Effect of Implant- and Patient-Related Factors on Risk of Dislocation after Reverse Shoulder Arthroplasty (RSA): A Study by the American Shoulder and Elbow Surgeons Multicenter Complications of RSA Research Group

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INTRODUCTION:

Instability following reverse shoulder arthroplasty (RSA) can result in poor clinical outcomes and lead to revision procedures. Currently, there is a lack of generalizable evidence to discern risk factors for dislocation secondary to studies incorporating small sample size, single-center, or single-implant methodologies. In this study, we sought to determine both patient- and implant-related risk factors of dislocation through a large, multicenter approach with varying implants.

METHODS:

A retrospective analysis using data from fifteen institutions and 24 ASES members across the United States was performed. Patients who underwent an RSA procedure between January 2013 and June 2019 and had a minimum follow up of 3 months were included. All methodology components, including key term definitions, data collection factors, study design, and statistical analysis specifics were established using the Delphi method, an iterative survey process that requires > 75% consensus from all principal investigators to finalize the inclusion of each methodology component. Dislocations were defined as complete loss of articulation between the humeral component and the glenosphere and required radiographic confirmation. Baseline characteristics and implant-related factors of patients with and without confirmed postoperative dislocation were compared through univariate analysis. Binary logistic regression was performed to determine predictors of dislocation following RSA.

RESULTS:

The final cohort included 6,621 patients with a mean follow up of 19.2 ± 15.6 months. The average age was 70.8 ± 8.6 years and was 60.3% female (n = 3995). The incidence of dislocation was 2.1% (n = 138), 1.6% (n = 99) for primary RSAs, and 6.5% (n = 39) for revision RSAs ($P < 0.001$). Dislocations occurred at a median of 7.0 weeks (IQR 3.0 – 36.0) after surgery with 23.0% (n = 32) following a trauma. Factors independently predictive of dislocation, in order of decreasing effect, were a preoperative diagnosis of nonunion fracture sequelae (odds ratio [OR] 8.31; $P < 0.001$), revision arthroplasty (OR 4.82; $P < 0.001$), presence of a spacer (OR 3.24; $P < 0.001$), preoperative diagnosis of rotator cuff arthropathy or massive rotator cuff tear (OR 2.91; $P < 0.001$), presence of a constrained polyethylene liner (OR 2.18; $P = .001$), male sex (OR 1.95; $P = .001$), and lack of subscapularis repair (OR 1.61; $P = .032$).

DISCUSSION AND CONCLUSION:

Both patient and surgical factors significantly contributed to the risk of dislocation following RSA. Tuberosity nonunion, revision arthroplasty, rotator cuff arthropathy, massive rotator cuff tear, and male sex were identified as patient factors potentially predisposing to dislocation. Surgical factors independently predictive of dislocation were the presence of a spacer, constrained polyethylene liner, and lack of subscapularis repair. These surgical factors indicate a surgeon awareness of potential instability intraoperatively and despite utilizing increased offset implants or improving articulation constraint, there remained a significant dislocation risk.

Table I: Univariate comparison of demographics between dislocation and non-dislocation patients

Parameter	N	Dislocation N = 138	No Dislocation N = 6483	P-Value
BMI	6603	31.3 ± 6.6	30.2 ± 6.7	**0.012***
Age	6621	68.6 ± 8.2	70.9 ± 8.6	**<0.001***
Sex				
Male	6621	79 (57.2%)	2547 (39.3%)	**<0.001***
Female		59 (42.8%)	3936 (60.7%)	
Smoker				
No	6374	69 (53.9%)	3418 (54.7%)	0.829
Former		51 (39.8%)	2365 (37.9%)	
Current		8 (6.3%)	463 (7.4%)	
Follow-up	6411	20.8 ± 17.5	19.2 ± 15.6	0.377
Osteoporosis				
No	6620	120 (87.0%)	5659 (87.3%)	0.999
Yes		18 (13.0%)	823 (12.7%)	
Inflammatory Arthritis				
No	6617	119 (86.9%)	5786 (89.3%)	0.442
Yes		18 (13.1%)	694 (10.7%)	
Previous Surgery				
No	6613	79 (57.2%)	4365 (67.4%)	**0.015***
Yes		59 (42.8%)	2110 (32.6%)	
Surgery				
Primary	6621	99 (71.7%)	5921 (91.3%)	**<0.001***
Revision		39 (28.3%)	562 (8.7%)	
ASA				
1		4 (3.2%)	116 (1.9%)	
2	6320	50 (39.7%)	2792 (45.1%)	0.292
3		71 (56.3%)	3157 (51.0%)	
4		1 (0.8%)	129 (2.1%)	
Primary Diagnosis				
Primary GHOA		14 (10.1%)	1671 (25.8%)	
RCA		54 (39.1%)	2539 (39.2%)	
Failed Arthroplasty		30 (21.7%)	623 (9.6%)	
MCT		16 (11.6%)	670 (10.3%)	
Chronic Dislocation	6621	0 (0.0%)	61 (0.9%)	**<0.001***
Malunion		2 (1.4%)	167 (2.6%)	
Nonunion		12 (8.7%)	154 (2.4%)	
Acute Fracture		4 (2.9%)	304 (4.7%)	
AVN		1 (0.7%)	72 (1.1%)	
PCA		0 (0.0%)	43 (0.7%)	
Primary IA		4 (2.9%)	171 (2.6%)	

* represents significance with alpha risk of 0.05; *α (b, c)* represents median (1Q, 3Q); *x ± s* represents mean ± standard deviation; *n (n%)* represents count and frequency; BMI - body mass index; ASA - American Society of Anesthesiologists Comborbidity Score; GHOA - Glenohumeral Osteoarthritis; RCA - Rotator Cuff Tear Arthropathy; MCT - Massive Rotator Cuff Tear; AVN - Avascular Necrosis; PCA - Post-Capsulorrhaphy Arthropathy; IA - Inflammatory Arthritis

Table II: Univariate comparison of implant related factors between dislocation and non-dislocation patients

Parameter	N	Dislocation N = 138	No Dislocation N = 6483	P-Value
Polyethylene Liner Type				
Constrained	6290	27 (20.1%)	544 (8.8%)	**<0.001***
Non-Constrained		107 (79.9%)	5612 (91.2%)	
Polyethylene Liner Thickness (mm)	6290	3.0 (0.0, 6.0); 3.4 ± 3.6	0.0 (0.0, 4.0); 2.2 ± 2.9	**<0.001***
Spacer				
No	6294	112 (83.6%)	5983 (97.1%)	**<0.001***
Yes		22 (16.4%)	177 (2.9%)	
Spacer Thickness (mm)	6621	0.0 (0.0, 0.0); 1.3 ± 3.5	0.0 (0.0, 0.0); 0.2 ± 1.3	**<0.001***
Neck-Shaft Angle (°)	6293	145.0 (135.0, 150.0); 143.7 ± 7.1	145.0 (135.0, 147.0); 143.5 ± 7.1	0.873
Tray Thickness (mm)	2629	0.0 (0.0, 5.0); 2.5 ± 3.8	0.0 (0.0, 0.0); 1.6 ± 3.3	**0.019***
Total Humeral LO (mm)	6293	4.0 (0.0, 8.0); 5.6 ± 6.2	0.0 (0.0, 5.0); 3.0 ± 4.4	**<0.001***
Baseplate with LO				
No	6194	92 (69.2%)	4610 (76.1%)	0.083
Yes		41 (30.8%)	1451 (23.9%)	
Baseplate LO Thickness (mm)	1466	2.0 (2.0, 2.5); 2.3 ± 0.6	2.0 (2.0, 2.5); 2.4 ± 0.7	0.584
Glenosphere with LO				
No	6282	53 (39.3%)	2704 (44.0%)	0.314
Yes		82 (60.7%)	3443 (46.0%)	
Glenosphere LO (mm)	6298	2.0 (0.0, 6.0); 3.2 ± 3.3	2.0 (0.0, 6.0); 2.9 ± 3.2	0.319
Glenosphere Size (mm)	6278	36.0 (36.0, 41.0); 37.4 ± 3.5	36.0 (32.0, 38.0); 36.2 ± 3.1	**<0.001***
Bone Graft				
No	6292	120 (88.9%)	5733 (93.1%)	0.083
Yes		15 (11.1%)	424 (6.9%)	
Bone Graft Thickness (mm)	443	1.0 (0.0, 1.0); 0.6 ± 0.5	0.0 (0.0, 1.0); 0.4 ± 0.5	0.074
Augment Baseplate				
No	6292	122 (90.4%)	5522 (89.7%)	0.908
Yes		13 (9.6%)	635 (10.3%)	
LO of Augment Baseplate (mm)	6296	0.0 (0.0, 0.0); 0.3 ± 1.0	0.0 (0.0, 0.0); 0.3 ± 1.0	0.582
Total Glenoid LO (mm)	6298	5.0 (2.0, 6.0); 4.9 ± 4.0	3.0 (2.0, 6.0); 4.0 ± 3.4	**0.013***

*represents significance with alpha risk of 0.05; *α (b, c)* represents median (1Q, 3Q); *x ± s* represents mean ± standard deviation; *n (n%)* represents count and frequency; LO - Lateral Offset

Table III: Binary Logistic Regression for Factors Predictive of Dislocation Following RSA

Parameter	Odds Ratio (95% CI)	P-Value
Primary Diagnosis of Fracture Nonunion	8.31 (3.76, 18.38)	< 0.001*
Revision Arthoplasty	4.82 (2.74, 8.47)	< 0.001*
Presence of Humeral Spacer	3.24 (1.82, 5.76)	< 0.001*
Primary Diagnosis of Rotator Cuff Disease	2.91 (1.77, 4.78)	< 0.001*
Constrained Poly Insert	2.18 (1.37, 3.48)	0.001*
Male Sex	1.95 (1.29, 2.93)	0.001*
Primary Diagnosis of Fracture Malunion	1.71 (0.40, 7.37)	0.474
No Subscap Repaired	1.61 (1.04, 2.49)	0.032*
Glenosphere Diameter	1.06 (0.99, 1.14)	0.075
Total Glenoid Lateralization	1.03 (0.98, 1.09)	0.224
Body Mass Index	1.01 (0.99, 1.04)	0.354
Neck-shaft Angle	0.98 (0.95, 1.02)	0.338

*Denotes statistical significance with alpha-risk set to 0.05
RSA - Reverse Shoulder Arthroplasty
Rotator Cuff Disease includes rotator cuff arthopathy and massive rotator cuff tears without arthritis