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Staged bilateral total shoulder arthroplasty: improved outcomes with less than 6 months between surgeries

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Background: Research on optimal timing of bilateral anatomic total shoulder arthroplasty (TSA) is lacking. The purpose of this study was to investigate functional outcomes in patients undergoing bilateral anatomic TSA to understand the ideal timing for the second arthroplasty.

Methods: Patients who underwent bilateral TSA for osteoarthritis between 2000 and 2012 with a minimum follow-up of 12 months since their most recent surgery were evaluated. Postoperative patient-reported outcomes (University of California–Los Angeles [UCLA] shoulder rating scale, Constant score, and Simple Shoulder Test [SST]), biometrics (strength and range of motion), and a subjective questionnaire were compared for 4 "interval groups" based on timing between surgeries: <6 months, 6 to 12 months, 12 to 24 months, and >24 months.

Results: Eighty-two shoulders (41 patients, 70 ± 9 years old) were analyzed. Mean postoperative UCLA, Constant, and SST scores were 29, 72, and 9 points, respectively; 83% of patients reported satisfaction with both shoulders. Patients with <6 months between surgeries demonstrated significantly better UCLA scores than 6- to 12-month interval patients ($P = .04$), greater Constant scores compared with all other groups ($P < .001$), and greater SST scores compared with 6- to 12-month and 12- to 24-month interval patients ($P = .002$), with no differences in length of follow-up between groups.

Conclusion: In the absence of extrinsic factors, such as convenience, changes in social support structure, or changes in health status, patients may be advised that having the second surgery within 6 months of the first might optimize their postoperative functional outcomes and satisfaction compared with waiting a longer interval between surgeries.

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

Keywords: TSA; UCLA; Constant; Simple Shoulder Test; timing; interval; spacing

The clinical impact of end-stage arthritis of the glenohumeral joint and its subsequent treatment with prosthetic replacement has been well documented in the literature. Excellent outcomes, in terms of patient satisfaction, pain relief,

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and function, should be expected for those undergoing anatomic total shoulder arthroplasty (TSA).[9-12,14,18,25,27,31] However, in contradistinction to hip[1,3-5,23,29,30] and knee replacement,[6,8,17,20,21,24,28] there remains a paucity of data regarding the effectiveness of bilateral shoulder arthroplasty.

Previous series focusing on bilateral shoulder replacement have compared its utility in a staged vs. simultaneous fashion and subsequently concentrated on the perceived benefits of the timing of the respective procedures. These reports are limited by small cohort sizes, short-term follow-up, and lack of a proposed best algorithm for when to perform the second surgery after the index replacement.[13,15] Importantly, determining the optimal timing interval between staged TSAs could help maximize functional outcomes and limit the overall time missed from activities.

The purpose of this study was to comprehensively evaluate postoperative patient-reported outcomes, strength, range of motion (ROM), and patient satisfaction after staged bilateral TSA to assess both patient-reported functional outcome and satisfaction for both procedures. Subsequently, we aimed to develop recommendations, temporally, as to when the second prosthetic replacement should take place. Our hypothesis was that patient satisfaction and functional outcomes would be similar for both shoulders irrespective of patient variables such as age, sex, sidedness, and timing of when the second arthroplasty took place.

Materials and methods

All data in this case series were reviewed in retrospective fashion. All shoulder arthroplasty surgeries were performed by the senior surgeon (D.M.D.) between 2000 and 2012. Patients were considered for inclusion if they met the following criteria: (1) symptomatic bilateral glenohumeral osteoarthritis patients who had failed to respond to conservative treatment measures for their shoulder pain and who underwent staged bilateral TSA and (2) minimum follow-up from the most recent surgery of 12 months. The only exclusion criterion was failure to complete the follow-up questionnaire (eg, loss to follow-up). TSAs were performed with either the Bio-Modular Choice System (n = 14, 17%) or Comprehensive Total Shoulder System (n = 68, 83%) prostheses (Biomet Inc, Warsaw, IN, USA).

Postoperative outcomes included validated, shoulder-specific patient-reported outcomes (University of California–Los Angeles [UCLA] shoulder rating scale, Constant shoulder score, and Simple Shoulder Test [SST]).[2,7,22] The UCLA shoulder score[2] evaluates shoulder outcomes with respect to pain, function, forward elevation, forward flexion strength, and overall satisfaction out of 35 points. The Constant score[7] is a shoulder-specific scoring system that analyzes pain, shoulder motion, strength, and function out of 100. The SST[22] consists of 12 questions with either yes or no response to subjective items and patients' ability to perform physical functions. For each of these patient-reported outcomes, a higher score indicates a better outcome. All scores were obtained for each reconstructed shoulder, and to avoid bias associated with lower scores in nonreconstructed shoulders during varying time intervals between surgeries, scores were collected only after both shoulder arthroplasties were performed.

In addition to patient-reported outcomes, biometrics (manual strength testing and ROM) and a novel subjective questionnaire to gauge patient satisfaction after the bilateral surgeries were collected as well. ROM was measured manually to be most generalizable to the clinical setting; manual joint ROM testing has been shown in previous studies to be reliable and valid compared with goniometry.[16,26] ROM included forward elevation in the sagittal plane, external rotation with the arm adducted and elbow flexed, and abduction as continuous variables and internal rotation measured as an ordinal variable corresponding to the uppermost spinous process reached up the patient's back. Rotator cuff strength testing (specifically, manual strength testing of the subscapularis as well as of the supraspinatus with the arm flexed forward to 90° in the plane of the scapula and maximally internally rotated) was also performed in the office to clinically assess the integrity of the rotator cuff musculature postoperatively. Patients also reported their level of pain, in each respective shoulder, based on a standard visual analog scale for pain (0 being no pain at all; 10 being the worst pain). All outcomes were assessed at a final follow-up visit or through a mailed questionnaire. Our shoulder questionnaire was designed to evaluate, in concert, the patient's perception of the shoulder surgeries. The questionnaire was made up of a series of 5 questions: (1) Are you satisfied with both shoulders? (2) Was one shoulder harder to recover from than the other? (3) Would you have spaced the timing between each surgery differently? (4) What was the main influence for why you chose one shoulder to undergo surgery first? and (5) Would you have both surgeries again?

Patients were divided into 4 "interval groups" based on their intervals between surgeries. Because there has been no precedent for similar categorization of surgical delay, intervals were based on quartiles for the current study cohort and rounded to the nearest month such that there would be relatively balanced groups for statistical comparison. Group 1 had an interval time of <6 months between surgeries, group 2 had an interval time between 6 and 12 months, group 3 had an interval time between 12 and 24 months, and group 4 had an interval time of >24 months.

Statistical analysis was performed using SAS software version 9.3 (SAS Institute, Cary, NC, USA) by a member of the research team with advanced training in biostatistics. Descriptive statistics were used to evaluate and to report the distribution of continuous variables and survey results. Clinical outcome data were assessed for normality, and comparative analyses were performed using nonparametric analyses. Preoperative and postoperative ROM was compared with Spearman correlation analysis. Outcome scores for each interval group were compared using Kruskal-Wallis 1-way analysis of variance, with Tukey-adjusted pairwise comparisons performed where appropriate. Comparisons of outcome between shoulders were performed using the Wilcoxon rank sum test and McNemar test, as appropriate. All comparative analyses were 2 tailed and used $P = .05$ as the threshold for statistical significance. This investigation was a retrospective review of all available patients who met inclusion criteria, and therefore an ad hoc power calculation was not possible.[19]

Results

A total of 114 shoulders (57 patients) met the inclusion criteria for the study. Sixteen patients (28%) were excluded because of loss of follow-up, leaving 82 shoulders (41 patients, 72%) for final analysis in this cohort. Mean age of the cohort was 70 ± 9 years (range, 45-87 years) at the time of surgery (each shoulder). Gender distribution of the cohort was