in the networks).

INDEX TERMS

Medical Subject Headings (MeSH)

Bone Plates; Fracture Fixation [adverse effects] [methods]; Fracture Fixation, Internal; *Hip Fractures [surgery]; Network Meta-Analysis

MeSH check words

Aged; Aged, 80 and over; Female; Humans; Middle Aged