J Shoulder Elbow Surg (2015) 24, 1908-1914

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Failure after reverse total shoulder arthroplasty: what is the success of component revision?

Eric M. Black, MD[a], Susanne M. Roberts, MD[b], Elana Siegel, BA[c], Paul Yannopoulos, BA[b], Laurence D. Higgins, MD[c], Jon J.P. Warner, MD[b,*]

[a]*Department of Orthopaedic Surgery, The Summit Medical Group, Berkeley Heights, NJ, USA*
[b]*The Shoulder Service, Department of Orthopaedic Surgery, Massachusetts General Hospital, Boston, MA, USA*
[c]*The Sports Medicine and Shoulder Service, Department of Orthopaedic Surgery, Brigham and Women's Hospital, Boston, MA, USA*

Background: Complication rates remain high after reverse total shoulder arthroplasty (RTSA). Salvage options after implant failure have not been well defined. This study examines the role of reimplantation and revision RTSA after failed RTSA, reporting outcomes and complications of this salvage technique.
Methods: Sixteen patients underwent component revision and reimplantation after a prior failed RTSA from 2004 to 2011. Indications included baseplate failure (7 patients, 43.8%), instability (6 patients, 37.5%), infection (2 patients, 12.5%), and humeral loosening (1 patient, 6.3%). The average age of the patient during revision surgery was 68.6 years. Outcomes information at follow-up was recorded, including visual analog scale score for pain, subjective shoulder value, American Shoulder and Elbow Surgeons score, and Simple Shoulder Test score, and these were compared with pre-revision values. Repeated surgeries and complications were noted.
Results: Average time to follow-up from revision was 58.9 months (minimum, 2 years; range, 24-103 months). The average postoperative visual analog scale score for pain was 1.7/10 (7.5/10 preoperatively; $P < .0001$), and the subjective shoulder value was 62% (17% preoperatively; $P < .0001$). The average postoperative American Shoulder and Elbow Surgeons score was 66.7, and the Simple Shoulder Test score was 52.6. Fourteen patients (88%) noted that they felt ''better'' postoperatively than before their original RTSA and would go through the procedure again if given the option. Nine patients suffered major complications (56%), and 6 of these ultimately underwent further procedures (38% of cohort).
Discussion: Salvage options after failure of RTSA remain limited. Component revision and reimplantation can effectively relieve pain and improve function compared with baseline values, and patient satisfaction levels are moderately high. However, complication rates and reoperation rates are significant.
Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Reverse shoulder arthroplasty; revision reverse shoulder arthroplasty; revision shoulder; complications; reimplantation

The reverse total shoulder arthroplasty (RTSA) was originally designed to improve pain and function in elderly patients with massive rotator cuff tears and associated arthritis, a condition known as cuff tear

Institutional Review Board approval was obtained by the Partners/Brigham and Women's Institutional Review Board: No. 2012P000631.

*Reprint requests: Jon J. P. Warner, MD, 55 Fruit St, Yawkey Center for Outpatient Care, Suite 3G, Boston, MA 02114, USA.
E-mail address: jwarner@mgh.harvard.edu (J.J.P. Warner).

1058-2746/$ - see front matter © 2015 Journal of Shoulder and Elbow Surgery Board of Trustees.
http://dx.doi.org/10.1016/j.jse.2015.05.029

arthropathy.[11] The role of RTSA has expanded significantly in recent years, and indications have included revision for failed total shoulder arthroplasty or hemiarthroplasty,[1,15,18,24,25] massive irreparable rotator cuff tears with pseudoparalysis,[9,21] proximal humeral fractures,[5,17,22,26,29] tumors,[7] and even shoulder osteoarthritis with severe glenoid bone loss and an intact rotator cuff.[19]

However, complication rates after RTSA remain high. A variety of complications may necessitate revision surgery in failed RTSA, including instability, component loosening or failure, fractures, and infection. In one meta-analysis of multiple series, reoperation and component revision rates after RTSA averaged 3.3% and 10.1%, respectively.[31] Of these, the most common complications were instability (4.7% of all cases), infection (3.8%), aseptic glenoid loosening (3.5%), and acromial fractures, glenoid disassembly, and humeral disassembly (all 1.5%). Revisions after failed RTSA were also significantly more common in cases in which a prior arthroplasty had been present compared with primary RTSA.

Salvage options after failed RTSA are limited and depend on the nature of the failure. Management options may include nonoperative treatment, component revision, conversion to hemiarthroplasty, and resection arthroplasty. Published outcomes after component revision are limited but demonstrate encouraging results. However, as expected, complication rates are high, as are the number of repeated surgeries required to achieve a reasonable result.[4,14]

The purpose of this study was to report outcomes, complications, and technical pearls in a series of patients with failed RTSA who underwent component revision.

Materials and methods

We performed a retrospective review of all RTSA surgeries performed at our institution between May 2004 and May 2011. All patients who underwent component revision for failure after a prior RTSA with >2 years of follow-up after revision were included in the study. Component revision was defined as any revision surgery in which humeral or glenoid reverse arthroplasty components were altered or replaced. This included removal and reimplantation of new components (i.e., for baseplate failure or loosening), removal with insertion of an antibiotic spacer (i.e., for infection) followed by RTSA reimplantation once the infection was eradicated, and revision of polyethylene spacer or addition of humeral component offset (i.e., for instability). Patients who underwent revision surgery without component revision (i.e., soft tissue procedures or reverse component failure with conversion to hemiarthroplasty) were excluded from the study. All revision surgeries were derived from index surgeries performed within our institution.

For each patient included in the study, clinical course was charted, and note was made of original indications for RTSA, indications for component revision, nature of the revision, and any subsequent procedures. Baseline preoperative outcome scores (before the original RTSA) were compared with most recent postrevision outcome scores. Outcome scores were collected by an independent researcher and included visual analog scale (VAS) score for pain, subjective shoulder value (SSV, expressed as a percentage), American Shoulder and Elbow Surgeons (ASES) score, and Simple Shoulder Test (SST) score (expressed as a percentage). Patients were also asked subjective questions of whether they would undergo their index RTSA operation again, if given the choice, and whether their shoulder felt "better" compared with the time before their index RTSA.

Statistical analysis was performed to compare preoperative and postoperative outcome data by Mann-Whitney test, and significance was determined as $P < .05$.

Results

During the study period, 2 senior surgeons performed reverse arthroplasties on 228 shoulders for the following indications: rotator cuff tear arthropathy, massive irreparable rotator cuff tears with pseudoparalysis (with or without glenohumeral arthritis), and revision of a failed prior hemiarthroplasty or total shoulder arthroplasty. Of these 228 procedures, there were 17 failures that necessitated component revision. One patient had died, leaving 16 patients available for inclusion in the study. An additional 6 patients underwent further procedures related to their index RTSA, although they were excluded from the study as they did not undergo component revision. Thus, in our entire RTSA cohort, the total rate of reoperation (including revision RTSA) was 10.1% of patients, with 7.5% of patients needing component revision.

There was no significant difference in component revision for patients undergoing index RTSA as a primary procedure (12 of 150 [8%]) or revision procedure (5 of 78 [6.4%]; $P = .66$).

Patient demographics, failure mode and indications for component revision, and time between surgeries for the 16 patients in the revision RTSA cohort are illustrated in Table I. Within the cohort, 8 patients (50%) originally underwent RTSA for cuff tear arthropathy, 5 patients (31.3%) underwent RTSA as a revision for failed hemiarthroplasty or total shoulder arthroplasty, and 3 patients (18.3%) underwent RTSA for massive irreparable rotator cuff tears with pseudoparalysis. Average time to follow-up from index surgery was 70.7 months, and average time to follow-up from component revision surgery was 58.9 months (minimum, 24 months). Cases not classified as infections had negative tissue cultures taken at time of revision surgery (all were held 14 days to rule out *Propionibacterium acnes* infection).

Components

Original components for the index RTSA included the Anatomical Reverse (Zimmer, Warsaw, IN, USA) in 10 shoulders, Aequalis (Tornier, Bloomington, MN, USA) in 4 shoulders, and Delta III (DePuy, Warsaw, IN, USA) in 2 shoulders. Glenosphere sizes were 36 mm in 12 shoulders, 40 mm in 3 shoulders, and 42 mm in 1 shoulder. Revision