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Minimal Invasive Treatment for Scaphoid Fractures Using the Cannulated Herbert Screw System

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ABSTRACT

Internal fixation of scaphoid fractures avoids the problems associated with prolonged plaster immobilization and, at the same time, allows an early return to activity for these mostly young patients.

Internal fixation of the scaphoid is greatly facilitated by the use of specially designed headless bone screws, such as the Herbert bone screw, originally developed specifically for internal fixation of the scaphoid; furthermore, the advent of cannulated scaphoid screws has made closed (percutaneous fixation) stabilization of the scaphoid a reality. Indeed, this method has now become the treatment of choice for the majority of acute scaphoid fracture, bringing with it all the advantages of internal fixation without the disadvantages of open surgery.

However, the success of closed treatment is also dependent on an accurate assessment of the fracture, and for this reason, we now advocate the routine use of computed tomography preoperatively. Because of the complex, 3-dimensional shape of the scaphoid, simple x-rays alone are inadequate, whereas computed tomography, parallel to the long axis of the scaphoid, allows excellent visualization of the fracture and any associated deformity, which must be corrected at the time of surgery.

We describe here our method of treating acute scaphoid fractures, and we report the outcome of minimally invasive fixation.
Keywords: scaphoid, fracture, minimally invasive fixation, Herbert screw, HBS

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HISTORICAL PERSPECTIVE

Until recently, nonoperative treatment, in a thumb spica cast, has been considered the treatment of choice for scaphoid fractures.[1] The main argument in favor of this approach was that nearly all fractures (over 90%) would heal if diagnosed and treated promptly. Because of the anatomic shape and position of the scaphoid, internal fixation has always been considered too technically demanding and in the past, has been reserved for the occasional case in which cast treatment appears inappropriate (eg, severe displacement, delayed treatment, etc.) (Fig. 1).

The problem with this approach is that treatment is often prolonged for many months, particularly if primary healing is not achieved; for the majority of young, active patients, this represents a major functional and economic disability. Furthermore, the fact is that with conservative treatment, nonunion of the scaphoid remains a common and disabling problem.[1,2]

In 1984, Herbert presented his results using a new, headless bone screw to treat scaphoid fractures by internal fixation.[3] Other reports followed, all claiming improved results for internal fixation, but the technical difficulties associated with open scaphoid surgery remained a major obstacle to general acceptance.[3–5] However, as reports started to appear[4,6–12] claiming similar success using percutaneous fixation, interest in this method has grown to the stage at which many now consider it to be the treatment of choice for the majority of acute scaphoid fractures. Indeed, given the apparent advantages, both in morbidity and in outcome, we have now reached the stage at which the decision to treat a scaphoid fracture in plaster must be carefully considered and justified on the likely outcome.

Our preferred method is to use the HBS cannulated

FIGURE 1. High and low compression type of HBS system cannulated for 1-mm wires are not adjustable.

scaphoid screw (Martin Medizin) because this implant has exactly the same external dimensions as the original and highly successful Herbert screw. The screw is available in both normal and high-compression configurations, the latter being used chiefly in conjunction with a bone graft in which the increased compression (approx 30%) is considered beneficial. A mini HBS (noncannulated), with a shaft diameter of only 1.5 mm is also available and is our implant of choice for fixation of small, proximal pole fractures (Type B3).

For the majority of cases, we use the standard HBS screw, which has a 1-mm guide wire, making it ideal for our method of minimally invasive treatment; fixation is sufficiently secure for us to dispense with the use of plaster, and our postoperative treatment involves the use of a simple elastic bandage for a period of 2 weeks.

■ INDICATIONS AND CONTRAINDICATIONS

Accurate radiologic assessment is essential to define the shape and size of the scaphoid, as well as to demonstrate the exact location and extent of the fracture and any associated displacement.

Initial x-rays should be of high quality and should include, at a minimum, posteroanterior views of both wrists in full radial and ulnar deviation, together with true lateral views with the wrist in neutral.[13,14]

Once a fracture is suspected or diagnosed, a computerized tomography (CT) bone scan should be performed. In addition to the standard sagittal and transversal views, we have found that cuts made in the sagittal plane parallel to the long axis of the scaphoid provide the best view of the fracture and any associated deformity[15] (Fig. 2).

We have found CT to be the most accurate means of assessing the fracture, and we reserve magnetic resonance imaging only for those cases in which there is a need to assess the vascularity of the proximal pole.[16]

To determine the most appropriate method of treatment, it is essential to use some form of classification of scaphoid fractures. We favor the Herbert classification, which relates the radiologic appearance of the fracture to its stability and prognosis (Table 1).

■ SURGICAL TECHNIQUE

The surgeon should be seated with the dominant hand at the outer end of the table. A radiolucent, hinged hand holding device is extremely useful, but failing this, a large, rolled-up towel is used to aid extension of the wrist. The availability of x-ray screening is an important prerequisite: we position the image intensifier on the opposite side from the surgeon, with the assistant seated at the head of the table (Fig. 3). This setup allows vertical x-ray images to be used, with minimal disturbance, throughout the procedure.

Initially, the scaphoid is screened with the image intensifier to confirm that fracture is suitable for closed treatment; when indicated, careful closed reduction is performed, facilitated by the use of percutaneous pins (joystick technique) where necessary. However, in most cases, simple hyperextension of the wrist will ensure an accurate reduction of the fracture, which is the reason that we prefer to operate with the arm extended.

Once satisfactory reduction of the fracture has been achieved, the tubercle of the scaphoid, which becomes more prominent in full radial deviation of the wrist, is palpated and marked on the skin. A short incision (3–5mm) is made over the scaphotrapezial joint, and the distal pole of the scaphoid is exposed. The drill guide is then firmly positioned on the surface of the distal pole, toward its radial side (the correct entry point should be confirmed by the image intensifier), and a 1-mm guide wire is inserted through the sleeve (Fig. 4A).

Then, aiming the guide toward the proximal pole of the scaphoid (approximately 45 degrees dorsally and 45 degrees ulnarly, with the wrist in neutral), the guide wire

FIGURE 2. A, Suspected fracture of the scaphoid. B, Fracture detected with computed tomography.

is inserted slowly, and under x-ray control (Fig. 4B). By continuously moving the wrist from pronation into supination, the position of the guide wire can be carefully monitored while it is being inserted. Ideally, it should be aligned along the mid-axis of the scaphoid in both planes, while remaining as closely perpendicular to the fracture as possible. The guide wire should enter, but not penetrate, the firm subchondral bone at the apex of the proximal pole.

Once the correct positioning of the guide wire has been achieved, its depth is used to indicate the length of screw required; this is measured by passing the depth gauge over the protruding end of the wire, taking care to ensure that the tip of the guide is pressed firmly onto the tubercle. The stop on the cannulated drill is then set to the measured length, and under x-ray control, the drill is passed over the wire and slowly inserted, using a small power drill at low rpm. It is important that the drill follows exactly the same line as the guide wire, and for this reason, it is important to use minimum force and to screen it during insertion. This is the reason that we prefer to use a suitable, small power instrument, rather than drill by hand, as this requires more force.

To avoid the risk of the guide wire being removed with the drill, we normally advance it across the joint and into the radius (Fig. 4C). However, when doing this, it is

TABLE 1. *Classification of scaphoid fractures (Herbert)*

Type A acute fractures—stable:
- A1—fracture of the tubercle
- A2—undisplaced fracture in the medial or distal third

Type B acute fractures—unstable:
- B1-oblique fracture
- B2-displaced or angulated fracture
- B3-fracture of the proximal pole
- B4-trans-scaphoid, perilunate fracture dislocation

FIGURE 3. Setup for minimal invasive approach.

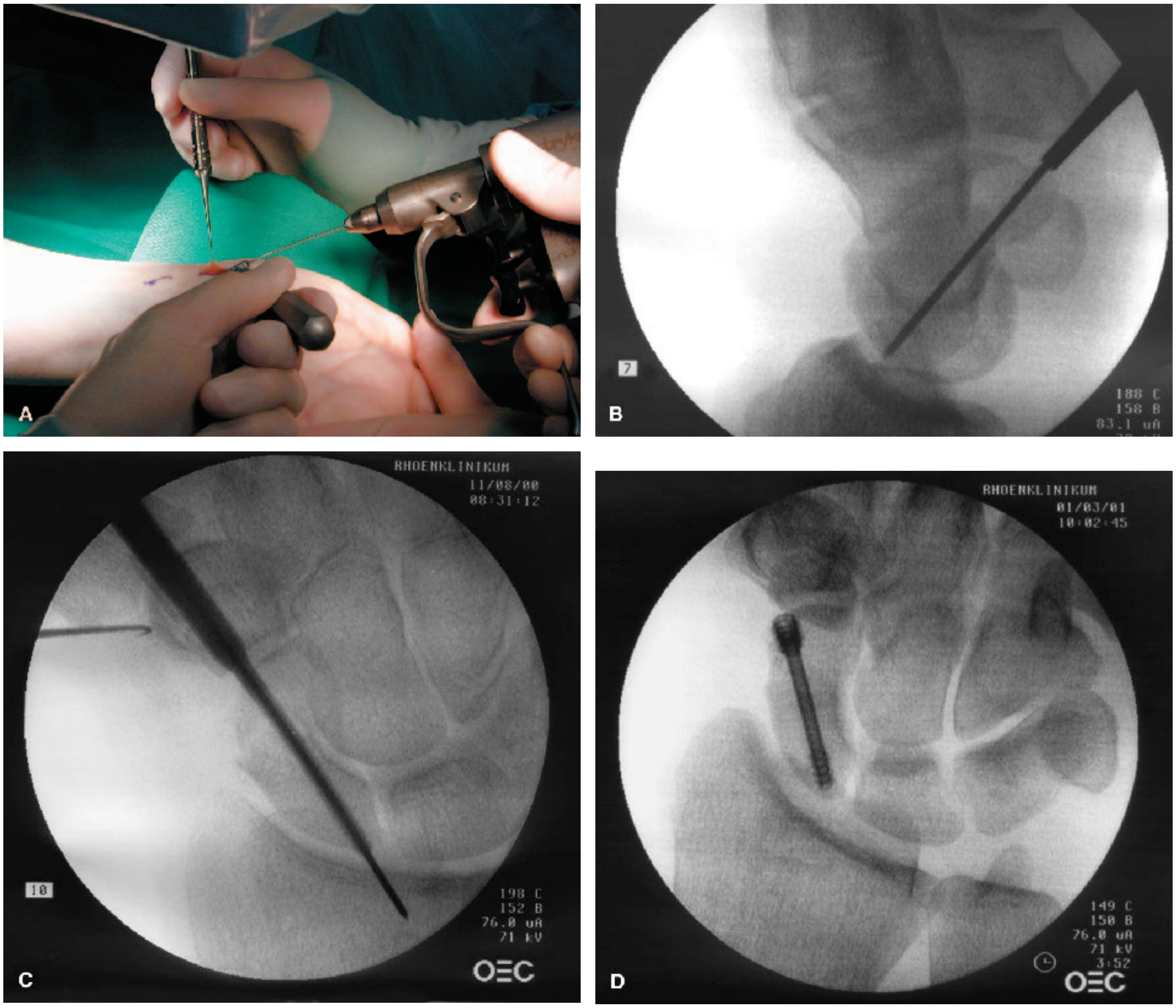

FIGURE 4. A, Insertion of the guide wire by power drill. B, Correct position on lateral projection. C, Drill passes the whole length of the scaphoid, K wire fixed inside of the radius. D, Correct positioning of the screw.

essential that the wrist joint is held immobile until the wire is removed (Fig. 5).

Once the drill has been fully inserted and its position checked by the image intensifier (Fig. 4D), a screw of appropriate length is selected, placed over the guide wire, and inserted. As soon as the trailing threads of the screw start to engage in the bone, the guide wire is removed. The screw is then fully tightened, ensuring that its threads are well buried beneath the surface of the tubercle. The final position, together with the stability of fixation, is once again checked by screening the wrist on the image intensifier.

POSTOPERATIVE AND REHABILITATION

Postoperatively, an elastic bandage is used for the first 2 weeks; this normally provides adequate support during the period of wound healing while allowing sufficient movement to prevent any risk of adhesions and joint stiffness. Heavy manual work and contact sports are avoided for at least 6 weeks.

Full function and range of movement are regained rapidly after minimally invasive surgery, and physiotherapy is rarely required.

COMPLICATIONS

Because the use of a cannulated screw carries a risk of the guide wire becoming bent or broken, this part of the procedure demands extra caution. In particular, if the guide wire crosses a joint, this must not be moved until the wire has been removed to avoid any risk of bending or breakage (Fig. 6). Similarly, when drilling, it is im-

FIGURE 5. Clinical example: A, Slight deformity at the radial cortex. B, Computed tomography scan shows dislocation of the fracture. C and D, Correct positioning of the screw in both planes.

portant to be sure that the tip of the drill has reached maximum depth. Otherwise, the screw may impinge against hard bone, causing the fracture to displace.

RESULTS

We have recently published a series of 17 patients treated by this method without immobilization in a cast.[3]

The majority had unstable fractures (12 type B2, 1 type B1), while there were 4 stable fractures (type A2). All fractures united, and there were no complications.

In a larger series of 68 patients, we have observed 2 nonunions; one of these was the result of a technical error (inadequate fixation of the proximal pole), while in the second case, a second injury to the wrist, sustained within 3 weeks of surgery, seemed to be the cause of failure.

CONCLUSION

Percutaneous fixation of selected acute scaphoid fractures, using the technique detailed here, accelerates functional recovery and allows an early return to work. When used appropriately, union rates approaching 100% may be anticipated, and provided that care is exercised with the technique, morbidity and complications are minimal.

We believe that minimally invasive stabilization is the treatment of choice for the majority of type A2, B1, and B2 scaphoid fractures.

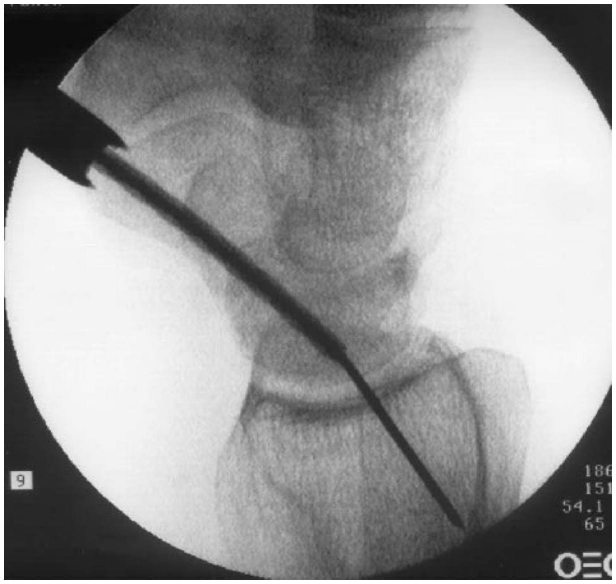

FIGURE 6. Risk of breakage of the K wire if the wrist is not fixed.

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