Comparison of Clinical Outcomes of Revision Reverse Total Shoulder Arthroplasty for Failed Primary Anatomic Versus Failed Reverse Shoulder Arthroplasty

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INTRODUCTION: Surgeons are increasingly performing reverse total shoulder arthroplasty (RTSA) in lieu of anatomic total shoulder arthroplasty (aTSA) as a primary procedure. In the event of a complication necessitating revision, RTSA is more commonly performed in both scenarios. The purpose of this study was to compare clinical outcomes between patients undergoing revision RTSA for failed primary anatomic versus reverse total shoulder arthroplasty.

METHODS: We performed a retrospective review of a prospective single-institution shoulder arthroplasty database. All revision RTSAs performed between 2007 and 2019 with minimum two year follow-up were initially included. After excluding patients with a preoperative diagnosis of infection, an oncologic indication, or incomplete outcomes assessment, we included 45 revision RTSAs performed for failed primary aTSA and 15 for failed primary RTSA. Demographics, surgical characteristics, active range of motion (external rotation [ER], internal rotation [IR], forward elevation [FE], abduction), outcome scores (ASES score, Constant score, SPADI, SST, and UCLA score), and the incidence of postoperative complications was compared between groups. Clinical outcomes were compared using bivariate and multivariate analysis.

RESULTS: Age at surgery (67 ± 8 vs. 70 ± 13, P = .286), proportion of females (53% vs. 53%, P = 1), and mean months of follow up (54 ± 30 vs. 44 ± 28, P = .619) were similar between the primary aTSA and primary RTSA groups respectively. Primary aTSA was most often indicated for DJD (73%), whereas primary RTSA was more often indicated for rotator cuff arthropathy (60%). On bivariate analysis, no statistically significant differences in any range of motion or clinical outcome measure were found between revision RTSA performed for failed aTSA vs. RTSA (P > 0.05 for all) (Table I). On multivariate linear regression analysis, revision RTSA performed for failed aTSA vs. RTSA was not found to significantly influence any outcome measure (Table II). Humeral loosening as an indication for revision surgery was associated with more favorable outcomes for all four range of motion measures and all five outcome scores assessed (Table II, III). In contrast, an indication for revision of peri-prosthetic fracture was associated with poorer outcomes for three of four range of motion measures (ER, FE, abduction) and four of five outcome scores (Constant, SPADI, SST, UCLA) (Table II, III). A preoperative diagnosis of fracture was associated with poorer postoperative range of motion in ER, FE, and abduction, but was not found to significantly influence any outcome score (Table II, III). However, only two patients in our cohort had this indication. Complication and re-revision rates after revision RTSA for failed primary aTSA and RTSA were 31% and 11% vs. 20% and 0%, respectively.

DISCUSSION AND CONCLUSION: Clinical outcomes of patients undergoing revision RTSA for failed primary shoulder arthroplasty were comparable regardless of whether aTSA or RTSA was initially performed. The choice to perform a primary aTSA or RTSA in patients with equivocal indications should depend on other factors besides the possible need for revision RTSA in the future.

Table II. Multivariate linear regression assessing the influence of primary shoulder arthroplasty (ATSA vs. RTSA) on postoperative outcome scores after revision RTSA.

Preoperative predictor	Outcome score/regression coefficient and *P* value				
	SPADI	SST	ASES	UCLA	Constant
Intercept	36.4	7.0	67.7	25.7	66.2
Revision RTSA from RTSA vs. ATSA	-	-	-	-	-
Age at surgery (years)	-	-	-	-	-
Male sex	-	1.2, P =.118	-	-	-
Body mass index (kg/m²)	-	-	-	-	-
Comorbidities					
Inflammatory arthritis	-	-	-	-	-
Heart disease	-	-	-	3.9, P =.130	10.1, P =.143
Diabetes mellitus	11.2, P =.110	-	-	-	-9.3, P =.162
Tobacco use	-	-	-	-	-
Reason for revision					
Humeral loosening	**-27.6, P <.001**	**3.8, P =.001**	**26.3, P <.001**	**8.5, P =.001**	**22.9, P =.001**
Glenoid loosening	-	-	-	-	-
Rotator cuff failure	-	-	-	**-4.5, P =.034**	**-11.4, P =.040**
Instability, dislocation, or subluxation	-8.1, P =.164	-	-	-	-
Periprosthetic fracture	**32.2, P =.002**	**-5.0, P =.003**	**-26.4, P =.014**	**-11.5, P =.002**	**-37.3, P <.001**
DJD/implant wear	-	-	-	-	-
Preoperative diagnosis of primary shoulder arthroplasty					
DJD	**10.1, P =.047**	-1.4, P =.087	**-13.0, P =.017**	-3.3, P =.083	-9.3, P =.059
Fracture	-	-	-	-	-
Rotator cuff arthropathy	-	-	-	-	-
Instability arthropathy	-	-	-	-	-
Avascular necrosis	-32.5, P =.081	5.0, P =.107	-	-	-

ASES, American Shoulder and Elbow Surgeons; ATSA, anatomic total shoulder arthroplasty; DJD, degenerative joint disease; RTSA, reverse total shoulder arthroplasty; SPADI, Shoulder Pain and Disability Index; SST, Simple Shoulder Test; UCLA, University of California, Los Angeles.
Multivariate linear regression performed with backwards stepwise selection.
Statistically significant comparisons are denoted in bold.

Table III. Multivariate linear regression assessing the influence of primary shoulder arthroplasty (ATSA vs. RTSA) on postoperative range of motion after revision RTSA.

Preoperative predictor	Active ROM measure/regression coefficient and *P* value			
	ER (°)	FE (°)	Abduction (°)	IR score
Intercept	54.4	127.6	123.1	6.1
Revision RTSA from RTSA vs. ATSA	-	-	-	-
Age at surgery (years)	-	-	-	-
Male sex	-	-	-	-
Body mass index (kg/m²)	-0.9, P =.074	-	-	**-0.1, P =.042**
Comorbidities				
Inflammatory arthritis	-	-24.1, P =.077	**-26.3, P =.041**	-
Heart disease	13.7, P =.086	**30.1, P =.006**	**32.3, P =.003**	-
Diabetes mellitus	-	-	-	-
Tobacco use	-	-	-	-
Reason for revision				
Humeral loosening	**17.5, P =.020**	**32.1, P =.004**	**30.9, P =.003**	**1.6, P =.008**
Glenoid loosening	-	12.1, P =.200	-	-
Rotator cuff failure	-	**-21.0, P =.025**	**-17.4, P =.033**	-
Instability, dislocation, or subluxation				15.3, P =.127
Periprosthetic fracture	**-25.9, P =.022**	**-80.6, P <.001**	**-73.9, P <.001**	-
DJD/implant wear	-	-	-	-
Preoperative diagnosis of primary shoulder arthroplasty				
DJD	-	**-28.6, P =.004**	**-23.9, P =.009**	-
Fracture	**-32.9, P =.025**	**-50.1, P =.025**	**-56.7, P =.008**	-
Rotator cuff arthropathy	-10.2, P =.095	-19.0, P =.077	-17.1, P =.086	-
Instability arthropathy	-	-	-	-
Avascular necrosis	-	-	-	-

ATSA, anatomic total shoulder arthroplasty; DJD, degenerative joint disease; ER, external rotation; FE, forward elevation; IR, internal rotation; RTSA, reverse total shoulder arthroplasty.
Multivariate linear regression performed with backwards stepwise selection.
Statistically significant comparisons are denoted in bold.

Table I. Comparison of range of motion and clinical outcome scores between patients undergoing revision RTSA for failed primary aTSA versus RTSA.

Outcome measure	Primary aTSA revised to RTSA (N = 45)	Primary RTSA revised to RTSA (N = 15)	P value
Preoperative			
SPADI score	64.0 ± 21.4	54.2 ± 23.8	.236
SST score	4.3 ± 3.2	5.2 ± 2.6	.370
ASES score	42.7 ± 18.5	52.9 ± 19.9	.151
UCLA score	14.7 ± 5.5	18.2 ± 7.6	.228
Constant score	40.7 ± 18.7	48.1 ± 17.8	.271
Active ER (°)	29 ± 27	19 ± 26	.343
Active FE (°)	70 ± 36	84 ± 36	.294
Active Abduction (°)	66 ± 35	81 ± 35	.212
Active IR score	4.0 ± 2.0	3.4 ± 2.2	.391
Postoperative			
SPADI score	40.8 ± 21.1	38.2 ± 23.3	.698
SST score	6.9 ± 3.4	7.0 ± 3.6	.950
ASES score	61.3 ± 21.2	61.9 ± 24.1	.929
UCLA score	23.3 ± 7.5	24.4 ± 8.6	.650
Constant score	58.3 ± 18.4	58.5 ± 27.8	.971
Active ER (°)	29 ± 20	19 ± 26	.220
Active FE (°)	105 ± 35	109 ± 48	.748
Active Abduction (°)	98 ± 32	102 ± 46	.721
Active IR score	4.0 ± 1.6	3.8 ± 2.0	.761
Improvement			
SPADI score	-23.8 ± 26.0	-17.3 ± 30.1	.526
SST score	3.1 ± 3.7	1.9 ± 3.6	.366
ASES score	18.9 ± 23.3	7.3 ± 22.9	.159
UCLA score	9.2 ± 8.3	4.6 ± 9.6	.214
Constant score	18.3 ± 20.0	10.2 ± 24.3	.356
Active ER (°)	2 ± 27	5 ± 20	.768
Active FE (°)	40 ± 34	21 ± 41	.185
Active Abduction (°)	34 ± 34	19 ± 38	.252
Active IR score	-0.2 ± 2.0	0.5 ± 2.3	.438

ASES, American Shoulder and Elbow Surgeons; ER, external rotation; FE, forward elevation; IR, internal rotation; SPADI, Shoulder Pain and Disability Index; SST, Simple Shoulder Test; UCLA, University of California, Los Angeles.
Data presented as mean ± standard deviation.
Statistically significant comparisons are denoted in bold.