Anatomic Versus Reverse Total Shoulder Arthroplasty for Primary Osteoarthritis: Case Controlled Comparisons using the Machine Learning Derived Shoulder Arthroplasty Score

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INTRODUCTION:

The role of reverse total shoulder arthroplasty (rTSA) in the management of glenohumeral osteoarthritis (GHOA) with an intact rotator cuff remains unclear especially with investigations demonstrating similar patient reported outcome measures to anatomic total shoulder arthroplasty (aTSA). However, legacy outcome scores are subject to skewed distributions with many patients achieving the maximum possible score (ceiling scores). The purpose of this investigation was to evaluate a cohort of primary rTSAs performed for GHOA with an intact rotator cuff compared to a case matched cohort of aTSAs utilizing the Shoulder Arthroplasty Smart score (SAS), a machine learning derived outcome score which eliminates the ceiling effect.

METHODS:

A retrospective review of an international shoulder arthroplasty database was performed between 2001 and 2020. Patients undergoing rTSA for rotator cuff intact GHOA (n = 367) were matched 1:1 with aTSA controls (n = 367) with a minimum of 2-year follow-up. Assessed variables included patient demographics, range of motion, American Shoulder Elbow Surgeons score (ASES), Simple Shoulder Test (SST), and the SAS score.

RESULTS:

Preoperatively, the SAS and SST scores were greater in patients undergoing aTSA versus rTSA (49.5 vs. 45.2, $P < .001$ and 4.7 vs. 4.1, $P = .002$) (**Table 1**). Similarly, the SAS score (82.3 vs. 77.6, $P < .001$) and SST score (10.8 vs. 10.3, $P = .003$) remained greater in patients undergoing aTSA postoperatively. In contrast, no differences in the ASES scores were found between aTSA and rTSA patients postoperatively ($P = .103$). However, a greater proportion of patients that underwent aTSA versus rTSA rated their ability postoperatively to perform five rotationally-demanding functional tasks as "Normal". Differences in patient's ability perform three of the five functional tasks were maintained when comparisons were isolated to patients that achieved a maximal SST score. Improvement preoperatively to postoperatively did not differ between aTSA and rTSA patients when assessed using the SAS (P = .257), ASES (P = .888), or SST scores (P = .510). A higher rate of complications (5.4% vs. 1.6%). and revision surgery (4.1% vs. 0.5%) were observed in patients undergoing aTSA compared to rTSA

DISCUSSION AND CONCLUSION:

Patients undergoing surgery for rotator cuff intact GHOA can expect similar levels of improvement after both aTSA and rTSA when evaluated using a validated outcome score without a ceiling effect. Unlike the ASES and SST scores which are limited by ceiling effects, a higher mean postoperative SAS score after an aTSA was observed but preoperative to postoperative SAS differences were similar to final rTSA values.

Table 1: Preoperative, postoperative, and pre-to-post-operative improvement in outcomes between aTSA and rTSA performed for GHOA with an intact rotator cuff.

Outcome Measure	aTSA (n = 367)	rTSA (n = 367)	*P* value
Preoperative			
SAS score inputs			
Active FE (°)	105 ± 32	92 ± 35	**<.001**
Active IR score	3.3 ± 1.6	3.0 ± 1.7	**.022**
Active ER (°)	23 ± 20	17 ± 19	**<.001**
Daily pain	6.2 ± 2.0	6.3 ± 2.2	.550
Pain lying on affected side	7.1 ± 2.6	7.2 ± 2.5	.545
Shoulder function	4.4 ± 2.0	4.0 ± 2.0	**.008**
SAS score	49.0 ± 10.7	45.2 ± 11.6	**<.001**
ASES score	38.2 ± 15.1	36.0 ± 16.1	.057
SST score	4.7 ± 2.8	4.1 ± 2.7	**.002**
Postoperative			
SAS score inputs			
Active FE (°)	152 ± 24	146 ± 24	**.001**
Active IR score	5.1 ± 1.4	4.3 ± 1.6	**<.001**
Active ER (°)	52 ± 18	40 ± 17	**<.001**
Daily pain	1.0 ± 1.9	0.9 ± 1.9	.769
Pain lying on affected side	1.2 ± 2.2	1.3 ± 2.4	.327
Shoulder function	8.7 ± 1.8	8.5 ± 1.8	.134
SAS score	82.3 ± 10.2	77.6 ± 10.9	**<.001**
ASES score	88.0 ± 16.0	86.0 ± 16.8	.103
SST score	10.8 ± 2.1	10.3 ± 2.3	**.003**
Improvement			
SAS score inputs			
Active FE (°)	47 ± 34	53 ± 38	**.011**
Active IR score	1.8 ± 1.8	1.3 ± 1.9	**.001**
Active ER (°)	29 ± 22	23 ± 20	**<.001**
Daily pain	-5.2 ± 2.6	-5.4 ± 2.7	.476
Pain lying on affected side	-5.9 ± 3.1	-5.9 ± 3.1	.822
Shoulder function	4.3 ± 2.5	4.5 ± 2.5	.279
SAS score	31.8 ± 14.2	32.7 ± 13.7	.257
ASES score	49.8 ± 19.8	50.0 ± 21.2	.888
SST score	6.1 ± 3.2	6.3 ± 3.2	.510

aTSA, anatomic total shoulder arthroplasty; *rTSA*, reverse shoulder arthroplasty; *SAS*, smart shoulder arthroplasty; *FE*, forward elevation; *IR*, internal rotation; *ER*, external rotation; *ASES*, American shoulder and elbow surgeons; *SST*, simple shoulder test.
Values expressed as a mean ± standard deviation.
Bold values are statistically significant.