FRACTURES OF THE CARPAL SCAPHOID

A CRITICAL STUDY OF THE STANDARD SPLINT

D. YANNI, P. LIEPPINS, M. LAURENCE

From Guy's Hospital, London

The effect of the position of splintage on displacement of fractures of the waist of the scaphoid was studied during operations and in cadavers. We found that these fractures were best splinted in neutral or slight palmar flexion with no ulnar deviation. Providing the wrist was not ulnar deviated, the position of the thumb had no effect on displacement.

Many different positions have been advocated for splinting the fractured scaphoid (London 1961; Mazet and Hohl 1963; Leslie and Dickson 1981; King, Mackenney and Elnur 1982; Sjolin and Andersen 1988; Gellman et al 1989). The most commonly used splint is a below-elbow plaster with a hand in the 'glass holding' position; the wrist is in dorsiflexion and the thumb immobilised. This is the so-called 'scaphoid plaster'.

The majority of scaphoid fractures are caused by a dorsiflexion force, such as a fall on the outstretched hand (London 1961; Fisk 1970; Linscheid et al 1972; Mayfield 1980; Leslie and Dickson 1981) so the 'scaphoid plaster' reproduces the injuring force, which seems illogical. We therefore studied the effect of different positions during operations and in cadavers.

MATERIALS AND METHODS

Four patients with fibrous nonunion following fractures of the waist of the scaphoid were operated on; in each a bone graft was inserted and the fracture fixed by a screw. During operation the effect of different positions on the fracture gap was noted.

In addition, eight cadaveric wrists were dissected. Through a small radial incision the scaphoid was fractured at the waist, using a scalpel so as to avoid any unnecessary bone destruction. The volar and dorsal ligaments were preserved although by necessity the radial collateral ligament had to be divided for the fracture to be performed.

To quantify the displacement radiologically, pin markers were placed in both halves of the scaphoid. The limb was positioned on a specially constructed radiolucent perspex platform so it rested on its ulnar border in exactly the same position in all eight limbs. The pin markers were placed parallel to the platform and perpendicular to the X-ray beam, which was centred on the scaphoid. In this way comparable radiological views were obtained. Using fine-definition films, radiographs were taken with the wrist flexed 40° and extended 40°.

As the wrist was moved into extension or flexion a rotatory movement occurred in the scaphoid which moved the pins away from their previously set plane. Although this movement has been shown to be negligible (Falkenberg 1985) it nevertheless gave an error of parallax in the radiographs. It was noted that the pins did not move more than 5° each from the horizontal plane in which they were initially set, thus making a combined angle of 10° of parallax error for both pins. Nevertheless, we assumed a possible error of 20° and we incorporated a correction factor into our readings to nullify this. The data for the correction graph was obtained by taking films of a series of radio-opaque needles angled at zero and at 20° inclination to the X-ray beam, 20° being the outer limit of the assumed parallax (Fig. 1).

RESULTS

Peroperative observations. In all four operations it was found that, with the hand in neither radial nor ulnar deviation, palmar flexion closed the fracture gap whereas dorsiflexion opened it.
**Dissections.** In all eight cadaveric dissections we found that, as the limb was moved from neutral into 40° of dorsiflexion, the fracture gap opened in an angular fashion, the pivot of movement being the dorsal aspect of the fracture line. When the wrist was moved from neutral into 40° of palmar flexion the fracture ends were compressed and the fracture gap remained closed (Fig. 2). From the base-line of fracture compression in palmar flexion, the bone fragments angulated through 3.4° (± 2.0°) during movement to the neutral position, and through 17.6° (± 4.9°) during movement to dorsiflexion.

We noted also that when the wrist was in the neutral position in the radio-ulnar plane, the scaphoid was locked between the trapezium and the radius, thus contributing further to closure of the fracture gap. Ulnar deviation reversed this effect and opened the fracture gap. In dorsiflexion the dorsal lip of the radius hinged against the waist of the scaphoid: this unlocked the fracture.

The position of the thumb had no effect on displacement providing the wrist was not in ulnar deviation. When the fracture gap was opened by ulnar deviation, then moving the thumb into abduction contributed to fracture gap closure.

**DISCUSSION**

The explanation for our observations lies in the anatomical configuration of the bones: the dorsal lip of the radius overhangs the scaphoid, while the scaphoid is convex dorsally and concave ventrally. A fracture of the scaphoid occurs when the wrist is forced into extreme dorsiflexion, as with a fall on the outstretched hand. The resultant fracture occurs at the point of impact between the overhanging dorsal lip of the radius and the convex waist of the scaphoid (Mayfield 1980; Mack et al 1984). In our dissections it was observed that the fracture hinged open in dorsiflexion because the dorsal lip of the radius impinged against the convex dorsal aspect of the scaphoid. This does not occur in palmar flexion because the radius does not overhang on the volar aspect and because the concave aspect of the scaphoid accommodates the radius and the soft tissues.

The position of the thumb had no influence on the fracture gap when the wrist was neither ulnar deviated nor dorsiflexed. However, when the wrist was in any position in which the fracture gap was open, then moving the thumb into abduction closed the gap. This may explain why so much importance in the past has been attached to abduction of the thumb in the traditional 'glass-holding' position; abducting the thumb reverses the distraction caused by dorsiflexion. Radial deviation locks the scaphoid between the trapezium and the radial articular surface thus leaving the scaphoid unaffected by thumb movements.

Most of the angulation of the fracture occurs in the arc of wrist movement between neutral and 40° of dorsiflexion. Consequently, we feel there is a strong case
for splinting fractures of the scaphoid in neutral or in slight palmar flexion. This is supported by the work of Cooney, Dobyns and Linscheid (1980) who found that this position favoured union. We also recommend that the wrist be immobilised in neutral deviation, that is, with neither ulnar nor radial angulation.

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REFERENCES


