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Causes of poor postoperative improvement after reverse total shoulder arthroplasty

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Background: Although reverse total shoulder arthroplasty (RTSA) has been successful in improving pain and function in most patients, some patients fail to improve clinically. The present study used a large registry of RTSA patients to evaluate associations between patient-related factors and poor postoperative improvement after RTSA.

Materials and methods: A prospectively collected shoulder arthroplasty registry was queried for consecutive patients who underwent RTSA from 2007 to 2013. Patients with baseline and minimum 2-year postoperative American Shoulder and Elbow Surgeons (ASES) scores were included. Poor postoperative improvement was defined as a change in the ASES of less than 12 points. Multivariate logistic regression analysis was used to identify independent risk factors.

Results: A total of 150 patients met inclusion and exclusion criteria. Logistic regression revealed that male sex (adjusted odds ratio [OR], 7.9; $P = .004$), presence of an intact rotator cuff at the time of surgery (adjusted OR, 4.8; $P = .025$), depression (adjusted OR, 11.2; $P = .005$), a higher baseline ASES score ($P < .001$), and higher total number of medical comorbidities ($P = .035$) were associated with poor postoperative improvement after RTSA.

Conclusions: Surrogates for better preoperative function after RTSA, such as a higher baseline ASES score and intact rotator cuff at the time of surgery, correlated with poor postoperative improvement. In addition, male sex, depression, and total number of medical comorbidities also correlated with poor postoperative improvement. Interestingly, factors such as patient age and indication for surgery were not found to correlate with poor improvement after RTSA.

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

Keywords: Reverse total shoulder arthroplasty; poor improvement; ASES score; risk factors; multivariate regression; high function

Total shoulder arthroplasty (TSA) has demonstrated immense success in patients with degenerative shoulder conditions, typically resulting in significant improvement in pain, range of motion, function, and overall quality of life. The volume of shoulder arthroplasty procedures performed in the United States has increased substantially during the past

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decade, from 14,000 shoulder hemiarthroplasty and TSA procedures performed in 2000 to more than 46,000 performed in 2008, an increase of nearly 12% per year.[22] If this trend continues, an estimated 100,000 shoulder arthroplasties will be performed annually this year.[35] Although at least part of these increases are due to an aging population that desires to remain active, a large percentage of this increase is due to rising popularity of, and expanding indications for, reverse TSA (RTSA).[31]

As surgeon comfort and familiarity with RTSA increases and associated complications decrease, the indications for the procedure have expanded. Initially designed for the treatment of the degenerative shoulder with rotator cuff insufficiency, published indications for RTSA have now grown substantially and include rotator cuff tear arthropathy,[7,8,13,41] massive rotator cuff tears without arthritis,[18] acute proximal humeral fractures,[1,4,9,16,17,30,32,33] proximal humeral fracture nonunions and malunions,[29,39] glenohumeral arthritis with posterior glenoid deficiency,[27] revision of failed previous shoulder arthroplasty,[6,21,24,28,37] inflammatory arthritis,[20,40] and reconstruction after tumor resection,[10,11] among others. In general, clinical and functional outcomes after RTSA have been favorable regardless of indication.[38]

Poor outcomes after RTSA have been noted with certain groups of patients, causing some concern that perhaps there has been an overzealous expansion of indications and enthusiasm for the procedure.[19] With the upcoming dramatic shifts in health care economics that place the burden on providers to deliver cost-efficient and effective care through bundled payments and outcomes-based reimbursement, it is important to ensure that expensive arthroplasty procedures are only performed on patients who are likely to improve from the procedure.[36] The primary goal of the present study was to use a large registry of RTSA patients to evaluate associations between patient-related factors and poor postoperative improvement after RTSA. The secondary objective of the study was to ascertain whether poor postoperative functional improvement was associated with lower patient satisfaction.

Materials and methods

A prospectively collected shoulder arthroplasty registry was queried for consecutive patients who underwent RTSA from 2007 to 2013. Patients with a primary diagnosis of rotator cuff tear arthropathy, proximal humeral fracture, osteoarthritis, or inflammatory arthritis were included. Patients who underwent primary or revision arthroplasty were included. A Biomet Comprehensive RTSA (Biomet Inc Warsaw, IN, USA) was implanted in all included patients. Patients were excluded if there was less than 2-year follow-up or if no baseline patient-reported outcomes were recorded. This yielded a final cohort of 150 patients who met inclusion and exclusion criteria from a total of 176 RTSA in the registry with baseline American Shoulder and Elbow Surgeons (ASES) data, representing a minimum 2-year follow-up rate of 85.2%.

Baseline patient demographics were queried from the database, including age, sex, body mass index (BMI), medical comorbidities, educational status, and surgical indication/diagnosis. Intraoperative rotator cuff findings were also queried. Baseline ASES scores and minimum 2-year ASES scores likewise were recorded from the database for each included patient.

Defining poor postoperative improvement

Because the primary outcome measure was to evaluate the association of patient-related variables with poor postoperative improvement after RTSA using the ASES score, a definition of poor postoperative improvement was first established. We used 2 methods to define poor postoperative improvement. First, the average change in the ASES score for the study population was calculated (average, 37), and poor postoperative improvement was defined as a change in ASES of less than 1 standard deviation below the average change. The standard deviation of the ASES change for the study sample was 25, yielding a definition of poor postoperative improvement of change in the ASES score of less than 12 using this method.

The second method defined poor postoperative improvement as a change in the ASES score that was less than the minimal clinically important difference (MCID) of the ASES score. Because no studies have specifically defined the MCID of the ASES score for shoulder arthroplasty procedures, 2 references were found that defined the MCID of the ASES score for other shoulder conditions. The first, and the most relevant, reported an MCID of 12 to 17 for patients with rotator cuff disease.[34] The second reported an MCID of 6.4 for a small cohort with a wide range of pathology, but a minimal detectable change of 16.[26] We decided to use the lower end of the MCID from the Tashjian et al[34] study because most of the patients in the current study had rotator cuff disease. Thus, both methods yielded a definition of poor postoperative improvement as a change in the ASES score of less than 12.

Univariate analysis

To select variables to include in the multivariate logistic regression analysis, a univariate analysis of all potential categoric variables using χ^2 tests was performed. All variables with $P < .350$ in univariate analysis were included in the logistic regression model. Univariate analysis was performed for the following categoric variables: sex; primary or revision procedure; report of any previous open or arthroscopic surgical procedure on the operated-on shoulder; medical comorbidities, including hypertension, heart disease, lung disease, diabetes mellitus, kidney disease, liver disease, gastric ulcer disease, rheumatoid arthritis, and depression; diagnosis/indication for the RTSA, including rotator cuff tear arthropathy, osteoarthritis, inflammatory arthritis, and proximal humeral fracture; educational status; and status of the rotator cuff at the time of surgery. Variables with $P > .350$ in univariate analysis included sex, primary or revision procedure, any previous procedure, diagnosis/indication for procedure, hypertension, heart disease, gastric ulcer disease, depression, and intact rotator cuff at the time of surgery.

All continuous variables were entered into the final logistic regression model, including age, BMI, total number of medical comorbidities, baseline ASES score, baseline shoulder activity score, and length of follow-up.