

Primary Treatment of Scaphoid Nonunions with Proximal Pole Avascular Necrosis with a Medial Femoral Condyle Free Vascularized Bone Graft

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Hypothesis

Several pedicled and free-vascularized bone grafts have been described for the treatment of scaphoid nonunions. The purpose of this study is to determine the outcome of free-vascularized medial femoral condyle bone grafts in the treatment of scaphoid nonunions with avascular necrosis. We hypothesize that this treatment restores scaphoid vascularity and architecture in patients who have documented avascular necrosis of the proximal pole resulting from scaphoid nonunion.



Figure 1: Preoperative PA, navicular view, and CT scan of a scaphoid nonunion treated with medial femoral condyle free vascularized bone grafting.

Methods

A retrospective review was conducted to identify all patients with scaphoid nonunions treated primarily with a free-vascularized medial femoral condyle bone graft. Between June of 2006 and October of 2016, 32 patients (28 male, 4 female) met inclusion criteria for the study with an average age of 23 at the time of injury. Mean time from injury to surgery was 17.8 months. All patients had avascular necrosis, defined as absent punctate bleeding in the proximal pole at surgery with tourniquet deflation and either scaphoid foreshortening, carpal collapse or both.

A headless compression screw provided fixation when possible (28 patients), or K-wires for small proximal fragments. Patients were immobilized post-operatively until radiographic union, defined as bridging trabeculae on plain radiographs and computed tomographic (CT) scan. Carpal indices, time to union, early functional outcomes and complications were recorded.

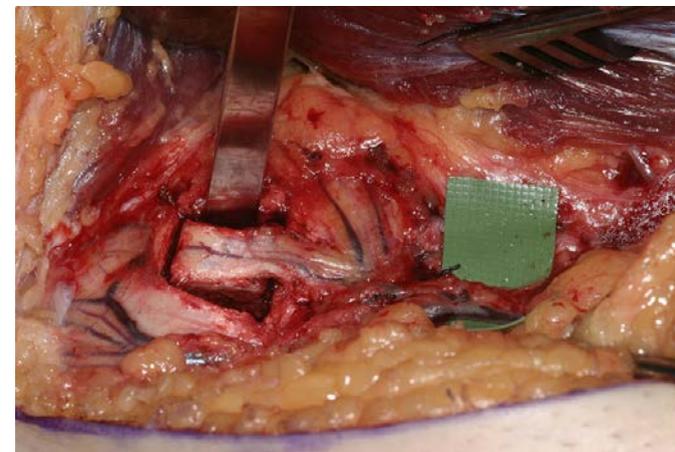


Figure 2: Graft harvested from the medial femoral condyle measuring 13mm wide x 14mm long x 10mm deep.

Results

30 of 32 (93.8%) patients treated with free-vascularized medial femoral condyle bone grafting healed at a mean of 13.6 weeks (range, 7.29 to 30.3 weeks). Radiographic evaluation demonstrated significant improvement from preoperative to postoperative scaphoid height-to-length ratio (0.76 and 0.63 respectively, $p < 0.0001$), lateral scaphoid angle (32.1 and 16.4 degrees, respectively, $p < 0.0001$), scapholunate angle (70.2 and 55.2 degrees, respectively, $p < 0.0001$), and radiolunate angle (19.9 and 4.89 degrees, respectively, $p < 0.0001$). Patients were permitted to weightbear as tolerated on their lower extremity immediately following surgery.

Wrist range of motion post-operatively averaged 44 degrees of extension and 38 degrees of flexion. Eight patients underwent subsequent procedures, including 8 hardware removals (4 planned Kirschner wire removals, 4 screw removals with or without bone grafting). One patient underwent scaphoidectomy and 4-corner fusion 15 months post-operatively after suffering a subsequent injury. Another patient underwent 1,2-intercompartmental supraretricular artery-based vascularized bone grafting four months after the procedure and the scaphoid excision with four-corner fusion four years later. There were no donor-site complications related to the vascularized bone graft harvest.

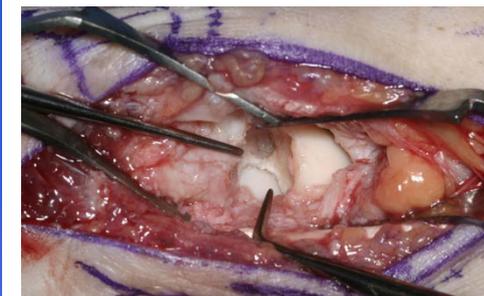


Figure 3: Scaphoid nonunion site debrided and prepared to accept the medial femoral condyle free vascularized graft.

Summary

Previously untreated scaphoid nonunions with an avascular proximal pole are reliably treated with free medial femoral condyle vascularized bone grafts. Carpal alignment was improved and healing occurred in 93.8% of patients, at a mean 13.6 weeks. The free medial femoral condyle vascularized graft restores scaphoid vascularity and architecture while promoting union in a subset of scaphoid nonunions that has historically been a clinical challenge.

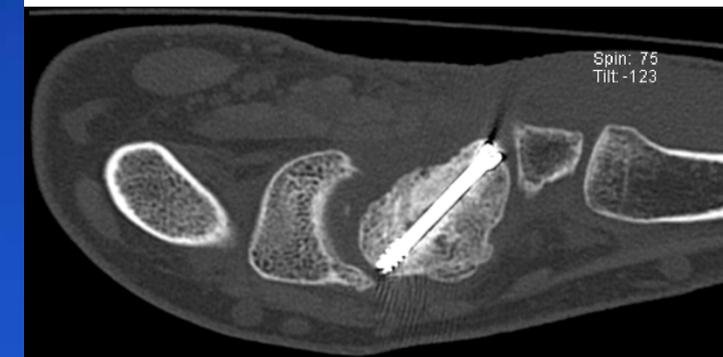


Figure 4: CT scan demonstrating union at both proximal and distal graft sites at 19 weeks post vascularized bone grafting.

Additional Resources

1. Mack G, Bosse M, Gelberman RH, Yu E. The Natural history of Scaphoid Non-union. *J Bone Joint Surg Am.* 1984;66(4):504-9.
2. Merrell GA, Wolfe SW, Slade JF. Treatment of scaphoid nonunions: quantitative meta-analysis of the literature. *J Hand Surg.* 2002;27(4):685-91.
3. Fisk GR. Carpal instability and the fractured scaphoid. *Ann R Coll Surg Engl.* 1970;46(2):63.