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Arthroscopic Reduction

Internal Fixation of the Scaphoid

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In 1992, Barton estimated the incidence of scaphoid fractures to be 35,000 per year.[1] This incidence is approximately 35 fractures per every 250,000 persons.[5] Injury to the scaphoid is one of the most common osseous wrist injuries, and can account for 70% of carpal fractures.[10] A high index of suspicion is essential because of the common occurrence of scaphoid fractures in young athletes. Approximately 1% of all college football players in the United States sustain a scaphoid fracture each year. High demands on athletes and their time constraints for those who cannot afford or tolerate prolonged immobilization, which can at times be as long as 6 months, have encouraged upper-extremity surgeons to develop a better treatment regimen for scaphoid fractures.[12] Young individuals who cannot afford prolonged immobilization are best suited for arthroscopic reduction of the scaphoid.

The arthroscope, now routinely used in aiding the diagnosis of wrist pain, ligamentous injuries, and triangular fibrocartilage complex radial and ulnar-sided repairs, has shown great benefit in the reduction of nondisplaced and displaced reducible scaphoid fractures.[9] Visualization of the articular surfaces of the wrist joint can be performed with the advantage of limiting morbidity associated with a wrist arthrotomy. This article describes the management of arthroscopic treatment of scaphoid fractures in carefully selected patients.

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HISTORY AND PHYSICAL EXAMINATION

Athletes fall on outstretched hands with subsequent radial-sided wrist pain. On physical examination, the patient may have tenderness in the anatomic snuffbox between the first and third dorsal compartments (Fig. 1).

Figure 1. Note the anatomic snuffbox (arrow) where the scaphoid is located between the first and third dorsal compartments. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996, p 214, with permission.)

Initial imaging of the patient should include a zero posteroanterior radiograph of the wrist. If the fracture is not seen, the patient should have posteroanterior radiographs taken of the wrist in radial and ulnar deviation (scaphoid and longitudinal profile with the elbow flexed at 90°) (Fig. 2).

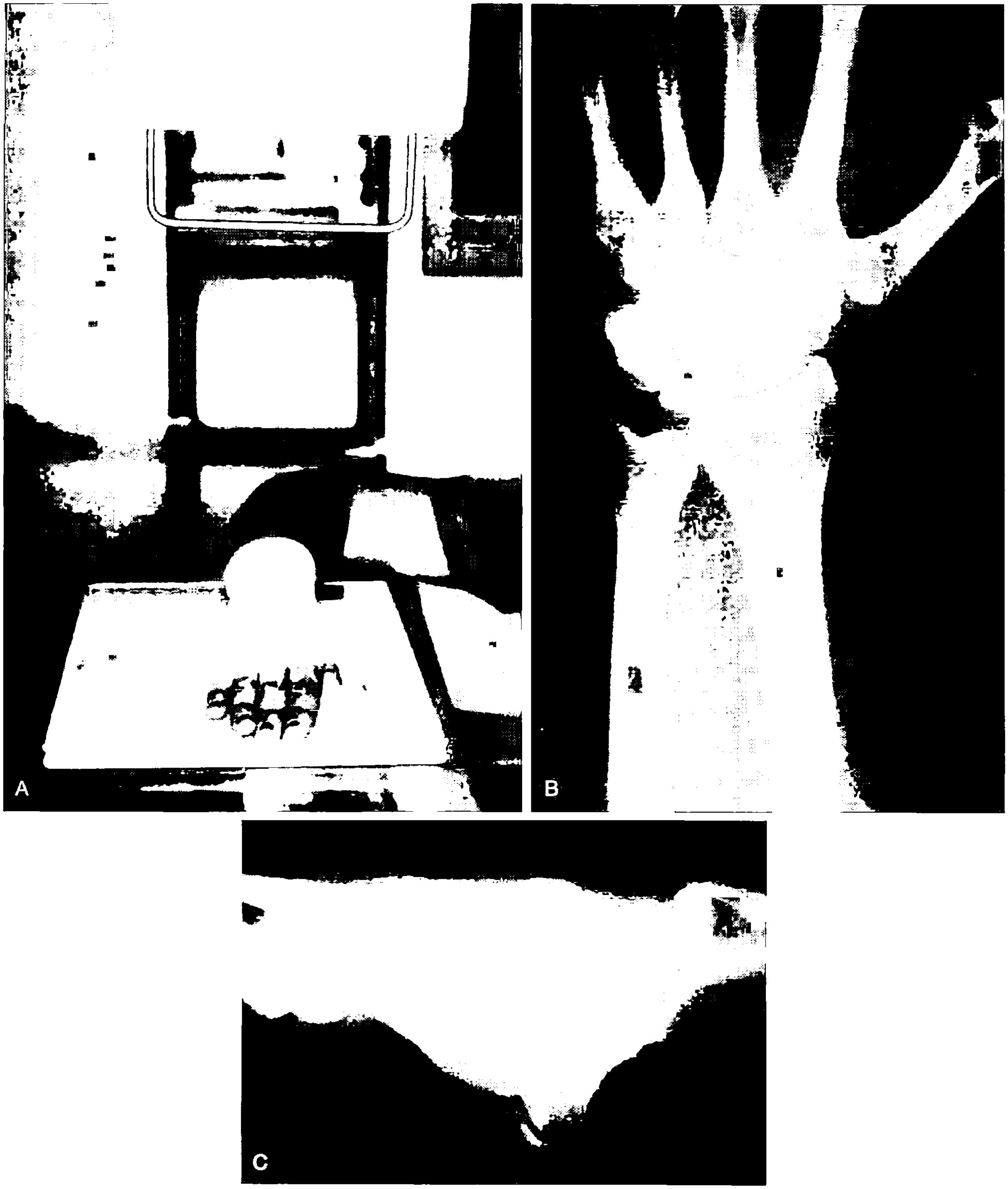

Figure 2. *A,* Positioned for zero rotation PA wrist radiograph. *B,* Zero rotation radiograph of the wrist. Note the distal radioulnar joint space congruity. This view is used to assess joint arthrosis and ulnar length. Note the scapholunate diastasis. *C,* Lateral radiograph of the wrist. Note the colinearity of the radius, lunate, capitate, and third metacarpal. Also note with the thumb abducted, the profile of the hook-of-the-hamate, pisiform, and pisotriquetral joint are well visualized. *D,* Positioned in ulnar deviation for PA radiograph of the wrist. *E,* This ulnar deviated view shows the scaphoid in a longitudinal profile. A scaphoid nonunion was identified as the cause of wrist pain in this adolescent. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996, pp. 213, 215; with permission.)

Illustration continued on following page

Figure 2 (*Continued*).

These views are used to define the anatomy of the scaphoid better, and allow visualization of its margins. A clenched fist in radial and ulnar deviation views also may diagnose a scapholunate ligament tear as the cause of the patient's pain.[6] If all radiographs are negative, further imaging to diagnose an occult scaphoid fracture, not seen on plain films, may be done with a bone scan. A negative bone scan 3 to 5 days after an injury rules out a scaphoid fracture. The author routinely uses CT evaluation of the scaphoid if there is evidence of a fracture. This test defines cortical integrity and fracture pattern best, and can evaluate a humpback deformity or dorsal intercalated segment instability pattern.[4]

Rapid diagnosis of scaphoid fractures is important for proper treatment to be initiated. Frequency of nonunion and proximal pole avascular necrosis with scaphoid fractures warrants the use of special imaging to identify an occult fracture that may cause a long-term disability if it is not diagnosed.[3]

INDICATIONS

The shape of a scaphoid resembles a cashew nut rather than a boat, from which its name is derived (*scaphe*, Greek for "dugout trough, or boat"). Nondisplaced and some reducible displaced scaphoid fractures are suitable for arthroscopic reduction and internal fixation of the scaphoid (Fig. 3*B*).

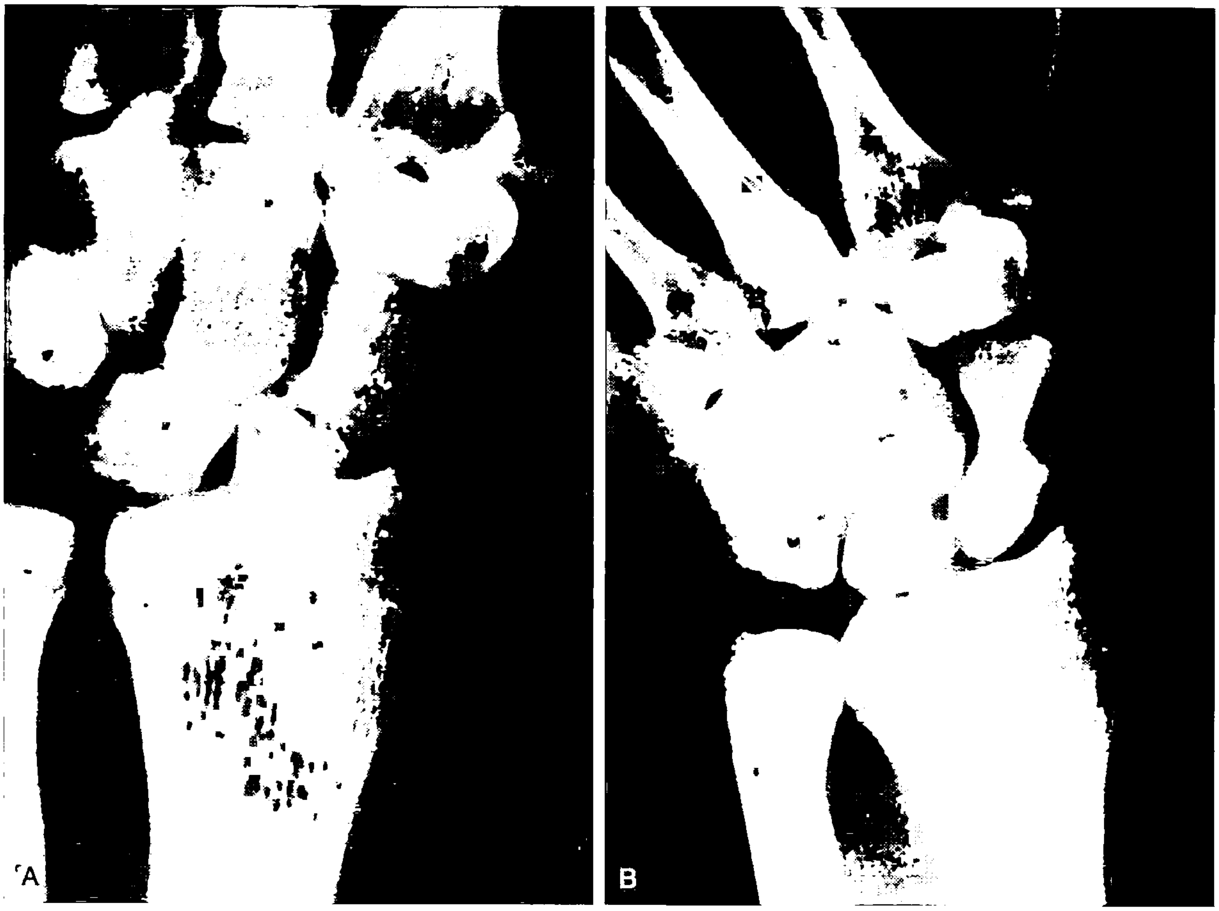

Figure 3. *A*, Clinical radiograph of reducible minimally displaced scaphoid fracture. *B*, Postoperative radiograph of healed scaphoid fracture with Herbert-Whipple screw. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996.)

Minimally displaced fractures may be treated by conservative means with casting, but young athletes cannot afford prolonged immobilization of the wrist because of its economic impact.[5] Fractures that have had more than 2 mm of displacement, comminuted or severely displaced fractures, still are treated by percutaneous dorsal volar open reduction, or internal fixation (Fig. 4).[7]

Figure 4. *A*, Dorsal intercalated segmental instability deformity with displaced scaphoid fracture, not suitable for arthroscopic reduction internal fixation (ARIF). *B*, Proximal pole scaphoid with avascular necrosis, displaced, not suitable for ARIF. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996.)

Arthroscopic reduction avoids violation of the strong volar radioscaphocapitate ligament in a volar approach, or perhaps may compromise the blood supply if a dorsal approach is performed.

Arthroscopic reduction internal fixation may avoid many other problems. Nonsurgical treatment of displaced fractures in the past has yielded poor results. Conservative treatment has reported a nonunion rate of 55% in scaphoid fractures with displacement greater than 1 mm.[4] Many adults who have severe financial constraints associated with long-term immobilization and the inability to be out of work for lengthy periods of time prefer an arthroscopic reduction. Whether the patient can afford a closed treatment technique is questioned.

OPERATING ROOM SET-UP

The operating room set-up is identical to that for elective wrist arthroscopy. The operating room table is turned 90° from the anesthesiologist. The shoulder is abducted 60° to 70°, and the upper limb is placed on the radial lucent hand table. A mini C-arm/fluoroscopic unit is positioned at the head of the operating room table with the video monitor and the arthroscopy cart placed at the foot of the bed, opposite to the hand table. The operating room nurse is placed at the end of the hand table to assist the surgeon. A Linvatec traction tower (Linvatec, Largo, FL) is used to place the fingers in correct anatomic alignment, and helps reduce the fracture and hold the hand in constant traction as the scaphoid is manipulated.[11]

SURGICAL TECHNIQUE

The hand is placed on the radial lucent table and the flexor carpi radialis, Lister's tubercle, distal one third of the trapezium, first extensor compartment, radial artery coursing through the snuffbox, and a point halfway between the extensor pollicis longus and extensor carpi radialis longus are marked out on the wrist. The hand is placed in the Linvatec traction tower with longitudinal traction applied through the finger traps on the index and long fingers. Ten to 15 lb of traction may be required for reduction of a displaced fracture, whereas 8 to 10 lb are recommended for nondisplaced fractures. A diagnostic arthroscopy is performed, entering the radial carpal joint through the 3–4 and 4–5 portals (Fig. 5).

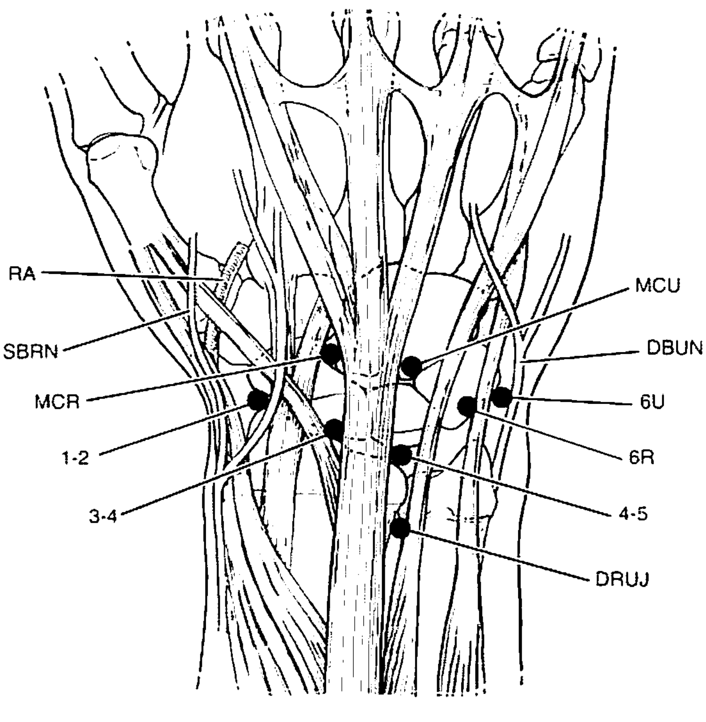

Figure 5. The dorsum of the hand and arthroscopic portal anatomy. The 3–4 portal is the primary viewing portal. Inflow is placed in the 6U portal, and the 4–5 portal is the main working portal. The midcarpal space is viewed through the midcarpal radial (MCR) portal. The MCU portal may be used as an alternative midcarpal portal as well, especially when clearing hematoma from a scaphoid fracture. (*From* Geissler WB: Arthroscopic Treatment of Intra-Articular Distal Radius Fractures. *In* Weiss A-P C (ed): Atlas of the Hand Clinics, vol 2, no 1. Philadelphia, WB Saunders, March, 1997, p 98; with permission.)

Fracture hematoma is evacuated, and the joint surfaces are assessed. Associated ligamentous injuries are noted, and are treated accordingly. A radial and ulnar midcarpal portal then is established, and the arthroscope is inserted into the wrist to help clear fracture hematoma with a needle or small shaver. With all hematoma removed, the fracture can be visualized and reduced with manual manipulation by using the minifluoroscopy unit. If necessary, a temporary Kirschner wire is drilled percutaneously into the proximal pole of the scaphoid to aid in the manipulation.

A 1.5-cm incision is made, centered over the scaphoid tubercle, and curved slightly to the radial side of the flexor carpi radialis (Fig. 6).

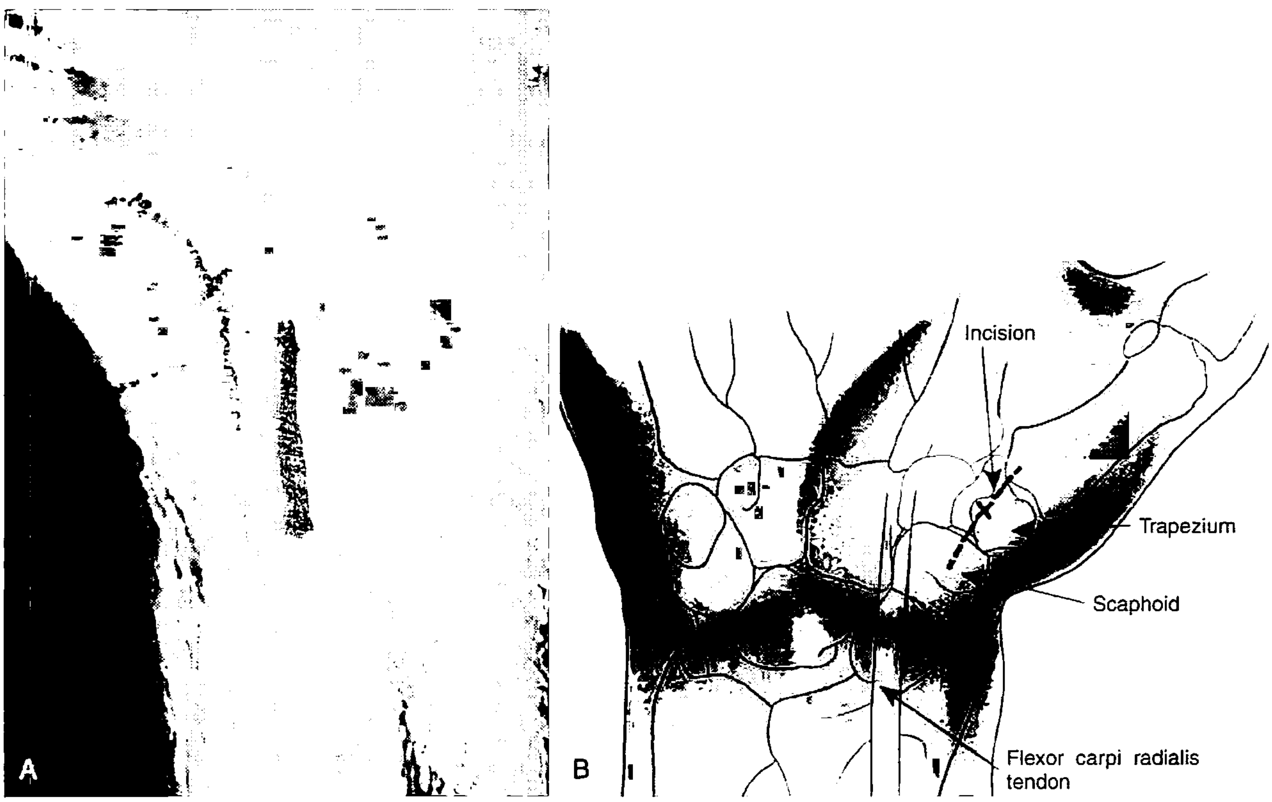

Figure 6. *A,* Curvilinear incision marked on the left wrist with the flexor carpi radialis marked as a solid line. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996, pp. 210–226; with permission.) *B,* Placement of the volar incision to allow for the introduction of the Herbert-Whipple compression jig. (*From* Gan BS, Richards RS: Arthroscopically Assisted Internal Fixation of Scaphoid Fractures. *In* Jurkiewicz MJ, Culbertson JH (eds): Operative Techniques in Plastic and Reconstructive Surgery, vol 4, no 1, Philadelphia, WB Saunders, 1997, p 35.)

A needle is used to identify the scaphoid trapezium joint and expose the scaphotrapezium joint with a T (transverse incision) made in the capsule. Blunt dissection is performed to protect the palmar cutaneous branch or any superficial branches of the radial nerve that may be present.[8] The periosteum is peeled off the volar surface of the trapezium, and the tubercle of the scaphoid and part of the trapezium are removed. The articular surface of the distal scaphoid now is exposed, and much time must be spent in getting this access point to allow for correct placement of the barrel of the Herbert-Whipple screw jig (Fig. 7).

Figure 7. Scaphotrapezial joint exposed in an arthroscopic reduction, internal fixation (*A*), and in an open reduction, internal fixation volar approach to the scaphoid (*B*). (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996, pp. 210–226.)

The hand now is placed back in the Linvatec traction tower with 15 lb of longitudinal traction. The arthroscope is placed in the 4–5 radiocarpal joint. A 1–2 portal is created, and the target hook of the compression jig is introduced to this portal and seated on the dorsal proximal scaphoid, just radial to the scapholunate ligament in the 3–4 portal (Fig. 8).

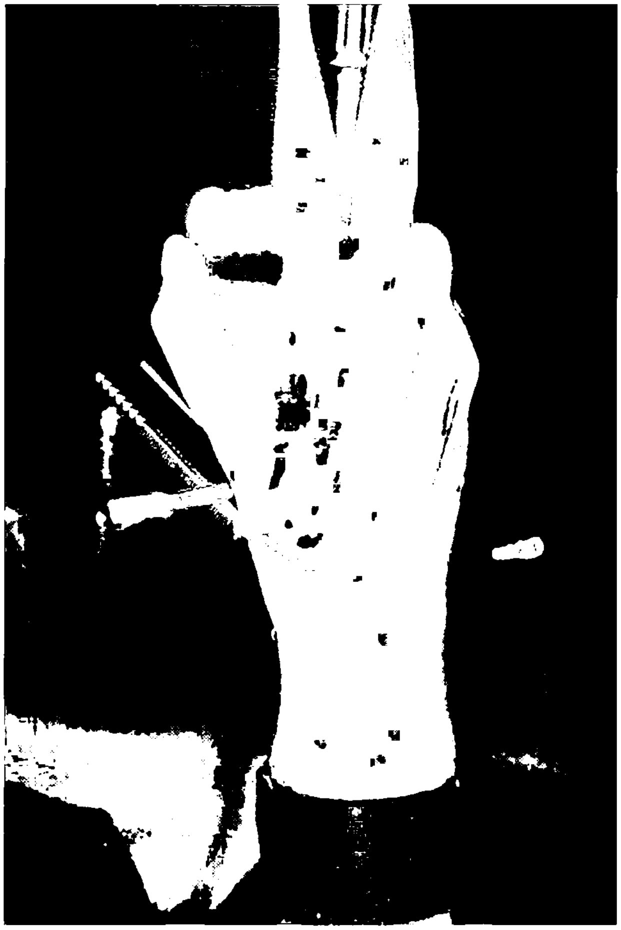

Figure 8. Compression jig for the Herbert-Whipple screw placed just radial to the scapholunate ligament in the 3–4 portal. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996, pp. 210–226.)

The distal guide barrel is seated on the volar distal scaphoid, and the jig now is compressed (Fig. 9) (holding the thumb in hyperextension helps to retract the trapezium dorsally, and facilitates exposure of the distal pole of the scaphoid).

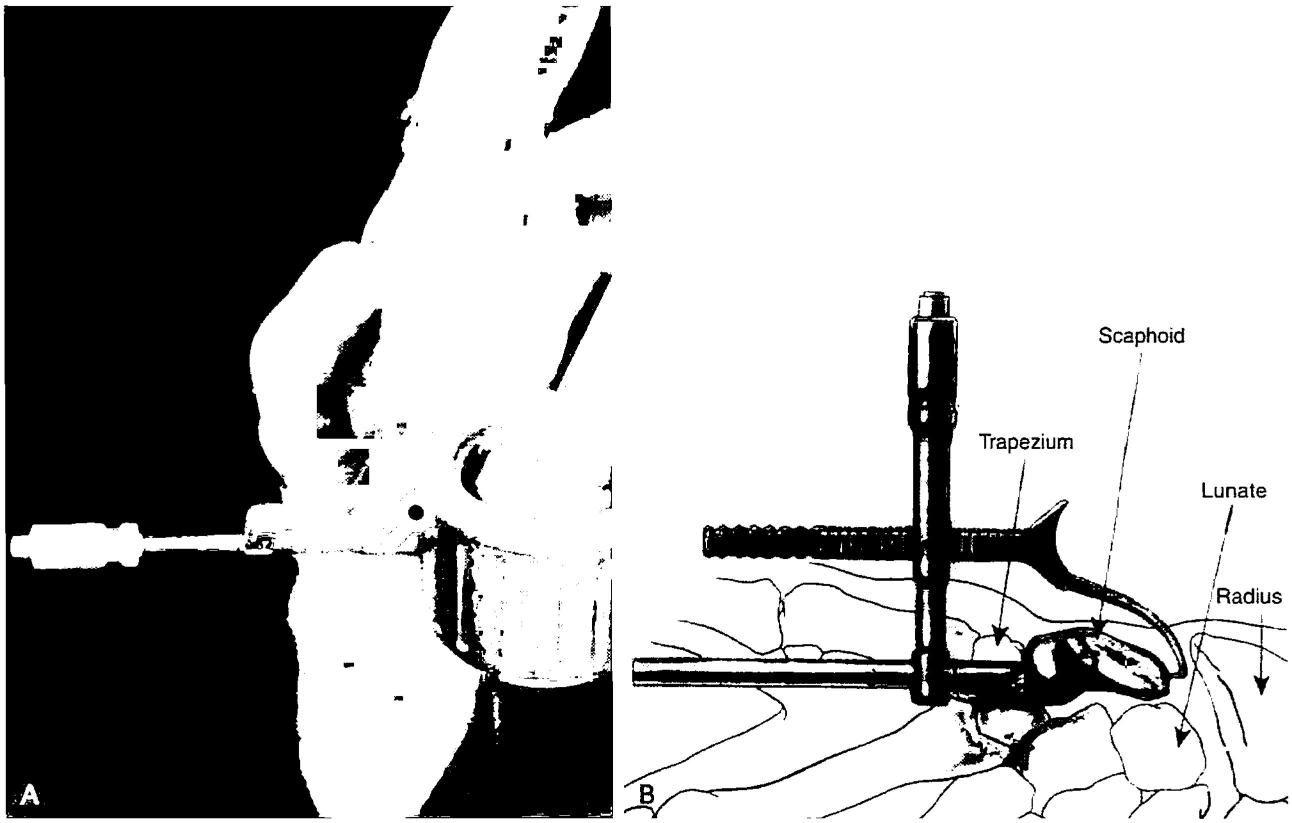

Figure 9. *A*, Distal barrel of the compression jig of the Herbert-Whipple screw seated on the volar distal scaphoid. *B*, Target hook and barrel of the compression Herbert-Whipple screw in place. The length of the screw is read from the calibrations on the blade of the hook. (*From* Gan BS, Richards RS: Arthroscopically Assisted Internal Fixation of Scaphoid Fractures. *In* Jurkiewicz MJ, Culbertson JH (eds): Operative Techniques in Plastic and Reconstructive Surgery, vol 4, no 1. Philadelphia, WB Saunders, 1997, p 34.)

The minifluoroscopic unit is moved into place; under fluoroscopic control, a guidewire is placed (Fig. 10).

Figure 10. Guidewire placed through the Herbert-Whipple compression jig. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996, pp. 210–226.)

A second guidewire is placed through the stem of the jig to prevent rotation of the device during screw placement. Care always is taken to avoid violating the midcarpal joint, which must be confirmed with the arthroscope.

If the fracture is oblique or represents a significantly unstable pattern, the surgeon should elect to leave the secondary guidewire in place, parallel to the screw, for the first 3 weeks postoperatively. A cannulated drill, followed by a tap, is placed over the central guidewire (Fig. 11).

Figure 11. Cannulated drill placed through the compression jig.

The calibration in the hand drill barrel allows for the selection of the proper length of screw. The process of screw placement is followed in real time with a minifluoroscopic unit. The screw is inserted over the pin, and reduction is confirmed arthroscopically again. Final screw position is confirmed with the minifluoroscopic unit (Fig. 12). The small, 1.5-cm incision is closed with sutures, and a postoperative thumb spica splint is applied.

Figure 12. Herbert-Whipple screw in place after arthroscopic reduction, internal fixation in a well-united scaphoid fracture seen in a rock climber. (*From* Jacobson MD, Plancher KD: Evaluation of Hand and Wrist Injuries in Athletes. *In* Drez D Jr, DeLee JC (eds): Operative Techniques in Sports Medicine, vol 4, no 4. Philadelphia, WB Saunders, 1996, pp. 210–226.)

REHABILITATION

Early active range of motion is started at 2 to 3 weeks with limited activity and protective splinting utilizing an RTV11. Full resumption of sporting activities without protective splinting is started only after CT scan documentation of healing. Each athlete's return to his or her respective sport is individualized to the type of sport and the progress in healing.

SUMMARY

Arthroscopically assisted internal fixation of the scaphoid of nondisplaced and displaced reducible scaphoid fractures provides a less invasive means of internal fixation of the scaphoid under direct visualization. Immobilization with this technique may be limited to 3 to 4 weeks postoperatively.

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