SCIENTIFIC ARTICLE

Hybrid Russe Procedure for Scaphoid Waist Fracture Nonunion With Deformity

Steve K. Lee, MD,* David J. Byun, BS,* Jorge L. Roman-Deynes, MD,† Zina Model, BA,* Scott W. Wolfe, MD*

Purpose To assess the results of a hybrid Russe procedure using a corticocancellous strut, cancellous autologous nonvascularized bone graft, and cannulated headless compression screw to reduce the deformity reliably from a collapsed scaphoid nonunion, provide osteoinductive stimulus, and stabilize the fracture for predictable union.

Methods A hybrid Russe procedure was performed for scaphoid waist fracture nonunions with humpback deformity and no evidence of avascular necrosis. A volar distal radius autologous bone graft was harvested and a strut of cortical bone was fashioned and placed into the nonunion site to restore length and alignment. We packed cancellous bone graft in the remainder of the nonunion site and fixed the scaphoid was with a headless compression screw. Union was determined by radiographs or computed tomography, and intrascaphoid, scapholunate, and radiolunate angles were calculated on final radiographs. We recorded wrist range of motion, grip strength, pinch strength, pain, and complications.

Results Fourteen male and 3 female patients (average age, 32 years; range, 16–78 years), with a mean follow-up of 32 months, were examined clinically and radiographically. All 17 scaphoids united with a mean time for union of 3.6 months. The mean postoperative intrascaphoid angle was significantly reduced from 65° preoperatively to 35° postoperatively. The mean radiolunate angle was significantly improved from 20° from neutral (lunate tilted dorsally) preoperatively to 0° postoperatively. The scapholunate angle also demonstrated significant improvement from 70° preoperatively to 56° postoperatively. Grip strength improved from 70% of the contralateral hand to 89% after the procedure. All patients were satisfied with the functional outcome and no donor site morbidity or hardware issues were identified.

Conclusions This straightforward hybrid Russe technique predictably restored radiolunate, scapholunate, and intrascaphoid angles with a 100% union incidence. The technique provides excellent functional results in patients with a challenging clinical problem, and we recommend it for scaphoid fracture waist nonunions with dorsal intercalated segment instability deformity. *(J Hand Surg Am. 2015;40(11):2198–2205. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Fracture, humpback deformity, modified Russe, nonunion, scaphoid.

*From the *Department of Orthopaedic Surgery, Weill Medical College of Cornell University, Hospital for Special Surgery; and the †Department of Orthopaedic Surgery, New York University Hospital for Joint Diseases, New York, NY.*

Received for publication October 3, 2014; accepted in revised form July 29, 2015.

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

Corresponding author: Steve K. Lee, MD, Department of Orthopaedic Surgery, Weill Medical College of Cornell University, Hospital for Special Surgery, 535 East 70th Street, New York, NY 10021; e-mail: lees@hss.edu.

0363-5023/15/4011-0012$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2015.07.028

Treatment of scaphoid nonunion with carpal collapse presents a unique challenge for hand surgeons. Although scaphoid union is the primary concern, surgeons must also be wary of scaphoid malalignment because the failure to recognize and treat all components of the deformity can result in progressive degenerative arthritis.[1–3]

Important principles that govern the treatment of scaphoid nonunion include excision of the pseudoarthrosis, correction of malalignment, provision of a bridging bone graft, mechanical compression, and stable fixation.[4] In cases where the proximal pole remains vascularized, open reduction internal fixation of the nonunion combined with nonvascularized autologous bone graft remains the standard for treatment.[5,6] Numerous techniques of bone grafting and internal fixation have variable degrees of success.[7–12]

The so-called humpback or flexed scaphoid nonunion results from chronic volar bone loss and an intrascaphoid collapse deformity with resultant dorsal tilt of the lunate (dorsal intercalated segment instability [DISI]). The humpback scaphoid is commonly repaired using an anterior iliac crest tricortical wedge graft and internal fixation. The use of an intramedullary screw has shown improvements in carpal instability and union in 71% to 100% of patients.[7,12–14] Intercalated wedge grafting can present technical challenges of sizing the graft, graft extrusion at the time of screw fixation, and donor site morbidity, primarily pain.[15] Pure cancellous grafting has the advantages of ease of access and rapid incorporation,[12] but it may lack sufficient mechanical strength to maintain anatomic scaphoid and lunate alignment.

In this study, we altered the Russe technique as modified by Green[8] using a single (rather than double) intramedullary cortical strut and obtained stable internal fixation with a cannulated compression screw. As described by Green, Russe[16] had many iterations of his technique, starting with using cancellous bone graft exclusively, then adding a cancellous plug from the iliac crest and cancellous chips, and finally using 2 back-to-back corticocancellous intramedullary iliac crest strut grafts. Green quoted Russe: "Cortical bone for stability, cancellous bone for osteogenesis!" Green reported his success using the modified Russe graft in an initial cohort of 48 patients receiving iliac crest graft and in a subsequent cohort of 6 using distal radius graft. None received internal fixation.

Our purpose was to present the surgical technique and clinical results of the hybrid Russe procedure to treat humpback scaphoid nonunion with DISI.

MATERIALS AND METHODS

Patients

We reviewed all skeletally mature patients from 2 institutions who had humpback scaphoid nonunion and DISI, had been treated with our hybrid Russe technique since 2006, and had a minimum of 6 months' follow-up. The study was performed with approval by an institutional review board from each institution. We excluded any patient with osteoarthritis (scaphoid nonunion advanced collapse) or avascular necrosis. We defined waist fractures as those occurring in the central one third of the scaphoid. Iliac crest bone grafts were used in 3 patients who had received prior distal radius grafting.

Seventeen patients (14 male and 3 female; average age, 32 years; range, 16–78 years) were identified with an average follow-up of 32 months (range, 6–103 months). Five patients had failed previous scaphoid nonunion surgery. One male patient was lost to follow-up after 6 months of follow-up and was excluded from the analysis because of insufficient clinical data. A review of his chart demonstrated that he had healed clinically and radiographically at 8 weeks after surgery. There were no differences in age, time to union, or preoperative intercarpal angles of the missing patient compared with the remaining patients.

The operating surgeon performed all diagnostic imaging reviews and physical examinations (including range of motion and strength). A hospital radiologist who was not aware of the protocol of the study confirmed radiographic and computed tomographic (CT) evaluation of union. Research staff collected Patient-Rated Wrist Evaluation (PRWE) scores, Disabilities of the Arm, Shoulder, and Hand (DASH) scores, visual analog scale, and radiographic angle measurements.

Criteria for union included the absence of snuffbox tenderness and the presence of bridging trabeculae on the posteroanterior, scaphoid, lateral, and oblique wrist radiographs. Computed tomography was obtained in 12 of the 17 patients and confirmed union in each. Postoperative flexion-extension and radioulnar deviation were measured with a goniometer and compared with preoperative range of motion. Grip strength (Jamar dynamometer level II, Sammons Preston Rolyan, Bolingbrook, IL) and pinch strength (Biometrics Ltd, Gwent, United Kingdom) were compared with the contralateral side. Pain was assessed using a visual analog scale (0 = no pain; 10 = the worst pain imaginable). Patient-Rated Wrist Evaluation and DASH scores were completed at the final follow-up.

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