Revision of Anatomic Total Shoulder Arthroplasty to Hemiarthroplasty: Does it work?

Running Title: Revision TSA to hemi

Abstract

Introduction: The impending burden of revision shoulder arthroplasty has increased interest in outcomes of revision procedures. Glenoid component removal and conversion to a hemiarthroplasty (HA) is an option for aseptic glenoid loosening after anatomic total shoulder arthroplasty (aTSA).

Methods: Patients who underwent revision shoulder arthroplasty over a 15-year period were identified. Pre-surgical and operative data were analyzed for 17 patients who met inclusion and exclusion criteria. Patients were contacted at a mean follow-up of 70 months from revision surgery for functional outcomes scores, reoperations, and implant survival.

Results: Implant survival was estimated to be 88% at 2 years and 67% at 5 years. Mean ASES score for surviving implants was 58 ± 22. Mean SANE score was 54 ± 24, and mean VAS pain score was 3.5 ± 2.8. Mean SF-12 Mental and Physical scores were 46 ± 15 and 38 ± 10, respectively. Five patients (50% of those with surviving implants) reported being either satisfied or very satisfied with the status of their shoulder. Complications were seen in 6 patients (35%) and 5 patients (29%) required reoperation.

Conclusions: HA following failed aTSA due to glenoid loosening produced modest clinical results and satisfaction rates. Reverse arthroplasty may be a more reliable treatment strategy in this patient population.

Level of Evidence: Level IV, Case Series

Key words: revision arthroplasty; hemiarthroplasty; total shoulder arthroplasty; implant survival; shoulder replacement; aseptic glenoid loosening.

Introduction

Anatomic total shoulder arthroplasty (aTSA) is a common procedure in the United States, with an increasing incidence in both younger and older patients [1]. As the incidence increases, the impending burden of revision procedures has become a concern. While results of primary shoulder arthroplasty are often reported, outcomes of revision procedures are less common due to small patient numbers and limited clinical follow-up.

Aseptic glenoid component loosening has been reported to account for 32% of all complications and occurs in 5.3% of all shoulders following aTSA[2, 3]. Aseptic glenoid loosening can be associated with contained or uncontained bone defects that may preclude the reimplantation of a glenoid component. In the setting of glenoid bone deficiency and a functional rotator cuff, removal of the loose glenoid component, conversion to hemiarthroplasty (HA), and concomitant bone grafting of the glenoid has historically been a common treatment strategy [4–7]. Recently, failed aTSA has more commonly been converted to a reverse arthroplasty given the improved glenoid fixation and the successful reported results[8–10]. Certainly, revision to reverse arthroplasty carries higher implant cost and risk for surgical complications. The purpose of this study was to evaluate results of revision of aTSA to a HA in patients with aseptic glenoid loosening and an intact rotator cuff.

Materials and Methods

This study was conducted after Institutional Review Board approval. Patients who underwent revision shoulder arthroplasty at a single tertiary care health system from 2000 to 2015 were identified. Cases were identified by common procedural (CPT) codes 23470 (hemiarthroplasty), 23472 (total shoulder arthroplasty), 23473 (revision of total shoulder arthroplasty, humeral or glenoid component), and 23474 (revision of total shoulder arthroplasty, humeral or glenoid component). A retrospective chart review was performed to identify all patients who were revised from an aTSA to a hemiarthroplasty. Exclusion criteria included patients who underwent placement of a hemiarthroplasty antibiotic spacer for infection, those who underwent revision for etiologies other than aseptic glenoid component loosening, those who underwent arthroscopic glenoid component removal, those with irreparable rotator cuff tears, and those with less than 2-years of clinical follow-up.

Preoperative variables were collected by retrospective chart review. Variables included age, gender, dominant-sided surgery, Charlson comorbidity index score, and the diagnosis for the original aTSA [11]. Operative notes were reviewed to classify glenoid bone loss, rotator cuff status, concomitant procedures (including glenoid bone grafting, humeral head exchange and stem revisions) and intraoperative complications. Extent of glenoid bone loss was graded based on location of deficiency (peripheral, central, or combined) and severity (mild, moderate, severe) as described by Antuna et al [4].

Retrospective chart review and contact of patients at minimum of 2 years after revision surgery were utilized to determine implant survival and postoperative complications. For surviving implants, patient-reported outcome measures including the American Shoulder and

Elbow Surgeons Score (ASES), Single Assessment Numerical Evaluation (SANE), Visual Analog Scale for pain (VAS; 10 point scale), the Short Form-12 Health Survey (SF-12), and patient satisfaction (on scale of 1-5, 1 being very dissatisfied and 5 being very satisfied) were obtained [12–15].

Statistical Methods

Outcome scores following hemiarthroplasty were analyzed for measures of central tendency and variation. Implant survival following hemiarthroplasty was summarized using the Kaplan-Meier method as a function of time elapsed from revision surgery.

Results

There were 618 patients who underwent revision shoulder arthroplasty at our institution during the study period and 32 patients who underwent glenoid component removal following aTSA. After applying inclusion and exclusion criteria, the authors retrospectively reviewed medical records of 17 patients (3% of all revision arthroplasties at our institution during the study period). Mean age at time of the index TSA was 56±7 years (range 41-71 years). There were 7 women and 10 men. The dominant extremity was involved in 12 patients. Mean Charlson Comorbidity Index was 3.8 ± 2.4 (range 0-10). Five patients underwent shoulder surgery prior to index aTSA and two patients underwent multiple (2) prior surgeries. Indications for the primary TSA included osteoarthritis (15), posttraumatic arthritis (1) and avascular necrosis (1). (Table 1). In all patients, the indication for revision surgery was painful glenoid component loosening. Three patients also had a diagnosis of concurrent humeral loosening and two patients had a diagnosis of humeral stem malposition. Preoperative functional scores and advanced imaging were scarcely available, and were therefore excluded from our data.

Operative Findings and Techniques

The characteristics of the study group at time of revision are shown in Table 2. The mean age at the time of revision to hemiarthroplasty was 63.9 ±8 years (range 44-78 years) and the mean duration from index surgery to revision hemiarthroplasty was 7.5±5 years (range 0.6-20.1) years).

Glenoid bone deficiency could be classified based on operative reports in 15 patients. Cases were classified as severe central (11), severe combined (2), severe peripheral (1) and moderate central (1). Sixteen shoulders underwent glenoid bone graft with cancellous allograft (15) or iliac crest autograft (1). Two patients underwent impaction grafting of the humerus using

cancellous allograft. Three patients had partial-thickness subscapularis tears, one patient had a full-thickness subscapularis tear, and one patient had a full-thickness supraspinatus tear. The humeral stem was revised in 5 patients due to loosening (3) or malpositioning (2). Humeral head component exchange was performed in all patients.

No clinical signs of infection were noted in any patients at revision surgery. Routine cultures showed bacterial growth in 4 patients [coagulase-negative Staphylococcus species (2), Propionibacterium acnes (1) and Staphylococcus aureus (1)]. All were treated with appropriate antibiotic courses.

Survival, Complications and Reoperation

Implant survival rate was estimated to be 88% (15 of 17) at 2 years and 67% (8 of 12) at 5 years by Kaplan-Meier analysis (Figure 1). There were no intraoperative complications and 6 (35%) post-operative complications following revision to HA. These included symptomatic glenoid-sided arthrosis (5) and humeral component loosening (1).

One patient with symptomatic glenoid arthrosis did not undergo reoperation during the study period. At time of survey, this patient had an ASES and pain scores of 40 and 7, respectively, and was awaiting reoperation. The remaining four patients with symptomatic glenoid arthrosis underwent glenoid reimplantation at a mean of 40 months (range, 9-63) following hemiarthroplasty. One patient also underwent stem revision due to component malpositioning. None of these patients with a complication were noted to have rotator cuff pathology, clinical signs of instability or positive intraoperative cultures at time of revision to HA. Two patients required repeat glenoid bone grafting at the time of reoperation. At time of survey, three patients had surviving reimplanted glenoids, however one did require reoperation for lesser tuberosity (LT) nonunion at 4 months following the second revision. Mean ASES and

pain scores in these three patients were 79 (range, 70-90) and 3.3 (range 1-7); two were very satisfied with their outcome and the third was satisfied.

The patient with humeral component loosening underwent stem revision and glenoid reimplantation at 8 months following HA. This patient was deceased at time of survey follow-up.

Outcomes in Implant Survival Group

Functional outcomes scores were obtained from 10 of 12 patients (83%) with surviving implants. Mean follow-up in cases of implant survival was 70 ± 21 months from HA (range 30-100). Two patients were deceased and one patient was unable to communicate due to other medical conditions. Mean ASES score for surviving implants was 58 ± 22 (range 27-98). Mean SANE score was 54 ± 24 (range 25-98), and mean VAS pain score was 3.5 ± 2.8 (range 0-7). Mean SF-12 Mental and Physical scores were 46 ± 15 (range 18-65) and 38 ± 10 (range 21-57), respectively. Five patients reported being either satisfied or very satisfied, 3 patients were neutral and 2 patients were very dissatisfied with the status of their shoulder. (Table 3)

Discussion

Aseptic glenoid loosening and failure of aTSA can result in deficient glenoid bone stock that is not amenable to glenoid component reimplantation. In comparison to arthroplasties of other joints, the small anatomic size of the glenoid can create a challenging reconstructive problem. Reverse arthroplasty has gained popularity in revision cases with poor glenoid bone stock due to the improved baseplate fixation and more reliable graft healing[6, 8, 16]. However, there may still be clinical situations such as patients of young age, well-preserved preoperative range of motion, and a healthy rotator cuff that may be better served with revision to HA.

In this study, patients typically had severe glenoid defects and underwent component removal and bone grafting with variable techniques. Outcomes in cases of implant survival varied, but were reasonably successful at a mean 5.8-years follow-up. Previous studies on outcomes of conversion of failed aTSA to HA have found wide ranges of functional scores but a significant number of patients with a good result (Table 4). Deutsch et al recorded ASES and 10-point pain scores and found mean values of 52 (range 22-91) and 3.5 (range 1.3-5.0), respectively, at 4-year follow-up. Based on the literature, it appears that reimplantation of a glenoid component in cases of aseptic loosening leads to better pain relief and satisfaction; however, conversion to HA can also lead to reasonable results[4, 17, 18].

Despite the successful results that can be achieved with conversion of aTSA to HA, there is risk of both complications and reoperation. Five of 17 patients (29%) required glenoid reimplantation following revision to HA, and all within approximately 5 years of HA. Previous studies have also reported high reoperation rates, ranging from 11-28%, and most commonly involving glenoid reinsertion (Table 4) [4, 7, 17]. While reverse arthroplasty may eliminate the need for revision due to symptomatic glenoid arthrosis, younger patients with healthy rotator cuff

status may be better served by treatment of aseptic glenoid loosening with conversion to HA. If glenoid arthrosis results in persistent symptoms, a glenoid component can be placed at a later date with reasonable results [19].

As RSA utilization continues to increase, the indications have expanded to include revision shoulder arthroplasty with glenoid bone loss. Recent studies have examined the outcomes of RSA in patients similar to the ones presented in our study. Melis retrospectively analyzed outcomes in a group of 37 patients with failed aTSA due to glenoid loosening at a mean follow-up of 47 months [20]. All patients were reported to have glenoid bone loss of unspecified severity with 29 (78%) requiring bone grafting. Different from our study, 65% had rotator cuff tears at time of RSA. The mean Constant score improved from 24 to 55, and the overall complication and reoperation rates were 30% and 22%. Walker et al. reported on a cohort of 22 patients at a minimum 2 year follow-up who underwent revision of a failed aTSA to an RSA [10]. Sixteen patients had deficient glenoid bone stock, 7 of which were rated as severe by the Antuna classification [4]. The mean ASES score was 68 (range 38-97) and the complication rate was 23%. It is unclear whether patients in our study would have had better results with conversion to RSA instead of HA; however, the literature would indicate a similarly diverse complication rate.

This study has multiple limitations, many of which stem from its retrospective nature. The small sample size and diverse demographics precludes the ability to statistically identify factors that may determine differences in clinical outcomes. This is in large part due to the rarity of this procedure, even at a high-volume institution. Pre-operative scores were not available for patients and range of motion and radiographic data was not consistently recorded either preoperatively or postoperatively to allow for useful analysis. We attempted to analyze

radiographs from final clinical follow-up for graft subsidence and medial erosion. However, this data was available for only 8 patients and only 2 had images from the minimum 2-year follow-up used for this study.

Conclusions

HA for failure of aTSA due to aseptic glenoid loosening is associated with modest survival rates and clinical results. There exists a high risk of reoperation, particularly due to persistent glenoid-sided pain. As indications for reverse arthroplasty continue to expand, it is important to view the results of revision of a failed aTSA to a reverse arthroplasty within the context of the result of alternative procedures, such as the option discussed in this study.

Conflict of interest statement: On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Revision TSA to hemi

Table Legend:

Table 1: Patient Characteristics at time of index aTSA

Table 2: Characteristics at revision to HA

Table 3: Outcomes in Surviving Implants

Table 4: Results from previous studies examining outcomes of HA following aTSA