



# Prospective Comparative Study of Preoperative Expectations and Postoperative Outcomes in Anatomic and Reverse Shoulder Arthroplasty

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## Abstract

**Background** Compared with anatomic total shoulder arthroplasty (aTSA), reverse total shoulder arthroplasty (RTSA) is associated with lower preoperative and postoperative outcome scores and range of motion. It is unknown whether patients' preoperative expectations of surgery are lower in RTSA compared with aTSA. The purpose of this study was to assess preoperative patient expectations and postoperative outcomes in aTSA and RTSA.

**Methods** A consecutive series of patients undergoing primary aTSA for diagnosis of osteoarthritis or primary RTSA for diagnosis of rotator cuff tear arthropathy were studied prospectively. Expectations were evaluated using the validated Hospital for Special Surgery's Shoulder Surgery Expectations Survey. Baseline demographics, comorbidities, and social factors were collected. Baseline and 2 years postoperative American Shoulder and Elbow Surgeons (ASES) score, visual analog scale pain, Single Assessment Number Evaluation (SANE), and patient satisfaction were obtained.

**Results** There were 128 patients (64 aTSA and 64 RTSA). There was no significant difference in total preoperative expectations score between groups. On multivariate linear regression analysis, aTSA ( $p = 0.024$ ) and younger age ( $p = 0.018$ ) were associated with higher expectations for improved ability to exercise. Changes in preoperative to postoperative ASES ( $p = 0.004$ ) and SANE ( $p = 0.001$ ) scores were higher in the aTSA group. Total preoperative expectations score was not correlated with postoperative functional outcomes or satisfaction in either group. In the aTSA group, expectations for participation in exercise were positively correlated with changes in preoperative to postoperative ASES score ( $p = 0.01$ ) and SANE score ( $p = 0.01$ ).

**Conclusion** Though patients undergoing primary aTSA demonstrated greater improvement in functional outcome than those undergoing primary RTSA, both groups reported similar aggregate preoperative expectations. Those undergoing aTSA had higher expectations for return to exercise which was positively correlated with postoperative functional outcomes.

**Level of Evidence** Level II, prospective cohort study.

## Keywords

- expectations
- reverse arthroplasty
- total shoulder arthroplasty
- exercise

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## Introduction

Previous studies have validated the quantification of patient-reported expectations of surgery.<sup>1</sup> Recent investigations in the orthopaedic literature have reported an association between expectations of surgery and patient-perceived reporting of preoperative pain and function.<sup>1–4</sup> In general, patients' expectations of shoulder surgery vary by demographics, diagnosis, and functional status.<sup>1</sup> It has been shown that patients undergoing anatomic total shoulder arthroplasty (aTSA) with worse shoulder function have higher expectations for improved self-care and daily activities.<sup>4</sup>

While the most common indication for aTSA is osteoarthritis and the most common indication for reverse total shoulder arthroplasty (RTSA) is rotator cuff tear arthropathy, patients undergoing both procedures typically complain of disabling pain and loss of motion. Though both procedures provide improvements in pain relief and restoration of function, the outcomes can vary significantly. In a comparison of aTSA and RTSA surgical outcomes, aTSA was associated with higher preoperative and postoperative outcome scores and greater postoperative range of motion.<sup>5</sup> More limited final range of motion, higher hospital readmission rates, and higher complication rates can be expected with RTSA compared with aTSA.<sup>5–7</sup> Greater preoperative expectations of aTSA have been associated with better outcomes.<sup>8</sup>

It is unknown whether patients who are undergoing aTSA or RTSA have differences in preoperative expectations. Knowledge of these variables may provide insight into the modifiable and nonmodifiable factors that could contribute to the shaping of patient expectations. The primary goal of this study was to compare preoperative expectations of patients undergoing aTSA for a diagnosis of osteoarthritis and RTSA for a diagnosis of cuff tear arthropathy and to determine whether there is association with postoperative functional results. Second, we sought to identify variables that were associated with expectations. We hypothesized that patients undergoing aTSA would have higher expectations and better postoperative functional results than patients undergoing RTSA.

## Methods

After obtaining Institutional Board Review approval, patients who underwent primary aTSA for a diagnosis of osteoarthritis and RTSA for the diagnosis of cuff tear arthropathy at a single institution were prospectively studied. Patients undergoing revision surgery, those with a history of prior shoulder arthroplasty, and those with other diagnoses, such as avascular necrosis, proximal humerus fracture, or inflammatory arthropathy, were excluded. Patients from the practices of five fellowship trained shoulder surgeons were included in the study, and standardized consent forms and patient information materials were utilized.

The data collected from the preoperative evaluation included patient demographics, body mass index (BMI), self-assessed comorbidities, marital status, preoperative measurements of active forward elevation, previous nonarthro-

plasty shoulder surgeries, and use of depression or anxiety medications. Preoperative function was assessed using the American Shoulder and Elbow Surgeons (ASES) score, visual analog scale (VAS) for pain, Single Assessment Number Evaluation (SANE), Simple Shoulder Test (SST), and the Veterans RAND 12-Item Health Survey (VR-12). The subjective ASES score measures shoulder comfort and function on a scale of 0 to 100, with 100 being the highest score.<sup>9</sup> The VAS pain score was taken from the patient response to the ASES question "How bad is your pain today?" Responses could range from 0 to 10 with 0 being "no pain at all" and 10 being "pain as bad as it could be." The SANE is an outcomes measure in which patients answer the question, "How would you rate your shoulder today as a percentage of being normal (0% to 100% scale with 100% being normal)?"<sup>10</sup> The SST is a 12-question survey that measures comfort and physical function of the shoulder.<sup>11</sup> The VR-12 is a health-related quality of life assessment in which patients answer questions related to eight domains of physical and mental health. A composite score is generated, which can be compared with the mean U.S. population score of 50.<sup>12</sup>

Patients were administered the Hospital for Special Surgery's (HSS) Shoulder Surgery Expectations Survey to assess preoperative expectations.<sup>1</sup> This instrument is a validated and reproducible patient-reported instrument for assessing the expectations related to symptom relief, physical function, and psychosocial function of patients undergoing shoulder surgery. Patients rate the importance of 17 different expectations of shoulder surgery as "very important," "somewhat important," "a little important," "I do not expect this," or "this does not apply to me." For individual expectations statements, scores ranged from 1 to 5 with 1 being "very important," and 5 being "I do not expect this, or this does not apply to me." For the purpose of this study, higher ratings of importance were defined as greater expectations. Scores were determined for each of the 17 items in the questionnaire in addition to a raw cumulative score (0–80 scale) which was then converted  $[(\text{raw score} / 80) \times 100]$  to a 0 to 100 scale with 100 indicating highest expectations. Both cumulative and individual statement expectations scores were analyzed. To limit the number of tests performed, 6 individual expectations statements that represented activities requiring higher level of function were selected for comparison. These statements included "Improve ability to carry objects over 10 pounds," "Improve ability to reach above shoulder level," "Improve ability to exercise or participate in recreational sports," "Improve ability to participate in overhead sports," "Improve ability to participate in recreational activities," and "For the shoulder to be back to the way it was."

All surveys, including the HSS Shoulder Expectations Survey, were administered after the patient was indicated for surgery and underwent the preoperative counseling and informed consent process at the discretion of the surgeon.

At 2 years postoperatively, patients were contacted via phone or email and were administered ASES, SANE, and satisfaction surveys. The satisfaction survey asked patients to respond to the question "How satisfied are you with the

**Table 1** Patient demographics

Measure	aTSA	Range	SD	RTSA	Range	SD	p-Value
Number of patients	64	—	—	64	—	—	—
Age (y)	65.7	36.6–86.3	9.6	71.4	51.1–91.4	8.8	0.002
Gender	22/64 (34.4%) female	—	—	41/64 (64.1%) female	—	—	0.001
BMI	30.0	19.3–45.9	6.3	28.7	19.5–46.5	5.3	0.360
Number of comorbidities	3.3	0.0–14.0	2.6	3.7	1.0–9.0	1.8	0.087

Abbreviations: aTSA, anatomic total shoulder arthroplasty; BMI, body mass index; RTSA, reverse total shoulder arthroplasty; SD, standard deviation.

result of your shoulder replacement?” with responses “very satisfied,” “somewhat satisfied,” “neutral,” “somewhat dissatisfied,” or “very dissatisfied.”

There is no established minimal clinically important difference (MCID) in HSS Shoulder Surgery Expectations Survey score; therefore, a power analysis could not be reliably performed. Patients were enrolled from March 2014 until June 2015. Groups were compared using *t*-tests for independent groups for continuous variables (or its non-parametric variant, Mann–Whitney if necessary) and Fisher’s exact test for categorical variables. When analyzing cumulative expectations in addition to each of the 17 individual expectations survey statements,  $p < 0.01$  was considered to be considered statistically significant due to the large number of tests performed. For the remainder of the analyses,  $p < 0.05$  was considered to be statistically significant. For the HSS Shoulder Surgery Expectations Survey, each item as well as the total score was correlated with patient outcomes using the Spearman’s correlation coefficient. Multivariate linear regression was performed to analyze if patient demographic variables were associated with expectations.

## Results

### Demographics

A total of 64 patients in the aTSA group and 64 patients in the RTSA group were included in the study. The mean patient age was significantly higher in the RTSA group ( $p = 0.002$ ), and the RTSA group was comprised of more females ( $p = 0.001$ ).

There were no significant differences in mean BMI and mean number of comorbidities between the aTSA and RTSA groups (► **Table 1**). Forty-nine patients (76.6%) in the aTSA group and 43 patients (67.2%) in the RTSA group were married ( $p = 0.335$ ). Ten patients (15.6%) in the aTSA group and 12 patients (18.8%) in the RTSA group self-reported depression as a comorbidity ( $p = 0.815$ ). Thirteen patients in the aTSA group and 37 patients in the RTSA group had a history of previous nonarthroplasty shoulder surgery ( $p < 0.001$ ). Twelve of the 13 (92.3%) previous shoulder surgeries in the aTSA group and 33 of the 37 (89.2%) previous shoulder surgeries in the RTSA group were ipsilateral ( $p < 0.001$ ). Seven of 128 patients enrolled in the study canceled surgery due to changes in their health or for personal reasons.

### Preoperative Functional Outcomes Scores

Patients in the aTSA group had significantly higher preoperative SST and VR-12 mental component scores compared with patients in the RTSA group ( $p = 0.014$  and  $0.009$ , respectively). Patients in the aTSA group had better preoperative active forward elevation compared with those in the RTSA group (109 vs. 81 degrees;  $p = 0.001$ ). There were no significant differences in preoperative ASES, VAS pain, SANE, and VR-12 physical component scores between the two groups (► **Table 2**).

### Expectations

There was no significant difference in cumulative preoperative expectations in patients undergoing aTSA compared with those undergoing RTSA (median 76.9 vs. 67.5;

**Table 2** Preoperative functional outcomes scores

Measure	aTSA	Range	SD	RTSA	Range	SD	p-Value
ASES	32.7	0.0–74.1	18.0	34.7	6.7–80.0	18.7	0.606
VAS pain	6.6	0.0–10.0	2.3	6.0	0.0–10.0	3.1	0.267
SANE	27.0	0.0–91.0	25.1	25.9	0.0–86.7	22.5	0.815
SST	33.5	0.0–83.3	22.0	23.4	0.0–66.7	16.1	0.014
VR-12 M	56.6	21.4–67.9	9.9	51.2	26.3–64.5	9.4	0.009
VR-12 P	35.9	20.8–63.2	8.0	36.1	16.4–55.0	8.0	0.914
AFE	108.6	60.0–160.0	28.0	80.9	0.0–170.0	46.9	0.001

Abbreviations: AFE, active forward elevation (degrees); ASES, American Shoulder and Elbow Surgeons score; aTSA, anatomic total shoulder arthroplasty; RTSA, reverse total shoulder arthroplasty; SANE, Single Assessment Number Evaluation; SD, standard deviation; SST, Simple Shoulder Test; VAS, visual analogue scale for pain; VR-12 M, Veterans RAND 12 Item Health Survey Mental Component; VR-12 P, Veterans RAND 12 Item Health Survey Physical Component.

**Table 3** Multivariate linear regression for expectations for improved ability to exercise

Variable	Unstandardized coefficient	p-Value	95% Confidence interval	
			Lower limit	Upper limit
aTSA	-0.64	0.02	-1.20	-0.86
Older age	0.04	0.02	0.01	0.07
Male	0.23	0.42	-0.33	0.77
Married	0.44	0.88	-0.55	0.64
# Comorbidities	0.01	0.89	-0.11	0.12
Previous failed ipsilateral surgery	-0.19	0.56	-0.84	0.46

Abbreviation: aTSA, anatomic total shoulder arthroplasty.

Note: Positive correlations reflect higher score for individual expectation statements, which patients rated 1 to 5 with 1 being "Very important to me" and 5 being "I do not expect this or this does not apply to me," meaning positive correlations reflect lower expectations.

interquartile range [IQR] 21.25; 23.13;  $Z = -2.19$ ;  $p = 0.028$ , respectively). Patients in the aTSA group had higher expectations for improved ability to exercise compared with those in the RTSA group (median 2.0 vs. 2.0; IQR 1.0, 3.0;  $Z = -2.76$ ;  $p = 0.005$ , respectively). There was no statistically significant difference in expectations on any of the other analyzed items on the HSS Shoulder Surgery Expectations Survey. On univariate analysis, gender, number of comorbidities, and previous failed ipsilateral surgery did not correlate with preoperative expectations in the aTSA and RTSA groups ( $p > 0.05$ ). On multivariate linear regression analysis, aTSA ( $p = 0.024$ ) and younger age ( $p = 0.018$ ) were associated with higher expectations for improved ability to exercise (►Table 3).

### Postoperative Functional Outcomes Scores

Ninety-one of 121 patients (75%) who underwent surgery were reached for follow-up at a minimum of 2 years postoperatively. Patients who underwent aTSA had higher ASES and SANE scores postoperatively ( $p < 0.001$ ,  $p = 0.002$ , respectively), and also had higher changes in ASES and SANE scores ( $p = 0.004$ ,  $p = 0.001$ , respectively) compared with those in the RTSA group. There were no significant differences in VAS pain scores or postoperative satisfaction scores between the two groups (►Tables 4 and 5).

### Relationship between Expectations and Functional Outcomes

Cumulative preoperative expectations score was not correlated with postoperative functional outcomes score in the aTSA group, RTSA group, or groups combined. In the aTSA group, preoperative expectations for ability to exercise were positively correlated with change in preoperative to postoperative ASES ( $R = 0.362$ ;  $p = 0.01$ ) and SANE scores ( $R = 0.360$ ;  $p = 0.01$ ). Other individual preoperative expectation statements were not correlated with functional outcomes in the aTSA, RTSA, or combined groups. Preoperative expectations scores, including cumulative score and individual expectations statements, were not correlated with postoperative satisfaction scores in the aTSA, RTSA, or combined groups.

### Discussion

The results of this study indicate that patients undergoing aTSA and RTSA have similar cumulative preoperative expectations; however, patients undergoing aTSA appear to have greater expectations for higher-level activities, such as participating in exercise. Additionally, we found that older patients undergoing RTSA had lower expectations for ability to participate in exercise. In line with previous literature, we

**Table 4** Postoperative functional outcomes scores

Measure	aTSA	Interquartile range	RTSA	Interquartile range	p-Value	Z
ASES	95.0	15.0	83.3	20.0	< 0.001	-3.97
VAS pain	0.0	2.0	1.0	2.5	0.251	-0.73
SANE	90.0	11.8	83.0	33.0	0.002	-3.13
Delta ASES	55.3	—	43.2	—	0.004	—
Delta VAS	-5.4	—	-4.4	—	0.141	—
Delta SANE	60.5	—	46.6	—	0.001	—
Satisfaction	1.0	0.0	1.0	1.0	0.162	-1.37

Abbreviations: ASES: American Shoulder and Elbow Surgeons score; aTSA, anatomic total shoulder arthroplasty; RTSA, reverse total shoulder arthroplasty; SANE, Single Assessment Number Evaluation; VAS, visual analog scale for pain.

Note: Patient-reported satisfaction scored 1–5 with 1 being "very satisfied" and 5 being "very dissatisfied." ASES, VAS pain, SANE, and satisfaction reported as median values. Delta ASES, delta VAS, and delta SANE reported as mean values.

**Table 5** Postoperative satisfaction scores

	Very satisfied	Somewhat satisfied	Neutral	Somewhat dissatisfied	Very dissatisfied
aTSA	41/50 (82%)	6/50 (12%)	1/50 (2%)	2/50 (4%)	0/50 (0%)
RTSA	29/41 (70.7%)	6/41 (14.6%)	2/41 (4.9%)	2/41 (4.9%)	2/41 (4.9%)
Total	70/91 (76.9%)	12/91 (13.2%)	3/91 (3.3%)	4/91 (4.4%)	2/91 (2.2%)

Abbreviations: aTSA, anatomic total shoulder arthroplasty; RTSA, reverse total shoulder arthroplasty.

report that patients who underwent aTSA had higher postoperative functional outcomes than those who underwent RTSA.<sup>5,7</sup> In a comparison of postoperative outcomes, Flurin et al<sup>5</sup> showed that patients who underwent RTSA had significantly lower SST scores and range of motion compared with patients who underwent aTSA. Puskas et al<sup>7</sup> further corroborated these findings by demonstrating greater preoperative and postoperative impairment and lower strength and range of motion in patients undergoing RTSA compared with aTSA.

Previous literature has analyzed expectations of shoulder arthroplasty and associations with postoperative outcomes.<sup>2,4,8,13,14</sup> Henn et al<sup>4</sup> found younger patients had greater expectations of aTSA; however, previous studies<sup>13,14</sup> have not found an association between patient age and expectations of RTSA. Our investigation demonstrated younger patients had higher expectations for improved ability to exercise. Previous study also reported patients with glenohumeral osteoarthritis, higher preoperative function, and no history of joint replacement had greater expectations of RTSA. Similar to our findings, Rauck et al<sup>13</sup> demonstrated cumulative preoperative expectations of RTSA were not associated with improved outcomes; however, particular expectations, such as relief of nighttime pain and ability to participate in nonoverhead sports, were associated with improved functional outcomes. Our investigation demonstrated that there is some association between preoperative expectations and postoperative functional outcome. Although cumulative preoperative expectations score was not correlated with postoperative functional outcome, higher expectations for the ability to exercise were associated with increased change in preoperative to postoperative functional scores in the aTSA group. In 2016, one study<sup>15</sup> reported that men more often expect to return to sports following shoulder arthroplasty while women tend to expect to be able to return to household chores, and both genders had high levels of achieving their expectations. Another study<sup>16</sup> reported an association between self-reported motivation to return to sports and postoperative return to sports following total hip arthroplasty. Patients who desire to return to higher functioning levels of activity such as exercise may be more motivated with the postoperative rehabilitation process.

Despite aTSA yielding better functional outcomes than RTSA in this study and other studies,<sup>5,7</sup> patients in both groups had the similar aggregate preoperative expectations and postoperative satisfaction scores. Qualitative research demonstrates expectations for recovery after orthopaedic injury are based on physician diagnosis and treatment, prior

experiences with injury, others' experiences and attitudes, information from the Internet, and a sense of self-resilience.<sup>17</sup> Literature shows patient satisfaction is associated with met expectations, particularly regarding information and explanation of medical condition and treatment.<sup>18,19</sup> Patients in both the aTSA and RTSA groups had high rates of postoperative satisfaction, indicating their expectations were met. Our findings that RTSA patients have lower preoperative functional scores and lower expectations for high-level activities may indicate that patients' expectations of surgery were appropriate, and they received satisfaction more from pain relief rather than ability to participate in higher level of functional activities.

This study has several limitations. The sample size is relatively small and given the lack of an MCID for the expectations scale used, we are unable to calculate one. As a result, it is possible that nonsignificant findings are a result of inadequate power. Furthermore, while the consent forms and educational materials were consistent for all surgeons, patients may have had variable levels of preoperative education from other sources (family, friends, Internet, etc.). This lack of consistency could have influenced the expectations, but we believe that this is most reflective of the true clinical situation. Given that patients were included from the practices of five surgeons, the sample size did not allow comparison of expectations between surgeons. Prior study has shown that current mechanisms of preoperative counseling did not influence patients' preoperative expectations of shoulder surgery.<sup>20</sup>

## Conclusion

Though patients undergoing primary aTSA demonstrated greater improvement in functional outcome than those undergoing primary RTSA, both groups reported the same aggregate preoperative expectations. Those undergoing aTSA and younger patients have higher expectations for higher level activities, including exercise. In the aTSA group, patients' preoperative expectations for return to exercise were positively correlated with postoperative functional outcomes.

## Note

Investigation was performed at the Rothman Institute, Thomas Jefferson University Hospitals, Philadelphia, Pennsylvania.

## Conflict of Interest

M.L. reports personal fees from Tornier, outside the submitted work; In addition, M.L. has a patent Shoulder



Arthroplasty with royalties paid to Tornier. G.W. reports other from Pennsylvania Orthopaedic Society, other from American Shoulder and Elbow Surgeons, other from Operative Techniques in Orthopaedic Surgery, other from Techniques in Shoulder and Elbow Surgery, other from American Academy of Orthopaedic Surgeons, grants and personal fees from DePuy, personal fees from DJO, personal fees from DePuy, Mitek, other from In vivo Therapeutics, outside the submitted work; In addition, G.W. has a patent Shoulder Arthroplasty licensed to DePuy, a patent Shoulder Arthroplasty issued to IMDS/ Cleveland Clinic, a patent Shoulder Arthroplasty with royalties paid to DJO, and a patent Shoulder Arthroplasty with royalties paid to Lippincott. S.N. reports other from Arthrex Inc, other from DJO Surgical, other from Flexion Therapeutics, other from Force Therapeutics, other from Integra LifeSciences, other from Miami Device Solutions, other from Parvizi Surgical Solutions, other from Synthes, other from ZimmerBiomet, other from Saunders Mosby-Elsevier, other from RubiconMD, other from MD Live, other from MD Valuate, outside the submitted work. J.A. reports other from DJO, other from Integra Life Sciences, other from Tornier, other from DePuy Synthes, other from Lippincott, Williams & Wilkins, outside the submitted work.

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