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Outcomes of an anatomic total shoulder arthroplasty with a contralateral reverse total shoulder arthroplasty

Ryan M. Cox, BS, Eric M. Padegimas, MD, Joseph A. Abboud, MD, Charles L. Getz, MD, Mark D. Lazarus, MD, Matthew L. Ramsey, MD, Gerald R. Williams Jr, MD, John G. Horneff III, MD*

Department of Orthopaedic Surgery, The Rothman Institute at Thomas Jefferson University, Philadelphia, PA, USA

Background: It is common for patients to require staged bilateral shoulder arthroplasties. There is a unique cohort of patients who require an anatomic total shoulder arthroplasty (TSA) and a contralateral reverse shoulder arthroplasty (RSA). This study compared the outcomes of patients with a TSA in 1 shoulder and an RSA in the contralateral shoulder.

Methods: Our institutional database was queried to identify all patients with a TSA and a contralateral RSA. Data collection included patient demographics, preoperative and latest follow-up shoulder range of motion, radiographic analysis, and postoperative complications. Identified patients were assessed at follow-up visits or contacted by phone for functional outcome scores.

Results: Nineteen patients met our inclusion/exclusion criteria. There was statistically significant greater internal rotation in the TSA shoulder ($P = .044$) but no significant difference in forward elevation ($P = .573$) or external rotation ($P = .368$). There was no radiographic evidence of humeral or glenoid component loosening of any arthroplasty implants. There were no significant differences between TSA and RSA shoulders for the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment ($P = .381$), Simple Shoulder Test ($P = .352$), Single Assessment Numerical Evaluation ($P = .709$), and visual analog scale satisfaction ($P = .448$) or pain scores ($P = .305$). Thirteen patients (68.4%) preferred the RSA side, 1 patient (5.3%; $z = 4.04$, $P < .001$) patient preferred the TSA side, and 5 patients expressed no preference.

Conclusion: Despite known limitations and differences between TSA and RSA designs, patients who have received both implants are highly satisfied with both. The only parameter in which the TSA had superior outcomes was internal rotation.

Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Total shoulder arthroplasty; reverse shoulder arthroplasty; bilateral shoulder arthroplasty; clinical outcomes; functional outcomes; shoulder arthroplasty

Total shoulder arthroplasty (TSA) has evolved significantly over the years and continues to be a very successful procedure to provide patients with excellent pain relief and range of motion (ROM) for a variety of degenerative and traumatic shoulder conditions.[4,5,16,26,29,31] Modern reverse shoulder

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*Reprint requests: John G. Horneff III, MD, The Rothman Institute, 925 Chestnut St, Philadelphia, PA 19107, USA.

E-mail address: jghorneff3@gmail.com (J.G. Horneff III).

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arthroplasty (RSA) was developed by Grammont and Baulot[14] for the management of patients with a failed rotator cuff. This arthroplasty design was routinely used in Europe throughout the 1980s and 1990s and gained Food and Drug Administration approval in the United States in 2004. RSA is currently used for the treatment of cuff tear arthropathy (CTA), massive irreparable rotator cuff tears, complex proximal humeral fractures, and revision shoulder arthroplasty surgery, with respectable midterm and long-term results.[1-3,7] Despite the significant biomechanical differences between TSA and RSA, both procedures are able to successfully provide patients with good long-term results.[1,31,36] However, RSA is known to have limitations in rotational motion, which may limit patients' abilities to perform activities of daily living and is one of the primary reasons TSA is preferred over RSA.[18,27]

Studies have shown that the number of shoulder arthroplasty procedures being performed in the United States is increasing significantly with expanding indications, partly due to the Food and Drug Administration approval of the RSA and shoulder arthroplasty being used more frequently in the aging population, complex glenoid morphology (ie, B2 glenoids), and younger patients.[17,28] With the increase in shoulder arthroplasty, it is common for patients to require staged bilateral shoulder arthroplasties. Typically, patients with bilateral disease will demonstrate a similar presentation in both shoulders and require the same procedure bilaterally (ie, bilateral TSAs or bilateral RSAs). Studies have shown good functional outcomes of patients requiring both staged bilateral TSAs and staged bilateral RSAs.[9,15,21,23,25,34,37] However, there is a unique cohort of patients that requires a TSA in 1 shoulder with a RSA in the contralateral shoulder. Latif et al[19] reported the early clinical outcomes of 12 patients with a TSA and contralateral RSA and found that patients had significantly better forward elevation (FE), external rotation (ER), and American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment scores with their TSA shoulder.[19] Aside from this study, there are no other reports in the literature regarding outcomes of patients with a TSA and contralateral RSA.

The purpose of this study was to compare the outcomes of patients who have a TSA in 1 shoulder and an RSA in the contralateral shoulder and examine their outcomes at a minimum of 2 years of follow-up. We hypothesized that patients would have better ROM, better functional outcomes, and greater satisfaction of the TSA shoulder compared with the RSA shoulder.

Materials and methods

We queried our institutional billing database using the Current Procedural Terminology (American Medical Association, Chicago, IL, USA) code 23472 (total shoulder arthroplasty) to identify all patients who underwent a TSA procedure from 2004 to 2015. A retrospective record review was performed to identify all patients who underwent staged bilateral shoulder arthroplasties with a TSA and a contralateral RSA. Inclusion criteria required patients undergoing arthroplasty procedures be at least 18 years old and have at least 2 years of clinical and radiographic follow-up from the latest arthroplasty surgery. Exclusion criteria were revision arthroplasty surgery or a chronic neurologic condition. Preoperative and postoperative ROM were assessed by clinical examination in medical record reviews. Radiographic analysis included reviewing a standard 4-view shoulder series consisting of anteroposterior views in internal and external rotation, scapular Y views, and axillary lateral views. Postoperative complications, readmissions, and reoperations were recorded.

Patients were assessed at follow-up visits or contacted by phone for arthroplasty design preference, ASES score, Simple Shoulder Test (SST), Single Assessment Numerical Evaluation (SANE), visual analog scale (VAS) pain, and VAS patient satisfaction scores of both shoulders.[22,24,38] Preoperative outcomes scores were not available for comparison.

All procedures were performed by 1 of 6 fellowship-trained shoulder and elbow surgeons. All operations were performed through a standard deltopectoral approach, as previously described.[40] Of the TSA shoulders, 15 patients received a Global AP system (DePuy Synthes, Warsaw, IN, USA), 3 received a Aequalis-Ascend Flex system (Wright Medical, Memphis, TN, USA), and 1 received the Titan system (Integra LifeSciences, Plainsboro, NJ, USA). Of the RSA shoulders, 7 patients received the Trabecular Metal System (Zimmer Biomet, Warsaw, IN, USA), 6 received a Delta XTEND system (DePuy Synthes), 3 patients received an Aequalis-Ascend Flex system (Wright Medical), 2 received the Titan Reverse system (Integra LifeSciences), and 1 received the DJO Reverse system (DJO, Vista, CA, USA). All patients underwent a standardized postoperative physical therapy protocol.

Study population characteristics are reported using measures of central tendency (mean) and variability (standard deviation [SD] and range). Patients' shoulders were compared using independent-samples *t* tests for continuous variables and χ^2 analyses for categoric variables to detect differences between groups. A P value of <.05 was used to determine significance of statistical tests.

Results

Patient demographics and clinical characteristics

From 2004 to 2015, 5261 shoulder arthroplasties were performed at our institution; of these, 24 patients were identified to have a TSA with a contralateral RSA, with 19 meeting our inclusion/exclusion criteria (Table I). Of the 5 patients that were excluded, 3 required revision arthroplasty, 1 had Parkinson disease, and 1 lacked adequate clinical and radiographic follow-up. One patient underwent revision of TSA to hemiarthroplasty 3 months postoperatively for subscapularis rupture, 1 patient underwent 2-stage revision 14 months postoperatively for periprosthetic joint infection, and 1 patient underwent revision of TSA to RSA 6 months postoperatively for rotator cuff tear.

There was no significant difference in age at time of surgery between the TSA and RSA shoulders (70.1 ± 7.7 vs. 71.6 ± 7.9 years, $P = .563$). Among the 19 patients, indications for TSA included osteoarthritis in 17 (89.5%), inflammatory arthritis