Scaphoid Nonunions Treated With 2 Headless Compression Screws and Bone Grafting

Ryan M. Garcia, MD, Fraser J. Leversedge, MD, J. Mack Aldridge, MD,
Marc J. Richard, MD, David S. Ruch, MD

Purpose To evaluate union and complication rates associated with the use of 2 headless compression screws and bone grafting for the treatment of scaphoid nonunions.

Methods A total of 19 patients (18 male and 1 female) at an average age of 21 years were treated with open reduction and internal fixation with 2 cannulated, headless, compression screws for scaphoid nonunions. Bone grafting techniques included corticocancellous autograft from the iliac crest in 14 patients, capsular-based vascularized distal radius graft in 3, and medial femoral condyle free vascularized bone graft in 2. Patients were treated an average 19 months after the injury. Fracture nonunions were at the waist (n = 12), proximal third (n = 5), or distal third (n = 2) of the scaphoid. Dorsal (n = 7) and volar (n = 12) surgical approaches were used.

Results All fractures had clinical and radiographic evidence of bone union at an average of 3.6 months. Postoperative computed tomography scans were available in 13 patients and showed union without evidence of screw penetration of the scaphoid cortex. No complications occurred in this series, and no revision procedures have been necessary.

Conclusions Our results indicate that the use of 2 headless compression screws for the treatment of scaphoid nonunions is safe and effective. A variety of bone grafting techniques can be used with this technique. The use of 2 compression screws may provide superior biomechanical stability and ultimately improve outcomes measured with future long-term comparative studies. *(J Hand Surg Am. 2014;39(7):1301−1307. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Fracture, navicular, nonunion, scaphoid, screw.

FRACTURE OF THE SCAPHOID IS A common injury, accounting for 60% of carpal fractures.[1] Eighty percent of the scaphoid surface is covered by cartilage, and 70% to 80% of the blood supply to the scaphoid is provided by branches of the radial artery entering at the dorsal ridge in a predominantly retrograde manner.[2] The unique anatomy and tenuous blood supply to the scaphoid ultimately led to the introduction of a compression screw in 1984 by Herbert and Fisher[3] for the treatment of scaphoid fractures. Since then, newer generations of screws with the same design mechanics of variable thread pitch have been developed and extensively studied for optimal biomechanical strength.[4,5] Operative treatment of displaced scaphoid fractures and established nonunions is typically performed with a single variable-pitch compression screw. The single screw may not provide absolute stability, particularly with rotation, when considering the complex and multidirectional

From the Department of Orthopaedic Surgery, Duke University Medical Center; and Triangle Orthopedic Associates, Durham, NC.

Received for publication November 8, 2013; accepted in revised form February 25, 2014.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: David S. Ruch, MD, Department of Orthopaedic Surgery, Duke University Medical Center, Medical Center Boulevard, Winston-Salem, NC 27157-1070; e-mail: d.ruch@dm.duke.edu.

0363-5023/14/3907-0009$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2014.02.030

movement of the scaphoid during wrist flexion-extension, radial-ulnar deviation, and dart-throwing motions.[6–10] Torsional stability may be further enhanced with the use of a derotational Kirschner wire.[11–13] Trumble et al[12] advocated the use of a temporary (removed at 8 wk) derotational wire in 34 patients treated for scaphoid nonunion. We suspected that using 2 headless compression screws would further increase the torsional stability of fracture fixation and lead to an increased union rate and improved clinical outcomes.

The objective of this study was to assess the clinical and radiographic union rate in a consecutive series of patients treated with 2 cannulated, headless, compression screws for scaphoid nonunions. We also aimed to analyze the complication rate associated with this method of fixation, including cortical penetration of either screw. We hypothesized that union and complication rates after the treatment of scaphoid nonunions using 2 headless compression screws would be similar to published reports using a single, centrally placed screw.

MATERIALS AND METHODS

We retrospectively reviewed the medical records and radiographs of 19 consecutive patients with the diagnosis of scaphoid nonunion, who underwent open reduction, debridement, bone grafting, and internal fixation with 2 cannulated, headless, compression screws from August 2009 to September 2012. No patient presenting with a scaphoid nonunion was treated with a single headless compression screw during this time. Eighteen of the patients were men. All 19 patients were right handed. Ten operations were performed on the left wrist and 9 on the right. The average patient age at the time of surgery was 21 years (SD, 5 y). Patients had no medical comorbidities, and no patient smoked. Indications for the use of 2 headless, compression screws were unstable scaphoid nonunions that demonstrated a scaphoid humpback deformity with an increased lateral scapholunate angle, or associated bone loss indicating rotational instability. Our rationale for the use of 2 screws was to provide multiple points of fixation in a series of unstable nonunions. Institutional review board approval was obtained before the collection of any data.

The average time to surgery from the initial injury was 19 ± 10 months (range, 2–78 mo). Injury mechanisms included falls on outstretched hands in 8 patients, sporting activities in 7, motorcycle accidents in 2, and automobile accidents in 2. Five patients were initially treated with cast immobilization for a known acute scaphoid fracture, and 2 had previously undergone open reduction and internal fixation with a single scaphoid screw. The remaining 12 patients had not sought medical treatment after their injury. We observed all patients until we identified clinical and radiographic evidence of fracture union. Any intraoperative or postoperative complication including the need for revision surgery for any reason was recorded.

Fractures occurred at the scaphoid waist in 12 patients, the proximal third in 5, and the distal third in 2. According to the classification of Herbert and Fisher,[3] there were 6 fibrous nonunions (type D1), and 13 pseudoarthroses (type D2). The classification of each nonunion was made from radiographic images and confirmed intraoperatively. We used a volar wrist approach in 12 patients and a dorsal approach in 7; 4 of these had a proximal third fracture, 1 had a scaphoid waist fracture treated with a capsular-based vascularized distal radius graft, and 2 had humpback or dorsal intercalated segment deformities. Fourteen patients received nonvascularized corticocancellous bone grafting from the iliac crest, 3 had a capsular-based vascularized distal radius graft,[14] and 2 had a vascularized medial femoral condyle free bone graft[15] before placement of the 2 screws. Patients treated with a free vascularized bone graft had a longer average interval from injury to surgery (59 vs 14 mo), which resulted from a delay in referral. Three of the patients receiving vascularized bone grafts had proximal third fractures, and 2 had waist fractures. At the discretion of the surgeon, an external bone stimulator was used immediately postoperatively in 12 patients and continued for 4 to 6 weeks. The screws we used were Trimed (Trimed, Inc, Valencia, CA) (8 patients) and combined Acutrak Mini and Acutrak 2 Micro (Acumed, Beaverton, OR) (11 patients). Screw diameters ranged from 2.3 to 3.0 mm, and screw lengths ranged from 18 to 28 mm, with an average difference in screw length between the 2 screws of 4 mm (range, 0–8 mm). The operating surgeon determined screw manufacturer and size.

All patients underwent similar postoperative management. They were immobilized in a thumb spica cast in the immediate postoperative period. After 2 weeks, this was changed to a removable thumb spica orthosis and an outpatient therapy program was started. The therapy program was then continued, based on patient progress at the discretion of the operating surgeon. Patients were allowed to progress to full weightbearing after we observed clinical and radiographic evidence of union.

Radiographic union was confirmed by computed tomography scan at the time of symptom resolution