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Outcomes of reverse total shoulder arthroplasty as primary versus revision procedure for proximal humerus fractures

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Background: Reverse total shoulder arthroplasty (RTSA) has been shown to be an effective treatment for proximal humerus fracture (PHF). This study evaluates outcomes of all patients with PHF treated with RTSA as a primary procedure for acute PHF, a delayed primary procedure for symptomatic PHF malunion or nonunion, a revision procedure for failed PHF hemiarthroplasty (HA), or a revision procedure for failed open reduction and internal fixation (ORIF).

Methods: Patients who underwent RTSA for PHF were evaluated for active range of motion and Shoulder Pain and Disability Index (SPADI), Simple Shoulder Test-12, American Shoulder and Elbow Surgeons (ASES), University of California–Los Angeles (UCLA) shoulder rating scale, Constant, and 12-Item Short Form Health Survey scores. Scaption and external rotation (ER) strength were also assessed.

Results: RTSA was performed in 49 patients with PHF; 13 patients underwent RTSA for acute PHF, 13 for malunion or nonunion, 12 for failed PHF HA, and 11 for failed PHF ORIF. ER range of motion, SPADI, ASES, UCLA, and Constant scores achieved significance. The acute fracture group significantly outperformed the failed HA group in SPADI, ASES, and UCLA scores. The malunion/nonunion group significantly outperformed the failed HA group in ASES and UCLA scores. The acute fracture and malunion/nonunion groups each had significantly greater ER than the failed HA group.

Conclusion: RTSA is an effective treatment option for PHF as both a primary and a revision procedure. Primary RTSA outperformed RTSA done as a revision procedure. RTSA for acute PHF is comparable to RTSA for malunions and nonunions. Our outcomes of revision RTSA for failed HA and ORIF are more promising than previously published.

Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Failed hemiarthroplasty; failed open reduction–internal fixation; malunion; outcomes; proximal humerus fracture; reverse total shoulder arthroplasty

The majority of proximal humerus fractures (PHFs) in the elderly can be treated nonoperatively. When surgical intervention is indicated, the treatment options in this population of patients include open reduction and internal fixation (ORIF), hemiarthroplasty (HA), and reverse total shoulder arthroplasty (RTSA).

The Western Institutional Review Board approved this study (No. 1112376).

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The outcomes of ORIF and HA are mixed and unpredictable.[1,3,14,17,20] Recent comparative outcome studies have found RTSA to be equivalent or superior to ORIF and HA.[5,7,8]

Several case series have advocated the use of RTSA for PHF. RTSA can be a primary treatment option in acute PHF, with satisfactory outcomes reported.[4,9,10] RTSA has been effectively used as a primary treatment option for symptomatic malunions and nonunions of PHF.[2,12,19] RTSA can be a revision option for failed HA used to treat PHF.[11,15,16,18] RTSA can also successfully revise failed PHF ORIF.[6,13]

The literature lacks a single study that has compared RTSA outcomes for PHF across the 4 surgical indications using a comprehensive panel of shoulder outcome measures. Furthermore, there is a lack of strength assessment and comparison. The purpose of this study was to assess functional outcomes, active range of motion (ROM), and strength after RTSA for PHF based on indication. We hypothesized that acute fracture RTSA would outperform RTSA for malunion and nonunion. We also hypothesized that primary RTSA would outperform revision RTSA for failed HA or ORIF.

Materials and methods

This was a retrospective case-control study compiled from a research database. We included all patients from the database who had RTSA performed by the senior author (T.W.W.) from 2006 to 2014 after sustaining a PHF regardless of initial management.

Patients were categorized into 4 groups based on the indications for RTSA. Group 1 was composed of patients who received a primary RTSA for an acute PHF. Group 2 was composed of patients who received a primary RTSA for a malunion or nonunion. Group 3 was composed of patients who received a revision RTSA for a failed PHF HA. Group 4 was composed of patients who received a revision RTSA for a failed PHF ORIF. Indications for revision in the failed ORIF group consisted of symptomatic avascular necrosis with head collapse and intra-articular screw penetration.

Outcome scores assessed included the Shoulder Pain and Disability Index (SPADI), Simple Shoulder Test-12 (SST-12), American Shoulder and Elbow Surgeons (ASES) shoulder score, University of California–Los Angeles (UCLA) shoulder rating scale, normalized Constant shoulder score, and 12-Item Short Form Health Survey (SF-12). Active motion was measured in forward elevation (FE), abduction (AB), external rotation at 0° AB (ER), and internal rotation anatomic level (IR) in a standardized manner using a goniometer by a research coordinator (A.M.S.). Static strength measurements were obtained using a hand-held dynamometer (TBS 2000 Functional Testing Systems Software; Quest Medical Group, Inc, West Jordan, UT, USA). Scaption strength was performed at 30° of AB in the scapular plane; ER strength was performed at the subject's side at 0° of ER. The average of 3 repetitions was used to calculate each measurement.

Surgical technique

All patients were positioned supine, upper body elevated about 30°, with the surgical extremity prepared in the field. All RTSAs were performed with a prosthetic stem that was distally cemented. The same implant system was used for all cases (Equinoxe Reverse System; Exactech, Gainesville, FL, USA; Fig. 1). The standard deltopectoral approach was used in all cases. The tuberosities were selectively repaired. We released the supraspinatus and subscapularis and did not repair them. The posterior aspect of the greater tuberosity—site of insertion of the infraspinatus and teres minor—was repaired to the stem. Ideally, an osteotomy of the tuberosity was performed to allow bone healing to the stem. Healing rates were not assessed with radiographs because of their lack of clinical correlation in RTSA.

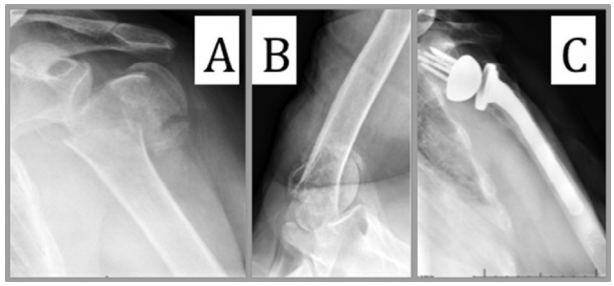

Figure 1 Acute proximal humerus fracture treated with a reverse total shoulder arthroplasty. (**A**) Anteroposterior shoulder radiograph preoperatively. (**B**) Axillary shoulder radiograph preoperatively. (**C**) Anteroposterior shoulder radiograph postoperatively.

Postoperative rehabilitation

Aftercare for RTSA consisted of sling immobilization for 6 weeks. Initially, sling wear was full-time. Three weeks postoperatively, patients began gentle passive ROM exercises. Six weeks postoperatively, patients were advanced to active assist ROM exercises. Twelve weeks postoperatively, patients started a strengthening program.

Data analysis

Data were organized in Excel (Microsoft, Redmond, WA, USA). Analyses were performed in SPSS (IBM, Armonk, NY, USA). After creation of descriptive statistics with means and standard deviations, the data were evaluated with the Kolmogorov-Smirnov test and found to be non-normally distributed. Therefore, statistical analyses were performed using the nonparametric Kruskal-Wallis 1-way analysis of variance. Post hoc testing was performed using the Wilcoxon rank sum test. Significance was set at P value < .05.

Results

In total, 49 patients were identified during the study period. The mean follow-up was 32 months (range, 24-36 months). Table I shows the number of patients in each group, sex, age at time of RTSA, and average follow-up. There were 39 women in total. The average age at the time of RTSA was 71 years (range, 66-78 years). The primary RTSA groups were significantly older than the revision RTSA groups (Table I).

Final follow-up SPADI, SST-12, ASES, UCLA, Constant, and SF-12 scores for each of the 4 groups are shown in Table II. There was a significant difference between groups