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Outcomes of Primary Reverse Shoulder Arthroplasty for Dislocation Arthropathy

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Abstract

Background: Proper soft tissue balance is paramount to maintaining stability and a functional arc of motion in shoulder arthroplasty but is impaired in patients with prior glenohumeral (GH) dislocations. The purpose of this study was to determine the clinical outcomes, revisions, and complications of reverse shoulder arthroplasty (RSA) in patients with a history of glenohumeral dislocation.

Methods: Twenty-four patients with a history of GH dislocations that developed arthropathy underwent primary RSA from 2007 to 2013 were retrospectively reviewed. Mean follow-up was 3.3 years (2–7 years). Mean age was 70 years. Eight patients (33%) and 7 patients (29%) had complete or partial subscapularis deficiency, respectively.

Results: Twenty-two patients (92%) had little to no pain at final follow-up. Mean shoulder elevation improved from 48° to 120° ($P < .001$) and mean external rotation increased from 13.2° to 48° ($P < .001$). There were trends toward less complete pain relief and poorer motion in those with complete subscapularis deficiency. None of the patients experienced a postoperative dislocation or evidence of glenoid loosening at final radiographic follow-up, but 1 patient (4.2%) underwent early revision to a hemiarthroplasty for glenoid loosening.

Conclusion: RSA provides patients with prior glenohumeral dislocations a stable, pain-free arc of motion. Postoperative instability was not identified as a major failure mode at short-term follow-up. Complete subscapularis deficiency is a risk factor for poorer clinical outcome.

Keywords

Reverse shoulder arthroplasty, glenohumeral dislocations, shoulder instability, arthropathy

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Introduction

The utilization of the reverse shoulder arthroplasty (RSA) has become more widespread over the past decade, accounting for over one third of the primary shoulder arthroplasties performed in the United States in 2011.[1,2] Traditionally designed as a salvage option due to its biomechanical advantages compared to an anatomic total shoulder arthroplasty (TSA), its indications continue to expand.[3,4] From advances in implants and surgical technique, the indications for RSA have expanded to include primary rotator cuff arthropathy; and rheumatoid arthritis, proximal humerus fractures, and fracture-dislocations; and proximal humerus malunions and nonunions.[5–12] While early studies report high complication rates and early failure, especially in the revision setting, more recent reports indicate good clinical outcomes and survivorship of primary RSA.[6,13–15]

One main design and biomechanical advantage of a reverse prosthesis is its ability to compensate for deficient dynamic and static shoulder stabilizers in cases in which an anatomic TSA has historically failed.[3,4] However, postoperative prosthetic instability remains a real complication and represents a challenging problem.[16,17] The major risk factors for prosthetic instability are

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inadequate soft tissue tensioning, including an insufficient subscapularis tendon and component malposition.[3,4,16–19] Prior shoulder operations have also been identified as a significant risk factor, likely secondary to soft tissue disruption.[16,18]

There is a paucity of studies examining patients with prior glenohumeral dislocations and dislocation arthropathy undergoing primary RSA. We sought to characterize the clinical outcomes, overall complication rate including prosthetic dislocations, and implant survivorship at intermediate follow-up of potentially high-risk patients with a history of glenohumeral dislocation undergoing primary RSA.

Materials and Methods

After approval from our Institutional Review Board, we identified all patients who underwent primary RSA from January 1, 2007 to December 31, 2013 using our institutional total joint registry. Dislocations were confirmed on clinical review. We retrospectively reviewed patient demographics, details of the surgical operation, medical and surgical history, complications, and clinical and radiographic outcomes information.

Patients

Forty-three patients were identified with a history of prior glenohumeral dislocation. Exclusion criteria included proximal humerus fracture-dislocation (n = 11) and patients with less than 2 years of clinical follow-up (n = 8). Mean follow-up was 3.3 years (range 2–7 years). There were 24 remaining patients, 10 of which were female (42%), whom had past glenohumeral dislocation. Mean age was 70 years (50–87 years) and mean body mass index (BMI) was 30 kg/m^2 (18–49 kg/m^2). Eleven patients (46%) were treated nonoperatively for their resultant glenohumeral instability while 13 patients (54%) required surgical intervention to alleviate symptomatic instability and/or shoulder dysfunction. All patients had some degree of glenohumeral instability on preoperative examination including 7 patients (29%) with passive moderate subluxation, 6 patients (25%) with passive severe subluxation, 3 patients (13%) with active moderate subluxation, and 8 patients (33%) with active severe subluxation. All patients presented with shoulder dysfunction, pain, instability on examination as stated, which we have termed dislocation arthropathy (Figure 1).

Surgical Technique and Postoperative Care

All patients underwent primary RSA at our institution by a fellowship trained shoulder specialist. The primary indications for surgery were pain, functional limitation, and evidence of glenohumeral instability on clinical examination. The operative details are summarized in Table 1. Implants were used from 3 different companies, including 3 Encore Reverse Shoulder Prosthesis (DJO Surgical, Austin, TX), 2 Delta III and 3 Delta Xtend (Depuy Orthopaedics, Warsaw, IN), and 16 Comprehensive Reverse Shoulder (Biomet). All humeral components were placed in either 20° (6 patients) or 30° (18 patients) of retroversion.

At the time of arthroplasty, 9 patients (37.5%) had an intact subscapularis tendon intra-operatively while 7 patients (29%) and 8 patients (33.3%) had incomplete and complete deficiency of the subscapularis tendon, respectively (Table 1). Two patients (8.3%) were found to have a significant deficiency of their posterior–superior rotator cuff as well and underwent concomitant latissimus dorsi transfers to assist in restoration of external rotation and shoulder stability. Two patients (8.3%) required glenoid bone autograft augmentation of the glenoid, both for anterior glenoid bone deficiency. None of the patients required humeral bone graft augmentation (Table 1).

Postoperative protocol included a shoulder immobilizer for 3 weeks with no shoulder range of motion, transitioning at 3 weeks to gentle passive range of motion of the shoulder. Patients were progressed to active-assisted range of motion at 6 weeks and active range of motion at 10 weeks with a lifelong 15 pound overhead lifting restriction.

Clinical and Radiographic Assessment

Both preoperative and postoperative pain and active shoulder motion were collected for all patients. Pain levels were graded as none, mild, moderate with usual activities, moderate at rest, or severe. Shoulder range of motion was assessed using goniometers. Postoperative American Shoulder and Elbow Society and Simple Shoulder Test were available in only 6 of 24 patients and they were therefore not included in this study. Radiographic follow-up data were available for all shoulders at a mean follow-up of 3.3 years (2–5 years) or just prior to revision surgery. Radiographs were reviewed for the presence of humeral component subluxation and scapular notching, as well as glenoid and humeral stem component lucency. Subluxation was classified as none (0%), mild (25%), moderate (25%–50%), or severe (>50%). Scapular notching was classified according to the previously established classification system: type I—defect confined to pillar, type II—contact with the lower screw, type III—defect extends over the lower screw, and type IV—defect extends under baseplate.[20]

Statistical Methods

Descriptive statistics and univariate analysis was performed. The differences between preoperative and

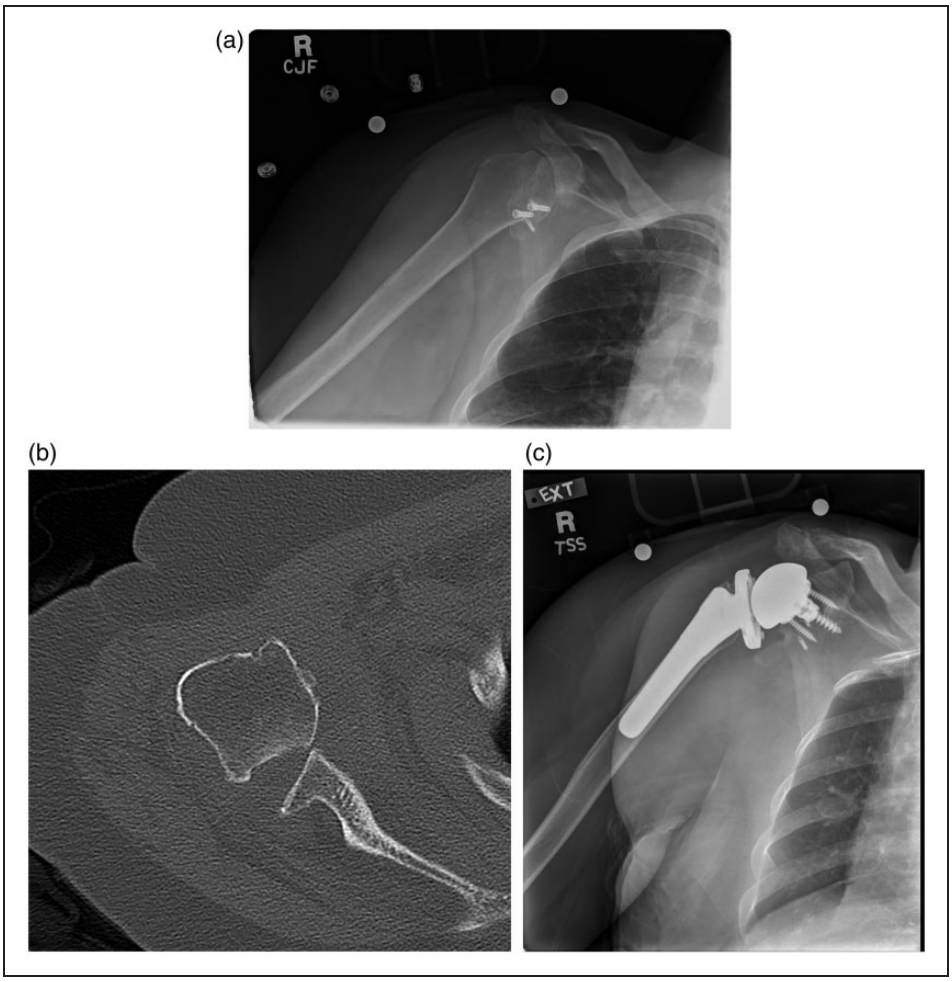

Figure 1. Fifty-six years female with history of recurrent dislocations status post laterjet procedure presented (a) with active subluxation, pain, and limited ROM. Preoperative radiographs (a) and CT scan (b) showed anterior escape and arthropathy. Intraoperative assessment showed subscapularis deficiency. Elevation improved to 150°, ER to 50° after primary reverse shoulder arthroplasty. Radiograph at 2 years postoperative show well fixed components in good position (c).

Table 1. Operative Details, Number (percent).

Humeral retroversion	27°
20°	6 (25%)
30°	18 (75%)
Cemented humeral components	9 (37.5%)
Subscapularis	
Intact	9 (37.5%)
Incomplete deficiency	7 (29%)
Complete deficiency	8 (33%)
Humeral bone grafting	0 (0%)
Glenoid bone grafting	2 (8.3%)
Intraoperative glenoid fracture	1 (4.2%)

postoperative data were compared using the 2-sample T-test for continuous variables and the Fisher's exact test for categorical variables. We analyzed primary and secondary endpoints of revision surgery, dislocations, and clinical outcomes with the JMP software version 10.0 (SAS, Cary, NC, USA); a significance value was set at alpha < 0.05.

Results

Clinical Outcomes

Twenty-two patients (92%) had pain scores of "minimal" or "none" at final clinical follow-up. The average shoulder elevation significantly improved from 48° (range 10–140) preoperatively to 120° (range 70–170) postoperatively ($P < .001$). Only 5 patients (20%) were able to elevate less than 100°. Similarly, there was a significant increase in external rotation pre- and postoperatively with an average of 13° (range −40–70) and 48° (range 20–90), respectively ($P < .001$). Only 4 patients (17%) achieved external rotation of less than 30° postoperatively. The average increase in external rotation was 34°.

None of the patients experienced a postoperative dislocation. One patient (4.2%) underwent revision to a hemiarthroplasty for glenoid loosening at 3 months postoperatively. Of note, during the primary arthroplasty, the patient had completely deficient subscapularis tendon and significant glenoid wear at the index procedure. No other patients required revision surgery. None of the patients experienced glenohumeral subluxation or instability on examination. One patient (4.2%) experienced an intraoperative glenoid fracture during glenoid component insertion. The fracture was deemed minimal and the baseplate was secured normally; the fracture healed without issue at final follow-up.

Radiographic Outcomes

Seventeen of the 23 patients (74%) with remaining implants had radiographic follow-up at least 2 years from surgery, at an average of 3 years (range 2–5 years). At the last follow-up, none of the patients had any evidence of glenoid or humeral loosening. Three radiographs (16%) had evidence of scapular notching of unclear significance; 2 of these were type I defects and 1 was a type II defect.

Complete Subscapularis Deficiency

In a subgroup analysis, we compared 8 patients (33%) with complete deficiency of the subscapularis tendon with 16 patients (67%) with at least partial subscapularis continuity (Table 2). The completely deficient group had a significantly higher number of previous shoulder operations of 2.25 (range 0–6) compared to 0.75 operations (range 0–4) in the other group ($P = .018$). There was a trend for worse shoulder elevation (105° vs 130°, $P = .06$) and external rotation (41° vs 50°, $P = .2$) in the completely deficient group. Both groups had minimal internal rotation. Two patients (25%) in the completely deficient group had ''moderate'' or ''severe'' pain at final clinical follow-up compared to 0 patients in the comparative group ($P = .10$). The only revision, for glenoid component loosening, occurred in the subscapularis complete deficiency group. Two patients (12.5%) with subscapularis continuity and 1 patient (12.5%) with complete subscapularis deficiency developed scapular notching ($P = 1.0$). There was no evidence of humeral or glenoid loosening in either group.

Discussion

RSA has become the primary implant utilized in patients with soft tissue or bony compromise, such as those with rotator cuff deficiencies and proximal humerus nonunions or bone deficiencies.[6,12,21,22] The implant utilizes a medial center of rotation to lengthen the deltoid's lever arm, providing both stability and functional motion, while utilizing its semi-constrained design to add extra stability to enable patients to have a stable arthroplasty with a functional arc of motion.[6,21] Therefore, it would inherently make sense to utilize this implant in patients with history of glenohumeral dislocations. As demonstrated in the current study, many of these patients have deficient soft tissue envelopes that the native shoulder and alternative shoulder implants depends on for stability.[3] However, there remains a paucity of studies examining the outcomes of RSA in patients with prior dislocations.

Postoperative dislocation and instability after RSA typically occurs early, at an average of 3.4 weeks in one series and all occurring within 6 months in another series.[16,17] At a mean of 3.3 year follow-up in the current study, none of the patients experienced dislocation or glenohumeral instability and only 1 patient required revision surgery for glenoid component loosening. Further, the vast majority of patients achieved a pain-free, functional range of motion postoperatively. Based on our findings in a small series of high-risk patients, a history of dislocation and glenohumeral instability is not

Table 2. Outcomes Based on Subscapularis Integrity.

Variables	Complete Subscapularis Deficiency	Normal or Incomplete Subscapularis Deficiency	*P*-value
Number	8	16	
Range of motion, degrees (range)			
Elevation	105 (70–140)	130 (100–170)	.06
External rotation	41 (20–60)	50 (30–70)	.2
Prior shoulder procedures (range)	2.3 (0–6)	0.75 (0–4)	.018
Smokers, number (percent)	1 (13%)	0 (0%)	.33
Pain (mod/severe), number (percent)	2 (25%)	0 (0%)	.1
Revision surgery, number (percent)	1 (13%)	0 (0%)	.33

a significant risk factor for revision surgery or postoperative instability. The results in this study are consistent with the findings by Raiss et al.[23] in which they reported excellent functional outcomes in 13 patients with prior anterior shoulder stabilization surgeries that developed osteoarthritis and rotator cuff deficiency treated with RSA.

A history of instability and the lack of a functional rotator cuff would make the anatomic total shoulder arthroplasty (TSA) a poor option for this patient cohort.[24] Deficiency of the posterosuperior rotator cuff has been shown to lead to superior migration and instability of the humeral head in TSA.[22,24–26] Further, Lehmann et al.[24] reported a 40% complication rate and 20% revision rate for patients with dislocation arthropathy undergoing primary TSA. Anterior and posterior instability also occurs less commonly, reported at approximately 1%, and are due to soft tissue deficiency and component malpositioning.[26] Therefore, in this patient cohort with inadequate soft tissues, deficient subscapularis, a history of glenohumeral dislocation, and glenohumeral subluxation on physical examination, the anatomic TSA would not be a viable option.[24]

Risk factors for acute dislocation after RSA include inadequate soft tissues, subscapularis deficiency, component malposition, and prior shoulder operations.[3,16–19,21] Based on these reported risk factors, the patient cohort presented in this paper represents a high-risk population for postoperative instability. All patients were undergoing arthroplasty for instability on examination and had a history of acute glenohumeral dislocation (Figure 1). Over half of the patients have had previous shoulder operations with one third of patients having 2 or more operations. Further, 33% of patients had complete and 29% of patients had complete or partial subscapularis deficiency, respectively. Despite these risks, the design of the reverse prosthesis and the surgical techniques allowed for good clinical and radiographic outcomes in this high-risk patient cohort.

We acknowledge that this study is a retrospective review that lacks a control or comparative group. However, given that a RSA was likely the only viable surgical option for a majority of patients included in this cohort, a prospective study or randomized controlled trial may be challenging. Further, there is an institutional bias, as all surgeries were performed at a single center. While all surgeons in this study utilize very similar indications, operative techniques, and postoperative rehabilitation protocols, there may be discrete differences in indication and soft tissue tensioning. The low number of patients included also limits this study, as does the 8 patients lost to follow-up. However, other similar reports of instability after RSA have similar numbers, demonstrating the relative rarity of shoulder instability in this patient population. While the majority of acute dislocations after RSA, the primary endpoint of this study, occur within 6 months of the index operation, longer follow-up periods may have yielded different clinical or radiographic results.

This study shows that a history of glenohumeral dislocation, glenohumeral subluxation on examination, and inadequate soft tissues is not a contraindication to RSA and minimally impacts clinical outcomes. These patients can achieve excellent early clinical and radiographic results with appropriate intraoperative soft tissue tensioning, component selection and positioning, and conservative postoperative protocols. Complete subscapularis deficiency, however, may be a risk factor for poorer clinical outcomes.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr. Cofield/Royalties: Smith/Nephew, DJO; Dr. Sperling/Royalties: Biomet; Dr. Sanchez-Sotelo/Royalties: Stryker; other authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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