



Patient reported outcome measures of bilateral reverse total shoulder arthroplasty compared to bilateral anatomic total shoulder arthroplasty



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ABSTRACT

The purpose of this study was to compare patient reported functional outcomes following bilateral aTSA vs rTSA. A retrospective review was conducted on twenty-six patients who underwent staged bilateral aTSA or rTSA, with a minimum of 2 years follow up. Thirteen patients were included in each group, and patient assessed functional outcomes were measured using the PENN Score, ASES, SST, and SF-12. No statistically significant differences were found between the two groups for all functional outcome scores, patient satisfaction, or SF-12. These findings suggest that patients undergoing bilateral rTSA can expect functional outcomes similar to those obtained after bilateral aTSA.

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1. Introduction

Since receiving FDA approval in 2004, the use of reverse total shoulder arthroplasty (rTSA) has steadily increased in the U.S, as has shoulder arthroplasty in general.^{1,2} However, many orthopaedic surgeons remain reluctant to accept bilateral rTSA as an acceptable treatment option and recommend against it. The primary reason for this is a perceived limitation in activities of daily living (ADLs) that require internal rotation for activities such as perineal care or dressing oneself.^{3,4} This is in contrast to bilateral anatomic total shoulder arthroplasty, which has been accepted as a recommended treatment option for some time.

Over the past decade, rTSA has become the surgical treatment of choice for rotator cuff tear arthropathy (CTA).⁵ This entity was originally described by Neer et al., in 1983⁶, and aTSA was later found to be a poor treatment option due to glenoid loosening and unpredictable outcomes resulting in early failure.^{7–9} As a result, shoulder hemiarthroplasty became the surgical treatment of choice prior to the advent of rTSA.¹⁰ rTSA resulted in consistent pain relief but varying degrees of success in improving overall function.⁵ Recent studies have shown that

rTSA provides better pain relief and improved function over hemiarthroplasty for treatment of CTA.^{5,10} Despite this, hemiarthroplasty contralateral to a previously implanted rTSA remains the treatment of choice for physicians who recommend against bilateral rTSA in patients with bilateral CTA.

Despite the increasing number of rTSA being performed, there are still limited numbers of studies that assess the outcomes of bilateral rTSA. Two previous studies have compared patient function and satisfaction following bilateral rTSA with outcomes following unilateral rTSA, but these studies did not compare outcomes of bilateral rTSA with those after bilateral aTSA.^{2,4} Similarly, Stevens et al. reviewed the functional outcomes following bilateral rTSA, but did not use any comparators in the study.³ Wirth et al. also evaluated patient function and internal rotation following bilateral rTSA in a larger cohort but also only looked at patients with bilateral rTSA without comparators.¹¹ Other studies have compared outcomes following rTSA and aTSA; however, these studies used either a mixture of unilateral arthroplasties or both rTSA and aTSA in the same patient.^{12,13}

The purpose of this study was to evaluate patient assessed functional outcomes in patients who underwent bilateral rTSA and compare

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them to a matched control group of bilateral aTSA. To our knowledge, this is the first paper that has directly compared the functional outcomes of bilateral TSA and bilateral rTSA performed by a single surgeon. This information will help to further clarify the level of function and satisfaction observed in patients following bilateral rTSA and how this compares to the widely accepted application of bilateral aTSA. We hypothesized that when comparing patients who have undergone staged bilateral anatomic total shoulder arthroplasty with those who have undergone staged bilateral reverse total shoulder arthroplasty, there will not be a significant difference in self reported patient function or overall satisfaction.

2. Materials and methods

A retrospective review was conducted to identify patients who underwent either staged bilateral aTSA or bilateral rTSA between 2006 and 2014. All of the surgeries were performed by the senior author. Inclusion criteria were that the patients had a minimum of 2 years of follow up from the second surgery and received the same type of arthroplasty in both shoulders.

The search using these criteria yielded a total of 26 patients, with 13 receiving bilateral aTSA and 13 receiving bilateral rTSA. The anatomical TSA group was composed of 7 females and 6 males with a mean age of 72 (range 64–85 years). The reverse TSA group was made up of 9 females and 4 males with a mean age of 75 years old (range 64–87 years).

As mentioned, all of the surgeries were performed by the senior author in Charleston, SC. A Deltopectoral approach was used for both anatomic and reverse TSA surgeries. The subscapularis was repaired in all rTSA cases and the humeral implant was placed in 20–30° of retroversion. Three implant manufacturers were used for both aTSA and rTSA, with 32 DJO (20 reverse/12 anatomic), 15 Exactech (4 reverse/11 anatomic), and 5 Tornier (2 reverse/3 anatomic) implants used. The DJO and Exactech rTSA implants were lateralized, while the 2 reverse Tornier implants were not lateralized implants.

Twenty five of the 26 rTSA were performed for osteoarthritis with massive rotator cuff tearing. One rTSA was performed for failure of an aTSA that developed a large rotator cuff tear, high riding humeral head and subsequent glenoid component loosening. All of the aTSA's were performed for primary osteoarthritis with intact rotator cuffs.

At follow-up, patients answered a questionnaire comprising the American Shoulder and Elbow Surgeons Score (ASES), PENN Score, Simple Shoulder Test (SST), and 12-Item Short Form Health Survey, which was completed via telephone interview for each patient. Patient Satisfaction was also determined using questions included in the survey.

For the statistical analyses, demographics, patient characteristics, and functional outcomes between the aTSA and rTSA groups were analyzed using the *t*-test, chi-square, and Mann-Whitney test. Statistical significance was set at alpha = 0.05. Statistical analysis was performed with IBM SPSS 23. The study was approved by the university IRB.

3. Results

There were no significant differences between the aTSA and rTSA groups with regards to age, gender, or body mass index. (Table 1). The mean follow-up since the second surgery was 44 months (range 24–142 months) for the aTSA and 47 months for the rTSA (range 25–88 months), and the mean time between arthroplasties was 25 months for aTSA and 28 months for rTSA.

There were no significant differences in patient satisfaction between the two groups. The aTSA group reported a mean satisfaction of 8/10 while the mean satisfaction in the rTSA group was 9/10 (p = 0.55). The mean Penn Score and ASES score were slightly higher in the aTSA group, but this was not statistically significant and there was not a significant difference between the two groups for any of the shoulder

Table 1
Demographics and characteristics.

	aTSA	rTSA	p-value
Gender			0.42
Female	7 (54%)	9 (69%)	
Male	6 (46%)	4 (31%)	
	mean (std)	mean (std)	p-value
Age	72.0 (6.38)	75.1 (6.13)	0.07
BMI	30.9 (5.41)	31.0 (5.15)	0.97

Table 2
Results of self-reported functional outcome measures recorded at follow up.

	mean	aTSA (n = 13)	mean	rTSA (n = 13)	p-value
		std		std	
PENN Score	84.64	19.08	76.80	21.94	0.30
ASES Score	84.81	19.37	75.42	24.00	0.33
SST	9.38	2.96	9.38	1.80	0.52
SF12:PCS	43.95	10.53	38.68	11.95	0.27
SF12:MCS	54.16	8.99	53.78	14.12	0.34

function scores, for these data (Table 2). The mean SST score was the same for both groups. There was also not a significant difference between the two groups for the three activities that require the greatest amount of internal rotation: reach small of back to tuck in shirt, (p = 0.24), wash middle of back/hook bra, (p = 0.13), perform toileting duties, (p = 0.52). Specifically, both groups were able to perform toileting activities with almost no difficulty (p > 0.05).

There were four patients who scored below 50 on either the PENN score or ASES, three in the rTSA group and one in the aTSA group. Three of these patients (2 rTSA and 1 aTSA) also scored considerably low on the SF-12 survey, and had considerably poor overall health. One subject also reported severe dissatisfaction following bilateral aTSA (1/10) despite having an ASES score of 82 and a PENN score of 74.

There were three surgical complications that occurred, with two occurring in the aTSA group and one occurring in the rTSA group. In the aTSA group, a partial brachial plexus palsy following an interscalene block resolved spontaneously, and a calcar crack in the proximal humerus was treated with a prophylactic cerclage wire intraoperatively. Partial median nerve numbness in a rTSA resolved without incident postoperatively.

4. Discussion

The primary indications for reverse total shoulder arthroplasty continue to be osteoarthritis with a deficient rotator cuff and cuff tear arthropathy; however, the indications for rTSA have expanded in recent years, and there are now several new indications that have increased the use of rTSA.^{9,14} Recent evidence indicates that rTSA is now used as frequently as aTSA in Medicare patients.¹⁵ With the total number of rTSAs being performed greatly increasing and the indications for rTSA expanding, it is important to understand potential outcomes and have accurate expectations regarding functionality and satisfaction following rTSA for both patients and physicians. Currently, many physicians recommend against bilateral rTSA for their patients despite improved pain relief, range of motion and function in CTA and rotator cuff deficient shoulders.^{5,10} The purpose of this study was to compare the functional outcomes and patient satisfaction in those with bilateral rTSA to patients with bilateral aTSA, as few studies have evaluated outcomes following bilateral rTSA. This study found no significant difference in patient satisfaction or self-reported shoulder function scores between the two groups.

The use of patient reported outcomes rather than physician derived

scoring systems to assess functional outcomes following orthopaedic surgery has increased over the past several decades. There are several reasons for this trend, but foremost is that the majority of orthopaedic surgery, including TSA, is performed with the purpose of improving the patients' perceived quality of life and ability to function on a daily basis.¹⁶ More objective, physician-derived scoring systems fail to adequately account for patients' perceived quality of life, and thus, frequently lead to discrepancies between the patient's and physician's reported satisfaction on the outcomes of surgery.¹⁷ Since patient satisfaction and ability to perform desired ADLs and activities should ultimately dictate the use of TSA, more subjective shoulder scores have been widely used to assess outcomes following TSA, and it is for these reasons that such scores were used in this study.

The findings of this study indicate that bilateral rTSA results in high patient satisfaction similar to that seen with bilateral aTSA. This is consistent with previously published studies for reverse and anatomic total shoulder arthroplasty^{9,12,18}; however, we are not aware of any previously published studies that have directly compared function outcomes and patient satisfaction between bilateral rTSA and bilateral aTSA. There were no significant differences in the ASES, SST, or PENN scores between the two groups, indicating that patients undergoing bilateral rTSA can expect functional outcomes similar to those obtained after bilateral aTSA. For this reason, we failed to reject our hypothesis that there would not be a significant difference in self reported patient function or overall satisfaction when comparing patients who have undergone staged bilateral aTSA and those who have undergone staged bilateral rTSA.

Stevens et al. evaluated the degree of function following bilateral rTSA and reported that patients did not have difficulty performing genital hygiene following bilateral rTSA, but did have difficulty performing other activities that required greater amounts of IR such as tucking in ones shirt or fastening a bra.³ Their study did not incorporate a control or comparator and simply reported outcomes in 15 patients who underwent bilateral rTSA. A more recent study performed by Wirth et al. evaluated similar outcomes, looking specifically at internal rotation and function following bilateral rTSA in a larger cohort of 57 patients with similar outcomes.¹¹ An earlier study by Latif et al. compared the function between rTSA and aTSA in contralateral shoulders of individual patients and found a significant difference in ASES and Constant scores between rTSA and aTSA, but patient satisfaction was the same for both arthroplasties.¹² However, they did not involve patients who underwent bilateral rTSA. Also, neither of these studies evaluated patient satisfaction following bilateral aTSA. Another study conducted by Triplet et al. specifically compared differences in internal rotation between rTSA and aTSA, but they also did not specifically evaluate bilateral arthroplasties.¹³ A final, more recent study evaluated outcomes following bilateral rTSA in comparison to unilateral rTSA.² None of these prior studies directly compared the functional outcomes and patient satisfaction following bilateral rTSA with bilateral aTSA.

As mentioned, the current study is the only one to our knowledge that compares functional outcomes following bilateral rTSA with those following bilateral aTSA. The results of this study support previous findings that bilateral rTSA is a viable option for patients with bilateral cuff deficient arthropathy.^{2,3,11} Furthermore, this study suggests that bilateral rTSA may be recommended with expected functional outcomes and patient satisfaction similar to that seen with bilateral aTSA.

One variable that may affect outcomes following rTSA and may have previously contributed to the hesitation seen in some orthopaedic surgeons with recommending bilateral rTSA is the differences observed with a lateralized vs. non-lateralized center of rotation. The rTSA design aims to re-tension the deltoid and increase its moment arm, thus increasing is torque-producing capacity in abduction.¹⁹ The result is that in a non-lateralized rTSA, there is a significant increase in flexion and abduction; however, both external and internal rotations are not usually significantly improved.^{20,21} Prosthesis designs that utilize a more lateralized center of rotation have shown to have increased active

range of motion following surgery and thus offer improved capability to perform ADLs which require higher levels of internal or external rotation. A recent systematic review reported better improvement in both ASES and external rotation following rTSA with a lateralized center of rotation.¹⁸ Our data supports these findings that newer prosthesis designs which utilize a more lateralized center of rotation offer improved range of motion and ability to perform ADLs.

There are several limitations to this study. The sample size is small and the mean follow up time for each group is not long term. Due to its retrospective design, this study also failed to collect pre-surgical data, which would have provided better insight into the overall benefits of bilateral rTSA. Also, the limited number of patients available for inclusion in this study did not allow for the study to be properly powered, and this greatly limited the conclusions that could be drawn from the data. Expanding this study to include larger sized cohorts in future studies may allow for stronger conclusions to be drawn. The assessment scores used are also subjective measurements of patient function, and quantitative values for internal rotation were not collected. Patient reported outcomes are useful tools for reporting surgical outcomes, but they fail to account for the impact the patient's overall physical and mental health has on reporting. However, this consideration should not negate the use of self-reported outcome measures that have been validated to assess shoulder function, and the benefits of such measures were previously discussed. Another possible weakness of this study is the use of multiple types of prosthesis in both the aTSA and rTSA groups. Strengths of this study are that a single surgeon performed all of the operations and that validated outcome measures were used.

5. Summary/conclusions

The use of rTSA continues to expand as the overall number of total shoulder arthroplasties and indications for use of rTSA grow. Despite this growth, many orthopaedic surgeons recommend against bilateral rTSA due to fears regarding ability to perform ADLs that require large amounts of internal rotation. The data presented in this study suggests that bilateral rTSA results in similar patient reported outcomes measures and satisfaction as those seen with aTSA. This study also supports that patients are able to perform important ADLs following bilateral rTSA comparable to those who receive bilateral aTSA, and patient satisfaction is high in both groups. These findings suggest that previous concerns regarding limitations of motion and function following bilateral rTSA are not substantiated.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jor.2019.08.001>.

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