Mid-Term Results of the Use of Structural Humeral Head Autograft to Correct Glenoid Bone Loss in Reverse Total Shoulder Arthroplasty

Adam Shafritz, MD[1]; Jack Mangan, BA[2]; Michael DeSarno, MS[3]; Christopher D. Kanner, DO[4]
[1]Department of Orthopaedic Surgery, University of Vermont Medical Center, Burlington, VT; [2]Larner College of Medicine, University of Vermont, Burlington, VT; [3]Department of Medical Biostatistics, University of Vermont, Burlington, VT; [4]Department of Radiology, University of Vermont Medical Center, Burlington, VT
Jack.Mangan@med.uvm.edu

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INTRODUCTION: Native glenoid bone loss presents technical challenges in shoulder arthroplasty. Significant bone loss can be managed with metal augments, autografts, allografts, and custom implants. We observed that in many cases of glenoid bone loss the defect tends to mirror the shape of the humeral head, and that the humeral head seemed to fit the glenoid defect perfectly (Figure I). Because the glenoid component in our preferred RSA implant is screwed into position, it seemed intuitive that the patient's humeral head might serve as an ideal structural bone graft to correct severe bone loss and restore the native paleo-glenoid morphology. In the present study, we report the mid-term clinical and radiographic outcomes of patients treated with structural humeral head autograft reconstruction of glenoid bone loss in the setting of reverse total shoulder arthroplasty (rTSA).

METHODS: A retrospective review was performed for all cases of rTSA where structural humeral head autograft was used to correct glenoid bone loss between the years 2005 – 2019 at our institution. Pre- and post-operative range of motion, Visual Analog Pain Scale (VAS), Simple Shoulder Test scores (SST), Disabilities of the Arm, Shoulder, and Hand scores (DASH), glenoid retroversion and superior inclination angles were collected. Additionally, medical co-morbidities, smoking status, and pre-operative glenoid vault depth were recorded. Patients were divided into 2 cohorts: alive or deceased. Statistical analyses were performed to determine if humeral head autograft augmentation of glenoid bone loss is a viable solution for patients undergoing rTSA.

RESULTS SECTION: 30 shoulders in 28 patients were included in this study. Seventeen shoulders had rotator cuff tear arthropathy, seven shoulders had osteoarthritis with posterior glenoid bone loss along with posterior instability and tears to the superior subscapularis with fatty atrophy of the muscle belly, four shoulders had rheumatoid arthritis with erosive bone loss and rotator cuff insufficiency, and two shoulders had post-capsulorraphy arthropathy with subscapularis insufficiency secondary to prior Putti-Platt procedure. The mean age at time of surgery was 73.5 years (range: 63-89 years) and the mean BMI at the time of surgery was 31.0 kg/m2 (range: 17.0 – 47.5 kg/m2). Ten patients died for reasons not related to their shoulder surgery. Patients were followed for an average of 3.1 years for the deceased cohort (range: 0.2 – 8.5 years), and 4.3 years for the alive cohort (range: 2.0 – 7.6 years). Pre-operatively, patients were found to have a mean glenoid vault depth of 20.0 mm (range: 11.0 – 30.0 mm, SD: 4.3 mm), with an average retroversion angle of 10.6 degrees (range: -32.0 – 40.0 degrees, SD: 17.6 degrees), and a superior inclination angle of 4.3 degrees (range: -12.0 – 25.0 degrees, SD: 10.0 degrees). Post-operatively, the mean retroversion angle was 6.8 degrees (range: 0.0 – 16.0 degrees, SD: 4.3 degrees), and the mean inclination angle was -8.4 degrees (range: -23.0 – 9.0 degrees, SD: 7.7 degrees). Mean retroversion angle correction was found to be -3.7 degrees (range: -30.0 – 42.0 degrees, SD: 17.8 degrees), and mean glenohumeral inclination angle correction was -12.8 degrees (range: -30.0 – 3.0 degrees, SD: 8.3 degrees) (Table I). Patient-reported outcome measures improved during the study period with VAS improving from 4.9 to 0.03 (range: 0 – 1, SD: 0.2, p-value < 0.001), SST improving from 2.6 to 8.7 (range: 1 – 12, SD: 3.4, p-value < 0.001) and DASH improving from 53.6 to 24.5 (range: 0 – 67, SD: 23.9, p-value < 0.001). In addition, forward flexion improved from 76.4 degrees to 148.7 degrees (range: 80 – 170 degrees, SD: 22.2 degrees, p-value < 0.001), abduction increased from 64.3 degrees to 137.9 degrees (range: 60 – 170 degrees, SD: 28.7 degrees, p-value < 0.001), internal rotation improved from 2.1 to 4.3 (range: 2 – 8, SD: 1.6, p-value < 0.001), and external rotation increased from 20.8 degrees to 54.7 degrees (range: 30 – 70 degrees, SD: 12.8 degrees, p-value < 0.001). Compared against current or former smokers, non-smokers were found to have a significant improvement in both forward flexion (p = 0.04) and external rotation (p = 0.04). We did not find any significant differences in functional or patient-reported outcomes when analyzing implant laterality in relation to a patient's dominant hand, diabetes status, history of a prior shoulder surgery, age, sex, or BMI. No revision procedures were performed, and all patients were satisfied with their shoulder post-operatively. Bone grafts were found to incorporate into 100% of shoulders, with no prosthetics displaying signs of loosening or other structural concerns. Two patients developed scapular notching on follow-up. One patient sustained a scapular body fracture as the result of a fall that healed without surgery.

DISCUSSION: The use of a humeral head autograft to reconstruct glenoid bone loss in patients undergoing rTSA is a safe and effective procedure. It allows for a local graft source to be utilized thus avoiding potential comorbidity and complications associated with the use of alternative site autografts or allografts and has the advantage of nearly congruent fit within the defect.

SIGNIFICANCE/CLINICAL RELEVANCE: For patients with severe bone loss to the glenoid, with or without concomitant rotator cuff arthropathy, RTSA with autograft humeral head bone augmentation seems to be a viable surgical option that has not previously been described.

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Figure I. Humeral head autograft fits native glenoid defect perfectly. Glenoid defect modelled via 3D printed glenoid targeting guide.

Variable	Mean (Range)
Pre-Op Glenoid Vault Depth (mm)	20.0 (11.0 – 30.0)
Retroversion Angle (º)	
Pre-Op	10.6 (-32.0 – 40.0)
Post-Op	6.8 (0.0 – 16.0)
Correction	-3.7 (-30.0 – 42.0)
Superior Inclination Angle (º)	
Pre-Op	4.3 (-12.0 – 25.0)
Post-Op	-8.4 (-23.0 – 9.0)
Correction	-12.8 (-30.0 – 3.0)

Table I. Anatomical and intraoperative details. All numbers are absolute values.