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Patient reported outcomes and ranges of motion after reverse total shoulder arthroplasty with and without subscapularis repair

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Background: In performing reverse total shoulder arthroplasty (rTSA), the role of repairing the subscapularis has been debated. Our objective was to determine the effect of subscapularis repair following rTSA on postoperative shoulder ranges of motion and patient reported outcome scores (PROs).

Methods: A prospective registry was reviewed to establish a cohort of primary rTSA patients with a 135-degree humeral implant, with a minimum of 2 years of follow-up. Variables collected included demographics, subscapularis repair information, diagnosis, glenosphere size, and glenoid lateralization information. Outcomes collected were range of motion measurements, subscapularis strength, and multiple generic and shoulder PROs. Multivariable linear regression models were created to predict these 2-year outcomes.

Results: The 143-patient cohort had a mean age of 69 years with 68% of patients undergoing subscapularis repair. After adjustment in the multivariable models, whether the subscapularis was repaired did not significantly predict a 2-year forward elevation, external rotation, internal rotation, subscapularis strength, Western Ontario Osteoarthritis of the Shoulder score, VR-12 scores, Constant Score, or American Shoulder and Elbow Surgeons Shoulder Scores. Increased glenoid lateralization significantly predicted greater internal rotation, higher VR-12 physical score, and higher Constant Score. There were no dislocations in either group.

Conclusions: After adjusting for patient and implant factors, subscapularis repair was not associated with a 2-year postoperative range of motion, strength, or any PROs suggesting that repairing the subscapularis may not affect functional outcome. Increased glenoid lateralization through the baseplate and glenosphere independently predicted better internal rotation, VR-12 physical score, and Constant Scores indicating a benefit to lateralization during rTSA.

Reverse total shoulder arthroplasty (rTSA) was originally developed to treat a rotator cuff tear arthropathy. In recent years, its indications have been expanded to treat primary glenohumeral arthritis with glenoid deficiency, proximal humerus fractures, massive irreparable rotator cuff tears, and revision of failed anatomic shoulder arthroplasty. With added indications, the utilization of rTSA has been increasing in the United States with 7.3 procedures per 100,000 persons in 2012 rising to 19.3 procedures per 100,000 persons and over 62,000 rTSAs performed in 2017.[3]

In performing an rTSA, the role of repairing vs. not repairing the subscapularis has been debated in both clinical and biomechanical papers. Proponents of repair have suggested that repair is associated with improved internal rotation[26] and decreased dislocation risks.[5] Edwards et al reported that a subscapularis that was irreparable resulted in a statistically significant increase in dislocations after rTSA.[9] In a biomechanical cadaver study, Oh et al demonstrated that loading an intact subscapularis in rTSA resulted in an increased force required to dislocate the prosthesis anteriorly.[19] Proponents of not repairing the subscapularis believe that this

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Table I
Baseline study cohort characteristics (N = 143).

Characteristics	No repair (n = 46)	Subscapularis repair (n = 97)	*P* value
Demographics			
Sex, Female, N (%)	16 (35)	47 (48)	.13
BMI, Kg/M^2, Mean ± Sd	30.80 ± 6.5	30.35 ± 5.9	.68
Age, Yr, Mean ± Sd	67 ± 6.9	69 ± 7.6	.19
Non-smoker, N (%)	43 (93)	90 (93)	.88
Not Diabetic, N (%)	44 (96)	84 (87)	.1
Not Workman's Comp, N (%)	41 (89%)	87 (90)	.92
Dominant Arm, Yes, N (%)	30 (65)	63 (65)	.98
Underlying Diagnosis			
RCA, N (%)	30 (65)	65 (67)	.83
Arthritis, N (%)	11 (24)	23 (24)	.97
PH FX, N (%)	1 (2)	0	.15
Failed RTCR	3 (7)	6 (6)	.93
AVN, N (%)	0	2 (2)	.33
Capsulorrhaphy, N (%)	1 (2)	2 (2)	.59
Pre-Operative ROM			
Active FF, Degrees ± Sd	95.09 ± 36.7	98.55 ± 37.9	.61
Active ER At Side, Degrees ± Sd	34.78 ± 17.5	37.0 ± 22.3	.56
Active ER At 90, Degrees ± Sd	26.87 ± 26.9	29.13 ± 30.7	.67
Active IR, Spinal Level	L3-L4	L4	.25
Active IR At 90, Degrees ± Sd	21.73 ± 21.7	21.0 ± 25.6	.87
Subscapularis Strength, Lbs ± Sd	8.58 ± 6.9	7.81 ± 4.8	.44
Pre-Operative PROs			
Constant Score, N ± Sd	34.49 ± 11.8	32.12 ± 14.3	.33
ASES, N ± Sd	42.60 ± 17.4	37.95 ± 18.8	.16
WOOS, N ± Sd	39.86 ± 17.39	36.29 ± 22.3	.34
VR-12 Physical Score, N ± Sd	33.11 ± 8.0	33.67 ± 7.5	.69
VR-12 Mental Score, N ± Sd	54.36 ± 11.0	47.99 ± 12.5	**.004**

SD, standard deviation; *BMI*, body mass index; *RCA*, rotator cuff arthropathy; *PH FX*, proximal humerus fracture; *RTCR*, rotator cuff repair; *AVN*, avascular necrosis; *ROM*, range of motion; *FF*, forward flexion; *ER*, external rotation; *IR*, internal rotation; *Lbs*, pounds; *PROs*, patient-reported outcomes; *ASES*, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *WOOS*, Western Ontario Osteoarthritis Shoulder; *VR-12*, Veterans RAND, 12-Item Health Survey.
Boldface indicates significance.

can improve external rotation without compromise of clinical outcomes. In a cohort study of 340 rTSA patients with a 145-degree onlay humeral prosthesis, Friedman et al reported the non-repaired cohort had increased active abduction and passive external rotation.[12] In a single surgeon cohort with 3 years follow-up, rTSA with or without subscapularis repair showed similar patient reported outcomes scores (PROs), ranges of motion (ROM), and complications.[25] A cadaveric biomechanical study showed that repair of the subscapularis significantly increased the force required by the deltoid and posterior rotator cuff to function and increased the joint reactive force.[18] Implant specific factors of a medialized vs. relatively lateralized center of rotation can, further, influence the outcomes of rTSA with or without subscapularis repair.[14]

With the ongoing debate about the influence of repairing vs. not repairing the subscapularis, the present study aimed to determine the effect of subscapularis repair following rTSA on postoperative shoulder ROM and PROs. With detailed implant data, the study will also evaluate, if component lateralization affects outcomes with or without subscapularis repair. We hypothesize that subscapularis repair following rTSA will not affect clinical outcomes.

Materials and methods

Database and study cohort

A retrospective cohort of rTSA was generated from a prospectively collected multicenter database of shoulder arthroplasties enrolled from 09/09/2015-08/06/2019 with 14 surgeons at 12 sites. Inclusion criteria comprises the following: 1) underwent primary rTSA, 2) comply with postoperative follow-up visits with preoperative and 2-year postoperative patient-reported outcomes and ROM measurements. Patients without complete dataset or revision cases were excluded from this study. Among an initial cohort of 220 patients, a subset of 143 patients (65%) had a 2-year follow-up including ROM and PROs outcomes.

The hospital institutional review board approved the study. Initial analyses were separated by whether subscapularis repair was performed based on surgeon preference at the time of the arthroplasty. The decision to repair or not repair the subscapularis after rTSA as well as techniques, were not standardized and done at the attending surgeons' discretion. The subscapularis was taken down via a subscapularis peel, subscapularis tenotomy, or a lesser tuberosity osteotomy. The method of subscapularis repair was by suture only in cases of tenotomy, suture through bone tunnels drilled in the proximal humerus, suture through eyelets in the prosthesis only, or suture through bone and prosthesis holes. Variables collected included demographics, underlying shoulder diagnosis, preoperative ROM (active forward flexion, active external rotation, active internal rotation), and preoperative PROs (Table I). Patients received a shoulder arthroplasty through a deltopectoral approach per standard of care utilizing an Arthrex Univers Revers prosthesis (Arthrex, Inc. Naples, FL, USA) with a 135° neck-shaft angle. Rehabilitation was not standardized between surgeons. Further information was collected regarding glenosphere size (33, 36, 39, 42 mm) and a cumulative glenoid lateralization (CGL) variable as created. The CGL variable was in ordinal increments ranging from 0-8 through various combinations of baseplate (0, +2, or +4 lateral augmentation) and glenosphere lateralization (0 or +4 lateralization).

Clinical outcomes

Active ROM measurements for active forward flexion (FF), active external rotation (ER) at the side and at 90° abduction, and active internal rotation (IR) at 90° abduction and to the nearest spinal level were obtained by the examiner at the preoperative visit and the 2-year follow-up. Subscapularis strength was measured with a belly press test using a manual muscle testing dynamometer in pounds before surgery and at 2-years postoperatively. Subscapularis strength can be reliably tested with a dynamometer.[13] The operating surgeon did the postoperative assessment and was not formally blinded to the subscapularis repair status.

PROs obtained are as follows: Constant Score (CS), American Shoulder and Elbow Surgeons Assessment Form (ASES) total score, Western Ontario Osteoarthritis Score (WOOS) total score, Veterans RAND 12-Item Health survey (VR-12) physical score, and VR-12 mental score. The CS assessment combines physical examination tests (65 points) with patient reported evaluations (35 points).[2,6,7] It has become the most widely used shoulder evaluation instrument in Europe. The score consists of 4 domains as follows: pain, activities of daily living (ADLs), mobility, and power/strength. Scores range from 0 (worst) to 100 (best). The ASES score was developed in 1993 to assess function or disability with ADLs with a patient self-evaluation section applicable to all shoulder patients regardless of diagnosis.[2,21] It contains a patient self-assessment section divided into 3 sections (pain, instability, and ADLs), and a section completed by an examiner (ROM, signs, strength, and instability). Scores range from 0 (worst) to 100 (best). Normative data provided in a graph form and are stratified by a 10-year age group.[23] The WOOS assessment was created in 2001 to evaluate primary outcome measures for patients with symptomatic primary shoulder osteoarthritis.[16,17] It contains 4 areas including physical symptoms, sport/recreation/work, lifestyle, and emotional functions. Scores range from 0% or raw score 1900 (worst) to 100% or raw score 0 (best quality of life). The VR-12 physical and mental assessments were developed from the VR-36, which are generic instruments to measure health-related qualify of life.[15,24] Scoring is based on weights derived from VR-36 in the 1999 Large Health Survey of Veteran Enrollees.[24] The VR-12 includes 12 questions that do not give an overall score but yield a Physical and Mental component score, which are standardized to the US population with a mean of 50 and standard deviation of 10.

Statistical analysis

Baseline and demographic variables were summarized with descriptive statistics; means and standard deviation for continuous data, and counts and proportions for categorical variables. T-tests were used to evaluate for differences between subscapularis repair and no repair groups. Multivariable linear regression models were created for each dependent 2-year outcome measures using a selection of predictor variables as follows: preoperative score of the outcome of interest, sex, age, body mass index, diabetes, subscapular repair status, subscapularis tear status, underlying diagnosis, glenosphere size, and cumulative glenoid lateralization. Variables were selected based on expert opinion and prior literature as potential confounders in outcome assessment. The subscapularis repair status was the primary predictor of interest. Sample size was adequate to make reliable predictions with at least 10 patients per predictor included in the model.[1] STATA/MP 14.2 (Stata Corp., College Station, TX, USA) was used for statistical analysis. A P value < .05 was considered statistically significant.

Results

Study cohort

Baseline cohort characteristics, baseline ROM, and baseline PROs are stratified by subscapularis repair and provided in Table I. Overall, 68% of patients underwent subscapularis repair at the time of rTSA. 69% of patients were noted to have a partial or full thickness subscapularis tears. Rotator cuff arthropathy was the most common preoperative diagnosis for rTSA. There were no significant differences in the preoperative ROM between the two groups. VR-12 mental score was the only baseline characteristic with a significant difference between subjects who underwent subscapularis repair and those who did not (P value = .004).

2-Year clinical outcomes

This 143-patient cohort had a minimum 2-year follow-up with repeated PROs and ROM outcomes. Active external rotation at the side was the only 2-year outcome with significant difference between the no repair and repair groups at 2 years (Table II). Active FF, ER, and IR in degrees had statistically significant improvements from baseline to 2-year postoperative examination in both subscapularis repair and not repaired groups. Subscapularis strength significantly improved in the patients with subscapularis repair only.

In the group without subscapularis repair, PROs with a statistically significant improvement from baseline were the Constant Score, ASES score, WOOS score, and VR-12 physical score (Table II). The only outcomes without a significant difference in this group were the VR-12 mental score and subscapularis strength. In the patients who underwent subscapularis repair, all PROs had a statistically significant improvement from the baseline (Table II).

Multivariable regression

After adjustment with regression analysis, the preoperative outcome of interest significantly predicted its own 2-year outcomes for FF (P value = .03), ER (P value < .001), subscapularis strength (P value < .001), CS (P value = .006), ASES (P value = .02), WOOS (P value = .046), VR-12 physical score (P value < .001), and VR-12 mental score (P value < .001) (Table III). The demographic variables that significantly predicted a difference in active ER at two years after surgery was sex and diabetes (both P values = 0.02). Sex (P value = .001) and body mass index (P Value = .048), significantly predicted the 2-year subscapularis strength. At the time of surgery, partial subscapularis tear deemed repairable, significantly predicted better active ER at 2 years postoperatively (P value = .02). Subscapularis repair status did not significantly predict 2-year outcomes for any of the clinical outcomes. Among the implant-specific variables, glenosphere size significantly predicted an improvement in VR-12 physical score only (P value = .01). Based on model coefficients, a 1 mm increase in glenosphere size improved the VR-12 physical score by 1 point. Furthermore, increased CGL significantly predicted a greater active IR (P value = .001), higher CS (P value = .04), and higher VR-12 physical score (P value = .03) (Table III). Based on coefficients in each regression model, every 1-point increase in CGL improved the active internal rotation by 3.1 degrees, improved the Constant Score by 1.4 points, and improved the VR-12 physical score by 0.9 points.

Complications

Three complications (6%) were reported in the group without subscapularis repair with one revision (2%) (Table IV). In contrast,

Table II
Two year clinical outcomes (N = 143).

Outcomes	Baseline		2-Y outcomes			Total change baseline to 2-y	
	No repair (N = 46)	Subscap repair (N = 97)	No repair (N = 46)	Subscap repair (N = 97)	*P* value comparing groups at 2 y	No repair *P* value	Subscap repair *P* value
ROM							
Active FF, Degrees ± Sd	95.1 ± 36.7	98.5 ± 37.9	137.4 ± 21.6	131.4 ± 33.0	.27	**<.001**	**<.001**
Active ER At Side, Degrees ± Sd	34.8 ± 17.5	37.0 ± 22.3	46.7 ± 11.3	48.9 ± 23.9	.56	**<.001**	**<.001**
Active ER At 90, Degrees ± Sd	26.9 ± 26.9	29.1 ± 30.7	60.6 ± 25.3	50.0 ± 27.5	**.03**	**<.001**	**<.001**
Active IR, Degrees ± Sd	21.7 ± 21.7	21 ± 25.6	31 ± 20.8	31 ± 17.4	1	**.04**	**.002**
Subscapularis Strength, Lbs ± Sd	8.6 ± 6.9	7.8 ± 4.8	9.8 ± 4.0	9.5 ± 4.4	.66	.27	**.01**
PROs							
Constant Score, N ± Sd	34.5 ± 11.8	32.1 ± 14.3	63.6 ± 13.4	61.0 ± 15.8	.33	**<.001**	**<.001**
ASES Index Score, N ± Sd	42.6 ± 17.4	38.0 ± 18.8	79.7 ± 20.3	78.6 ± 17.7	.75	**<.001**	**<.001**
WOOS Total Score, N ± Sd	39.9 ± 17.4	36.3 ± 22.3	83.2 ± 19.6	80.6 ± 21.2	.5	**<.001**	**<.001**
VR-12 Physical Score, N ± Sd	33.1 ± 8.0	33.7 ± 7.5	42.7 ± 9.5	42.3 ± 9.0	.79	**<.001**	**<.001**
VR-12 Mental Score, N ± Sd	54.4 ± 11.0	48.0 ± 12.5	54.9 ± 8.2	53.2 ± 9.6	.31	.78	**.001**

SD, standard deviation; *ROM*, range of motion; *FF*, forward flexion; *ER*, external rotation; *IR*, internal rotation; *Lbs*, pounds; *PROs*, patient-reported outcomes; *ASES*, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *WOOS*, Western Ontario Osteoarthritis Shoulder; *VR-12*, Veterans RAND, 12-Item Health Survey.
Boldface indicates significance.

Table III
2-Year regression model results.

Predictor variable	Active FF	2-year regression model *P* values							
		Active ER	Active IR	Subscap strength	CS	ASES	WOOS	VR-12p	VR-12M
Pre-Op value	**0.03**	**<0.001**	0.24	**<0.001**	**0.006**	**0.02**	**0.046**	**<0.001**	**<0.001**
Sex	0.33	**0.02**	0.74	**0.001**	0.25	0.17	0.08	0.12	0.24
Age	0.42	0.6	0.36	0.08	0.73	0.4	0.14	0.7	0.36
BMI	0.84	0.56	0.9	**0.048**	0.77	0.72	0.47	0.76	0.19
Diabetes	0.97	**0.02**	0.67	0.19	0.13	0.83	0.55	0.67	0.78
Pre-Op diagnosis									
Failed RTCR	0.58	0.87	0.7	0.42	0.06	0.06	**0.01**	0.19	0.45
Irreparable RTC	0.3	0.11	0.45	**0.005**	0.25	0.65	0.75	0.31	0.91
PH FX	0.43	0.4	0.24	0.48	0.66	0.98	0.96	0.4	0.18
AVN	0.9	0.75	0.89	0.83	0.99	0.77	0.63	0.65	0.79
RCA	0.88	0.27	0.58	0.08	0.54	0.5	0.65	0.64	0.48
Subscapularis tear									
PTR	0.7	**0.02**	0.57	0.29	0.64	0.56	0.55	0.55	0.08
PTU	0.13	0.17	0.88	0.14	0.53	0.58	0.54	0.55	0.24
FTT	0.18	0.15	0.84	0.91	0.48	0.92	0.89	0.54	0.49
Subscapularis repair	0.28	0.52	0.96	0.75	0.53	0.91	0.39	0.95	0.67
Glenosphere size, mm	0.39	0.45	0.75	0.44	0.1	0.1	0.13	**0.01**	0.21
Cumulative glenoid lateralization (CGL)	0.36	0.37	**0.001**	0.83	**0.04**	0.84	0.77	**0.03**	0.79

BMI, body mass index; *RTCR*, rotator cuff repair; *RTC*, rotator cuff; *PH FX*, proximal humerus fracture; *AVN*, avascular necrosis; *RCA*, rotator cuff arthropathy; *SS*, subscapularis; *PTR*, partial tear repairable; *PTU*, partial tear unrepairable; *FTT*, full-thickness tear; *CGL*, cumulative glenoid lateralization; *CS*, Constant Score; *ASES*, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *WOOS*, Western Ontario Osteoarthritis Shoulder; *VR-12P*, Veterans RAND, 12-Item Health Survey Physical Assessment; *VR-12M*, Veterans RAND, 12-Item Health Survey Mental Assessment.
Boldface indicates significance.

the complication rate was nearly doubled with thirteen complications (13%) in the subscapularis repair group with 3 reported revisions (3%). The most common cause of revision was loosening between the groups. There were no dislocations in either group.

Discussions

With or without adjustment for patient and implant factors, subscapularis repair was not associated with the 2-year postoperative range of motion, strength, or any of the PROs studied. Increased glenosphere size and higher cumulative glenoid lateralization independently predicted improved 2-year VR-12 physical scores. Higher cumulative glenoid lateralization independently predicted improved active internal rotations and improved the Constant Score. Patients showed statistically significant improvements in active forward flexion, external and internal rotations, Constant Score, ASES score, WOOS, and VR-12 physical and mental scores 2 years after rTSA with or without subscapularis repair. Complication data showed that implant loosening was the most common cause of revision, but a low number of complications prevented further conclusions.

Literature on the outcomes comparing rTSA with or without subscapularis repair have been mixed regarding the effect on range of motion, PROs, and complications. A recent systematic review and meta-analysis by De Fine et al[8] evaluated the role of the subscapularis in rTSA and incorporated 6 retrospective cohort studies[4,11,12,22,25,28] on the topic. The pooled results from the meta-analysis showed no difference in the dislocation rate and noted no qualitative difference in ROM and PROs between the repairing vs. not repairing the subscapularis. Regarding ROM, three studies[4,22,25] showed no difference with or without subscapularis repair. Another study showed patients with subscapularis repair had significantly more IR and patients, without repair had significantly more active abduction and passive ER.[12] A different study found

Table IV
Complications.

Complications	No repair (N = 46)	Subscap repair (N = 97)
Loosening	1 (2%)	2 (2%)
Periprosthetic fracture	2 (4%)	1 (1%)
Nerve damage	0	1 (1%)
Stiffness	0	1 (1%)
Venous thrombosis	0	1 (1%)
Other medical issue	0	4 (4%)
Other surgical issue	0	2 (2%)
Death	0	1 (1%)
Revisions/reoperations		
Loosening	1 (2%)	1 (1%)
Periprosthetic fracture	0	0
Nerve damage	0	1 (1%)
Stiffness	0	1 (1%)

higher IR in repaired patients and higher abduction in the group without repair.[11] Regarding PRO comparison with or without subscapularis repair, de Boer found no difference in Constant Scores,[4] Roberson found no difference in VR-12 and ASES scores,[22] Vourazeris found no difference in ASES scores,[25] Friedman showed and improved ASES scores and Constant Scores in the repair group,[12] and Francschetti discovered no difference in Constant Scores.[11] Although these papers comparing rTSA with or without subscapularis repair are very informative on the subject, they were all retrospective cohorts that did not use multivariable methods to adjust for confounders. In the only randomized trial on the topic, Engel et al studied 50 rTSA patients that were randomized to subscapularis repair vs. non-repair groups and found that repairing the subscapularis resulted in an improved Constant Score and internal rotation 12 months postoperatively.[10] The study however acknowledged a limitation of low sample size of 20 and 21 patients with follow-up in each group and a switch in prosthesis use part way through the study.

Our study is unique in that it uses a prosthesis with 135° neck-shaft angle, and uses multivariable regression modeling to adjust for confounding variables which allows for independent evaluation of the effect of subscapularis repair on rTSA outcomes. Using these methods, our study showed no difference in ROM or any of the PROs measured 2 years postoperatively with or without subscapularis repair.

Trends in rTSA prosthesis design have moved towards a more lateralized center of rotation from the initial Grammont prosthesis to achieve lower rates of scapular notching and implant stability.[20] Werner et al evaluated rTSA with or without subscapularis repair and the influence of glenosphere lateralization with adjustments through stratification.[28] In a retrospective cohort with 2-year follow-up, they found patients with a lateralized glenosphere and a repaired subscapularis had significantly less improvement in ASES scores compared to patients without lateralization and without repair. Using a t-test, this study found no significant difference in change of ASES score between patients with or without subscapularis repair.[28] Our study incorporated lateralization into the modeling using glenosphere size and a cumulative glenoid lateralization variable that ranged from 0-8 through various combinations of baseplate and glenosphere lateralization. The multivariable regression method enables independent assessment of how lateralization affects outcomes using these variables. Our study showed improved 2-year internal rotation, Constant Score, and VR-12 physical score with increased lateralization of the glenoid in rTSA independent of subscapularis repair status. For every 1-point increase in cumulative glenoid lateralization, active internal rotation increased by 3.1 degrees, the Constant Score increased by 1.4 points, and the VR-12 physical score increased by 0.9 points. Since the effects are additive, implant decision making in changing from a non-lateralized combination with CGL of 0 vs. a fully lateralized combination with CGL of 8 would have a larger effect on these outcomes. It is unknown how much the glenoid component can be lateralized before subscapularis repair, is not feasible and this warrants further investigation. It is possible that internal rotation improvements after lateralization could be due to impingement-free ranges of motion. The improvement in active internal rotation with more glenoid lateralization is in line with a recently published study with the same implant.[27]

Our study has several limitations to consider when interpreting the results. A retrospective database was used, leading to limited later input into variable selection and a contraction of sample size due to missing variables for patients. Multiple surgeons contributed patients to the cohort and performing the procedure with or without subscapularis repair was at the surgeons' discretion. As this cohort came from a multicenter database of shoulder arthroplasties, there was no standardization in the rehabilitation protocols across sites which could lead to heterogeneity in therapy for these patients. Lastly, our study used the subscapularis repair status at the time of surgery in data analysis. There was no further advanced imaging to assess for healing or integrity of the subscapularis at 2 years when outcomes were assessed.

Conclusions

Patients had similar outcomes in the range of motion and patient reported outcome scores with or without subscapularis repair at the time of rTSA. Increased glenoid lateralization through the baseplate and glenosphere was associated with better active internal rotation, VR-12 physical score, and Constant Scores indicating a benefit to lateralization during rTSA.

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