Title: The Role of Index Humeral Stem Length in Outcomes after Revision to Reverse Shoulder Arthroplasty

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Introduction: The development of modular platform humeral stems has introduced multiple variables to consider during revision of a failed anatomic shoulder arthroplasty to reverse (RTSA). While studies have demonstrated that retention of a well-fixed and well-positioned stem is associated with less blood loss, faster surgical time, and lower complication rates, stratification based on stem length has been limited[1,2]. This study investigates clinical outcomes after revision RTSA in relation to humeral component conversion versus explantation.

Materials & Methods: This was a retrospective case series of consecutive patients from 2014 to 2021 who underwent revision from anatomic shoulder arthroplasty or hemiarthroplasty to RTSA. Exclusion criteria included any operation indicated for fracture, infection, or malignancy and stemless humeral components. Manual chart review included variables such as indication for revision, estimated blood loss (EBL), changes in preoperative and postoperative hemoglobin/hematocrit, operative time, need for osteotomy or cortical window, intraoperative/postoperative complications, and reoperations. Functional and patient-reported outcomes were also compiled for forward elevation, external rotation, visual analogue scale (VAS) pain, American Shoulder and Elbow Surgeons (ASES) standardized assessment, and Single Assessment Numeric Evaluation (SANE) scores. The cohort was divided into three categories, (1) stem conversion regardless of length, (2) short stem explant, and (3) standard stem explant. Univariate statistics were conducted via an analysis of variance (ANOVA) and chi-square analysis with post-hoc tests for continuous and categorical variables respectively. Additionally, logistic regressions were modeled for potential risk factors associated with complications or reoperations.

Results: Final analysis included 73 patients (23 conversions, 15 short explants, 35 standard explants) (Table 1). The overall length of follow-up after revision surgery was 1.8 years (range 1.2-7.8, p=0.64). Time from index to revision surgery was significantly longer in the standard explant group (2.1 vs. 2.5 vs. 4.5 years, p=0.01). Indication for revision included cuff failure with instability (53.4%), subscapularis insufficiency (21.9%), isolated instability (9.6%), isolated cuff failure (5.5%), glenoid failure (5.4%), stiffness (2.7%), and humeral component failure (1.4%) (p=0.38). A cortical window or osteotomy was performed among 11 of 35 standard length explants and none among the conversions or short stems (p=0.001). EBL was higher among standard explants (161 vs. 161 vs. 250cc, p=0.04). There was a similar trend in operative time; however, this did not reach statistical significance (118 vs. 124 vs. 148 minutes, p=0.19). Postoperative patient-reported outcomes (VAS, ASES, SANE) were comparable but there was a significant decrease in forward elevation (138.7 vs. 126.2 vs. 110.9, p=0.004) and external rotation (33.6 vs. 35.4 vs. 23.1, p=0.001) in the standard explants. On binary logistic regression modeling, only time between index and revision surgery was weakly associated with postoperative complications (OR 1.001, CI [1.000-1.003]). There were no differences between groups with regards to intraoperative complication and reoperation rates (Table 1).

Discussion: In this review of patients undergoing revision RTSA surgery, the authors found a clinically-relevant increase in operative blood loss and surgical time when explanting standard length stems in comparison to conversions and short stems. There did not appear to be an advantage to convertibility over explantation of a short-stem implant. Given the shift in the market to short-stem and canal sparing anatomic arthroplasty, convertibility of implants appears to be a less important design feature with regards to ease of revision.

References:

1. Kew ME, Mathew JI, Moran J, et al. Factors associated with humeral stem revision in anatomic to reverse total shoulder arthroplasty revision. J Shoulder Elb Surg. 2023;32(9):1867-1875. doi:10.1016/j.jse.2023.01.030

2. Cisneros LGN, Atoun E, Abraham R, Tsvieli O, Bruguera J, Levy O. Revision shoulder arthroplasty: does the stem really matter? J Shoulder Elb Surg. 2016;25(5):747-755. doi:10.1016/j.jse.2015.10.007

Table 1. Intraoperative details from revision surgery, complication/reoperation rates, outcomes

	Total (n=73)	Conversion (n=23)	Short Explant (n=15)	Standard Explant (n=35)	p-value
Operative Details					
Operative Time (minutes)	135	118	124	148	0.19
Cortical Window/Osteotomy (%)	11 (15.0%)	0	0	11 (31.4%)	**0.001**
Blood Transfusion (%)	1 (1.4%)	0	0	1 (2.9%)	0.58
Estimated blood loss (cc)	204	161	161	250	**0.04**
Preop Hgb (g/dL)	14	14	14	14	0.95
Preop Hct %	41	41	41	41	0.80
Post Hgb (g/dL)	11	11	12	11	0.15
Post Hct %	33	34	36	32	0.09
Hgb Delta (g/dL)	-3	-3	-2	-3	0.05
Hct Delta %	-8	-7	-6	-8	0.08
Intraoperative Complications (%)	9 (12.3%)	1 (4.3%)	3 (20.0%)	5 (14.3%)	0.32
Postoperative Complications (%)	21 (28.8%)	10 (43.5%)	6 (40.0%)	5 (14.3%)	**0.03**
Reoperations (%)	14 (19.2%)	6 (26.0%)	2 (13.3%)	6 (17.0%)	0.57
Preoperative Outcomes					
ASES	40.3	42.0	34.3	41.3	0.47
VAS	6.5	5.8	6.6	6.8	0.43
SANE	32.6	26.0	35.3	37.3	0.32
FE (degrees)	96	100	100	91	0.73
ER (degrees)	30	31	41	26	0.08
Postoperative Outcomes					
ASES	62.8	61.0	64.8	63.2	0.91
VAS	4.3	6.7	3.3	3.1	0.36
SANE	63.4	62.3	62.4	64.5	0.96
FE (degrees)	123	139	126	111	**0.004**
ER (degrees)	29	34	35	23	**0.001**