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Revision shoulder arthroplasty: Patient-reported outcomes vary according to the etiology of revision

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ABSTRACT

Background: The study evaluates patient-reported outcomes in revision shoulder arthroplasty (RevSA) according to etiology.
Methods: Twenty-three consecutive RevSA (minimum 2-year follow-up) were retrospectively reviewed. Patient-reported outcome (PRO) scores and range of motion were compared by the type of revision procedure and indication.
Results: EQ5D-QOL, VAS-pain, ASES, and forward elevation improved after RevSA. The infection group had least improvements. Revision to a reverse total shoulder arthroplasty (RTSA) demonstrated the most improvement in VAS-pain, forward elevation, and ASES.
Conclusions: Revision to RTSA significantly improved PRO scores compared to hemi- or total shoulder arthroplasty. RevSA for infection demonstrated the least improvement in outcomes.

1. Introduction

Shoulder arthroplasty (SA) is an effective procedure in providing pain relief and functional improvement.[1,2] Long-term studies have demonstrated excellent survivorship with primary shoulder arthroplasty with revision rates occurring as high as 13%.[3] With the increasingly aging population and increase in number of primary arthroplasties, a higher prevalence of revision SA has resulted.[4]

Failure of primary shoulder arthroplasty can result from multiple causes including rotator cuff failure, component loosening, instability, and infection– all of which can present substantial challenges when performing a revision procedure.[5,6] Previous studies have demonstrated worse outcomes and higher complication rates with revision SA when compared to primary arthroplasty.[7,8] Certain risk factors including male sex, younger age, smoking, obesity, and poor surgical technique have been identified as significant predictors for poorer outcomes and subsequent revision procedures following primary arthroplasty.[3,5] However, few studies have identified the influence of etiology and type of revision procedure on outcomes of revision SA. Thus, the purpose of this study is to evaluate how the different indications and type of revision implant impacts postoperative outcomes after revision SA. The study will specifically compare these outcomes using patient reported outcomes (PRO) scores and clinical assessments.

2. Materials and methods

Following approval from the Institution's Review Board (IRB), all consecutive revision SA procedures performed at our institution between August 2012 and November 2014 were retrospectively reviewed. Revision SA was defined as any procedure in which either the glenoid or humeral component was replaced, and included revision to hemiarthroplasty (HA), total shoulder arthroplasty (TSA), and reverse total shoulder arthroplasty (RTSA). Patients who underwent a subsequent procedure to the ipsilateral shoulder within 2 years of the shoulder revision were excluded.

The authors have no competing interests to declare.

2.1. Data collection

This is a retrospective cohort study. Patients with a minimum follow-up of 2 years following their procedure were included. Electronic medical records were reviewed to collect patient baseline characteristics including age, gender, BMI, American Society of Anesthesiologist (ASA) scores, and index procedure. Clinical

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assessments as measured by PRO scores and range of motion (ROM) measurements (external rotation [ER] and forward elevation [FE]) were collected from preoperative and postoperative clinic notes. Four PROs that were collected prospectively were evaluated including EuroQol-5D (EQ-5D) scores,[9] a measure of quality of life, American Shoulder and Elbow Surgeons (ASES) score,[10] as well as visual analog scale (VAS) scores for pain and quality of life.

For the sub group analysis patients were grouped into four cohorts based on the indication for the revision SA including infection (INF), rotator cuff deficiency (RCD), aseptic component loosening (ASL), and instability (INSTAB).

2.2. Statistical analysis

2.2.1. Patient baseline characteristics were summarized using standard descriptive

Summaries (e.g. means and standard deviations [SD] for continuous variables, and percentages for categorical variables) and stored using Excel software (Microsoft Corporation, Richmond WA, USA). Chi-squared tests were used to compare categorical baseline patient characteristics between the different cohorts. ANOVA testing was used to compare means of the PRO scores and ROM measurements between the four cohorts. A p-value of < 0.05 was considered statistically significant. All statistical analyses were done using SPSS Statistics software (International Business Machine Corporation, IL, USA).

3. Results

A total of 44 patients who underwent revision shoulder arthroplasty were initially identified. Seven patients were excluded for having an ipsilateral shoulder procedure within 2 years of their latest revision procedure and 14 were excluded for not having adequate follow up information documented in their EMR. A total of 23 patients were included in the study – 10 (43.5%) INF patients, 4 (17.4%) RC patients, 7 (30.4%) ASL patients, and 2 (8.7%) INSTAB patients. The mean follow-up in the cohort was 35.5 months. In the INF group, 6 patients were treated with a single-stage procedure while 4 were treated using a two-stage. Five HA, 11 TS A, and 7 RTSA in the cohort were revised to RTSA (14; 60.9%), TSA (5; 21.7%), and Hemi (4; 17.4%).

The average age of the total cohort was 66 years (range 37–82 years). Thirteen (56.5%) females and 10 (43.5%) males were included in the study with an average BMI of 28.0 (± 4.4) kg/m^2 and an average ASA score of 2.4 (± 0.6). No significant difference with respect to age, BMI, or ASA scores were found between the 4 cohorts, while a significantly lower prevalence of females ($p = 0.02$) was found in the INF cohort (Table 1). The average number of revisions per cohort and the time since index surgery are presented in Table 1.

In the entire cohort, EQ5D-QOL improved by 0.13 points ($p = 0.04$), VAS pain scores improved by 2 points ($p = 0.01$), ASES scores improved by 20.5 ($p = 0.01$), and FE improved by 37° ($p < 0.01$) after revision surgery (Table 2). Of note, a 1.4-point and 21-point improvement in VAS-pain score and ASES score, respectively, have been identified as a clinically significant improvement following shoulder arthroplasty.[11] VAS-QOL improved by 2.9 points ($p = 0.60$) and external rotation improved by 13° ($p = 0.07$). When comparing the cohort by indications, no significant differences were demonstrated in PRO scores or ROM metrics. The INF group had the least improvements in outcome measures (Table 3). When comparing outcomes based on the type of revision surgery, revision to an RTSA cohort demonstrated significant improvements in VAS pain score (3.1 versus −1.0 and 1.0 points, $p = 0.01$), ASES score ($p = 0.02$), and FE ($p = 0.03$) compared to revision to TSA and HA cohort (Table 4). Higher improvements in EQ5D ($p = 0.25$) VAS-QOL ($p = 0.26$), and ER rotation ($p = 0.94$) were also observed in the revision to RTSA cohort compared to the revision to TSA and HA cohort, although the results did not reach statistical significance.

Table 1
A comparison of demographics between the study groups.

Demographics	INF (n = 10)	RC deficiency (n = 4)	ASL (n = 7)	INSTAB (n = 2)	p-value
Age, (SD)	67.5 (9.4)	64.6 (11.9)	65.0 (13.7)	65.9 (13.5)	0.96
Gender, F (%)	2 (20)	3 (75)	6 (85.7)	2 (100)	0.02
BMI	29.5 (2.7)	23.6 (3.7)	28.0 (5.8)	29.4 (1.4)	0.13
ASA					0.45
2	5	2	6	2	
3	3	2	1	0	
4	2	0	0	0	
Average (SD)	2.7 (0.8)	2.5 (0.5)	2.1 (0.4)	2.0 (0)	
Avg# of revisions (SD)	1.5 (0.7)	1.3 (0.5)	1.4 (0.8)	1.0 (0)	0.78
Time since index surgery (months) (SD)	38.7 (33.1)	33.0 (22.1)	56.5 (36.2)	6.5 (8.2)	0.27

*ASL – Aseptic loosening; BMI – Body mass index; INF – Infection; INSTAB – Instability; RC – Rotator cuff.

Table 2
Change in patient reported outcome (PRO) score and range of motion (ROM) for revision shoulder arthroplasty cohort (overall).

Outcomes value	n	Preop score	Final follow- up score	Change in score	p-value
EQ5D	23	0.63	0.76	0.13	0.04
VAS - QOL	23	67.3	70.1	2.9	0.60
ASES	23	39.6	60	20.5	**0.01**
VAS - Pain	23	6.1	4	−2	**0.01**
FE	21	87	134	37	**< 0.01**
ER	21	18	31	13	**0.07**

*ASES – American Shoulder and Elbow Surgeons; EQ5D – EuroQol 5 dimensions; ER – External rotation; FE – Forward elevation; VAS – Visual analog scale; QOL – Quality of life.

Table 3
Change in patient reported outcome (PRO) score and range of motion (ROM) for revision shoulder arthroplasty according to surgery indication.

Outcome value	Change in variable (Preop to Final follow-up value)				
	INF	RC deficiency	ASL	INSTAB	p-values
EQ5D	0.1 (0.6–0.7)	0.2 (0.7–0.9)	0.1 (0.6–0.7)	0.1 (0.7–0.8)	0.90
VAS - QOL	−5.1 (71.5–66.4)	9.5 (64.8–74.3)	11.2 (56.7–67.9)	0.5 (88.0–88.5)	0.91
ASES	16.5 (39.2–55.7)	18.9 (41.0–59.9)	23.2 (37.7–60.9)	34.0 (45.0–79.0)	0.95
VAS - Pain	−1.7 (6.1–4.4)	−2 (6.0–4.0)	−2.3 (6.3–4.0)	−3 (5.5–2.5)	0.95
FE	22 (96–118)	72 (65–137)	56 (87–143)	90 (80–170)	0.09
ER	12 (13–25)	18 (15–33)	11 (22–33)	25 (0–25)	1.0

*ASES – American Shoulder and Elbow Surgeons; ASL – Aseptic loosening; EQ5D – EuroQol 5 dimensions; ER – External rotation; FE – Forward elevation; INF – Infection; INSTAB – Instability; QOL – Quality of life; RC – Rotator cuff; VAS – Visual analog scale.

We also analyzed our original cohort with 1- year outcomes (see appendix). Results demonstrated similar results to the 2-year follow-up cohort including improved PRO scores and ROM values for the total revision cohort, as well as the most improved outcomes among patients who underwent RSTA.