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ORIGINAL ARTICLE

Functional results of bilateral reverse total shoulder arthroplasty

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Background: The purpose of this study was to analyze a population of patients with bilateral reverse total shoulder arthroplasty (RTSA) to evaluate their ability to perform activities of daily living and personal hygiene tasks.

Methods: At a minimum 2-year follow-up, we retrospectively reviewed 50 patients (100 shoulders) with a mean age of 72 years who underwent staged bilateral RTSA. The average follow-up period was 61 months (range, 24-121 months), with a minimum 2-year follow-up after the second surgical procedure. Functional outcomes were assessed with American Shoulder and Elbow Surgeons, Simple Shoulder Test, and Short Form 12 (SF-12) scores. In addition, a unique questionnaire regarding personal hygiene habits and activities of daily living reliant on shoulder rotation was administered to all patients.

Results: Patients showed significant improvements in pain (mean improvement in visual analog scale score from 5.7 to 1.0, $P < .001$) and forward elevation (mean improvement from 71° to 136° , $P < .001$). Clinical outcome scores showed significant improvements: The mean American Shoulder and Elbow Surgeons score improved from 35.8 to 76.5 ($P < .001$), Simple Shoulder Test score improved from 2.4 to 8.0 ($P < .001$), SF-12 mental component subscore improved from 51.9 to 54.1 ($P < .001$), and SF-12 physical component subscore improved from 30.5 to 39.7 ($P < .001$). Internal and external rotation showed significant improvements (from 33° to 53° [$P < .005$] and from 27° to 44° [$P < .001$], respectively). All patients retained independence with personal hygiene and activities of daily living. Complications included prosthetic instability (3%), acromial fracture (5%), and periprosthetic joint infection (1%). The overall reoperation rate was 5%.

Conclusions: Bilateral RTSA provides predictable pain relief and improved function. Hygiene practices are unaltered for most patients, and the other patients rapidly develop simple compensatory strategies and retain independence in activities of daily living.

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

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Keywords: Reverse total shoulder arthroplasty; bilateral; shoulder replacement; activities of daily living; hygiene; rotator cuff tear arthropathy

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Reverse total shoulder arthroplasty (RTSA) has been shown to have efficacy for a variety of indications including rotator cuff tear arthropathy (RCTA),^{8,23} osteoarthritis (OA) in the setting of a rotator cuff tear,^{8,23} irreparable massive rotator cuff

tears with associated pseudoparalysis,¹⁶ rheumatoid arthritis,²⁹ and sequelae of proximal humeral fractures,^{4,14} as well as revision of a failed shoulder arthroplasty.²⁵ Although several large series have shown excellent short-term outcomes and restoration of painless active forward elevation (AFE),^{5-7,12,18} active external rotation and internal rotation have less reliably been restored postoperatively.^{1,26} External rotation and internal rotation movements are necessary for activities of daily living (ADLs), perineal care, and hygiene.^{13,17,19}

Bilateral RTSA may be inadvisable, as patients may struggle with ADLs. This is especially true in patients who need to reach behind their back on the operative side, perform personal hygiene activities, or use the toilet. Other activities that can be difficult include washing behind the back, washing the contralateral shoulder, putting on a bra, and tucking in a back shirt-tail. In unilateral RTSA cases, the patients can compensate for these activities by learning to use the contralateral extremity. However, previous authors have been concerned that patients who undergo bilateral RTSA may not be able to adequately compensate.^{2,18,27,28} Although a small number of previous series have shown good outcomes after bilateral RTSA, these studies have been limited by small sample sizes and few data were focused specifically on hygiene.^{15,22,28}

To better understand the effect of bilateral RTSA on a patient's ADLs, we retrospectively reviewed our own series of bilateral RTSA cases with standardized functional outcome measures and a unique questionnaire on personal hygiene practices and ADLs. We hypothesized that bilateral RTSA would lead to significant functional improvements and that, although bilateral RTSA would alter a minority of patients' hygiene habits, patients would develop compensatory habits and thus these changes would have minimal overall impact on their lifestyle.

Materials and methods

This study was a retrospective case series. Between 2004 and 2013, the operative databases of the 2 senior authors (G.P.N. and A.A.R.) were reviewed. Patients who underwent staged bilateral RTSA were included. The exclusion criteria were patients with incomplete medical records and patients with less than 2 years of follow-up. Three patients with incomplete preoperative data from 2005 were excluded from the study. All patients were then contacted by phone to respond to a questionnaire that included questions regarding hygiene.

Data collection

Data were recorded in Excel X (Microsoft, Redmond, WA, USA). Preoperative, perioperative, and postoperative records were reviewed. Preoperative data collected from the chart for each shoulder included age at the time of RTSA, sex, body mass index (BMI), time between right and left RTSA, diagnosis (divided into OA, RCTA, irreparable massive cuff tear [MCT], and revision from a prior shoulder arthroplasty), and whether previous surgery on the

ipsilateral shoulder had been performed. Preoperative radiographs were reviewed by an orthopedic shoulder and elbow fellow (C.R.M.) to include Walch grading for those patients with OA²⁴ and Favard grading for those patients with RCTA.²¹ Operative data included whether glenoid bone grafting was required, the prosthesis used, the degree of retroversion of the humeral component, the glenosphere size, and the need for adjunctive procedures at the time of RTSA.

The incidence of surgical complications including the need for revision surgery was obtained from existing clinical data and confirmed with a phone call from an independent observer. The following outcome measures were collected preoperatively and at final follow-up for both sides for each patient: visual analog scale score for pain, Simple Shoulder Test (SST) score, American Shoulder and Elbow Surgeons (ASES) score, functional portion of the ASES score (ASES-Functional), and Short Form 12 (SF-12) quality-of-life physical component subscore (PCS) and mental component subscore (MCS). Range-of-motion measurements, including AFE, abduction, active internal rotation at 90° of abduction (AIR), and active external rotation at the side (AER), were taken by an independent observer with a goniometer preoperatively and at final follow-up for both sides for each patient. Radiographs were evaluated at final follow-up for evidence of loosening as well as scapular notching, which was graded by the Nerot-Sirveaux system.²¹

Several specific outcomes related to hygiene habits were collected via a questionnaire administered over the phone or in the office (Fig. 1). The questionnaire was developed through discussion with patients over the years to determine the tasks of personal hygiene with which they may struggle. It was not validated to any standard. The questionnaire was designed to allow the patients to compare their abilities after bilateral RTSA with their preoperative status. It was not administered preoperatively. Patients were asked if they were able to wash the contralateral shoulder with each extremity, if they were able to tuck a shirt-tail into the back of their pants with each shoulder, if they were able to use the same hand while toileting as before surgery, whether their overall hygiene habits had changed, and if they required the use of assistive devices in the shower or during toileting.

Statistical analyses

Statistical analyses were performed by use of SPSS software (version 21; IBM, Armonk, NY, USA). Descriptive statistics and frequencies were calculated and are reported. All comparisons were planned a priori. Continuous variables were evaluated for normality with the Kolmogorov-Smirnov test, and preoperative and postoperative data were then compared by use of paired Student *t* tests or Wilcoxon signed rank tests as appropriate. Post hoc analyses were performed comparing changes in outcomes from preoperatively to postoperatively in subgroups to better understand the determinants of outcomes. Specifically, laterality was compared, patients older than 70 years were compared with those younger than 70 years, patients with a history of rotator cuff surgery were compared with those with no history of rotator cuff surgery, patients with RCTA were compared with those with OA, and patients with RCTA were compared with those with MCT by use of independent-samples *t* tests or Mann-Whitney *U* tests as appropriate based on data normality. Pearson correlation coefficients were calculated to determine whether humeral version correlated with internal rotation or external rotation at final follow-up or the change in these measurements.

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