Surgical and Patient Factors Associated with Baseplate Failures After Reverse Shoulder Arthroplasty: A Study by the ASES Complications of RSA Multicenter Research Group

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INTRODUCTION:

Baseplate failure continues to be a major clinical concern following Reverse Shoulder Arthroplasty (RSA) and often results in poor clinical outcomes and possible revision procedures. Currently, there is a lack of generalizable evidence to discern risk factors for baseplate failure due to small sample size, single-center, or single-implant methodologies. This study aimed to identify surgical, implant and patient factors contributing to baseplate failures following RSA.

METHODS:

In a multi-center retrospective study, patients who underwent RSA from June 2013 to May 2019, with a minimum 3-month follow-up were examined. This study involved 24 ASES surgeons from 15 U.S. institutions. Study parameters were defined through the Delphi method, requiring 75% agreement among surgeons for consensus. Multivariable logistic regression identified both patient and surgical factors linked to baseplate failures. Baseline characteristics and implant-related factors of patients with and without confirmed postoperative baseplate failure were compared through univariate analysis. Binary logistic regression was performed to determine predictors of baseplate failure following RSA. Baseplate failure was defined as a gross shift of the baseplate component or hardware breakage, confirmed radiographically by X-ray or Computed Tomography Scan (CT)

RESULTS:

Among 5,049 patients, the overall incidence of baseplate failure was 1.6% [n=83]. [b1] The median time since surgery of failure was 72 weeks (IQR = 40-137). The failures were atraumatic in 76.0% of cases (n=63), traumatic in 12.0% (n=10) of cases, and the nature of the failure was unknown in 10 cases involving baseplate failures. Radiographic analysis revealed 68.7% of failures contained hardware breakage [n=57] while out of those with breakage, 33.3% contained a fracture in central screw/post/peg [n=19] and 86.0% in the peripheral screw [n=49]. In 78.3% of all baseplate failures there was a gross shift of the baseplate component [n=65]. Factors independently predictive baseplate failure, in order of decreasing effect, were revision arthroplasty (OR 4.57; P < .001), utilization of a bone graft (OR 2.81; P < .001), and total glenoid-sided lateral offset (OR 1.08; P = .002). Utilizing a screw instead of a peg or post for central fixation was independently associated with a decreased risk of baseplate failure (OR = 0.55; P = 0.014).

DISCUSSION AND CONCLUSION:

The strongest patient-related factor independently associated with baseplate failure was undergoing a revision arthroplasty while the strongest implant-related factors were the utilization of a bone graft and total glenoid-sided lateral offset. Central fixation with a screw as opposed to a peg or post appeared to be a significant protector against baseplate failure. The majority of failures were also atraumatic, indicating that internal factors play a larger role in most baseplate failures. Hardware breakage was also a common occurrence in baseplate failures indicating potential areas of improvement in implant design. These modifiable and non-modifiable risk factors of baseplate failure following RSA can be used to optimize preoperative patient counseling as well as surgeon decision-making at time or surgery.

Table I: Nonmodifiable Patient Characteristics

Parameters	*N*	No Baseplate Failure *N* = 4868	Baseplate Failure *N* = 67	P Value
Sex	5049			
Male		2057 (41.4%)	52 (62.7%)	< 0.001*
Female		2909 (58.6%)	31(37.3%)	
Age	3745	70.4 ± 8.5	67.4 ± 9.9	0.007*
BMI (kg/m^2)	3728	30.2 ± 6.7	30.3 ± 6.3	0.943
Follow-up Duration (months)	3745	7.3, 12.8,18.4	10.2, 24.0,34.6	< 0.001*
ASA Comorbidity Score > 2	5032*	2631(53.1%)	53 (64.6%)	0.037*
Comorbidities				
Immunosuppresants ‡	4442	497 (11.4%)	11 (13.4%)	0.694
Osteoporosis	5049	647 (13.0%)	8 (9.6%)	0.455
Presence of IA	5045	497 (10.0%)	12 (14.5%)	0.250
Diabetes ¤	5047	1031(20.8%)	12 (14.5%)	0.204
Smoking	4857			
Never		2665 (56.4%)	43 (55.1%)	
Former		1708 (36.1%)	29 (37.2%)	0.975
Current		352 (7.4%)	6 (7.7%)	
Prior Ipsilateral Shoulder Surgery	5044	1637 (33.0%)	51(61.4%)	< 0.001*
Primary Diagnosis	5049			
GHOA		1385 (27.5%)	23 (27.7%)	
CTA		1883 (37.3%)	17 (20.5%)	
MCT without GHOA		480 (9.7%)	2 (2.4%)	< 0.001*
Failed Arthroplasty (revision)		423 (8.5%)	35 (42.2%)	
Other		795 (16.0%)	6 (7.2%)	

* denotes statistical significance; *n (%)* represents count and frequency; *x ± s* represents mean and standard deviation; *x̃, Q1, Q3* represents 1st quartile, median, and 3rd quartile; ‡ Immunosuppresants used within three months of surgery; ¤ Diabetes types I and II aggregated into one group for analysis; BMI, body mass index; ASA, American Society of Anesthesiologists; IA, inflammatory arthritis; GHOA, glenohumeral osteoarthritis; CTA, rotator cuff tear arthropathy; MCT, massive rotator cuff tear

Table II: Modifiable Surgical Elements

	Parameters	*N*	No Baseplate Failure *N* = 4866	Baseplate Failure *N* = 67	P Value
GLENOID COMPONENTS	Baseplate Lateral Offset (mm)	3736	$\tilde{x}_{1,3}$ 2 (2.1 ± 0.6)	$\tilde{x}_{2,4}$ 2 (2.1 ± 0.2)	0.464
	Bone Graft	5042	469 (9.6%)	28 (34.1%)	< 0.001*
	Amount of LO (mm)	162	9.8 ± 4.5	10.4 ± 5.5	0.676
	Metal Wedge	5040	111 (3.6%)	0 (0%)	< 0.001*
	Metal Wedge Type	111			
	Hall		40 (36.0%)	0 (0%)	< 0.001*
	Full		71 (64.0%)	0 (0%)	
	Augmented Baseplate	5040	596 (13.5%)	27 (4.3%)	< 0.001*
	Central Fixation	5039			
	Screw		3050 (61.5%)	33 (40.2%)	< 0.001*
	Peg/Post		1907 (38.5%)	49 (59.8%)	
	Number of Peripheral Screws	3716	3.5 ± 0.8	3.8 ± 0.8	0.003*
	Superior Screws Used	5030	4623 (97.5%)	77 (93.9%)	0.095
	Baseplate Surface	4560			
	Ongrowth		992 (20.3%)	18 (21.7%)	0.17
	Ingrowth		3875 (79.7%)	65 (78.3%)	
	Central Boss	5015	2199 (44.5%)	45 (54.2%)	0.100
	Glenosphere Diameter (mm)		35.5 ± 2.8	35.9 ± 3.1	0.373
	Amount of LO (mm)	3229	2.9 ± 3.5	3.6 ± 3.4	0.090
	Eccentric Glenosphere	3737	1139 (23.0%)	6 (7.5%)	0.002*
	Total Glenoid-Sided LO (mm)	3636	2.7 ± 3.2	3.4 ± 2.9	0.002*
HUMERAL COMPONENTS	Neck-Shaft Angle (°)	3737	144 ± 8	144 ± 9	0.766
	Polyethylene Insert Type	3737			
	Constrained		129 (3.5%)	4 (10.0%)	0.052
	Nonconstrained		3568 (93.5%)	36 (90.0%)	
	Polyethylene Thickness (mm)	3739	$\tilde{x}_{1,3}$ 6 (2.5 ± 3.2)	$\tilde{x}_{3,4}$ 6 (6.7 ± 3.9)	0.073
	Spacer	3739	95 (2.6%)	5 (12.5%)	0.003*
	Thickness (mm)	100	8.4 ± 1.9	11.0 ± 4.2	0.124
	Total Humeral-Sided LO (mm)	3682	$\tilde{x}_{1,3}$ 4 (3.9 ± 5.1)	0, 4, 9 (5.7 ± 6.9)	0.095

* denotes statistical significance; *n (%)* represents count and frequency; *x ± s* represents mean and standard deviation; *x̃, Q1, Q3* represents 1st quartile, median, and 3rd quartile; ° degrees; mm, millimeter; LO, lateral offset;

Table IV: Predictors of Baseplate Failure following RSA

Parameter	Odds Ratio	Confidence Interval 2.5	Confidence Interval 97.5	P value
Revision (Ref: Primary)	4.57	2.77	7.57	< 0.001*
Inflammatory Arthritis †	1.69	0.88	3.26	0.115
Osteoporosis	0.65	0.30	1.41	0.277
Age ‡ (in years)	0.98	0.96	1.00	0.075
Glenoid-Sided Bone Graft	2.81	1.52	5.17	< 0.001*
Total Glenoid-Sided Lateral Offset ‡ (in mm)	1.08	1.03	1.13	0.002*
On-Growth Baseplate Surface (Ref: In-growth	0.97	0.55	1.71	0.914
Central Screw Fixation (Ref: Peg/Post)	0.55	0.34	0.88	0.014*

* Statistical significance with alpha risk of 0.05; † Presence of inflammatory arthritis regardless of primary diagnosis; ‡ Odds ratios for continuous variables represent the change per unit increase of the variable; mm, millimeter.