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Outcomes of staged bilateral reverse shoulder arthroplasties for rotator cuff tear arthropathy

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Background: The purpose of this study was to evaluate outcomes in patients with rotator cuff tear arthropathy after staged bilateral reverse shoulder arthroplasties (RSAs) and to compare them with an age-, gender-, and diagnosis-matched control group with a unilateral RSA.
Methods: We identified 11 patients with bilateral RSAs for rotator cuff tear arthropathy with a minimum of 2-year follow-up in a prospective shoulder arthroplasty registry. The bilateral group was matched to a control group of 19 patients with a unilateral RSA. Shoulder function scores, mobility, patient satisfaction, and activities of daily living were assessed preoperatively and at final follow-up.
Results: There was no statistical difference between the first RSA or second RSA and the control group regarding age, gender, or follow-up. No group differences were noted preoperatively for shoulder function scores or mobility ($P > .10$). All groups significantly improved on all shoulder function scores (Constant score, American Shoulder and Elbow Surgeons score, Western Ontario Osteoarthritis of the Shoulder index, Single Assessment Numeric Evaluation score) and mobility at final follow-up (all $P < .01$). There were no significant differences in shoulder function scores or mobility between the first and second RSA in the bilateral group or between either shoulder in the bilateral group and the unilateral group (all $P > .10$). Patient satisfaction improved and patients were successfully able to perform many important activities of daily living after bilateral RSAs.
Conclusions: Patients with bilateral rotator cuff tear arthropathy can be advised that staged bilateral RSAs can be successful when indicated. Improvements in shoulder function scores, patient satisfaction, and mobility are possible for both the first RSA and the second RSA.
Level of evidence: Level III, Retrospective Cohort Design, Treatment Study.

Keywords: Reverse shoulder arthroplasty; bilateral; rotator cuff tear arthropathy

Originally designed for the treatment of rotator cuff tear arthropathy and painful pseudoparalysis of the shoulder[3,5,16] the reverse total shoulder arthroplasty (RSA) remains a relatively new technology in the United States with indications continuing to evolve. Likewise, utilization rates of the RSA have increased with time[21,36]

The Institutional Review Board at the Texas Orthopedic Hospital approved this study: TOH143.

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to match this expansion.[36] Although promising results have been reported for RSA with various pathologic processes,[4,11,16,25,30,41,46] complication rates ranging from 7% to 75% remain a concern after RSA, including instability, infection, glenoid/acromial/scapular fractures, and peripheral nerve injury.[2,8,10,17,26,33,44,47] However, more recent work suggests an improvement in complication rates over time and with experience.[17,20,40]

The majority of studies have examined results in older, lower demand patients with a single affected shoulder,[7,13,25,35,41] but some more recent studies have found positive short-term outcomes in younger patients as well.[12,30,34] Unfortunately, there continue to be subsets of the population for which little information exists to help guide treatment decisions. Wiater et al published the first data examining the role of staged bilateral RSAs in a heterogeneous patient population.[43]

Given the unpredictability of internal and external rotation after RSA,[1,41] some concern exists that it could be challenging for a patient to undergo bilateral RSAs.[6,32,42,43] External rotation is important for activities of daily living (ADLs) above the waist,[22] whereas internal rotation is important for toileting and bathing.[22] However, patients can sometimes present with bilateral rotator cuff arthropathy and do not have the luxury of depending on a healthy contralateral shoulder to compensate for the poor function of their other arm.

The purpose of this study was to evaluate shoulder function scores, patient satisfaction, and mobility in patients with rotator cuff tear arthropathy after staged bilateral RSAs and to compare them with an age-, gender-, and diagnosis-matched control group with a unilateral RSA. Our primary hypothesis was that patients with bilateral RSAs would see significant improvements in shoulder function scores, patient satisfaction, and mobility. Our secondary hypothesis was that there would be no differences in shoulder function scores, patient satisfaction, and mobility between the bilateral group and the unilateral case-control group.

Materials and methods

We identified all bilateral RSAs completed for rotator cuff tear arthropathy from a prospectively collected shoulder arthroplasty registry from 2004 to 2011. All cases were performed at a single, high-volume shoulder arthroplasty center by a single surgeon (T.B.E.). All patients had rotator cuff tear arthropathy documented with physical examination findings and anteroposterior, scapular Y view, and axillary view radiographs. The status of the rotator cuff was evaluated with preoperative computed tomography arthrography or magnetic resonance imaging and confirmed at the time of surgery. A total of 259 RSAs were completed for rotator cuff tear arthropathy in 243 patients. Sixteen patients had bilateral RSAs for rotator cuff tear arthropathy; 11 patients with a minimum of 2-year follow-up were included in the study.

Eight of the patients were female (73%), with an average age of 67.1 ± 7.4 years (range, 51-82 years). Our database was searched for all patients with a unilateral RSA who matched as closely as possible to the bilateral RSA patients for age, gender, and diagnosis. Patients were matched on the entire set of variables, so the groups may differ slightly on specific matching variables but are similar on the multivariate aggregate. Multiple-variable matching potentially provides multiple unilateral RSA patients per bilateral RSA patient. All unilateral cases that were identified as matches were included in the analysis. Use of several unilateral cases per bilateral case, when available, improves the consistency and precision of the analysis. The unilateral case-control group consisted of 19 patients with rotator cuff arthropathy and included 13 female patients (68%) with an average age of 69.2 ± 6.5 years (range, 54-83 years). There was no statistical difference between the first RSA and second RSA, respectively, and the matched control group regarding age ($P = .432$ and $P = .587$), gender ($P = .770$), or follow-up ($P = .554$ and $P = .809$).

Clinical and radiographic assessment

Patients were prospectively enrolled in a shoulder arthroplasty registry and observed clinically. The average clinical follow-up for the bilateral RSA cohort was 36.8 months (range, 24-99 months), whereas the average clinical follow-up for the unilateral RSA cohort was 38.9 months (range, 24 to 100 months). The average time between the first RSA and the second RSA was 8.0 months (range, 2-21 months).

Patients were examined by the senior surgeon (T.B.E.) preoperatively and then repeated examinations were completed postoperatively at 1 week, 6 weeks, 3 months, 6 months, 12 months, and then annually after that. Radiographs were obtained at each clinic appointment and included anteroposterior in the plane of the scapula, scapular Y view, and axillary views. Radiographs were reviewed preoperatively by the senior surgeon (T.B.E.) to determine the classification of rotator cuff tear arthropathy according to Hamada et al (grades 1-5) and glenoid erosion according to Sirveaux et al (types E0, E1, E2, E3).[19,35] The status of the subscapularis and teres minor was evaluated by the senior surgeon (T.B.E.) preoperatively by computed tomography arthrography or magnetic resonance imaging. The subscapularis had a full-thickness tear in 9 of 22 shoulders in the bilateral group and was not reparable in these 9 cases at the time of RSA. The subscapularis had a full-thickness tear in 9 of 19 shoulders in the unilateral group and was not reparable in these 9 cases at the time of RSA. The teres minor was intact in 19 of 22 shoulders in the bilateral group. The teres minor was intact in 15 of 19 patients in the unilateral group. No patients had a latissimus dorsi transfer at the time of RSA. No significant differences were noted in the distribution of intact subscapularis ($P = .677$) or teres minor ($P = .750$) between the bilateral and unilateral groups.

Shoulder function scores gathered at preoperative and postoperative appointments included the Constant score,[9] the American Shoulder and Elbow Surgeons score,[29] the Western Ontario Osteoarthritis of the Shoulder index,[28] and the Single Assessment Numeric Evaluation score.[45] Satisfaction was assessed by having the patients describe themselves as very dissatisfied, dissatisfied, satisfied, or very satisfied. ADLs were assessed preoperatively and at final follow-up by asking the patients to describe their ability to perform activities as not difficult, somewhat difficult to do, very difficult to do, or unable to do. The ability to dress alone,[28] to

Table I Shoulder function scores (means ± standard deviation)

	Bilateral patients, first shoulder		Bilateral patients, second shoulder		Unilateral patients	
	Preoperative	Final follow-up	Preoperative	Final follow-up	Preoperative	Final follow-up
Constant, pain	2.4 ± 2.4	11.4 ± 4.9	3.1 ± 2.5	10.8 ± 4.9	3.5 ± 3.1	10.3 ± 5.8
Constant, activity	5.4 ± 4.0	15.5 ± 4.8	5.7 ± 2.9	13.6 ± 5.7	4.8 ± 2.3	12.8 ± 6.0
Constant, mobility	7.1 ± 5.0	29.6 ± 11.3	10.5 ± 10.0	26.6 ± 11.6	9.5 ± 10.6	27.3 ± 10.7
Constant, strength	0.8 ± 2.4	7.4 ± 6.2	1.2 ± 2.6	7.4 ± 5.6	0.7 ± 1.5	7.4 ± 4.3
Constant, total	15.8 ± 10.1	63.8 ± 21.7	20.6 ± 12.2	58.4 ± 22.6	18.9 ± 13.1	56.6 ± 22.2
Constant, adjusted	21.8 ± 14.1	89.9 ± 31.9	28.5 ± 17.2	82.2 ± 32.2	24.9 ± 16.9	82.7 ± 30.3
ASES	24.7 ± 13.6	73.5 ± 24.8	25.6 ± 16.1	68.0 ± 27.0	26.8 ± 16.9	64.7 ± 30.3
ASES, pain	6.8 ± 2.5	1.3 ± 2.2	6.5 ± 2.6	1.9 ± 2.7	6.9 ± 2.7	2.3 ± 3.2
WOOS	82.4 ± 16.7	26.0 ± 29.9	77.5 ± 15.6	30.4 ± 28.8	75.8 ± 14.9	32.5 ± 29.9
SANE	24.8 ± 29.9	56.0 ± 39.4	33.3 ± 33.0	53.4 ± 33.2	27.6 ± 25.8	53.8 ± 35.0

ASES, American Shoulder and Elbow Surgeons score; *WOOS*, Western Ontario Osteoarthritis of the Shoulder index; *SANE*, Single Assessment Numeric Evaluation.
There were no statistically significant differences between shoulder groups for preoperative or final follow-up scores for any of the measures (all $P > .10$). Preoperative to final follow-up changes showed statistically significant ($P < .01$) improvement for all measures.

comb the hair,[29] to manage toileting,[29] and to use the back pocket[28] were ADLs assessed as part of modified function and lifestyle scores from validated shoulder outcome measures (Western Ontario Osteoarthritis of the Shoulder index[28] and American Shoulder and Elbow Surgeons score[29]). Assessment of perineal hygiene, use of the hand to eat with a utensil, and ability to wash the armpit of the opposite arm were ADLs assessed as part of our patient survey form and not part of validated shoulder outcome measurement tools. Mobility was determined with a hand-held goniometer to assess active range of motion measurements. The level reached by the dorsum of the hand determined internal rotation. The levels included lateral thigh, buttocks, lumbosacral junction, lumbar vertebra 3, thoracic vertebra 12, and thoracic vertebra 7. Strength of abduction was measured with a hand-held digital dynamometer (Chatillon Digital Force Gauge 200 lbf; AMETEK, Inc, Largo, FL, USA). All intraoperative and postoperative complications were recorded.

Complications

There were 2 complications in 1 patient in the bilateral RSA group and no complications in the unilateral comparison group. The patient had a humeral shaft fracture that required a long stem and internal fixation and secondarily had a radial nerve traction injury that resolved.

Surgical technique and postoperative rehabilitation

The Aequalis (Tornier, Edina, MN, USA) reversed shoulder arthroplasty system was used for all patients during the study period. The RSA technique used for patients during the study period is well described.[13,34] A standardized postoperative rehabilitation protocol was followed.[14,27,38]

Statistical analysis

A mixed linear model was used to test for differences in preoperative, final follow-up, and preoperative to final follow-up change (i.e., improvement) in the shoulder function scores and mobility between shoulders (first or second shoulder) in the bilateral group, for differences between the bilateral and unilateral groups, and for differences between dominant and nondominant arm in the bilateral group. The analysis accounted for the matching of bilateral and unilateral cases and allowed heterogeneity of variances in the measures at each time point and each shoulder. Exact χ^2 and McNemar tests were used to compare internal rotation and satisfaction between groups and changes from preoperative to final follow-up, respectively, because the scales of those variables were categorical. Exact χ^2 tests were used to compare the bilateral and unilateral groups for distribution of grades of rotator cuff arthropathy.

Results

All groups significantly improved on all shoulder function scores and mobility (except internal rotation) from preoperative to final follow-up (all $P < .01$) as noted in Table I and Table II. There were no significant differences in the preoperative or the final follow-up shoulder function scores or mobility (forward flexion, abduction, and external rotation) between the first and second RSA in the bilateral group or between either shoulder in the bilateral group and the unilateral group (all $P > .10$) (Tables I and II). In addition, the magnitude of improvement in shoulder function scores and mobility (forward flexion, abduction, and external rotation) from preoperative to final follow-up did not differ significantly between shoulders in the bilateral group or between either shoulder in the bilateral group and the unilateral group (all $P > .10$) (Table III). Furthermore, there were no significant differences in the preoperative, final follow-up, or preoperative to final follow-up improvements in shoulder function scores or mobility between the dominant and nondominant arm in the bilateral group (all $P > .05$).

Table II Mobility–forward flexion, abduction, and external rotation (means ± standard deviation)

	Bilateral patients, first shoulder		Bilateral patients, second shoulder		Unilateral patients	
	Preoperative	Final follow-up	Preoperative	Final follow-up	Preoperative	Final follow-up
Forward flexion	35 ± 38	144 ± 32	48 ± 58	116 ± 56	51 ± 52	144 ± 32
Abduction	35 ± 36	142 ± 36	46 ± 56	116 ± 56	48 ± 51	134 ± 44
External rotation	10 ± 11	32 ± 16	15 ± 17	24 ± 16	9 ± 12	32 ± 21

There were no statistically significant differences between shoulder groups for preoperative or final follow-up scores for any of the measures (all $P > .10$). Preoperative to final follow-up changes showed statistically significant ($P < .01$) improvement for all measures.

Table III Comparisons of improvement in preoperative to final follow-up outcomes by shoulder group for select measures

	Bilateral first	Bilateral second	Bilateral first vs second *P* value	Unilateral	Bilateral first vs unilateral *P* value	Bilateral second vs unilateral *P* value
Constant, pain	9.0	7.7	.259	6.8	.250	.986
Constant, total	48.0	37.8	.220	37.7	.222	.593
Constant, adjusted	68.1	53.7	.203	57.8	.284	.501
ASES	48.8	42.4	.664	40.9	.268	.591
Forward flexion	109	68	.290	94	.428	.447
Abduction	106	70	.294	87	.252	.672
External rotation	22	9	.200	23	.971	.135

ASES, American Shoulder and Elbow Surgeons score.

Table IV Mobility-internal rotation

Level	Bilateral patients, first shoulder (n = 12)		Bilateral patients, second shoulder (n = 12)		Unilateral patients (n = 19)	
	Preoperative	Final follow-up	Preoperative	Final follow-up	Preoperative	Final follow-up
Lateral thigh	1 (9.1%)	0 (0%)	2 (18.2%)	2 (18.2%)	8 (42.1%)	2 (10.5%)
Buttocks	5 (45.5%)	3 (27.3%)	2 (18.2%)	4 (36.4%)	3 (15.8%)	7 (36.8%)
Lumbosacral junction	1 (9.1%)	1 (9.1%)	3 (27.3%)	1 (9.1%)	2 (10.5%)	3 (15.8%)
Lumbar vertebra 3	2 (18.2%)	1 (9.1%)	0 (0%)	2 (18.2%)	2 (10.5%)	2 (10.5%)
Thoracic vertebra 12	2 (18.2%)	3 (27.3%)	4 (36.4%)	1 (9.1%)	2 (10.5%)	1 (5.3%)
Thoracic vertebra 7	0 (0%)	3 (27.3%)	0 (0%)	1 (9.1%)	2 (10.5%)	4 (21.0%)
Preoperative to final follow-up change*	$P = .363$		$P = .500$		$P = .500$	

Level is the level reached by the dorsum of the hand.

* McNemar test for preoperative to final follow-up change in ability to reach above or below lumbosacral junction.

The average time between the first RSA and the second RSA was 8.0 months (range, 2-21 months). The time between RSAs ($\leq$3 months vs >3 months) had no significant association with final status or preoperative to postoperative change for any of the outcomes or range of motion measurements (all $P > .05$).

The Hamada classification for patients in the bilateral RSA group was Hamada grade 1 (3 patients), Hamada grade 2 (2 patients), Hamada grade 3 (4 patients), Hamada grade 4 (13 patients), and Hamada grade 5 (0 patients). The Hamada classification for patients in the unilateral RSA group was Hamada grade 1 (0 patients), Hamada grade 2 (3 patients), Hamada grade 3 (0 patients), Hamada grade 4 (15 patients), and Hamada grade 5 (1 patient). The differences in Hamada classification between the bilateral and unilateral groups were statistically significant ($P = .006$), with the bilateral group having a higher proportion of Hamada grades 1 to 3. The classification of glenoid erosion for patients in the bilateral RSA group was type E0 (14 patients), E1 (2 patients), E2 (0 patients), and E3 (6 patients). The classification of glenoid erosion for patients in the unilateral RSA group was type E0 (17 patients), E1 (0 patients), E2 (1 patient), and E3 (1 patient). The differences in glenoid erosion classification types between the bilateral and unilateral groups were statistically significant ($P = .042$), with the bilateral group having a higher proportion of type E3.

Table V Mobility-internal rotation dominant and nondominant arm, bilateral group only (n = 11)

Level	Dominant shoulder		Nondominant shoulder	
	Preoperative	Final follow-up	Preoperative	Final follow-up
Lateral thigh	1 (9.1%)	2 (18.2%)	2 (18.2%)	0 (0%)
Buttocks	4 (36.4%)	3 (27.3%)	3 (27.3%)	4 (36.4%)
Lumbosacral junction	3 (27.3%)	1 (9.1%)	1 (9.1%)	1 (9.1%)
L3	2 (18.2%)	2 (18.2%)	0 (0%)	1 (9.1%)
T12	1 (9.1%)	1 (9.1%)	5 (45.5%)	3 (27.3%)
T7	0 (0%)	2 (18.2%)	0 (0%)	2 (18.2%)
Preoperative to postoperative change*	$P = .377$		$P = .500$	

Level is the level reached by the dorsum of the hand.

* McNemar test for preoperative to final follow-up change in ability to reach above or below lumbosacral junction.

Table VI Patient satisfaction

	Bilateral patients, first shoulder (n = 11)		Bilateral patients, second shoulder (n = 11)		Unilateral patients (n = 19)	
	Preoperative	Final follow-up	Preoperative	Final follow-up	Preoperative	Final follow-up
Very satisfied	0 (0%)	7 (63.6%)	0 (0%)	7 (63.6%)	0 (0%)	9 (47.4%)
Satisfied	0 (0%)	2 (18.2%)	0 (0%)	2 (18.2%)	0 (0%)	4 (21.1%)
Dissatisfied	10 (90.9%)	1 (9.1%)	3 (27.3%)	1 (9.1%)	2 (10.5%)	4 (21.1%)
Very dissatisfied	1 (9.1%)	1 (9.1%)	8 (42.1%)	1 (9.1%)	17 (89.5%)	2 (10.5%)
Preoperative to final follow-up change*	$P = .250$		$P = .250$		$P = .008$	

* McNemar test for preoperative to final follow-up change in satisfied (very satisfied or satisfied) vs dissatisfied (very dissatisfied or dissatisfied).

Mobility with regard to internal rotation did not significantly change from preoperative to final follow-up (Table IV), and internal rotation was not significantly different in the dominant or nondominant arm (Table V). In the bilateral group, internal rotation achieved at final follow-up was not significantly associated with patient satisfaction ratings for either the first ($P = .375$) or second ($P = .063$) RSA.

All patients were very dissatisfied or dissatisfied before their first RSA, but 9 of 11 patients (81.2%) were very satisfied or satisfied after the first RSA. All patients were very dissatisfied or dissatisfied before the second RSA, but 9 of 11 patients (81.8%) were very satisfied or satisfied after the second RSA (Table VI). The changes in patient satisfaction were not statistically significant for either the first RSA ($P = .250$) or the second RSA ($P = .250$). However, the preoperative to final follow-up shift from the dissatisfied categories to the satisfied categories in both situations was very large and was comparable to that observed among the matched unilateral RSA patients (from 0% very satisfied or satisfied before surgery to 65% after surgery; $P = .008$).

Assessment of ADLs is noted in Table VII. Although some challenges were noted with specific activities, all patients after bilateral RSAs were able to use at least one arm to comb their hair, to use their back pocket, to use their hand to eat with a utensil, to wash the armpit of the opposite arm, and to manage toileting. One patient was unable to perform perineal hygiene with either arm, and the same patient was unable to dress alone after bilateral RSAs.

Discussion

Staged bilateral RSAs in patients with bilateral rotator cuff arthropathy resulted in significant improvements in shoulder function scores and mobility for both the first shoulder and the second shoulder. Results were similar to those of an age- and diagnosis-matched unilateral group. Patient satisfaction improved and patients were successfully able to perform many important ADLs after bilateral RSAs.

One of the first reported cases of bilateral RSAs was a case report by Ueblacker et al in a patient with bilateral shoulder arthropathy after traumatic syringomyelia.[39] This patient had satisfactory results after short-term follow-up. More recently, 2 studies examined outcomes after staged bilateral RSAs.[37,43] Wiater et al reported similar improvements regarding staged bilateral RSAs; however, that investigation included a heterogeneous group of preoperative diagnoses, including failed humeral head replacement, rotator cuff tear arthropathy, and massive rotator cuff tears without osteoarthritis.[43] Furthermore, our investigation reports no differences in clinical outcomes and range of motion measurements between the first RSA and the second RSA, contrary to their findings.[43] This may be

Table VII Activities of daily living after bilateral RSAs, N (%)

	Not difficult (n = 22 shoulders)	Somewhat difficult (n = 22 shoulders)	Very difficult (n = 22 shoulders)	Unable to do (n = 22 shoulders)	Patients able to complete activity using at least one arm (n = 11 patients)
Dressing alone	6 (27.3%)	7 (31.8%)	5 (22.7%)	4 (18.2%)	10 (90.9%)
Perineal hygiene	10 (45.5%)	1 (4.5%)	8 (36.4%)	3 (13.6%)	10 (90.9%)
Use back pocket with arm	5 (22.7%)	4 (18.2%)	11 (50.0%)	2 (9.1%)	11 (100%)
Use hand to eat with a utensil	10 (45.8%)	5 (22.7%)	6 (27.3%)	1 (4.5%)	11 (100%)
Wash the opposite armpit	4 (18.2%)	5 (22.7%)	12 (54.5%)	1 (4.5%)	11 (100%)
Comb hair	10 (45.5%)	7 (31.8%)	3 (13.6%)	2 (9.1%)	11 (100%)
Manage toileting	12 (56%)	6 (27.3%)	3 (13.6%)	1 (4.5%)	11 (100%)

explained by the amount of heterogeneity of the population in that study and the fact that the preoperative diagnoses were different between shoulders in some patients. Also, the average forward flexion and abduction at final follow-up in our study were less after the second RSA, although this difference was not statistically significant. The inability to detect a difference may be attributable to the small sample size in our study.

Namdari et al described the average shoulder motions to perform functional tasks in healthy volunteers.[31] They determined that less than full range of motion is adequate to perform many functional tasks. The average range of motion measurements reported to perform these tasks were 121° of flexion, 46° of extension, 128° of abduction, 116° of cross-body adduction, 59° of external rotation with the arm abducted to 90°, and 102° of internal rotation with the arm at the side.[31] Nine patients (82%) after the first RSA, 7 patients (63.6%) after the second RSA, and 13 patients (68.4%) in the unilateral group achieved more than 121° of flexion in our study. Nine patients (82%) after the first RSA, 6 patients (54.5%) after the second RSA, and 12 patients (63.2%) in the unilateral group achieved more than 128° of abduction. No patients in the bilateral RSA group and 3 patients (15.8%) in the unilateral group achieved more than 59° of external rotation.

Stevens et al reported results of staged bilateral RSAs in a population with a single diagnosis of rotator cuff tear arthropathy and found significant functional improvements in both shoulders using multiple validated outcome measures similar to our study.[37] They also demonstrated the ability to perform ADLs in the majority of the shoulders (29 of 30) in their group.[37] However, some heterogeneity was noted in the patient population, with multiple RSA prostheses used (4 different types) and a mix of cemented and press-fit humeral stems.[37] The impact of these differences is unknown but could introduce confounding. Also, they did not present a direct comparison of the first to second shoulder as noted in this study.

Prior studies report concerns about reliability of improving mobility after RSA.[6,32,42,43] However, we demonstrated significant improvements in preoperative to final follow-up range of motion measurements in both the first and second RSA with the exception of internal rotation, which did not change. This is important to note because there are patients who ultimately require intervention for both shoulders. In a study by Latif et al, a group of patients underwent bilateral shoulder arthroplasties, with one side receiving an anatomic total shoulder arthroplasty (TSA) and the other receiving an RSA.[23] Their results demonstrated satisfactory outcomes in both shoulders, with better range of motion measurements in the TSA group. However, objective range of motion measurements may not be as significant as patient-reported function after TSA or RSA. Lawrence et al reported no differences in patient-reported activities after unilateral RSA, TSA, or hemiarthroplasty.[24] Our data confirmed that patients were successfully able to perform many important ADLs after bilateral RSAs, including the ability to dress alone, to perform perineal hygiene, to use their back pocket, to use their hand to eat with a utensil, to wash the armpit of their opposite arm, to comb their hair, and to manage toileting. There was one patient with bilateral RSAs who was unable to perform perineal hygiene with either arm, and the same patient was unable to dress alone after bilateral RSAs.

Another question regarding bilateral RSA procedures is the optimal timing of each procedure. Gerber et al evaluated the results of bilateral TSAs in a single vs staged fashion.[15] Their results indicated better results when both procedures were performed at the same time, whereas Gruson et al indicated similar results between shoulders when TSA was performed in a staged fashion.[18] Wiater et al[43] reported a mean interval of 13.7 months between the first and second shoulder, whereas Stevens et al[37] reported a mean interval of 21.6 months between shoulders. The results of this study are consistent with the idea that similar results can be obtained in a staged fashion with an average time of 8.0 months between shoulders (range, 2-21 months). Similar to Stevens et al, we do think that satisfactory results can be obtained with as little as a 2- to 3-month interval between sides in bilateral RSAs.[37] We are not aware of anyone currently advocating simultaneous bilateral RSA.

A limitation of this study is the small number of patients included. The small sample size introduces the possibility of a type II error. Finally, 2-year follow-up is still early in the expected longevity of the RSA, and longer follow-up with a larger series is needed to confirm the results. Another limitation of the study is use of a matched cohort, which introduces the possibility of selection bias. Strengths of this study include a homogeneous preoperative diagnosis of rotator cuff tear arthropathy in all patients, multiple validated shoulder function scores, a single surgeon, standardized surgical technique, and the same prosthesis used in all patients.

Conclusion

Patients with bilateral rotator cuff tear arthropathy can be advised that staged bilateral RSAs can be successful when indicated. Improvements in shoulder function scores, patient satisfaction, and mobility are possible for both the first RSA and the second RSA.

Disclaimer

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