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Revision of failed hemiarthroplasty and anatomic total shoulder arthroplasty to reverse total shoulder arthroplasty

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Background: The impending burden of revision shoulder arthroplasty has increased interest in outcomes of revision procedures. Revision of failed anatomic arthroplasty to reverse total shoulder arthroplasty has shown promise alongside concerning complication rates.
Methods: Patients who underwent revision shoulder arthroplasty during a 7-year period at a tertiary care health system were identified. Presurgical and operative data were analyzed for 110 patients who met inclusion and exclusion criteria. Patients were contacted at a mean follow-up of 57 ± 26 months (range, 23-113 months) from revision surgery for functional outcomes scores, reoperations, and implant survival.
Results: Implant survival was 92% at 2 years and 74% at 5 years. Mean American Shoulder and Elbow Surgeons score, Single Assessment Numerical Evaluation score, and visual analog scale pain scores were 63 ± 24 (range, 5-97), 60 ± 25 (range, 0-100), and 2.9 ± 2.9 (range, 0-10), respectively. Seventy percent of patients were "very satisfied" or "satisfied with their outcome. Complications occurred in 18 patients (20%), and 10 patients (11%) underwent reoperation.
Conclusions: Modest patient results and satisfaction can be achieved with revision of a failed anatomic arthroplasty to a reverse total shoulder arthroplasty. As is typical of revision surgery, complications are common and can compromise results. Further study is needed to identify factors that may contribute to successful outcomes.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Anatomic total shoulder arthroplasty; reverse total shoulder arthroplasty; hemiarthroplasty; revision arthroplasty; shoulder complications; patient satisfaction

The increasing incidence of total shoulder arthroplasty (TSA) in the United States[10,19] has brought attention to the impending burden of revision procedures. Published studies on conversion of an anatomic TSA (aTSA) or hemiarthroplasty (HA) to another anatomic arthroplasty have demonstrated consistent improvements in pain and functional scores; however, outcomes are unpredictable, and complication rates are high.[2,4,5,7-9,11,17,22-24]

The Thomas Jefferson University Office of Human Research Institutional Review Board approved this study (IRB Control #15D.417).

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Reverse TSA (rTSA) has gained popularity for revision shoulder arthroplasty since its early description by Boileau et al.[3] The reversed design mitigates soft tissue deficiencies commonly encountered in the revision setting by increasing the resting tone and the moment arm of the deltoid while providing an inherently stable center of rotation. rTSA has also demonstrated benefits in addressing glenoid bone loss by improving glenoid-sided fixation and allowing for compression of bone grafts.[16] Previously published outcomes on rTSA as a revision for failed aTSA or HA have reported significant improvements in pain and function alongside complication rates ranging from 7% to 50%.[1,6,13-15,18,21,25-29]

The purpose of this study was to describe the indications, survival, complications, and clinical results of a single-institution experience with revision of a failed aTSA or HA to rTSA.

Materials and methods

Patients who underwent revision shoulder arthroplasty at a single tertiary care health system from 2008 to 2015 were identified. Cases were identified by Common Procedural Terminology (American Medical Association, Chicago, IL, USA) 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 and glenoid component). A direct retrospective record review was performed to identify all patients who were revised from an aTSA or HA to a rTSA. We excluded patients who underwent rTSA after a 2-stage revision for infection.

Preoperative variables were collected by retrospective record review, including age, sex, dominant-sided surgery, Charlson Comorbidity Index score, indication for primary shoulder arthroplasty, and indication for revision. Operative notes were reviewed for rotator cuff status, concomitant procedures (including glenoid bone grafting, humeral head exchange, and stem revisions), and intraoperative complications.

Postoperative records were reviewed for complications and reoperations. We attempted to contact all patients for implant survivorship, complications, and reoperations that occurred at another institution. Implant survivorship was defined as retention of the glenoid baseplate and humeral stem. Patients requiring polyethylene or glenosphere exchange for instability were considered to have surviving implants; however, these patients were included as complications.

For surviving implants, patient-reported outcome measures included the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) score, Single Assessment Numerical Evaluation (SANE), visual analog scale (VAS) for pain (10-point scale), and the Short-Form 12-Item Health Survey. Patient satisfaction was assessed by a single question that asked the patient to "rate your satisfaction with your surgical procedure on scale of 1 to 5" (1 very dissatisfied to 5 very satisfied). Patients were contacted by email or telephone, and all surveys were performed using Research Electronic Data Capture (REDCap; Vanderbilt University, Nashville, TN, USA). REDCap, a secure, web-based application designed to support data capture for research studies, provides an intuitive interface for validated data entry.

Results

During the study period, 417 patients underwent revision shoulder arthroplasty at our institution. Of these, 110 patients (26%) underwent revision to rTSA after failed aTSA (40 of 110 [36%]) or HA (70 of 110 [64%]). During the same time period, 16 patients underwent revision of a failed aTSA to another aTSA, 13 underwent revision of failed aTSA to HA, and 40 underwent revision of a failed HA to aTSA. In the remaining patients, the prior procedure could not be identified from the available records or the procedure was removal of hardware with placement of a cement spacer.

The mean age at primary arthroplasty was 64.8 ± 8.5 years (range, 36-81 years) and was similar with regards to prior aTSA (65 ± 7 years; range, 49-81 years) or prior HA (65 ± 9 years; range 36-80 years). Before the primary arthroplasty, 21 patients (23%) had nonarthroplasty shoulder surgery (14 patients had undergone arthroscopic rotator cuff repair and 7 had undergone open reduction and internal fixation of a proximal humeral fracture). The indications for primary arthroplasty were osteoarthritis (46 of 110 [42%]), acute fracture (30%), rotator cuff tear arthropathy (10%), fracture sequelae (8%), inflammatory arthritis (5%), and osteonecrosis of the humeral head (3%). The indication of fracture sequelae included tuberosity malunion or nonunion, post-traumatic arthritis, and avascular necrosis after proximal humeral fracture.

Nonarthroplasty reoperations were performed in 9 patients (8%) between the index procedure and rTSA, including subscapularis repair in 3, capsular release in 2, and in 1 patient each, fixation of greater tuberosity, fixation of periprosthetic humeral shaft fracture, diagnostic arthroscopy, and polyethylene exchange for an early deep wound infection. Eight patients underwent component revision to another anatomic arthroplasty before rTSA because of glenoid loosening in 3, painful glenoid arthrosis in 3, rotator cuff tear in 1, and instability in 2.

Mean age at revision to rTSA was 69 ± 8 years (range, 49-88 years; Table I). There were 79 women and 31 men. Patients underwent revision surgery at a mean of 43 ± 53 months (range, 1-235 months) after the index operation. All patients had multiple diagnoses contributing to the need for revision surgery. We therefore grouped indications as isolated rotator cuff failure (including rotator cuff tears and clinical insufficiency), rotator cuff failure with component failure (glenoid or humeral loosening), rotator cuff failure with instability, fracture sequelae (tuberosity nonunion, malunion, or resorption after proximal humeral fracture), and recalcitrant stiffness (Table I).

Operative findings and techniques

All operations were performed through a deltopectoral approach. Glenoid bone deficiency was classified based on

Table I Characteristics at reverse total shoulder arthroplasty

Variable	Overall (N = 110)	Prior aTSA (n = 40)	Prior HA (n = 70)
Age, yrs	69 ± 8 (49-88)	69 ± 8 (52-88)	68 ± 8 (49-83)
Sex, No.			
Female	79	25	54
Male	31	15	16
Body mass index, kg/m^2	29 ± 7 (17-59)	29 ± 6 (18-44)	29 ± 7 (17-59)
Charlson Comorbidity Index	1 ± 1 (0-4)	1 ± 1 (0-4)	1 ± 1 (0-4)
Time to failure, mo	43 ± 53 (1-235)	51 ± 51 (3-200)	40 ± 53 (1-235)
Indication			
Isolated cuff failure	35 (32)	9 (23)	26 (37)
Cuff failure with instability	27 (25)	14 (35)	13 (19)
Cuff and component failure	19 (17)	17 (43)	2 (3)
Fracture sequelae	28 (25)	0	28 (40)
Recalcitrant stiffness	1 (1)	1 (3)	0

aTSA, anatomic total shoulder arthroplasty; *HA*, hemiarthroplasty.
Continuous data are presented as mean ± standard deviation (range) and categorical data number (%) or as indicated.

intraoperative findings[20] as contained in 26 patients and uncontained in 21 patients. Glenoid bone grafting was performed in 27 patients (25% of all patients) and was more common in those with prior aTSA (20 [50%]) than HA (7 [10%]; $P < .01$). Cancellous allograft was used in 20, femoral head allograft in 3, osteophyte autograft in 2, iliac crest autograft in 1, and femoral strut allograft in 1.

Removal of the humeral stem required humeral corticotomy in 30 patients (27%) or greater tuberosity osteotomy in 4 patients (4%). The rate of these techniques was very similar between patients with prior HA (22 of 67 [33%]) and aTSA (12 of 37 [32%]). Cancellous allograft was used for stem impaction in 14 patients. The rates of this technique for patients with prior HA and aTSA were 15% (10 of 67) and 11% (4 of 37; $P = .56$), respectively. Five patients did not require stem removal because a modular prosthesis was used at prior arthroplasty.

There were 21 intraoperative fractures (19%), and all occurred during stem removal or retraction for glenoid exposure, involving the greater tuberosity in 15, humeral shaft in 5, and humeral metaphysis in 1. The rates of intraoperative fracture were also similar between patients with prior HA (22% [15 of 67]) and aTSA (16% [6 of 37]; $P = .45$). All greater tuberosity fractures were repaired with suture. Humeral shaft fractures were repaired with cerclage wires. The metaphyseal fracture occurred in a patient with prior HA and was nondisplaced and required no fixation. A proximal humerus allograft prosthetic composite was used in 1 patient.

No clinical signs of infection were noted at revision surgery. Routine intraoperative cultures showed growth in 5 patients with *Cutibacterium* (formerly *Propionibacterium*) *acnes* (3; very light growth in 2 and broth only in 1), *Candida albicans* in 1, and unspecified coagulase-negative *Staphylococcus* spp in 1, which was considered to be a contaminant. The remaining 4 patients were treated with antibiotic courses postoperatively under the direction of infectious diseases consultants. No patients were prescribed chronic suppressive antibiotics.

Survival, complications, and reoperation

There were 89 patients (81%) with a minimum of 2-year clinical or survey follow-up. Ten patients had died, and 1 was unable to communicate due to other medical conditions. The remaining 10 patients could not be contacted despite multiple attempts. Implant survival rate was 97% (86 of 89) at 6 months, 92% (82 of 89) at 2 years, and 74% (25 of 34) at 5 years by Kaplan-Meier analysis (Fig. 1). The implant survival rate for patients with prior HA and aTSA was 95% (52 of 55) and 89% (30 of 34), respectively ($P = .28$), at 2 years and was 94% (22 of 24) and 30% (3 of 10), respectively ($P < .01$), at 5 years.

There were 17 (19%) postoperative complications. These included scapular stress fracture in 4, periprosthetic fracture in 3, baseplate loosening in 2, glenosphere dissociation in 2, instability in 2, infection in 2, painful hardware in 1, and greater tuberosity nonunion in 1. The 4 patients with scapular stress fractures were treated nonoperatively.

Ten patients (11%) required reoperation. One patient with baseplate loosening underwent baseplate revision with glenoid bone graft at 8 months after rTSA. The other patient with baseplate loosening underwent 2-stage revision to another rTSA because of a severe cavitary defect at 10 months after the original rTSA. Both patients went on to have excellent function (ASES scores of 90 and 83, respectively) and pain improvement (VAS pain of 1 and 0, respectively) at survey follow-up of 42 and 80 months after reoperation, respectively.

One patient with glenosphere dissociation underwent polyethylene exchange and glenosphere revision 1 week after rTSA. This patient then developed baseplate loosening and was converted to HA with a cuff tear arthropathy (CTA) head at 26

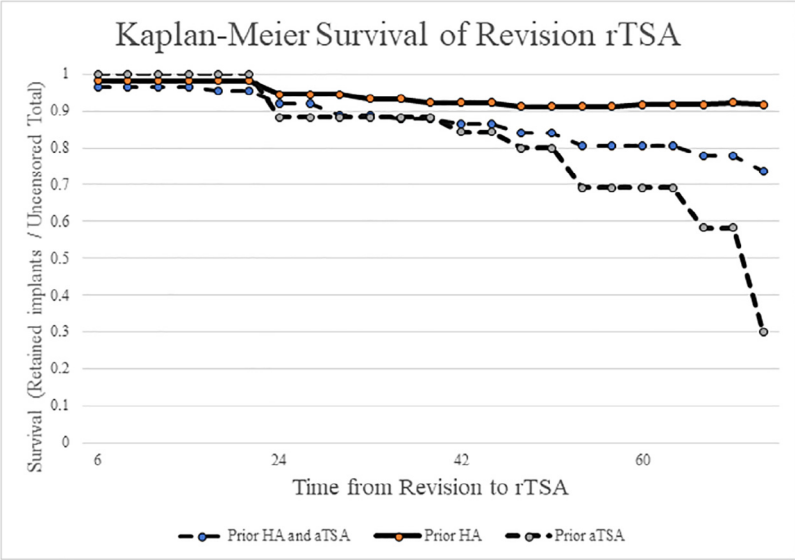

Figure 1 Kaplan-Meier survival analysis. *rTSA*, reverse total shoulder arthroplasty; *HA*, hemiarthroplasty; *aTSA*, anatomic total shoulder arthroplasty.

months after the previous procedure. This patient had a good result with ASES and VAS pain scores of 77 and 3, respectively, at 62 months after the reoperation. The other patient with glenosphere dissociation underwent conversion to HA with a CTA head at 35 months postoperatively. At survey follow-up 36 months after reoperation, the patient's ASES and VAS pain scores were 45 and 5, and she was dissatisfied with her outcome.

The patient diagnosed with greater tuberosity nonunion had significant pain 13 months after the original rTSA, and it was thought the symptoms could be related to baseplate loosening with glenoid graft resorption. At time of reoperation (15 months after rTSA), a greater tuberosity nonunion was found and it was felt that it was causing a painful, levering force to the glenoid component during external rotation. The baseplate was solidly fixed, and components were not revised. The patient underwent fixation of the greater tuberosity. The patient's ASES and VAS pain scores at 11 months after this procedure were 43 and 5; however, the patient was satisfied with his outcome.

One patient with a dislocation on the first postoperative day underwent closed reduction; this patient had no further dislocations. Another patient with recurrent dislocations in the first 3 weeks after rTSA underwent liner and glenosphere upsizing as well as excision of a portion of the inferior capsule that appeared to be providing a dislocating force.

The 2 patients with infections underwent reoperation at 23 and 26 months after rTSA. One underwent a 2-stage revision, and cultures from the reoperation showed no growth. The other patient underwent a 1-stage revision. *Cutibacterium acnes* grew in 3 of 4 cultures from the reoperation. One patient underwent surgical exploration and cerclage wire removal 5 months after rTSA because of concern for infection; however, were no clinical or gross signs of infection, and cultures showed no growth.

A humeral shaft fracture was found at the tip of a long stem prosthesis on radiographs ordered for increasing pain 6 years after rTSA. The patient was evaluated for infection, but the results of all laboratory testing were negative, and her pain improved without intervention. The pain returned 1 year later, at which time the patient was scheduled for hardware removal and conversion to a cement spacer. The patient cancelled the operation because of other medical conditions.

One patient who sustained a traumatic glenoid fracture underwent conversion to HA with a CTA humeral head at 79 months after rTSA. ASES and VAS pain scores at 34 months after this procedure were 35 and 5; she was "very dissatisfied" with her outcome.

Outcomes in the implant survival group

Functional outcome scores could be obtained from 73 of 82 patients (82%) with a minimum 2-year follow-up and surviving implants. The mean follow-up was 57 ± 26 months (range, 24-113 months). The mean ASES score for all patients was 63 ± 24 (range, 5-97; Table II). The mean SANE score for all patients was 60 ± 25 (range, 0-100). The mean VAS pain score for all patients was 2.9 ± 2.9 (range, 0-10). Fifty-one patients (70%) were "very satisfied" or "satisfied," and 16 (22%) were "dissatisfied" or "very dissatisfied."

Age at first arthroplasty, body mass index, and Charlson Comorbidity score were not associated with functional outcome scores ($r^2 < 0.04$). Patients with dominant-sided surgery or prior nonarthroplasty operations did not appear to have worse outcomes ($P = .718$ and $P = .893$, respectively).

Table II Functional outcomes by prior surgery and indication

Variable	ASES	SANE	VAS	Satisfaction
Prior surgery				
aTSA	59 ± 27 (5-95)	61 ± 26 (0-100)	3.3 ± 3.0 (0-10)	3.8 ± 1.3 (1-5)
Hemiarthroplasty	66 ± 22 (10-97)	60 ± 25 (0-100)	2.7 ± 2.7 (0-10)	3.6 ± 1.3 (1-5)
P value	.277	.941	.341	.504
Indication				
Isolated cuff failure	56 ± 29 (7-95)	57 ± 23 (15-95)	3.9 ± 3.3 (0-10)	3.5 ± 1.4 (1-5)
Cuff failure with instability	66 ± 14 (30-87)	65 ± 25 (15-100)	2.8 ± 2.3 (0-9)	3.9 ± 1.2 (2-5)
Cuff and component failure	55 ± 29 (5-95)	60 ± 28 (0-97)	4.0 ± 3.6 (0-10)	3.6 ± 1.4 (1-5)
Fracture sequelae	72 ± 17 (38-97)	61 ± 26 (0-100)	1.4 ± 1.8 (0-5)	3.8 ± 1.2 (1-5)
P value	.0724	.8014	.0143	.7153

ASES, American Shoulder and Elbow Surgeons score; *SANE*, Single Assessment Numerical Evaluation; *VAS*, visual analog pain score; *aTSA*, anatomic total shoulder arthroplasty.
Data are presented as mean ± standard deviation (range).

There were no statistically significant differences based on indication for primary surgery in any score ($P > .790$). There were no statistically significant differences based on the requirement for humeral corticotomy or greater tuberosity osteotomy in ASES ($P = .718$), SANE ($P = .377$), satisfaction ($P = .230$), and VAS pain scores ($P = .904$). No statistically significant differences were found in any outcome score based on the occurrence of an intraoperative fracture ($P > .618$). Duration of follow-up was not associated with any outcome score ($r^2 < 0.04$).

Discussion

Although somewhat unpredictable, modest functional outcomes can be achieved with revision rTSA at early to midterm follow-up. This study was not able to identify preoperative predictors of successful results, likely due to our relatively small and heterogeneous sample.

In the existing literature, revision rTSA performed for various indications has resulted in consistent improvements in range of motion and patient-reported outcomes at early and midterm follow-up (Table III).[1,6,12-15,18,21,25-29] Patel et al[21] examined 28 revisions to rTSA after aTSA, HA, or previous rTSA at a mean follow-up of 41 months and reported a mean ASES and VAS pain improvement from 24 to 66 and 7.0 to 2.6, respectively; 68% of patients rated their outcome as "excellent" or "good." Melis et al[15] reported outcomes of 37 revisions to rTSA for glenoid loosening with associated soft tissue failures at a mean 47-month follow-up and found an overall Constant score improvement from 24 to 55 and an increase in forward elevation from 68° to 121°; 86% patients were "very satisfied" or "satisfied" with their outcome. Overall, the functional results in this study are consistent with prior studies that have demonstrated a somewhat unpredictable but overall encouraging result for these complicated patients.

We report a 19% postoperative complication rate, which is consistent with previous reports ranging between 7% and 50% (Table III). Although summarizing these complications is difficult, they appear to carry significant morbidity, with a reoperation rate of 11% in this study and ranging from 0% to 24% in the literature (Table III). The 2-year and 5-year survival rates from this study are difficult to contextualize because survival rates by Kaplan-Meier analysis have not been widely reported; however, Melis et al[15] did report implant survival in 35 of 37 (95%) patients at their mean follow-up of 47 months. Although this study did identify a statistically significant difference in 5-year survival between patients with prior HA and aTSA, the follow-up at 5 years was limited for the aTSA group. Because the failure modes and reasons for reoperations were heterogeneous in both the hemiarthroplasty and aTSA groups, this trend will require more complete analysis with larger patient numbers and more comprehensive assessment of glenoid bone defects, soft tissue contracture, and implant-specific variables.

Intraoperatively, there was significant morbidity associated with stem revision, because 27% of patients required humeral corticotomy and 19% incurred intraoperative fractures. Of note, our study showed no difference in rates of humeral-sided intraoperative fractures between patents with prior HA and aTSA. Although modular components may address humeral-sided complications that arise in revision surgery, only 5 patients in this series were converted to a rTSA with stem retention; however, based on limitations in the data, how many patients in our series were implanted with convertible stems at the index operation is unclear. Published reports on midterm outcomes of rTSA performed with convertible components have demonstrated minimal intraoperative complication rates in addition to reduced operative time and blood loss.[6,28,29] With increased use of stemless and short-stem humeral components in aTSA, we expect humeral-sided complications to decrease in the future.

On the glenoid side, we found that 50% of patients with prior aTSA required bone grafting compared with only 10% with prior HA. Limitations in our data prevented a comparison between the types of defects encountered in these 2 groups; however, most of the grafts were cancellous

Table III Literature review

Article	No.	F/U (mo)	Prior HA/ aTSA/rTSA	Indications		AFE (Pre/Post)	AER (Pre/Post)	Functional outcomes	Pre	Post	Complications	Reoperations
Levy et al,[14] 2007	29	35	29/0/0	Fx Sq	29	38/73		ASES	22	52	8 (28%)	7 (24%)
								Satisfaction	16 E/G, 7 S.			
Wall et al,[27] 2007	45	40	30/24	Unspecified		58/118	5/9	CST (0v)	20	52	37%	—
Flury et al,[12] 2010	21	46	16/5	Cuff failure	18	43/97	26/12	CST (0v)	17	56	8 (38%)	2 (9.5%)
				Instability	2			DASH	61	83		
				PJI	1			Satisfaction	16 (84%) "better" or "much better"			
Kelly et al, 2012[13]	30	34	11/8/1	Instability	25	42 ± 35/106 ± 31	7 (SD 27)/8 (SD 23)	CST (0v)	18 (SD 15)	49 (SD 18)	15 (50%)	7 (23%)
								ASES	55 (SD 6)	72 (SD 13)		
								Satisfaction	24 (80%) S or VS			
Melis et al,[15] 2012	37	47	0/40/0	GL w/associated:		68/121 ± 32.	16/17	CST (0v)	24	55 ± 17	11 (30%)	8 (22%)
				RCT	24			Satisfaction	32 of 37 (86%) S or VS			
				Ssc failure	29							
				Instability	13							
Patel et al,[21] 2012	28	41	17/8/6	RCT	11			ASES	24	66	3 (11%)	2 (7%)
				PJI	7			VAS Pain	7	2.6		
				Instability	6			Satisfaction	68% E/G, 14% S			
				Fx Sq	4							
				Loosening	3							
Walker et al,[26] 2012	22	40	0/23/0	Instability	19	50/130	13/50	ASES	36	68	5 (23%).	1 (5%)
				Component failure	2			VAS pain	5	1.5		
				PJI	2			Satisfaction	17 (77%) E/G, 3 S			
Abdel et al,[1] 2013	33	42	21/12	Instability	33	40 ± 27/97 ± 36		VAS pain	7.2	2.2	2 (6%)	0
								Neer Criteria	13 E, 10 S, 10 US			
Castagna et al,[6] 2013	26	32	18/8	Painful HA	18	?/120		CST (0v) f	25 (SD 3)	48 (SD 5)	0	0
				Cuff failure	8			VAS Pain	8 (SD 1)	1 (SD 1)		
Ortmaier et al,[18] 2013	50	51	23/13/14	RCT	23			CST (0v)	18	49	12 (24%)	5 (10%)
				Instability	10			UCLA	7	22		
				Infection	9			SST	1.2	5.6		
				Component loosening	4			VAS pain	7	1		
				Tuberosity resorption	4			Satisfaction	32 (64%) E/G, 6 (12%) S			
Werner et al,[29] 2013	14	30	14/0/0	Cuff failure	14	51/98	1/10	CST (0v)	9	41 (17-74)	2 (14%)	2 (14%)
Valenti et al,[25] 2014	30	36	25/4	Painful HA	9	55/108	14/18	CST (0v)	25 (8-46)	52 (30-67)	8 (27%)	5 (17%)
				Tuberosity migration	5							
				GL w/cuff failure	4							
				Cuff failure	4							
				Malpositioning	3							
				Glenoid erosion	2							
				Humeral loosening	1							
				PJI	1							
Weber-Spickschen et al,[28] 2015	15	43	2/13	Cuff failure	8	—	—	ASES	12 (0-35)	75 (23-96)	1 (7%)	1 (7%)
				Component failure	4			VAS Pain	8	1		
				Tuberosity malunion	2							
				Instability	1							

F/U, follow-up; *HA*, hemiarthroplasty; *aTSA*, anatomic total shoulder arthroplasty; *rTSA*, reverse total shoulder arthroplasty; *AFE*, active forward elevation; *AER*, active external rotation; *Fx Sq*, fracture sequelae; *ASES*, American Shoulder and Elbow Surgeons; *E*, excellent; *G*, good; *CST (0v)*, overall Constant score; *DASH*, Disabilities of the Arm, Shoulder and Hand; *PJI*, reimplantation after prosthetic joint infection; *SD*, standard deviation; *GL*, glenoid loosening; *RCT*, rotator cuff tear; *VS*, very satisfied; *Ssc*, subscapularis; *VAS*, visual analog scale; *US*, unsatisfied; *UCLA*, University of California Los Angeles Shoulder Rating Scale; *SST*, Simple Shoulder Test.

allografts, indicating a predominance of contained defects. Although having bone grafts available during cases of revision aTSA to RTSA is important, the advent of augmented glenoid baseplate components and enhanced fixation techniques may decrease the need for grafting.

Functional outcomes of revision rTSA after failed aTSA or HA due to soft tissue failure have been demonstrated to be superior to alternative procedures.[11,22] With the lack of long-term survival data and poor salvage options for failure, the use of rTSA continues to be limited by patient age. However, rTSA is likely the best option in the treatment of soft tissue–related failure of anatomic shoulder arthroplasty in patients unlikely to require another shoulder arthroplasty in their lifetime. Further studies are needed to optimize outcomes of this procedure and to determine revision indications that may be better approached with alternative treatments.

This study also identified a statistical trend toward superior ASES and VAS pain scores in patients undergoing revision to rTSA for fracture sequelae compared with the other indications. Levy et al[14] reported fair results in their study of 29 patients who underwent revision to rTSA for fracture sequelae. The mean ASES score at 35 months was 52, and the authors concluded that rTSA provides a salvage-type solution for failed HA for glenoid arthritis or rotator cuff deficiency. In light of our findings in 28 patients, revision to rTSA may provide better outcomes than previously thought.

The study has numerous limitations stemming from its retrospective design, namely, the inability to identify causal relationships vs. correlative ones. The lack of preoperative patient-reported outcomes, range of motion, and radiographic analysis limits a full understanding of the improvement afforded by revision rTSA. Moreover, the relatively small sample precludes our ability to identify factors that may contribute to successful outcomes.

Lastly, although it may reflect the complexity of patients undergoing revision arthroplasty in general, our cohort was heterogeneous with regard to surgical history and indications for revision. Therefore, the statistical analyses regarding the effects of preoperative variables and intraoperative complications on complications, survival, and functional outcomes are underpowered when considering the different types of patients that were grouped in this study.

Conclusions

Revision rTSA was performed for diverse and multifactorial etiologies. The surgeon should be prepared for humeral-sided intraoperative complications in both prior aTSA and HA as well as the need for glenoid bone grafting with prior aTSA. Patient-reported outcomes at early to midterm and range of motion were satisfactory in those that did not experience failure. However, the overall complication and reoperation rates were 20% and 11%, respectively. Future studies are needed to identify factors that may contribute to successful outcomes for this procedure.

Disclaimer

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