Headless Compression Screw Fixation of Scaphoid Fractures

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KEYWORDS

• Scaphoid fracture • Headless screw • Herbert screw
• Acutrak screw • Twinfix screw

The scaphoid is the most commonly fractured carpal bone and most common hand fracture, accounting for 60% and 11% of fractures respectively.[1] The annual incidence of scaphoid fractures is estimated to be 38 to 43 per 100,000[2,3]; patients are an average age of 25.[4,5] Of these fractures, 70% to 80% occur at the scaphoid waist and 10% to 20% involve the proximal third.[6] Inadequately treated scaphoid fractures are prone to develop into malunions and nonunions that can cause pain, altered carpal kinematics, diminished range of motion, disuse osteopenia, and decreased grip strength, and result in dorsal intercalary segmental instability and degenerative changes.[1]

Nondisplaced and minimally displaced fractures of the scaphoid can be treated successfully with cast immobilization. The prolonged immobilization required for nonoperative treatment of scaphoid fractures can pose significant morbidity as well as a socioeconomic burden to the patient.[2] Scaphoid fractures are a significant problem in college and professional athletics, with the incidence of scaphoid fractures in college football players estimated to be 1 in 100.[7] Young, active patients, or those who cannot entertain prolonged absence from their occupations may prefer definitive operative fixation to prevent prolonged immobilization and to facilitate return to work or sports.[4]

APPLIED ANATOMY OF THE SCAPHOID

Scaphoid is derived from the Greek work *scaphe*, for skiff or boat,[1,8] although some think it more resembles a twisted peanut.[9] The scaphoid has a palmar concave and ulnar concave curvature.[8] The proximal, distal, medial, and half of the lateral surface are covered with cartilage.[1] The blood supply to the scaphoid has been extensively studied. The distal pole is richly vascularized by direct branches from the radial artery.[8] Most of the intraosseous blood supply arises from the perforating branches of the radial artery that enter dorsally on the dorsal ridge and dorsal tubercle.[1] These vessels enter the scaphoid at a nonarticular portion, through a foramina on the dorsal ridge at the level of the scaphoid waist.[10] Retrograde flow allows dorsal branches to supply the proximal pole.[1] Consequently, fractures involving the proximal pole are at risk for osteonecrosis and nonunion.[11] The distal pole also receives blood supply from the superficial palmar branch of the radial artery.[1,10]

The scaphoid has numerous ligamentous attachments, leading to the characteristic humpback deformity when fracture occurs.[11] The scapholunate interosseous ligament attaches along the ulnar aspect of the proximal pole. The proximal pole, therefore, extends because of its attachment to the lunate while the distal fragment remains

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flexed because of its attachment to the trapezium and trapezoid via the scaphotrapezial ligament.[1,11] Just proximal to the attachment of the scaphotrapezial ligament is the attachment of the dorsal intercarpal ligament along the dorsum of the scaphoid.[1] The scaphocapitate ligament is directly palmar to the distal pole of the scaphoid.[1] The long radiolunate ligament passes along the palmar aspect of the proximal part of the scaphoid as it inserts on the lunate.[1] The radioscaphocapitate ligament inserts on the waist of the scaphoid.[1]

The anatomy of the scaphoid contributes greatly to the risk of malunion and nonunion. Scaphoid fractures unite by primary bone healing without external callus. The scaphoid is almost completely covered with articular cartilage, limiting the amount of surface area for bone contact and healing. Owing to its intra-articular location, synovial fluid may pass between the fracture fragments, delaying healing.[4,7]

TREATMENT CONSIDERATIONS

The reported rates of nonunion for scaphoid fractures range from 5% to 25%, with displaced fractures carrying a higher risk.[1] Displacement of more than 1 mm, fracture of the proximal pole, history of osteonecrosis, vertical oblique fracture pattern, and nicotine use are all risk factors for nonunion.[1] Malunion and nonunions present difficult management problems. They can result in pain, altered carpal kinematics, diminished range of motion, disuse osteopenia, and decreased grip strength and result in dorsal intercalary segmental instability and degenerative changes.[1,7,10,11] Most investigators have recommended internal fixation of all displaced scaphoid fractures and several also recommend internal fixation of nondisplaced fractures in young, active individuals who require full use of their hands for work or sports.[2,5,7,11] Prolonged inability to return to work or sports can compromise a worker's employment or an athlete's scholarship.[7] Additionally, patients treated nonoperatively with cast immobilization require frequent office visits and radiographic evaluations to monitor for evidence of fracture union and avoid malunion or nonunion.[2] Patient dissatisfaction secondary to prolonged immobilization, frequent clinic visits, and radiographic monitoring is common.[7]

Approximately 95% of acute nondisplaced scaphoid fractures will eventually achieve successful union with cast immobilization.[12] The average time to union varies greatly, depending on the location of the fracture. Distal one-third fractures demonstrate radiographic union in an average of 6 to 8 weeks, middle one-third fractures demonstrate healing in 8 to 12 weeks, and some proximal pole fractures can require 12 to 23 weeks of immobilization to achieve union.[13] Cooney[14] reviewed 45 acute scaphoid fractures at the Mayo Clinic from 1976 to 1978[15] and found that 30 (94%) of 32 nondisplaced fractures achieved radiographic union whereas only 7 (54%) of 13 displaced fractures achieved union.

The major advantages of internal fixation of scaphoid fractures include limited immobilization and the potential for earlier to return to sports and work.[11] Capo and colleagues[16] noted that cast immobilization does not eliminate micromotion at the fracture site and does not alter the biologic environment to promote healing. Rigid internal fixation may allow early mobilization, decreased time to union, and improved range of motion, and can lead to a more rapid functional recovery.[17] Bond and colleagues,[18] in a prospective analysis, randomized 25 military recruits with acute nondisplaced fractures of the scaphoid waist to either cast immobilization or percutaneous cannulated Acutrak (Acumed, Beaverton, OR, USA) screw fixation. The patients in the screw fixation group achieved a faster time to union (7 weeks vs 12 weeks) and a faster return to work (8 weeks vs 15 weeks). There was no significant difference between the 2 groups in regard to range of motion or grip strength.

McQueen and colleagues,[5] in a recent prospective randomized trial, randomly allocated 60 consecutive patients with scaphoid waist fractures to percutaneous fixation with a cannulated Acutrak screw (Acumed) or cast immobilization. Patients who underwent percutaneous fixation showed a faster time to union (9.2 weeks vs 13.9 weeks, $P<.001$). There was a trend toward a higher rate of nonunion in the nonoperative group (4 of 30 vs 1 of 30), although this was not statistically significant. Patients treated with percutaneous internal fixation had a more rapid return of function and return to sports and work compared with those managed nonoperatively with a low complication rate. The authors recommended that all active patients should be offered percutaneous stabilization for fractures of the waist of the scaphoid.

Similarly, the goals of percutaneous fixation of stable scaphoid fractures include early motion and return to activity while improving union rates, avoiding problems associated with prolonged immobilization, and minimizing morbidity from surgical dissection. Percutaneous screw fixation is primarily indicated for minimally or nondisplaced scaphoid waist and proximal pole fractures. Displacement of more than 1 mm is an indication for open reduction to obtain anatomic alignment.[19]