Influence of Timing after Rotator Cuff Repair on Clinical Outcomes of Reverse Shoulder Arthroplasty

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INTRODUCTION: Reverse shoulder arthroplasty (RSA) after prior rotator cuff repair (RCR) is commonly indicated due to recurrence of pain and dysfunction; however, the influence of prior RCR timing and technique on outcomes of RSA has not been adequately explored. This study aims to evaluate the relationship between RCR technique and timing on pain and functional outcomes after subsequent RSA.

METHODS: A prospectively-collected single institution shoulder arthroplasty database was queried to identify patient who had undergone primary RSA after prior RCR between 2004-2022 for non-tumor and non-fracture indications with minimum 2-year clinical follow-up. Our primary aim was to evaluate the relationship between the postoperative American Shoulder and Elbow Surgeons (ASES) score and whether prior RCR was performed open versus arthroscopic and the time interval between RSA and prior RCR. Secondary outcomes were forward elevation and external rotation. Multivariable analysis was used to adjust for potential confounders: respective baseline score/motion, age, sex, follow-up, tobacco use, and whether the infraspinatus and teres minor were intact at the time of RSA.

RESULTS: We included 104 RSAs (99 patients) who underwent primary RSA at a mean 8.8 years after RCR, with a mean age of 68 years and 45% females (Table 1). Prior RCR was performed arthroscopically in 62% (Figure 1). Mean follow-up in this cohort was 4.8 years. The diagnosis at the time of RSA was most commonly rotator cuff arthropathy (60%), followed by osteoarthritis with a torn rotator cuff (14%) and massive rotator cuff tear (14%). On bivariable analysis, prior arthroscopic RCR was associated with a greater postoperative ASES score compared to open RCR (73.0 ± 19.7 vs. 63.8 ± 25.7, P=.044; Table 2). On multivariable analysis, arthroscopic RCR was independently associated with a 13-point greater postoperative ASES score (P=.008), 14° greater forward elevation (P=.011), and 8° greater external rotation (P=.018) compared to open RCR (Table 3). A 10-year increase in time between RCR and RSA was associated with 7-point greater postoperative ASES score (P=.029) and 5° greater external rotation (P=.015).

DISCUSSION AND CONCLUSION: A greater time interval between prior RCR and RSA as well as arthroscopic instead of open RCR are associated with improved outcomes after primary RSA.

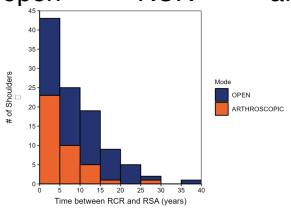

Table I. Demographics of included RSAs.

Characteristic	Overall (n=104)
Age at surgery (years)	68.4 ± 8.3
Follow-up (years)	4.8 ± 2.8
BMI (kg/m^2)	30.3 ± 7.1
Female sex	45.2% (47)
Comorbidities	
Inflammatory Arthritis	3.8% (4)
Hypertension	69.2% (72)
Heart disease	23.1% (24)
Diabetes	26.9% (28)
Tobacco use	11.5% (12)
Chronic renal failure	2.9% (3)
Chronic liver failure	0.0% (0)
Preoperative diagnosis	
Rotator cuff tear arthropathy	59.6% (62)
Osteoarthritis with a torn cuff	14.4% (15)
Massive rotator cuff tear	13.5% (14)
Osteoarthritis with an intact cuff	7.7% (8)
Avascular necrosis	2.9% (3)
Rheumatoid arthritis	1.9% (2)
Time between RCR and RSA (years)	
Mean ± SD	8.8 ± 7.3
Median [interquartile range]	6.5 [3-12]
Rotator cuff tendon torn	
Subscapularis	45.2% (47)
Supraspinatus	83.7% (87)
Infraspinatus	65.4% (68)
Teres minor	22.1% (23)
Type of RCR	
Open	61.5% (64)
Arthroscopic	38.5% (40)

BMI, body mass index; RCR, rotator cuff repair; RSA, reverse shoulder arthroplasty; SD, standard deviation. Values are mean ± standard deviation or % (N), unless

Table II. Comparison of clinical outcomes based on whether prior RCR was performed arthroscopic or open.

Outcome Measure	Arthroscopic (n=40)	Open (n=64)	P	P*
Preoperative				
SPADI	68.5 ± 15.2	66.8 ± 15.0	.591	.924
SST	3.7 ± 2.5	3.9 ± 2.8	.713	.924
ASES score	33.9 ± 15.8	39.2 ± 15.7	.101	.405
Active ER (°)	16 ± 17	24 ± 20	**.033**	.397
Active FE (°)	78 ± 34	87 ± 33	.188	.527
Active IR score	3.4 ± 1.9	3.5 ± 1.9	.738	.924
Active abduction (°)	79 ± 33	80 ± 36	.825	.924
ER strength (lbs.)	7.1 ± 3.3	7.1 ± 4.3	.924	.924
FE strength (lbs.)	5.7 ± 2.9	5.9 ± 2.8	.758	.924
Daily pain score	6.6 ± 2.3	5.7 ± 2.3	.080	.405
Worst pain score	9.2 ± 1.5	8.8 ± 1.8	.220	.527
Shoulder function score	4.1 ± 2.2	4.1 ± 1.6	.905	.924
Postoperative				
SPADI	29.2 ± 21.0	37.6 ± 26.6	.076	.236
SST	8.8 ± 3.0	7.8 ± 3.6	.125	.236
ASES score	73.0 ± 19.7	63.8 ± 25.7	**.044**	.236
Active ER (°)	34 ± 15	29 ± 17	.138	.236
Active FE (°)	125 ± 25	117 ± 28	.132	.236
Active IR score	4.0 ± 1.9	4.1 ± 1.7	.770	.770
Active abduction (°)	120 ± 29	108 ± 29	.062	.236
ER strength (lbs.)	10.3 ± 4.5	9.9 ± 5.6	.688	.750
FE strength (lbs.)	10.9 ± 5.2	9.8 ± 4.7	.297	.395
Daily pain score	2.3 ± 2.4	3.1 ± 3.1	.123	.236
Worst pain score	4.3 ± 3.3	4.8 ± 3.6	.498	.598
Shoulder function score	7.4 ± 2.6	6.8 ± 2.6	.246	.368
Improvement				
SPADI	-39.0 ± 21.9	-29.2 ± 27.4	**.045**	.108
SST	5.0 ± 3.3	3.9 ± 4.1	.132	.191
ASES score	38.5 ± 22.5	24.3 ± 28.0	**.006**	**.033**
Active ER (°)	16 ± 15	6 ± 19	**.003**	**.033**
Active FE (°)	46 ± 31	31 ± 35	**.027**	.081
Active IR score	0.7 ± 2.1	0.5 ± 2.1	.664	.725
Active abduction (°)	40 ± 33	28 ± 39	.102	.191
ER strength (lbs.)	3.5 ± 3.7	3.3 ± 4.4	.774	.774
FE strength (lbs.)	5.2 ± 3.9	4.1 ± 4.1	.143	.191
Daily pain score	-4.2 ± 3.0	-2.5 ± 3.5	**.011**	**.044**
Worst pain score	-4.9 ± 3.2	-3.8 ± 3.5	.116	.191
Shoulder function score	3.3 ± 3.3	2.7 ± 2.8	.367	.440

ASES, American shoulder and elbow surgeons; BMI, body mass index; ER, external rotation; FE, forward elevation; IR, internal rotation; RSA, reverse shoulder arthroplasty; SPADI, shoulder pain and disability index; SST, simple shoulder test. Values represent mean ± standard deviation unless otherwise noted. Bold indicates statistical significance.
P values for clinical outcomes were adjusted for multiple comparisons using the Benjamini and Hochberg false discovery rate.

Table III. Comparison of clinical outcomes based on whether prior RCR was performed ≥5.5 years ago before RSA.

Outcome Measure	≥5.5 years (n=43)	<5.5 years (n=61)	P	P*
Preoperative				
SPADI	69.3 ± 15.8	66.2 ± 14.5	.304	.406
SST	3.3 ± 2.4	4.2 ± 2.8	.087	.262
ASES score	34.9 ± 16.5	38.7 ± 15.4	.218	.356
Active ER (°)	22 ± 15	21 ± 22	.729	.746
Active FE (°)	70 ± 31	93 ± 33	**.000**	**.006**
Active IR score	3.2 ± 1.9	3.6 ± 1.9	.409	.491
Active abduction (°)	67 ± 30	89 ± 36	**.001**	**.007**
ER strength (lbs.)	6.5 ± 4.0	7.5 ± 3.9	.182	.356
FE strength (lbs.)	5.1 ± 2.7	6.3 ± 2.8	.030	.121
Daily pain score	6.1 ± 2.6	6.0 ± 2.1	.746	.746
Worst pain score	8.6 ± 2.0	9.2 ± 1.3	.123	.296
Shoulder function score	3.8 ± 2.1	4.3 ± 1.7	.211	.356
Postoperative				
SPADI	33.6 ± 26.5	34.8 ± 23.8	.814	.919
SST	8.2 ± 3.7	8.1 ± 3.3	.919	.919
ASES score	69.3 ± 25.2	65.9 ± 23.1	.480	.919
Active ER (°)	30 ± 18	31 ± 15	.899	.919
Active FE (°)	118 ± 29	122 ± 26	.475	.919
Active IR score	3.7 ± 1.9	4.2 ± 1.7	.167	.919
Active abduction (°)	111 ± 29	114 ± 30	.648	.919
ER strength (lbs.)	9.9 ± 4.8	10.2 ± 5.5	.746	.919
FE strength (lbs.)	9.8 ± 4.3	10.5 ± 5.3	.428	.919
Daily pain score	2.5 ± 2.8	3.0 ± 2.9	.364	.919
Worst pain score	4.4 ± 3.5	4.7 ± 3.5	.599	.919
Shoulder function score	7.1 ± 2.8	7.0 ± 2.4	.770	.919
Improvement				
SPADI	-35.2 ± 26.9	-31.4 ± 25.0	.462	.617
SST	4.9 ± 3.7	3.9 ± 3.9	.215	.617
ASES score	33.6 ± 27.7	27.1 ± 26.1	.226	.617
Active ER (°)	9 ± 19	11 ± 18	.688	.824
Active FE (°)	46 ± 29	30 ± 36	**.015**	.184
Active IR score	0.4 ± 1.9	0.7 ± 2.2	.424	.617
Active abduction (°)	41 ± 36	27 ± 37	.053	.317
ER strength (lbs.)	3.9 ± 4.3	3.0 ± 4.0	.329	.617
FE strength (lbs.)	4.6 ± 2.9	4.5 ± 4.8	.876	.876
Daily pain score	-3.5 ± 3.7	-2.9 ± 3.2	.391	.617
Worst pain score	-4.1 ± 3.5	-4.3 ± 3.4	.756	.824
Shoulder function score	3.3 ± 3.2	2.7 ± 2.9	.291	.617

ASES, American shoulder and elbow surgeons; BMI, body mass index; ER, external rotation; FE, forward elevation; IR, internal rotation; RSA, reverse shoulder arthroplasty; SPADI, shoulder pain and disability index; SST, simple shoulder test. Values represent mean ± standard deviation unless otherwise noted. Bold indicates statistical significance.
P values for clinical outcomes were adjusted for multiple comparisons using the Benjamini and Hochberg false discovery rate.