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ORIGINAL ARTICLE

Longitudinal observational study of reverse total shoulder arthroplasty for irreparable rotator cuff dysfunction: results after 15 years

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Hypothesis: This study investigated the hypothesis that functional outcome remains significantly improved over the preoperative state beyond 15 years of reverse total shoulder arthroplasty (RTSA) for irreparable rotator cuff dysfunction.

Methods: Operations were performed on 22 shoulders at a mean age of 68 (range, 54-77) years. The patients could personally be reviewed clinically and radiographically in intervals of 2 to 5 years and with a final follow-up examination at no less than 15 years (mean, 16.1; range, 15-19 years). The RTSA was a primary procedure in 7 procedures, and 15 patients had undergone at least 1 previous nonarthroplasty procedure.

Results: The mean absolute Constant score (CS) had improved from 23 ± 11 to 58 ± 19 points ($P < .001$) and the relative CS (rCS) from 30% ± 13% to 73% ± 23% ($P < .001$) at final follow-up. Significant improvements were seen in mean pain scores (4 to 12 points; $P < .001$), active anterior elevation (53° to 101°; $P = .001$), abduction (55° to 86°; $P = .005$), and Subjective Shoulder Value (27% to 78%; $P = .001$). The mean rCS and Subjective Shoulder Value did not significantly deteriorate over 15 years, but mean active abduction was significantly reduced over time ($P = .018$). One or more complications were recorded in 13 patients (59%), with 6 failed RTSAs (27%).The mean rCS of patients with complications (explantations excluded) was not significantly inferior compared with that of patients without complications (62% vs. 81%; $P = .090$).

Conclusions: This early series of RTSA shows a substantial complication and failure rate. If, however, complications can be treated without removal of the implants, outcome is not compromised. Overall shoulder function and subjective outcome remained significantly improved and highly satisfactory during the entire study period.

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

Keywords: Reverse total shoulder arthroplasty; irreparable rotator cuff tear; cuff tear arthropathy; long-term; pseudoparalysis; shoulder dysfunction

In an increasingly aging population, developing strategies that enable patients to live an independent life as long as possible is important. Reverse total shoulder arthroplasty (RTSA) is a reliable means to restore shoulder function in elderly patients with pseudoparalysis of the shoulder due to an irreparable rotator cuff tear.[7,10,11,17,19,21,25,26]

The Cantonal Ethics Commission Zürich approved this retrospective study (Project Nos. 2015-0443/PB_2016-01637).

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Whether long-term functional improvement persists after RTSA is unclear.[2,9,17,23,25] Certain studies appear to document functional deterioration between 5 and 10 years.[9,17] Hence, the purpose of this study was to analyze the long-term clinical and radiographic outcome of RTSA for disabling loss of shoulder function caused by massive, irreparable rotator cuff tearing. We hypothesized that in such situations, RTSA provides a substantial clinical benefit for at least 15 years.

Materials and methods

Patients

Between 1997 and 2001, 52 consecutive patients (23 men, 29 women) with a mean age of 71 years (range, 53-87 years) with an irreparable rotator cuff tear and secondary pseudoparalysis of active anterior elevation (AAE) were treated with the Delta III prosthesis (DePuy, Saint-Priest, France). The results of 4 patients who were younger than 60 years at the time of operation are included in a published long-term study regarding the outcome of RTSA in patients younger than 60 years.[6] Because neither results with a minimum follow-up of more than 8 years for patients who were treated with a RTSA before age 60 nor results with a minimum follow-up of 15 years of RTSA have been published and are rare, 1 of the 2 series would be weakened by leaving the 4 patients out because they are part of the 2 differently defined cohorts. All patients gave written consent.

Rotator cuff tears were considered irreparable if pseudoparalysis was chronic (ie, >3 months), if the acromiohumeral distance was <7 mm on a plain anteroposterior radiograph, or if the fatty infiltration of the supraspinatus and infraspinatus or supraspinatus and subscapularis muscles was greater than stage 2 according to Goutallier.[12,16] Pseudoparalysis was defined as an AAE of <90° with preserved, free passive anterior elevation. Only patients with a minimum of 15 years of personal clinical and radiographic follow-up were included.

At the final follow-up, 4 patients (8%) had been lost to follow-up, and 26 (50%) had died. Of the patients who died, conversion to hemiarthroplasty (Delta I, DePuy) had been performed for recurrent instability in 1 patient and open reduction with internal fixation for a fractured acromion in a second patients. Both were included in the implant survival analysis. None of the remaining patients lost to follow-up had a history of infection or revision as confirmed by their medical records or telephone interview with family members.

The study cohort consisted of 22 shoulders of 22 patients (7 men, 15 women) who had undergone the index operation at a mean age of 68 years (range, 54-77 years). The dominant shoulder was involved in 19 patients (86%). Patients were personally reviewed at a mean follow-up of 16.1 years (range, 15-19 years). RTSA had been performed as the primary procedure in 7 patients (32%). Previous joint-preserving surgery had failed in the other 15 patients (68%), and 6 of these 15 patients (27%) had undergone more than 1 previous operation (Table I). According to the classification of Hamada et al,[18] 11 patients (50%) were classified as having cuff tear arthropathy (stages 4 and 5).

Table I Previous failed surgery in 15 shoulders

Variable	No. (%)
One previous operation	(n = 9)
Rotator cuff repair	7 (47)
Rotator cuff débridement	1 (7)
Osteosynthesis scapula fracture	1 (7)
Two previous operations	(n = 4)
Rotator cuff repairs (2)	2 (13)
Rotator cuff repair (1) and cuff débridement (1)	1 (7)
Rotator cuff repair (1) and deltoid flap (1)	1 (7)
Three previous operations	(n = 1)
Rotator cuff repairs (3)	1 (7)
Four previous operations	(n = 1)
Rotator cuff repair (1), deltoid flap (1), osteotomy of acromion (1), removal of metalware (1)	1 (7)

Clinical and radiographic assessment

Only the 16 patients with the Delta III prosthesis still in situ at the time of final follow-up were included. Assessment of clinical and radiographic outcome was performed at 1 year, 2 to 5 years, 5 to 8 years, 8 to 12 years, 12 to 15 years, and at ≥15 years.

At each time point, overall outcome was assessed in an institutionally standardized manner. Clinical examination was conducted by examiners different from the operating surgeon and included measurement of active and passive ranges of motion using a hand-held goniometer and scoring according to the absolute Constant and Murley score (aCS) and calculation of the age-matched and sex-matched relative CS (rCS).[4,13] The Subjective Shoulder Value (SSV)[15] and the patient-rated postoperative level of satisfaction ("excellent", "good", "fair", or "unsatisfactory") were recorded. Abduction strength was measured as previously described with a validated electronic dynamometer (Isobex; Cursor, Bern, Switzerland).[14]

The radiographic analysis had to be excluded for 1 patient because no postoperative radiographs were available. All other patients underwent standardized true anteroposterior, axillary lateral, and scapular lateral view radiographs preoperatively and throughout the postoperative course. Outcome measures on the postoperative radiographs included inferior scapular notching, osteolysis, radiolucent lines, and glenoid or humeral loosening. Inferior scapular notching was graded according to the classification of Sirveaux et al.[23] Radiolucency around the components was defined as grade 0 (no radiolucent line), grade 1 (incomplete 1-mm line), grade 2 (complete 1-mm line), grade 3 (incomplete 1.5-mm line), grade 4 (complete 1.5-mm line), and grade 5 (complete 2-mm line).[24] Two authors (L.E. and S.C.) who were blinded to the clinical outcome assessed all radiographs.

Surgical technique

All patients were operated on in the beach chair position through a deltopectoral approach under general anesthesia, regional anesthesia, or a combination of both. Implantation of RTSA was performed with the technique described by Werner et al.[26] The humeral component was cemented (Palacos; Heraeus Kulzer GmbH, Wehrheim, Germany) in 15 patients (68%). A 36-mm glenosphere was implanted in 21 patients (95%) and a 42-mm glenosphere in 1 patient (5%). A standard lateralized humeral polyethylene cup was implanted in all patients.