

## The use of computed tomography in identifying radiologically occult hip fractures in the elderly

S Heikal, P Riou, L Jones

Royal Devon and Exeter NHS Foundation Trust, UK

### ABSTRACT

**INTRODUCTION** Fractured neck of femur (NOF) is a cause of significant morbidity and mortality. Approximately 4% of patients with an initial normal hip x-ray in the emergency department (ED) will in fact have an occult fracture. In cases where there is ongoing clinical suspicion of NOF fracture despite a normal hip x-ray, alternative imaging should be used. Although available evidence supports the use of magnetic resonance imaging (MRI) for this, it is often not readily accessible from the ED. In our department, it is common practice to request computed tomography (CT).

**METHODS** A historical review was undertaken of all patients who presented between October 2007 and January 2011 who had CT requested by ED staff. Patients included in the study were those who presented following low impact trauma in whom fractured NOF was suspected despite a normal x-ray.

**RESULTS** Of the 65 included patients, fractures (pelvic and hip) were identified in 38 patients on CT. Fractured NOFs were found in 13 patients. Acetabular fractures were found in nine patients, five of whom required further orthopaedic management. One patient went on to have MRI to confirm the diagnosis of an impacted NOF fracture, suspected both on x-ray and CT. Further review was undertaken of the medical notes of discharged patients to identify any who reattended or required further imaging. No such cases were found.

**CONCLUSIONS** This review has shown the use of CT to be a practical approach to improving the care of patients with occult hip fractures.

### KEYWORDS

Emergency department – Fractures and dislocations – Imaging – X-ray – Computed tomography – Magnetic resonance imaging – Accidental fall

Accepted 30 September 2013

### CORRESPONDENCE TO

Sarah Heikal, CT2 in Anaesthetics, Royal Devon and Exeter Hospital, Barrack Road, Exeter EX2 5DW, UK  
E: sheikal@nhs.net

Fractured neck of femur is a serious consequence of falls in the elderly, and is associated with high morbidity and mortality.<sup>1</sup> Delay in surgical treatment has been shown to significantly increase mortality<sup>2</sup> while undisplaced fractures may become displaced if unrecognised and untreated, requiring surgery associated with much higher risk.<sup>3</sup>

The sensitivity of plain x-rays in detecting hip fracture is believed to be 90–98%, based on multiple studies.<sup>4–6</sup> More recent studies suggest that approximately 4% of patients with symptoms suspicious for a hip fracture but with a normal initial hip x-ray in the emergency department (ED) will in fact have an occult hip fracture.<sup>7,8</sup> As a result, where there is high clinical suspicion of hip fracture despite a negative x-ray (patients with significant pain or non-weight bearing after good analgesia), alternative forms of imaging must be considered.

Magnetic resonance imaging (MRI) has been suggested as the imaging of choice in these patients,<sup>7,9,10</sup> and some studies assert a sensitivity and specificity of 100%. Nevertheless, these studies have been small, and suffer from both selection

and verification bias.<sup>11–14</sup> Computed tomography (CT) can often define a fracture not seen on an x-ray. On the other hand, there are theoretical limitations (ie the potential to miss some fractures in patients with severely osteoporotic bone owing to the resolution of the trabecular structure and where the cuts are taken in a coincident plane). CT is more accessible from the ED setting, in many hospitals, than MRI but there is scant evidence to support its use in hip fracture as the few studies available are small and statistically insignificant.<sup>7</sup>

It is of note, however, that the majority of studies that compare MRI with CT did not consider multidetector CT (MDCT). MDCT not only provides much better three-dimensional spatial resolution, improving the accuracy of CT, but it also retains the other advantages of CT over MRI (availability, speed, cost and absence of contraindications such as confused patients or those with pacemakers). One study that did compare the sensitivity of MRI with MDCT suggested that MDCT is as good as MRI in the detection of occult hip fracture although, again, the population examined was too small for statistical confirmation.<sup>15</sup>

National guidelines on imaging in suspected occult hip fracture have only recently been published. Although it is advised by both National Institute for Health and Care Excellence (NICE)<sup>16</sup> and British Orthopaedic Association Standards For Trauma<sup>17</sup> guidelines that patients with negative hip x-rays should be offered MRI, both suggest that CT be considered as an alternative should MRI be contraindicated or not available within 24 hours. The NICE guidelines also suggest that further work is required to determine whether CT would be a clinical and cost effective alternative to MRI.

In our department, it has been common practice to request MDCT of the hip (owing to ease of access and in an attempt to speed clinical management) in those patients in whom femoral neck fracture is clinically suspected but not confirmed on x-ray. The aim of this review was to identify the number of patients whose management was changed as a result of MDCT.

## Methods

A historical review was undertaken of ED patients who presented between October 2007 and January 2011, and who underwent MDCT of the hip requested by emergency medicine staff. A total of 83 patients were identified using the radiology database. The corresponding clinical notes for each were obtained from the ED's electronic records.

Patients included in the study were those who were seen by a member of the ED team, had presented following low impact trauma and in whom fractured neck of femur was included in the differential diagnoses. There were 18 patients excluded from the study. Of these, 11 patients had been referred directly to the orthopaedic team and 7 had been injured in a high impact trauma. Data collected included the differential diagnoses of the attending doctor, initial interpretation of hip radiography by a senior ED physician, subsequent reporting of hip x-rays by the radiology team, outcome of MDCT of the hip and whether the patient was discharged or admitted to either an acute or community hospital.

## Results

Of the 65 patients included in the study, 23 were male and 42 were female. The oldest patient was 105 years of age while the youngest was 45 years old (mean: 81.2 years).

### Diagnosis

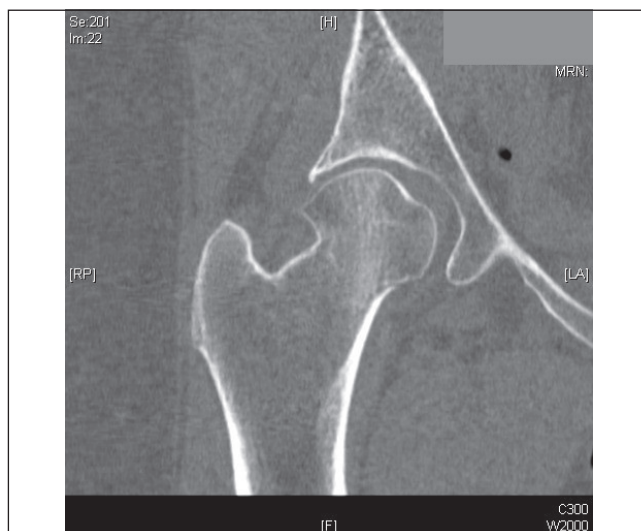
Fractures were identified in 38 patients (58.4%) on MDCT. Femoral neck fractures were present in 13 patients (20%), isolated greater trochanter fractures in 7 patients (10.7%), pubic ramus fractures in 9 patients (15.8%) and acetabular fractures in 9 patients (15.8%). A single patient, a 57-year-old woman, went on to have MRI to confirm the diagnosis of an impacted femoral neck fracture suspected both on x-ray and on MDCT (Figs 1–5). She was admitted following the MRI and was treated surgically using a Targon® plate (B Braun, Melsungen, Germany).

### X-ray interpretation

All patients underwent plain x-rays as well as anteroposterior pelvis and lateral hip x-rays prior to MDCT. These

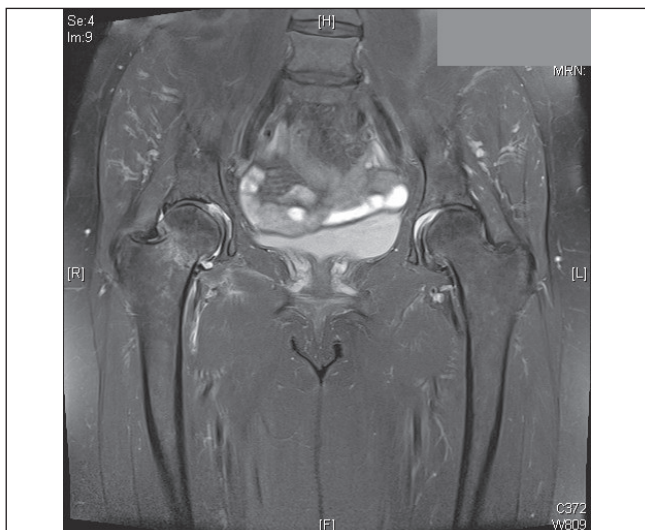


**Figure 1** X-ray reported as suspicious for right neck of femur fracture

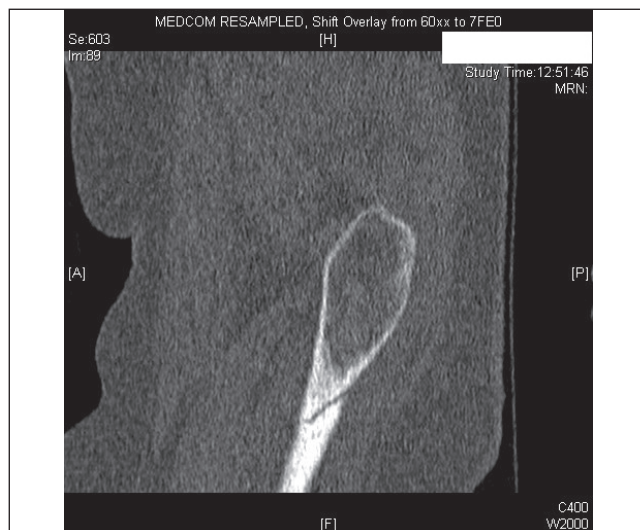


**Figure 2** Computed tomography of right hip in the same patient as Fig 1, again supporting clinical diagnosis of right neck of femur fracture

were reviewed by a senior ED physician at the time and later by the duty radiologist. Of the 13 patients found subsequently to have femoral neck fractures on MDCT, 3 (23%) had no identifiable fracture on plain radiography on review by the duty radiologist (Figs 4 and 5). A further six patients (46.1%) with fractured neck of femur on MDCT had x-rays that were inconclusive but suspicious for a fracture. The remaining four patients (30.7%) with fractured neck of femur on MDCT had fractures identified on x-ray when reviewed by the duty radiologist (although formal reporting occurred following MDCT and with MDCT images available).



**Figure 3** Magnetic resonance imaging of right hip (again in the same patient as Figs 1 and 2) showing bone oedema and confirming earlier clinical diagnosis



**Figure 5** Sagittal computed tomography confirming clinically suspected right neck of femur in the same patient as Fig 4



**Figure 4** X-ray reported as showing no bony injury

**Patient outcome**

All patients with femoral neck fractures were admitted under the care of the orthopaedic team. Of these 13 patients, 11 (84.6%) underwent surgical repair. The remaining two

were managed conservatively. The classification and management of each fracture is listed in Table 1.

No orthopaedic intervention was required in 12 out of 18 patients (66.6%) with pelvic fractures. These patients were either discharged home, admitted to community hospitals or medical wards. Surgical intervention was felt to be appropriate in one patient with significant fractures of the acetabular roof and floor but was not performed owing to pre-existing co-morbidities (including advanced dementia). The remaining five patients (27.8%) with fractures were admitted under the orthopaedic team for conservative management but did not require surgical intervention.

Further review was undertaken of the medical notes of those patients in whom MDCT showed no fracture or isolated greater trochanter fracture only, between the date of initial presentation and December 2011. The purpose was to identify any patients in whom reattendance or further imaging was required because of fractures not identified on MDCT (or in the case of greater trochanter fractures, those that extended into the femoral neck). No such cases were found.

**Discussion**

Elderly patients presenting with falls and subsequent femoral neck fractures are vulnerable. They face not only a high rate of morbidity and mortality but often long-term loss of mobility and independence as well. Appropriate diagnosis

Table 1 Classification of hip fractures as identified on computed tomography and the treatment received					
Type of fracture	Dynamic hip screw	Intramedullary nail	Cannulated screws	Managed conservatively	Unknown
Intertrochanteric	2	2	0	0	0
Pertrochanteric	0	0	0	2	0
Neck	1	0	4	1	1

and management of this group of patients is of increasing importance in a growing elderly population. The exclusion of fractures is also important as it allows early mobilisation and rehabilitation of patients. Although there is mounting evidence to support the use of MRI in the detection of occult hip fractures, it is not readily available in most departments.

This single centre study is limited by small patient numbers, which are by nature non-consecutive, and biased by having a preselected patient group. However, it does suggest that MDCT has a role in the diagnosis of occult hip and pelvic fractures in our hospital, where MDCT is much more readily available than MRI, reducing the rate of missed injury as well as enabling early and appropriate management. In our study, MDCT confirmed neck of femur fractures in a fifth of patients in whom it was clinically suspected despite normal radiography. It also identified clinically significant fractures in 20 of the 65 cases reviewed (30.7%), with 17 patients undergoing surgical repair. A single patient went on to require definitive imaging but, importantly, the MDCT for this patient was still suggestive of a fracture.

## Conclusions

Currently, there is scarce evidence in the literature to support the use of CT of the hip for occult hip fracture evaluation. This review of practice, acknowledging its limitations, has shown the use of MDCT to be a practical approach to improving the care of patients with occult hip fractures. We suggest CT should be strongly considered where MRI is difficult to access in this group of patients.

## Acknowledgement

The authors would like to thank Margaret Huntly for her help in identifying patients using the picture archiving and communication system radiology database.

## References

1. Reimers A, Laflamme L. Hip fractures among the elderly: personal and contextual social factors that matter. *J Trauma* 2007; **62**: 365–369.
2. Zuckerman JD, Skovron ML, Koval KJ *et al*. Postoperative complications and mortality associated with operative delay in older patients who have a fracture of the hip. *J Bone Joint Surg Am* 1995; **77**: 1,551–1,556.
3. Kim KC, Ha YC, Kim TY *et al*. Initially missed occult fractures of the proximal femur in elderly patients: implications for need of operation and their morbidity. *Arch Orthop Trauma Surg* 2010; **130**: 915–920.
4. Parker MJ. Missed hip fractures. *Arch Emerg Med* 1992; **9**: 23–27.
5. Perron AD, Miller MD, Brady WJ. Orthopedic pitfalls in the ED: radiographically occult hip fracture. *Am J Emerg Med* 2002; **20**: 234–237.
6. Lubovsky O, Liebergall M, Mattan Y *et al*. Early diagnosis of occult hip fractures MRI versus CT scan. *Injury* 2005; **36**: 788–792.
7. Cannon J, Silvestri S, Munro M. Imaging choices in occult hip fracture. *J Emerg Med* 2009; **37**: 144–152.
8. Dominguez S, Liu P, Roberts C *et al*. Prevalence of traumatic hip and pelvic fractures in patients with suspected hip fracture and negative initial standard radiographs – a study of emergency department patients. *Acad Emerg Med* 2005; **12**: 366–369.
9. Frihagen F, Nordsletten L, Tariq R, Madsen JE. MRI diagnosis of occult hip fractures. *Acta Orthop* 2005; **76**: 524–530.
10. Pandey R, McNally E, Ali A, Bulstrode C. The role of MRI in the diagnosis of occult hip fractures. *Injury* 1998; **29**: 61–63.
11. Conway WF, Totty WG, McEnery KW. CT and MR imaging of the hip. *Radiology* 1996; **198**: 297–307.
12. Quinn SF, McCarthy JL. Prospective evaluation of patients with suspected hip fracture and indeterminate radiographs: use of T1-weighted MR images. *Radiology* 1993; **187**: 469–471.
13. Rizzo PF, Gould ES, Lyden JP, Asnis SE. Diagnosis of occult fractures about the hip. Magnetic resonance imaging compared with bone-scanning. *J Bone Joint Surg Am* 1993; **75**: 395–401.
14. Lim KB, Eng AK, Chng SM *et al*. Limited magnetic resonance imaging (MRI) and the occult hip fracture. *Ann Acad Med Singapore* 2002; **31**: 607–610.
15. Gill SK, Smith J, Fox R, Chesser TJ. Investigation of occult hip fractures: the use of CT and MRI. *Scientific World Journal* 2013; 830319.
16. National Institute for Health and Care Excellence. *Hip Fracture*. London: NICE; 2011.
17. British Orthopaedic Association. *BOAST 1 Version 2*. London: BOA; 2012.