J Shoulder Elbow Surg (2017) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Dislocation following reverse total shoulder arthroplasty

Eitan M. Kohan, MD*, Peter N. Chalmers, MD, Dane Salazar, MD, Jay D. Keener, MD, Ken Yamaguchi, MD, Aaron M. Chamberlain, MD

Department of Orthopaedic Surgery, Washington University in St Louis, St Louis, MO, USA

Background: The etiology of instability following reverse total shoulder arthroplasty (RTSA) remains incompletely understood. The purpose of this study was to describe the shared characteristics, etiologies, and outcomes of early and late dislocations requiring operative revision.

Methods: We identified all patients at our institution who underwent operative revision of an RTSA for instability. Baseline demographic, clinical, and radiographic data were collected. Standardized outcome scores were collected preoperatively and at final follow-up. Characteristics of dislocations that occurred less than 3 months postoperatively (early) were compared with those that occurred more than 3 months postoperatively (late).

Results: Twenty-two patients met the criteria, and follow-up was obtained on 19 patients at 4.9 ± 2.5 years, with 14 early and 5 late dislocations. Most patients in both groups were men, were aged over 70 years, and had a history of shoulder surgery. On analysis of instability etiology, 68% had inadequate soft-tissue tensioning (10% due to partial axillary nerve injuries). The remaining patients had asymmetric liner wear, mechanical liner failure, or impinging heterotopic ossification. Asymmetric liner wear accounted for 60% of late dislocations. Recurrent instability after revision was present in 29% of early and 40% of late dislocators.

Discussion: No significant differences in outcomes or recurrence rates were found for early and late dislocations. Of the late dislocations, 80% had evidence of adduction impingement, via either heterotopic ossification or asymmetric polyethylene wear. Post-RTSA instability had 2 distinct etiologies: (1) instability due to inadequate soft-tissue tensioning and/or axillary nerve palsy and (2) instability due to impingement or liner failure.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Reverse total shoulder arthroplasty; reconstruction; revision; complication; dislocation; instability

Although outcomes for a wide variety of indications are generally excellent after reverse total shoulder arthroplasty (RTSA),[2,3,6,8,11,13,15,17,23] instability continues to be among the most common and difficult-to-treat postoperative complications.[24] In a systematic review, Zumstein et al[24] reported that dislocation was the most commonly reported postoperative complication, with a calculated incidence of 4.7%, with some series describing instability rates of up to 31%. This complication remains poorly understood, and expert surgeons do not agree as to the etiology of or risk factors for this complication. In prior studies, patient risk factors for dislocation were thought to include body mass index (BMI) greater than 30 kg/m^2, male gender, subscapularis deficiency, and previous surgery.[4,20] These risk factors do not

This study was approved by the Washington University in St Louis Institutional Review Board under protocol 201602009.

*Reprint requests: Eitan M. Kohan, MD, Department of Orthopaedic Surgery, Washington University in St Louis, 660 S Euclid Ave, Campus Box 8233, St Louis, MO 63110, USA.

E-mail address: emkohan@gmail.com (E.M. Kohan).

1058-2746/$ - see front matter © 2017 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
http://dx.doi.org/10.1016/j.jse.2016.12.073

point toward a specific mechanism for dislocation. Surgical factors were thought to include inadequate soft-tissue tensioning,[1,3,9,12] component malposition,[19] mechanical impingement, insufficiency of the subscapularis,[7] and use of the deltopectoral approach as compared with the anterosuperior approach.[1,3,10,22,24] Some surgeons have argued that early dislocations are due to technical error and should undergo operative revision,[10] whereas others have described success with closed treatment with multiple prosthesis designs.[4,20] Without a clear understanding of the etiology of instability after RTSA, no clear treatment recommendations can be developed.

To our knowledge, only 2 prior studies have focused specifically on instability after RTSA, with both focusing on the outcomes of closed reduction.[4,20] The purpose of this study was to describe the shared characteristics, etiologies, and outcomes of dislocations requiring operative revision.

Materials and methods

This study was a retrospective consecutive case series. The operative log of our high-volume, regional-referral shoulder arthroplasty center between January 2005 and July 2014 was reviewed. Patients who underwent revision of an RTSA for any reason were initially reviewed. Those who underwent revision for a radiographically documented dislocation were included in this study, including both those who underwent RTSA at our facility and those who underwent surgery at other facilities. Both RTSA performed as a primary procedure and RTSA performed as a revision of a prior arthroplasty were included. The exclusion criteria were patients who underwent operative revision for reasons other than instability and those successfully treated with closed reduction. Minimum follow-up for inclusion was 2 years from the operative revision.

Data collection

Preoperative data collected included gender, age at RTSA, age at dislocation, BMI, Charlson Comorbidity Index,[5] smoking status, laterality of RTSA, hand dominance, number and type of prior surgical procedures, indication for RTSA, and instability history. Intraoperative data before revision included component size, humeral version, status of the subscapularis, and any intraoperative complications. Immediate postsurgical radiographs were reviewed. Data collected also included time from surgery to dislocation, any antecedent event, method of reduction, and treatment between dislocation and revision. In addition, we collected data pertaining to the surgical methods used to obtain stability at the time of revision surgery. Preoperative and postoperative clinical data collected included active forward elevation, active adducted external rotation, American Shoulder and Elbow Surgeons (ASES) score,[16] visual analog scale (VAS) pain score, and Simple Shoulder Test (SST) score.[14] Preoperative radiographs were reviewed to classify glenoid morphology using the systems of Walch et al[21] and Sirveaux et al.[18] Post-revision postoperative radiographs were reviewed. Scapular notching was classified with the Nerot-Sirveaux system.[18]

Statistical analysis

No a priori sample size determination was performed as this was a retrospective study and all available patients were included. Planned statistical analysis with data normality determination using the Kolmogorov-Smirnov test was performed. Early and late dislocations were compared by the Student *t* test or Mann-Whitney *U* test based on data normality. Categorical data were compared by the Fisher exact test.

Results

Patient demographic characteristics

In total, 29 patients who met the inclusion and exclusion criteria were identified. During the study period, 946 primary RTSAs and 109 revision RTSAs were performed, yielding a total of 1055 RTSAs. One operative revision for instability was performed after a primary RTSA performed at another institution, and thus the institutional operative revision rate for instability after RTSA was 28 of 1055, or 2.7%. During this period, the vast majority of the 1055 primary and revision RTSAs performed at our institution were performed with the Trabecular Metal RTSA (Zimmer, Warsaw, IN, USA). Of the 29 included patients, 7 were deceased, leaving 22 available for follow-up. Of these, 1 refused participation, 1 was incarcerated in a federal prison and thus could not be contacted, and 1 could not be reached despite multiple attempts. Thus, the final cohort included 19 patients, 86% of those available for follow-up. Of these 19 patients, 14 had dislocations within 90 days of RTSA (early dislocators) and 5 had dislocations more than 90 days after RTSA (late dislocators) (Table I). It is acknowledged that any dividing line between

Table I Days from primary reverse total shoulder arthroplasty to dislocation

Patient No.	Time to dislocation, d
Early 1	64
Early 2	<14
Early 3	<14
Early 4	4
Early 5	13
Early 6	90
Early 7	27
Early 8	<14
Early 9	25
Early 10	<14
Early 11	64
Early 12	64
Early 13	<7
Early 14	64
Late 1	223
Late 2	299
Late 3	842
Late 4	454
Late 5	104