NEED THE THUMB BE IMMOBILISED IN SCAPHOID FRACTURES?

A RANDOMISED PROSPECTIVE TRIAL

NIGEL R. CLAY, JOSEPH J. DIAS, P. S. COSTIGAN, P. J. GREGG, N. J. BARTON

From Queen's Medical Centre, Nottingham and Leicester Royal Infirmary

Immobilisation of the thumb is widely believed to be important in the management of fractures of the carpal scaphoid. To assess the need for this, we randomly allocated 392 fresh fractures for treatment by either a forearm gauntlet (Colles') cast, leaving the thumb free, or by a conventional 'scaphoid' plaster incorporating the thumb as far as its interphalangeal joint.

In the 292 fractures which were followed for six months, the incidence of nonunion was independent of the type of cast used.

Fractures of the waist of the scaphoid are common, especially in young men, and are of considerable social and economic significance. It is generally accepted that these fractures should be immobilised to minimise the incidence of nonunion. Different authors have recommended the use of above-elbow or below-elbow plasters in a variety of different configurations in relation to the forearm, wrist, thumb and even fingers. No single type of cast has been shown to be best. In Great Britain, a below-elbow cast incorporating the thumb up to the interphalangeal joint has become, by convention, known as a 'scaphoid cast'.

In view of the lack of evidence for the need to enclose the thumb in this way, we used a randomised trial to compare the scaphoid cast with a forearm gauntlet (Colles') cast for the treatment of fresh fractures of the scaphoid.

N. R. Clay, FRCS Ed, Consultant Orthopaedic Surgeon
Glan Clwyd Hospital, Bodelwyddan, Rhyl, Clwyd LL18 5UJ, Wales.

J. J. Dias, MD, FRCS Ed, Consultant Orthopaedic Surgeon
P. J. Gregg, MD, FRCS, Professor of Orthopaedic Surgery
Leicester Royal Infirmary, Infirmary Square, Leicester LE1 5WW, England.

P. S. Costigan, FRCS, Orthopaedic Registrar
N. J. Barton, FRCS, Consultant Hand Surgeon
Queen's Medical Centre, Nottingham NG7 2UH, England.

Correspondence should be sent to Mr N. R. Clay.

0301-620X/91/5217 $2.00
J Bone Joint Surg [Br] 1991; 73-B:828–32.

PATIENTS AND METHODS

All patients who attended the Queen's Medical Centre in Nottingham or the Leicester Royal Infirmary with a history and clinical findings suggestive of recent scaphoid injury were examined radiologically. Postero-anterior, lateral, semi-pronated and semi-supinated views and an additional view as recommended by Ziter (1973) were taken. A temporary dorsal plaster slab was applied at the first visit to hospital and the patients were referred, in Nottingham, to the next available fracture clinic, and in Leicester to a weekly 'scaphoid clinic', where all radiologically proven scaphoid fractures were randomly allocated. Either a Colles' cast was applied or a scaphoid cast with the thumb enclosed to the interphalangeal joint. In both cases the wrist was held in 30° of dorsiflexion. In the scaphoid casts the thumb was positioned to allow pinch grip.

We excluded from the trial doubtful fractures, injuries presenting at later than two weeks, fractures of the scaphoid tubercle, fractures associated with carpal dislocation or with other injuries in the same limb, bilateral injuries and patients under 16 years of age.

Patients who entered the trial were reviewed at two weeks and at four weeks to check the integrity of their casts and to assess any functional problems. After eight weeks, the plaster was removed and the progress towards union was assessed clinically and radiologically. The appearance of trabeculae crossing the fracture line and/or signs of increased bone density at the edges of the fracture (Russe 1960) were accepted as evidence of a

healing fracture and plaster treatment was discontinued. If healing was in doubt, the wrist was immobilised for a further four weeks. After this the plaster was removed and patients were encouraged to mobilise the wrist.

At final review, six months after injury, the radiographic examination was repeated, using the same views. Our criterion for definite union was complete disappearance of the fracture line.

RESULTS

Between January 1986 and December 1988, 392 fractures of the waist of the scaphoid were entered into the trial. All the Leicester patients (192) were followed to the six-month stage, whereas in Nottingham only 100 attended for the final review with all data complete. The difference in follow-up rates reflects the effectiveness of a single person performing all the assessments in a specialised clinic, and the deliberate exclusion of temporary residents from the trial, as was the case in Leicester. The large number of university students in the Nottingham population accounted for many of those who failed to attend for follow-up visits. However, the outcome of those who were successfully followed to six months in Nottingham was similar in every way to that in the Leicester patients. The two groups have therefore been considered as one group of 292 patients.

Table I. Mechanism of injury in 292 scaphoid fractures

Mechanism	*Per cent*
Fall on outstretched hand	*59*
Road traffic accident	*12*
Direct blow	*7*
Forced hyperextension	*5*
Starting handle kickback	*3*
Fall on dorsum of hand	*3*
Unclassifiable	*11*

Table II. Number and distribution of fracture types in the two groups

	Scaphoid cast (n = 140)		Colles' cast (n = 145)	
Bohler fracture type	Number	*Per cent*	Number	*Per cent*
Transverse	81	*58*	98	*68*
Horizontal oblique	29	*21*	28	*19*
Distal pole	15	*11*	10	*7*
Vertical oblique	6	*4*	7	*5*
Proximal pole	9	*6*	2	*1*
Unclassified*	4		3	

*small variations in numbers and totals in Tables II, III and V are due to incomplete data in a few cases

The mean age of the patients was 29.7 years (16 to 71); 222 (76%) were male and the dominant and non-dominant hands were affected in equal numbers. Similar parameters were found in the 'scaphoid' group (144) and in the Colles' group (148). They are also comparable with previous studies of scaphoid fracture populations (Leslie and Dickson 1981; Morgan and Walters 1984; Thorleifsson, Karlsson and Sigurjonsson 1984).

The mechanisms of injury are recorded in Table I. Road traffic accidents accounted for more fractures than crank-handle injuries, in contrast to the series reported by Leslie and Dickson (1981). There were slightly more road traffic accidents in those assigned to the Colles' group but the difference was not statistically significant.

The fractures were classified radiographically by the method of Böhler, Trojan and Jahna (1954), as summarised in Table II. Vertical oblique and proximal pole fractures, which are said to have a poorer prognosis, were more common in the patients treated in scaphoid casts but as these are relatively rare fractures, the difference was not statistically significant.

Tolerance of casts and functional recovery. Both groups were asked about their ability to wash, dress, use a knife and fork, write (if the dominant hand was affected), work and drive a vehicle, while their arm was in plaster. Function was expressed as a percentage of the activities they could perform. Regardless of the type of cast, the patients experienced initial difficulties with everyday activities but soon overcame them. The difference between the two types of cast was minimal.

Table III. Outcome and type of fracture

Bohler fracture type	Definite union (*per cent*)	Probable union (*per cent*)	Nonunion (*per cent*)
Transverse (n = 179)	*76*	*14*	*10*
Horizontal oblique (n = 57)	*83*	*10*	*7*
Distal pole (n = 24)	*100*	-	-
Vertical oblique (n = 13)	*63*	*37*	-
Proximal pole (n = 11)	*61*	*8*	*31*

After removal of the casts, recovery of function was the same in both groups: by six months there was no significant restriction in patients whose fractures had united.

Outcome and type of fracture. The radiological appearances after six months are summarised in Table III. In approximately one in eight cases the fracture line, though partially consolidated, was still visible (Fig. 1) and was classified as 'probably united.' Twelve months after injury, further examination of all these fractures showed the radiographic appearances to be unchanged and the patients remained asymptomatic.

The proximal pole fractures showed the highest

Table IV. Outcome and degree of instability of fracture by Herbert's classification

Herbert's classification	Number of fractures	Definite union (*per cent*)	Probable union (*per cent*)	Nonunion (*per cent*)
Type A (stable)				
A1: Crack fractures	126	*84*	*9*	*7*
A2: Tubercle fractures*	5	*100*	–	–
Type B (unstable)				
B1: Distal third	39	*92*	*8*	–
B2: Waist - displaced	74	*63*	*23*	*14*
B3: Proximal pole	12	*59*	*8*	*33*
B4: Carpal dislocation	0	–	–	–
B5: Comminuted	28	*71*	*18*	*10*

*fractures of the tubercle with extension into the body of the scaphoid

Table V. Outcome and type of cast

	Definitely united		Probably united		Nonunion	
Cast	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*
Scaphoid (n = 143)	111	*78*	18	*12*	14	*10*
Colles' (n = 148)	114	*77*	19	*13*	15	*10*

Fig. 1

The fracture line is still visible after three months (see text).

incidence of definite nonunion at six months, but they were too few to be statistically significant. In the vertical oblique fractures there was a tendency for a visible fracture line to persist, but they did not exhibit true nonunion.

Herbert (1974) classified acute scaphoid fractures into five patterns of instability which related to their prognosis. Our prospective application of this classification (Table IV) showed that displaced fractures of the waist and comminuted fractures were more likely to show a persistent fracture line at six months, but that the incidence of definite nonunion, particularly of the comminuted fractures, was not significantly different.

Outcome and type of cast. The mean total time in plaster for the 'scaphoid' and the Colles' casts was 9.6 and 9 weeks respectively. The outcome in terms of nonunion was similar for the two types of treatment (Table V).

DISCUSSION

Before the advent of radiographs, fracture of the scaphoid was a barely recognised and poorly understood condition. In the early part of this century, treatment by brief splintage followed by massage and movement earned this fracture a bad reputation. In 1902, Stimson recorded that less than a dozen such fractures had been reported in the literature and that his three cases had all developed total stiffness of the wrist.

The unsatisfactory results of treatment by early mobilisation undoubtedly prompted the use of the plaster cast. From 1925 to 1942, Böhler employed a simple backslab leaving the thumb free. In 1942 he changed this method to include the thumb in the plaster. By 1954, he had treated 734 fractures and, of the 580 available for review, only 23 (4%) had failed to unite (Böhler et al 1954). The dramatic improvement in morbidity resulting from plaster treatment and the observation by Böhler

(and subsequently many others) that nonunion is more common when treatment is delayed, has obviated studies which involve withholding all forms of fracture stabilisation. For this reason, the true incidence of nonunion in untreated scaphoid fractures may never be discovered.

However, elimination of nonunion by immobilisation has not been the universal experience. Decoulx, Razemon and Lemerle (1959) reported that 36% of their fractures had failed to unite after plaster cast treatment. Thus, a variety of cast types have been employed in attempts to minimise nonunion. Most produce union rates in the region of 90% (London 1961). In 1938, Brittain suggested the use of a forearm cast with the thumb free for eight weeks. Soto-Hall (1945) recommended manipulative reduction of any displacement. In cadaveric studies, he found that any movement of the interphalangeal joint of the thumb produces a definite change of position of the fractured fragments, and felt that this could be prevented by incorporation of the thumb in the cast to the level of the thumbnail. He reported 95% union by this method and declared the treatment of recent fractures of this type as almost a solved problem. Russe (1960) included the thumb to the metacarpophalangeal joint only, but thought it necessary to include the fingers as well for unstable fractures.

It is difficult to establish when and why the cast, which incorporates the proximal phalanx of the thumb became established as the normal and correct treatment, so much so that it is often called a 'scaphoid plaster', as though there could be no other.

Watson-Jones, in the first edition of his famous and influential book, published in 1940, advocated a rather curious plaster which 'covers the first interosseous space and includes the whole of the first metacarpal as far as the thenar muscles'. This advice was repeated in the second edition (1941), but in the third edition (1943) Watson-Jones added that some surgeons also include the metacarpophalangeal joint of the thumb and even the interphalangeal joint. In the fourth edition (1955), he advised including the metacarpal bone of the thumb, or perhaps better still, the metacarpophalangeal joint and proximal phalanx. The fifth edition was published in 1976, after Watson-Jones' death; some chapters were revised by other authors but the one on the wrist appears to be unchanged. For the sixth edition (1982), a new chapter on the wrist was written by Fisk, who advised that the proximal phalanx of the thumb should be included in the plaster cast.

Thus, the scaphoid plaster seems to have come into vogue about 1955: this may have been under the influence of a paper published in 1954 by Stewart who reviewed 422 cases treated in the US Army and advocated a plaster extending to the base of the thumbnail on the dorsal aspect and to the proximal crease of the palmar side. Movement of the interphalangeal joint of the thumb was allowed, provided the plaster did not weaken and permit motion of the metacarpophalangeal joint. The first metacarpal was held in palmar abduction. In contrast, London (1967) recommended that the wrist should be encased in plaster in a useful position and with the thumb free. Our results support this method.

In 1954, Verdan (quoted by Broom et al 1964) drew attention to movement at the fracture site produced by pronation and supination of the forearm and recommended an above-elbow cast. This has been investigated by several authors with conflicting evidence as to its effectiveness (Broomé, Cedell and Colléen 1964; Goldman, Lipscomb and Taylor 1969; Thomaidis 1973; Alho and Kankaanpää 1975; King, Mackenny and Elnur 1982; Gellman et al 1989). Recent cadaveric studies by Kuhlmann et al (1987) have suggested that unrestricted pronation-supination of the forearm diminishes the rotational forces between the radius and the mid-carpus, and that immobilisation of the elbow is not only unnecessary but injurious. These writers concluded that inclusion of the thumb gave additional stability to the fracture and that the most important feature of the cast is that it be close-fitting.

The belief that inclusion of the thumb (or indeed any particular cast configuration) specifically influences the rate of nonunion has still to be demonstrated. Most of the previous reports are retrospective studies of a single method. The few prospective trials have not directly addressed the question of thumb immobilisation, and most have reported too few patients for any reported difference to be regarded as significant. As the rate of nonunion appears to be in the order of 3% to 10%, large numbers are required to detect the effect of different treatments. Even though we combined patients from two large accident units over a relatively long period, we were unable to collect enough data to draw conclusions regarding some of the less common fracture configurations.

The overall nonunion rate in this series appears high in comparison with other studies. There are several possible explanations for this. Our definition of a fracture for entry into the study was a clear lucent line or a step in the cortex of the scaphoid. Lindgren (1949) recognised that the trabecular pattern of a normal scaphoid can produce lines suggestive of a fracture. This has been shown to cause significant differences between observers in the threshold for diagnosis (Dias et al 1990). Since it is possible to over-diagnose scaphoid fractures, any estimate of the rate of nonunion would be reduced if a series included a number of soft-tissue injuries.

In addition, the radiological signs used to determine bone healing and the relatively short follow-up periods in earlier series may have produced unduly optimistic rates of union. Russe (1960) suggested that union was implied by the appearance of trabeculae crossing the fracture site or the presence of increased density at the edges of the fracture. Using these criteria, Leslie and Dickson (1981) reported that the mean time to union of all types of scaphoid fracture was nine weeks. However,

the interpretation of radiographs, even 12 weeks after injury, is subject to considerable inter-observer error (Dias et al 1988). Herbert and Fisher (1984) have suggested that the true incidence of nonunion after conservative treatment may be as high as 50%. They noted that although a fracture may appear to be united after treatment, radiographic follow-up later may reveal nonunion. Although we waited until six months after injury to make the radiological diagnosis we did not observe this phenomenon but even at that stage the radiographs were sometimes difficult to interpret, necessitating the third group of fractures which were 'probably united'. Twelve months after injury, the radiological appearances of this group were unchanged and they remained asymptomatic. In some fractures, definite evidence of union is therefore dependent not only upon radiological appearances but also upon prolonged follow-up and clinical assessment.

Böhler et al (1954) stated that "the part of the bandage which is in the palm must be carefully controlled, in order to guarantee a perfect support. If the plaster is broken, it must be replaced". Seeing the patients frequently, as we did in this study, it was found that the plasters were often unsatisfactory and needed to be replaced. We believe that the extent of the cast is of less importance than its quality, which must be well moulded into the palm and checked frequently throughout treatment.

Conclusion. Both types of cast were equally well tolerated and rehabilitation did not appear to be adversely affected by immobilisation of the thumb. However, the scaphoid cast is clearly more inconvenient for the patient and has the further disadvantage of being more costly to apply in terms of time and material.

For fresh, undisplaced fractures of the waist of the scaphoid, the simpler Colles' plaster would appear to be equally effective.

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.

REFERENCES

Alho A, Kankaanpää U. Management of fractured scaphoid bone: a prospective study of 100 fractures. *Acta Orthop Scand* 1975; 46: 737-43.

Böhler VL, Trojan E, Jahna H. Behandlungsergebnisse von 734 frischen einjachen Brüchen des Kahnbeinkörpers der Hand. *Reconstr Surg Traumatol* 1954; II:86-111.

Brittain HA. Fracture of the carpal scaphoid. *Br Med J* 1938; ii:671-3.

Broomé A, Cedell C-A, Colléen S. High plaster immobilisation for fracture of the carpal scaphoid bone. *Acta Chir Scand* 1964; 128:42–4.

Decoulx P, Razemon J-P, Lemerle P. Les fractures et pseudoarthroses du scaphoid carpien. *Lille Chirurigical* 1959; 14:113-33.

Dias JJ, Taylor M, Thompson J, Brenkel IJ, Gregg PJ. Radiological signs of scaphoid fractures: an analysis of inter-observer agreement and reproducibility. *J Bone Joint Surg [Br]* 1988; 70-B:299-301.

Dias JJ, Thompson J, Barton NJ, Gregg PJ. Suspected scaphoid fractures. *J Bone Joint Surg [Br]* 1990; 72-B:98-101.

Gellman H, Caputo RJ, Carter V, Aboulafia A, McKay M. Comparison of short and long thumb-spica casts for non-displaced fractures of the carpal scaphoid. *J Bone Joint Surg [Am]* 1989; 71-A:354-7.

Goldman S, Lipscomb PR, Taylor WF. Immobilisation for acute carpal scaphoid fractures. *Surg Gynec Obstet* 1969; 129:281-4.

Herbert TJ. Scaphoid fractures and carpal instability. *Proc R Soc Med* 1974; 67:1080.

Herbert TJ, Fisher WE. Management of the fractured scaphoid using a new bone screw. *J Bone Joint Surg [Br]* 1984; 66-B:114-23.

King RJ, Mackenny RP, Elnur S. Suggested method for closed treatment of fractures of the carpal scaphoid: hypothesis supported by dissection and clinical practice. *J R Soc Med* 1982; 75(11):860-7.

Kuhlmann JN, Boabighi A, Kirsch JM, Mimoun M, Baux S. An experimental study of plaster immobilisation for fractures of the carpal scaphoid. *Fr J Orthop Surg* 1987; 1:43-50.

Leslie IJ, Dickson RA. The fractured carpal scaphoid: natural history and factors influencing outcome. *J Bone Joint Surg [Br]* 1981; 63-B:225-30.

Lindgren E. Some radiological aspects on carpal scaphoid and its fractures. *Acta Chir Scand* 1949; 98:538-48.

London PS. The broken scaphoid bone: the case against pessimism. *J Bone Joint Surg [Br]* 1961; 43-B:237-44.

London PS. *A practical guide to the care of the injured* Edinburgh, etc: E & S Livingstone Ltd, 1967.

Morgan DAF, Walters JW. A prospective study of 100 consecutive carpal scaphoid fractures. *Aust NZ J Surg* 1984; 54:233-41.

Russe O. Fracture of the carpal navicular: diagnosis, non-operative treatment, and operative treatment. *J Bone Joint Surg [Am]* 1960; 42-A:759-68.

Soto-Hall R. Recent fractures of the carpal scaphoid. *JAMA* 1945; 129:335-8.

Stewart MJ. Fractures of the carpal navicular (scaphoid): a report of 436 cases. *J Bone Joint Surg [Am]* 1954; 36-A:996-1006.

Stimson LA. Fracture of the carpal scaphoid with dislocation forward of the central fragment. *Ann Surg* 1902; 35:574-7.

Thomaidis VT. Elbow-wrist-thumb immobilisation in the treatment of fractures of the carpal scaphoid. *Acta Orthop Scand* 1973; 44:679–89.

Thorleifsson R, Karlsson J, Sigurjonsson K. Fractures of the scaphoid bone: a follow-up study. *Acta Orthop Trauma Surg* 1984; 103:96-9.

Watson-Jones RJ. *Fractures and joint injuries.* 1st ed. 1940; 2nd ed. 1941; 3rd ed. 1943; 4th ed. Vol. 2 1955; 5th ed. (Wilson JN, ed.) 1976; 6th ed. (Wilson JN, ed) 1982. London, etc: Churchill Livingstone.

Ziter FM Jr. A modified view of the carpal navicular. *Radiology* 1973; 108:706-7.