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Shoulder arthroplasty after prior anterior stabilization procedures: do reverses have better outcomes?

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Background: Few studies have focused on shoulder arthroplasty after anterior stabilization procedures. This study compares the outcomes of total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA) after anterior stabilization surgical procedures.

Methods: All primary shoulder arthroplasties from 2000 to 2014 with prior surgery were retrospectively reviewed from a prospective research database. The inclusion criteria were primary TSA or RTSA, a history of anterior stabilization surgery, and minimum 2-year follow-up. Soft-tissue and bony anterior stabilization procedures were included. We compared the following between TSA and RTSA patients: active range of motion (ROM) and Shoulder Pain and Disability Index 130; Simple Shoulder Test; American Shoulder and Elbow Surgeons (ASES); Short Form 12; University of California, Los Angeles; and Constant scores. The RTSA group was also compared with an RTSA control group.

Results: The study included 15 TSA and 10 RTSA patients with average follow-up periods of 3.3 and 4.0 years, respectively. RTSA patients experienced greater improvements in all ROMs except internal rotation; these were not statistically significant despite the mean values for RTSA being above the minimal clinically important difference compared with TSA for forward flexion and abduction. RTSA patients had better improvements in all functional outcomes; only the ASES score was statistically significant. TSA patients had a 33% complication rate and a 20% reoperation rate. RTSA patients had no complications or reoperations. The group that underwent RTSA with prior anterior stabilization surgery had similar improvements in ROM and outcome measures to the RTSA control group.

Conclusion: RTSA patients had better postoperative improvement in most ROMs and all functional scores; only the ASES score was statistically significant. This study suggests better outcomes with a lower complication rate with RTSA after prior anterior stabilization procedures compared with TSA.

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

Keywords: Anterior stabilization procedure; anterior shoulder instability; functional outcomes; reverse shoulder arthroplasty; range of motion; total shoulder arthroplasty

Anterior shoulder instability, whether treated surgically or nonsurgically, can progress to glenohumeral arthritis.[6,12] This was first described by Neer et al[15] in 1982, and then Samilson and Prieto[19] coined the term "dislocation arthropathy." A recent

Western Institutional Review Boards approved this study (study No. 1112376).

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study reported improved stability with open Bankart repairs compared with Bristow-Latarjet procedures; however, dislocation arthropathy was more common after Bankart repairs (62% vs 30%) at long-term follow-up.[7] The same researchers subsequently reported dislocation arthropathy in 49% of patients, with 14% having moderate to severe arthropathy, after prior Bristow-Latarjet procedures at 15-year follow-up.[6] Multiple factors reportedly affect this progression following surgical stabilization including patient age at first dislocation, time between the initial instability episode and surgical stabilization, patient age at surgery, and presence of a glenoid fracture.[6,12,19]

Treatment of arthropathy due to shoulder instability can be challenging. High revision rates have been reported after arthroplasty for dislocation arthropathy.[1,5,10] Green and Norris[5] described the results of capsulorrhaphy arthropathy, showing reduced pain and improved function in 19 total shoulder arthroplasty (TSA) or hemiarthroplasty patients; however, they reported an 18% revision surgery rate. Lehmann et al[10] reported a 40% complication rate in their study reviewing TSAs and hemiarthroplasties in which 20% of patients required revision. They concluded that arthroplasty for instability-induced arthritis has a higher complication rate compared with idiopathic osteoarthritis.[10]

Limited literature exists on shoulder arthroplasty outcomes after prior shoulder anterior stabilization procedures. Only 2 studies included reverse total shoulder arthroplasty (RTSA) for the treatment of glenohumeral arthritis following operatively treated anterior shoulder instability,[3,18] with neither reporting on a control group. To our knowledge, no study has compared the outcomes of TSA versus RTSA after prior anterior stabilization procedures.

This study reports on clinical and functional RTSA outcomes in patients with prior anterior shoulder stabilization surgery and compares their results with patients with TSA after prior instability surgery. In addition, this study compares RTSA patients with prior shoulder stabilization with a group of matched control RTSA patients to evaluate whether prior instability surgery affects function after RTSA. Our hypothesis is that RTSA patients with prior anterior stabilization procedures will have at least similar outcomes to TSA patients with similar prior procedures and to a matched cohort of RTSA patients without prior surgery.

Materials and methods

We used our prospectively collected shoulder arthroplasty research database to perform a retrospective review of patients who underwent shoulder surgery before primary shoulder arthroplasty from 2000 to 2014. Medical records and a prospective research database were reviewed for demographic, operative, and clinical information. The inclusion criteria included primary TSA or RTSA within the study period, a history of anterior shoulder stabilization surgery, and minimum 2-year follow-up. The anterior stabilization procedures considered were anterior labral or Bankart repair, anterior capsulorrhaphy or capsular plication, and any bony procedure for anterior shoulder instability. All patients with a history of surgery were evaluated, and patients were included only if they had one of these prior procedures documented by either specific patient history or prior operative records or had radiographic confirmation of one of these previous procedures. Prior open and arthroscopic anterior stabilization procedures were included. The exclusion criteria were patients with a prior shoulder infection, any prior shoulder arthroplasty, and/or less than 2 years' follow-up.

The deltopectoral approach was used for all shoulder arthroplasty procedures. Biceps tenodesis was routinely performed to the pectoralis major insertion. The deltopectoral interval was closed with absorbable suture. The skin was closed with a subcuticular absorbable suture and Dermabond (Ethicon, Somerville, NJ, USA). The decision to perform TSA or RTSA was based on surgeon discretion, although a few patients included in the TSA group underwent surgery prior to US Food and Drug Administration approval of the RTSA.

Rehabilitation was similar for all patients, consisting of a physical therapist–directed home program. Active range of motion (ROM) was limited for 6 weeks, and external rotation was limited to neutral for RTSA and to 30° for TSA for 6 weeks. Sling use was discontinued 6 weeks postoperatively, and weight-restriction limitation was discontinued 3 months postoperatively.

Evaluated primary outcome measures included active ROM data and functional outcome scores collected in a prospective research database. A research coordinator (A.M.S.) obtained ROM measurements (forward elevation, abduction, internal rotation by vertebral level, and external rotation) using a goniometer. The American Shoulder and Elbow Surgeons (ASES) score, normalized Constant score, Simple Shoulder Test (SST) score, Short Form 12 score, and Shoulder Pain and Disability Index 130 (SPADI-130) score were used. In most patients, a clinical examination was performed and radiographs were obtained at final follow-up, but for patients unable to attend annual follow-up visits, a telephone interview or mailed questionnaire was obtained and their functional scores were calculated. Postoperative radiographs were taken at 2 weeks, at 3 months, and then annually postoperatively. All radiographs were reviewed by the study team and evaluated for any complications and notching.

Active ROM and outcome scores were compared between TSA and RTSA patients for preoperative values, postoperative values, and changes in values from preoperatively to postoperatively. The RTSA study group was also compared with a control group of patients who underwent primary RTSA for osteoarthritis or rotator cuff arthropathy without previous anterior stabilization procedures. These patients were matched for age and sex as closely as possible in a ratio of 1 study patient to 3 controls. Active ROM and outcome scores were also compared between RTSA patients with prior anterior stabilization procedures and the RTSA control group for preoperative values, postoperative values, and changes in values from preoperatively to postoperatively to evaluate whether prior anterior stabilization surgery affects outcomes in RTSA patients.

Quantitative comparisons were made using the Student *t* test to compare continuous variables and the Fisher exact test for dichotomous variables. Univariate analysis was used given the small numbers in each group. Statistical significance was set at $P < .05$.

Results

A total of 1298 primary shoulder arthroplasties (545 TSAs and 753 RTSAs) in 1136 patients were reviewed from the study

period; 25 patients met the inclusion criteria. The study population included 15 TSA patients (5 female and 10 male patients) and 10 RTSA patients (4 female and 6 male patients). The TSA group's mean age at surgery was 54.9 years, with an average follow-up period of 4.0 years. The RTSA group's mean age was 65.4 years, with an average follow-up period of 3.3 years. All implants were Exactech Equinox implants (Gainesville, FL, USA) except for 2 Tornier TSA implants (Montbonnot-Saint-Martin, France) and 1 DePuy TSA implant (Warsaw, IN, USA). Conversion to RTSA was performed in 2 TSA patients (13% conversion rate); they were not included in the outcome analysis for ROM or outcome scores. No patients with RTSA after prior anterior stabilization procedures required revision surgery. In addition, 1 patient from each group died of unrelated causes prior to the 2-year follow-up (death occurred 1.5 years postoperatively in the RTSA patient and 1.7 years postoperatively in the TSA patient). Both of these patients had well-functioning implants without complications at the time of death, but their outcomes were not included in our ROM or outcome analysis. All patients were included in the demographic, follow-up, and complication analysis.

Previous surgical procedures

In the RTSA group, 4 prior bony procedures (40%) were performed: 3 were Bristow procedures (1 patient also underwent a prior open rotator cuff repair) and 1 was a glenoid osteotomy. The remaining 6 patients underwent previous soft-tissue procedures that included the following: 3 with open anterior labral and capsular repairs (one of these with a total of 3 open reconstructive procedures), 2 with arthroscopic labral repairs, and 1 with a thermal capsulorrhaphy for instability with rotator cuff repair in the same setting.

In the TSA group, 4 patients underwent prior bony procedures (27%), all of which were Bristow procedures. One underwent multiple other non-arthroplasty shoulder surgical procedures, and another underwent 4 previous arthroscopic surgical procedures. The remaining 11 patients underwent previous soft-tissue procedures that included the following: 7 with arthroscopic anterior labral repairs and 4 with open anterior capsular reconstructions.

Status of rotator cuff

The subscapularis tendon was treated depending on the tendon quality. In the RTSA group, 3 subscapularis tendons were intact, 3 were poor quality, 2 were scarred, and 1 was deficient; in 1 case, the tendon quality was not recorded in the operative report. The intact subscapularis tendons were repaired (2 with a peel and 1 with a lesser tuberosity osteotomy). One of the poor-quality tendons and one of the scarred tendons were repaired using suture. The remaining subscapularis tendons were left as tenotomies. In the TSA group, all the subscapularis tendons were deemed of adequate quality by the operative reports. Eleven subscapularis tendons were repaired after a lesser tuberosity osteotomy, three subscapularis peels were repaired using suture, and one subscapularis peel was repaired using suture anchors.

The status of the other rotator cuff tendons was evaluated in the RTSA group (in 9 of 10 patients). The supraspinatus was intact in 2, partially torn or poor quality in 3, and absent (or with a full-thickness tear) in 4. The infraspinatus was intact in 5, poor quality in 1, and absent (or with a full-thickness tear) in 3. The teres minor was intact in 6, partially torn or poor quality in 2, and absent in 1. The remaining rotator cuff tendons were documented as being of adequate quality in all patients in the TSA group.

RTSA versus TSA

Comparison of preoperative scores of patients who underwent TSA or RTSA after prior anterior stabilization procedures showed that RTSA patients had similar preoperative ROM (Table I). When patients who underwent RTSA were compared with those who underwent TSA, preoperatively, all outcome scores were slightly lower for the RTSA group; however, none were statistically different and the means were not above the minimal clinically important difference (MCID) (Table I).[20]

Postoperative active ROM was both clinically and statistically similar between the TSA and RTSA groups after prior anterior stabilization procedures (Table I). Comparison of outcome scores postoperatively showed that the RTSA group had better mean outcome scores for all 6 outcome measures used, with a statistically significant difference in the SPADI-130 score ($P = .049$) and a trend toward significance in both the ASES ($P = .09$) and SST ($P = .06$) scores (Table I). The RTSA group's mean outcome scores were above the MCID for the ASES, SST, Constant, and SPADI-130 scores in comparison with the TSA group's scores.[20]

TSA and RTSA patients had improvements in all postoperative ROM and functional outcomes measured (Table II). Statistically significant improvements from preoperative to postoperative values were seen in most ROM and outcome scores evaluated except for internal rotation after RTSA and the Short Form 12 score after TSA (Table II). When improvements were evaluated between RTSA and TSA patients, RTSA patients had better mean improvements in active ROM; these were not statistically significant, but the RTSA group had mean forward flexion, abduction, and external rotation that were above the MCIDs compared with the TSA group.[20] The mean active change in internal rotation was higher for the TSA group; however, this was not statistically significant. RTSA patients also had better improvements in all functional outcome measures evaluated; however, only the ASES score was significant ($P = .049$), and the mean ASES, SST, and Constant scores were above the MCIDs compared with TSA patients (Table II).[20]

Table I Clinical outcomes of patients after prior anterior stabilization procedures and RTSA controls

	RTSA	TSA	RTSA controls	*P* value	
				RTSA vs TSA	RTSA vs controls
Preoperative					
Forward elevation, °	91	103	77	.18	.29
Abduction, °	84	94	71	.29	.30
External rotation, °	2	11	13	.27	.13
Internal rotation level	L4	Sacrum	L5	.14	.50
ASES score	32.0	43.4	31.9	.085*	.99
SST score	3.4	3.9	2.9	.64	.55
UCLA score	12.1	16.3	12.7	.056*	.74
Constant score	38.2	40.4	35.7	.72	.70
SPADI-130 score	82.9	84.7	91.8	.82	.22
SF-12 score	28.7	33.7	26.5	.16	.51
Postoperative					
Forward elevation, °	138	126	128	.27	.098
Abduction, °	128	120	118	.43	.054*
External rotation, °	31	36	24	.29	.26
Internal rotation level	L1	L3	L2	.53	.95
ASES score	83.1	68.2	78.3	.093*	.33
SST score	11.2	8.9	9.5	.064*	.065*
UCLA score	28.7	26.1	28.6	.41	.78
Constant score	76.5	68.9	71.4	.38	.40
SPADI-130 score	16.0	42.0	28.8	.049†	.10
SF-12 score	38.3	38.1	31.5	.97	.074*

RTSA, reverse total shoulder arthroplasty; *TSA*, total shoulder arthroplasty; *ASES*, American Shoulder and Elbow Surgeons; *SST*, Simple Shoulder Test; *UCLA*, University of California, Los Angeles; *SPADI-130*, Shoulder Pain and Disability Index 130; *SF-12*, Short Form 12.
Data are given as mean values.
* Trending towards significance.
† Statistically significant.

Table II Improvement in ROM and outcome scores in patients after prior anterior stabilization procedures and RTSA controls

Improvement from preoperatively to postoperatively	RTSA	TSA	RTSA controls	*P* value			
				RTSA vs TSA	RTSA vs controls	RTSA from preoperatively to postoperatively	TSA from preoperatively to postoperatively
Forward elevation, °	+47	+23	+46	.11	.96	<.0001	.028
Abduction, °	+46	+25	+45	.20	.84	<.0001	.034
External rotation, °	+29	+25	+16	.48	.59	.0009	.0002
Internal rotation level	+2.4 levels	+3.4 levels	+2.5 levels	.74	.97	.32	.035
ASES score	+49.6	+29.1	+46.1	.049	.50	<.0001	.005
SST score	+7.3	+5.4	+6.7	.12	.65	<.0001	.0003
UCLA score	+16.9	+12.3	+15.3	.25	.53	<.0001	.0005
Constant score	+37.3	+27.9	+35.8	.36	.85	.0007	.0003
SPADI-130 score	−66.1	−48.9	−62.5	.16	.76	<.0001	.0008
SF-12 score	+11.0	+6.8	+4.4	.28	.066	.046	.11

ROM, range of motion; *RTSA*, reverse total shoulder arthroplasty; *TSA*, total shoulder arthroplasty; *ASES*, American Shoulder and Elbow Surgeons; *SST*, Simple Shoulder Test; *UCLA*, University of California, Los Angeles; *SPADI-130*, Shoulder Pain and Disability Index 130; *SF-12*, Short Form 12.
Data are given as mean values.

RTSA versus controls

The control group consisted of 30 patients (15 male and 15 female patients) with a mean age at surgery of 64.5 years. The mean follow-up period for controls was 2.8 years. The patients undergoing RTSA after prior anterior stabilization procedures compared with the RTSA control group had similar mean preoperative values for active ROM and outcome measures, with none being statistically different (Table I). Postoperative ROM and outcome scores were all slightly better in the RTSA study patients, with none being statistically significant (Table I). Mean improvement in ROM and outcome

Table III Complications after primary shoulder arthroplasty after prior anterior stabilization procedures

	TSA (%)	RTSA (%)	RTSA controls (%)
Removal of retained hardware	1 of 15 (7)	0	0
Dislocation	1 of 15 (7)	0	0
Revision for interval rotator cuff failure	1 of 15 (7)	0	0
Revision for aseptic loosening	1 of 15 (7)	0	0
Deep infection	0	0	2 of 30 (7)
Disassociation of polyethylene liner	NA	0	1 of 30 (3)
Postoperative forward elevation < 90°	1 of 15 (7)	0	1 of 30 (3)
Reoperation for any reason	3 of 15 (20)	0	3 of 30 (10)
Total No. of patients with complications	5 of 15 (33)	0 of 10 (0)	4 of 30 (13)

TSA, total shoulder arthroplasty; *RTSA*, reverse total shoulder arthroplasty; *NA*, not applicable.

scores was similar between the RTSA study and control groups (Table II).

Complications

The RTSA patients had no complications after prior anterior stabilization procedures, whereas 2 TSA patients underwent revision to RTSA. One TSA was converted to RTSA after aseptic glenoid loosening, and one was converted to RTSA because of subsequent rotator cuff failure. One TSA patient had a dislocation, which was treated with closed reduction and did not require further surgery. No scapular notching was noted in the RTSA group. The recurrent instability rate was 7% after TSA and 0% after RTSA. The revision surgery rate was 20% after TSA and 0% after RTSA. For the RTSA control patients, the revision surgery rate was 13% and the dislocation rate was 0%. Complete complication data are available in Table III.

Discussion

The treatment of anterior shoulder instability including soft-tissue and bony stabilization procedures is relatively common, especially in athletes.[9,17] The progression to shoulder arthritis has been noted in patients with prior anterior shoulder instability.[6,7] In patients with a history of anterior instability, treated surgically or nonsurgically, TSA and hemiarthroplasty are reportedly viable salvage procedures, with improved ROM and Constant scores documented postoperatively.[10,12] However, there are only a few case series on shoulder arthroplasty after prior anterior stabilization procedures and even fewer that included patients who underwent RTSA for shoulder arthritis after prior anterior shoulder instability procedures.

Our study found that patients who underwent TSA or RTSA in the setting of anterior stabilization procedures noted a combined significant improvement in ROM and outcome scores. This confirms previous reports that shoulder arthroplasty is a viable treatment for arthropathy following anterior stabilization procedures,[5,10,12] although only 2 studies described RTSA as a treatment option.[3,18] Our study showed a trend toward better improvement in ROM and outcome scores in RTSA patients compared with TSA patients, with only the ASES score being statistically significant (20-point difference favoring RTSA) and several of the mean improvements being above the reported MCID.

TSA for the treatment of dislocation arthroplasty has been documented. Green and Norris[5] reported on the outcomes of 15 TSAs and 2 hemiarthroplasties after prior anterior stabilization procedures at a mean age of 47 years. All patients had improvement in pain and function except for 1 (94%), with 18% requiring additional surgery. Lehmann et al[10] also reported on 35 TSAs and 10 hemiarthroplasties with dislocation arthropathy (21 with prior stabilization surgery), showing improved average Constant scores (mean improvement of 32 points). However, they reported a 40% complication rate in this young patient population, with 20% requiring revision surgery. No difference in the outcomes was found between TSA and hemiarthroplasty patients or between patients with and patients without prior surgery.[10] Although both reports had high complication rates with anatomic shoulder arthroplasty, they also included some patients with glenoid bone grafting and subscapularis lengthening. In addition, most studies on TSA after prior anterior instability included patients with hemiarthroplasty in the study population as well (Table IV).

RTSA has also been reported in the treatment of posttraumatic arthritis after prior anterior stabilization surgery with rotator cuff insufficiency. Raiss et al[18] described 13 patients who underwent RTSA following anterior stabilization procedures and who had at least 1 deficient rotator cuff tendon, documenting comparable improvement in ROM and Constant scores to previous RTSA studies performed for other conditions and a 92% satisfaction rate. Chalmers et al[3] reported similar improvement in pain and ROM in a study population of 24 dislocation arthropathy patients who underwent RTSA. They also noted that RTSA patients with subscapularis deficiency underwent more prior procedures than patients with a normal subscapularis or with partial deficiency and trended toward worse outcomes and ROM. Neither study reported on a control group.

Matsoukis et al[12] reported on 55 patients who underwent TSA or hemiarthroplasty for dislocation arthropathy, with 49% having undergone prior surgery. TSA patients had improved postoperative outcomes compared with hemiarthroplasty

Table IV Summary of literature on shoulder arthroplasty after prior anterior stabilization procedures

Study	No. and type of arthroplasty	Age, yr	Mean follow-up, mo	% with prior surgery	% with bony stabilization procedures	Constant score (adjusted score)	Complication rate/ reoperation rate, %
Bigliani et al,[1] 1995	12 TSAs, 5 hemiarthroplasties	Mean, 43	35	100	NR	NR	23/18
Green and Norris,[5] 2001	15 TSAs, 2 hemiarthroplasties	Mean, 45	62	100	24	NR	29/18
Matsoukis et al,[12] 2003	39 TSAs, 16 hemiarthroplasties	Mean, 59.1	45	49	33	68.5 (adjusted, 79.8)	16/11
Lehmann et al,[10] 2010	35 TSAs, 10 hemiarthroplasties	Mean, 55.8	44	47	20	65.7 (adjusted, 81.3)	40/20
Raiss et al,[18] 2014	13 RTSAs	Median, 70	42	100	77	67	8/8
Chalmers et al,[3] 2017	24 RTSAs	Mean, 70	40	54	NR	NR	8/4
Current study	15 TSAs	Mean, 54.9	43	100	27	62.3 (adjusted, 68.9)	33/20
	10 RTSAs	Mean, 65.4	36	100	40	65.4 (adjusted, 76.5)	0/0

TSA, total shoulder arthroplasty; *NR*, not reported; *RTSA*, reverse total shoulder arthroplasty.

patients. Hemiarthroplasty also reportedly has inferior results compared with RTSA in cuff tear arthropathy.[11] This study suggests possible improved outcomes and decreased complications in RTSA patients compared with TSA patients with prior anterior stabilization procedures; however, larger studies are needed to validate this. When the findings of this study are combined with those of other RTSA-focused studies, there were lower complication and reoperation rates after RTSA but similar Constant scores compared with prior reports of anatomic shoulder arthroplasty (Table IV). These compiled data are likely biased, however, because all prior studies that included TSA also included some patients with hemiarthroplasty.

In this study, no difference in outcomes was seen between RTSA patients following anterior stabilization procedures and RTSA patients without prior surgery, suggesting that patients with prior anterior stabilization surgery should have similar outcomes to patients who undergo RTSA for other indications. This is the first study, to our knowledge, to compare RTSA patients with prior anterior stabilization procedures versus either a control or TSA group.

The possible benefit of RTSA in patients with prior anterior stabilization procedures may stem from the functional differences unique to RTSA compared with TSA. Prior anterior stabilization surgery can damage the native rotator cuff tendons; this is especially true of the subscapularis tendon with open procedures and the infraspinatus with arthroscopic procedures. Because RTSA does not fully rely on the rotator cuff for function and stability, it may offer a benefit compared with anatomic shoulder arthroplasty. Reports on prior anatomic shoulder arthroplasty in this setting have often described a complex soft-tissue repair being imperative to good outcomes,[1,5,10] which is generally not required in RTSA. In addition, patients with prior instability often have bony defects or deformity of the anterior glenoid.[5,10,13] These conditions make anatomic glenoid component placement challenging, which may make RTSA preferable given the implants' screw fixation and on-growth potential. This is evident in the midterm reported revision surgery rate of 11% to 20% with TSA (Table IV).

Our results show similar ROM and functional score improvements compared with other studies focusing on RTSA for other indications. Similar active ROM changes were reported when comparing our study with others in the literature.[2,4,8,14,16] In addition, improvements in several outcome scores are similar to our findings regarding RTSA for other indications including the Constant score[2,16]; ASES score[4,8,14,16]; SST score[4,14]; and University of California, Los Angeles score.[8]

The main limitations of our study are its retrospective nature, selection bias, and small sample size. Retrospective review risks selection bias as some patients may have been missed, although a prospective research database was used to help identify patients. There was selection bias in terms of patient age as well as the pathology selected, given that it is likely that the RTSA group had more pathology, especially of the rotator cuff tendons, than the TSA group. It is interesting

that this selection bias likely enhances our study as the RTSA group has a significant disadvantage given the worse pathology seen but still had mean ROM and outcome scores above the TSA group. Our small sample size despite many primary arthroplasties performed results from dislocation arthropathy's relative rarity. In addition, strict inclusion criteria were used, so it is possible that we missed some patients who had undergone prior procedures because of a lack of documentation of these prior procedures. Moreover, these patients had a relatively short mean follow-up (approximately 3 years); the outcomes of RTSA and TSA may change with longer-term follow-up.

Conclusion

RTSA patients showed a trend toward better postoperative ROM except for external rotation when compared with TSA patients for the treatment of instability arthropathy. RTSA patients also showed a trend toward better improvement in functional scores; however, only the ASES score showed a statistically significant improvement. RTSA had a lower complication rate than TSA after prior anterior stabilization procedures. When the RTSA study population was directly compared with an RTSA control group without prior shoulder anterior stabilization surgery, active ROM and outcome scores were similar. This study suggests that RTSA may be preferable in patients with previous shoulder instability surgery owing to lower complication and revision surgery rates in RTSA patients compared with TSA patients. This may be due to RTSA's superior ability to treat rotator cuff and bony glenoid defects. Longer follow-up and studies with larger numbers of patients will determine which approach is more durable.

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References

1. Bigliani LU, Weinstein DM, Glasgow MT, Pollock RG, Flatow EL. Glenohumeral arthroplasty for arthritis after instability surgery. J Shoulder Elbow Surg 1995;4:87-94.
2. Boileau P, Gonzalez J-F, Chuinard C, Bicknell R, Walch G. Reverse total shoulder arthroplasty after failed rotator cuff surgery. J Shoulder Elbow Surg 2009;18:600-6. http://dx.doi.org/10.1016/j.jse.2009.03.011
3. Chalmers BP, Wagner ER, Houdek MT, Sperling JW, Cofield RH, Sanchez-Sotelo J. Outcomes of primary reverse shoulder arthroplasty for dislocation arthropathy. J Shoulder Elbow Arthroplasty 2017;1:1-6. http://dx.doi.org/10.1177/2471549217717165
4. Cuff D, Pupello D, Virani N, Levy J, Frankle M. Reverse shoulder arthroplasty for the treatment of rotator cuff deficiency. J Bone Joint Surg Am 2008;90:1244-51. http://dx.doi.org/10.2106/JBJS.G.00775
5. Green A, Norris TR. Shoulder arthroplasty for advanced glenohumeral arthritis after anterior instability repair. J Shoulder Elbow Surg 2001;10:539-45.
6. Hovelius L, Sandström B, Saebö M. One hundred eighteen Bristow-Latarjet repairs for recurrent anterior dislocation of the shoulder prospectively followed for fifteen years: study II—the evolution of dislocation arthropathy. J Shoulder Elbow Surg 2006;15:279-89. http://dx.doi.org/10.1016/j.jse.2005.09.014
7. Hovelius LK, Sandström BC, Rösmark DL, Saebö M, Sundgren KH, Malmqvist BG. Long-term results with the Bankart and Bristow-Latarjet procedures: recurrent shoulder instability and arthropathy. J Shoulder Elbow Surg 2001;10:445-52.
8. Ji J-H, Jeong J-Y, Song H-S, Ok J-H, Yang S-J, Jeon B-K, et al. Early clinical results of reverse total shoulder arthroplasty in the Korean population. J Shoulder Elbow Surg 2013;22:1102-7. http://dx.doi.org/10.1016/j.jse.2012.07.019
9. Kawasaki T, Ota C, Urayama S, Maki N, Nagayama M, Kaketa T, et al. Incidence of and risk factors for traumatic anterior shoulder dislocation: an epidemiologic study in high-school rugby players. J Shoulder Elbow Surg 2014;23:1624-30. http://dx.doi.org/10.1016/j.jse.2014.05.007
10. Lehmann L, Magosch P, Mauermann E, Lichtenberg S, Habermeyer P. Total shoulder arthroplasty in dislocation arthropathy. Int Orthop 2010;34:1219-25. http://dx.doi.org/10.1007/s00264-009-0928-5
11. Leung B, Horodyski M, Struk AM, Wright TW. Functional outcome of hemiarthroplasty compared with reverse total shoulder arthroplasty in the treatment of rotator cuff tear arthropathy. J Shoulder Elbow Surg 2012;21:319-23. http://dx.doi.org/10.1016/j.jse.2011.05.023
12. Matsoukis J, Tabib W, Guiffault P, Mandelbaum A, Walch G, Némoz C, et al. Shoulder arthroplasty in patients with a prior anterior shoulder dislocation: results of a multicenter study. J Bone Joint Surg Am 2003;85:1417-24.
13. Mizuno N, Denard PJ, Raiss P, Melis B, Walch G. Long-term results of the Latarjet procedure for anterior instability of the shoulder. J Shoulder Elbow Surg 2014;23:1691-9. http://dx.doi.org/10.1016/j.jse.2014.02.015
14. Mulieri P, Dunning P, Klein S, Pupello D, Frankle M. Reverse shoulder arthroplasty for the treatment of irreparable rotator cuff tear without glenohumeral arthritis. J Bone Joint Surg Am 2010;92:2544-56. http://dx.doi.org/10.2106/JBJS.I.00912
15. Neer C II, Watson K, Stanton F. Recent experience in total shoulder replacement. J Bone Joint Surg Am 1982;64:319-37.
16. Nolan BM, Ankerson E, Wiater JM. Reverse total shoulder arthroplasty improves function in cuff tear arthropathy. Clin Orthop Relat Res 2011;469:2476-82. http://dx.doi.org/10.1007/s11999-010-1683-z
17. Owens BD, Duffey ML, Nelson BJ, DeBerardino TM, Taylor DC, Mountcastle SB. The incidence and characteristics of shoulder instability at the United States Military Academy. Am J Sports Med 2007;35:1168-73. http://dx.doi.org/10.1177/0363546506295179
18. Raiss P, Zeifang F, Pons-Villanueva J, Smithers CJ, Loew M, Walch G. Reverse arthroplasty for osteoarthritis and rotator cuff deficiency after previous surgery for recurrent anterior shoulder instability. Int Orthop 2014;38:1407-13. http://dx.doi.org/10.1007/s00264-014-2325-y
19. Samilson R, Prieto V. Dislocation arthropathy of the shoulder. J Bone Joint Surg Am 1983;65:456-60.
20. Simovitch R, Flurin P-H, Wright T, Zuckerman JD, Roche CP. Quantifying success after total shoulder arthroplasty: the minimal clinically important difference. J Shoulder Elbow Surg 2018;27:298-305. http://dx.doi.org/10.1016/j.jse.2017.09.013