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The incidence and effect of fatty atrophy, positive tangent sign, and rotator cuff tears on outcomes after total shoulder arthroplasty

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Background: Treatment choices for total shoulder arthroplasty (TSA) in the absence of full-thickness rotator cuff tears (RCTs) are not clearly defined in current literature. This study investigated the prevalence and effect of preoperative partial-thickness RCTs and muscular degenerative changes on postoperative outcomes after TSA.

Methods: Medical records and magnetic resonance imaging studies were reviewed for patients who underwent TSA for primary glenohumeral osteoarthritis with minimum 2-year follow-up to determine preoperative tear classification, Goutallier grade, and supraspinatus tangent sign. Postoperative pain on the visual analog scale, range of motion, and patient outcomes scores were obtained to correlate preoperative RCT status, Goutallier grading, tangent sign, and postoperative outcomes. Patients with full-thickness RCT on preoperative magnetic resonance imaging were excluded.

Results: Forty-five patients met all inclusion criteria (average age, 65 ± 10 years; average follow-up, 43 months). Of the patients undergoing TSA, 40% had a significant (>50% thickness) partial RCT. Grade 3 to 4 Goutallier changes were noted in 22% of all patients, and 13% demonstrated grade 3 to 4 changes in the context of no tear. Positive tangent sign was present in 7% of all patients. The preoperative Goutallier grade of the infraspinatus was significantly negatively correlated with postoperative forward elevation ($P = .02$) and external rotation ($P = .05$), but rotator cuff pathology, including tear status, Goutallier grade, and the presence of a tangent sign, did not correlate with postoperative functional outcome scores.

Conclusions: Even in the absence of a full-thickness RCT, rotator cuff atrophy, fatty infiltration, and partial thickness tearing are common findings. Although postoperative range of motion is correlated to Goutallier changes of the infraspinatus, rotator cuff pathology is not correlated to outcomes after TSA; therefore, one may proceed with TSA without concern of their effect on postoperative outcomes.

The Greenville Health System Institutional Review Board approved this study (#Pro00040469).

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

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Keywords: Glenohumeral osteoarthritis; rotator cuff tear; total shoulder arthroplasty; tangent sign; fatty infiltration; MRI

Rotator cuff dysfunction in the setting of total shoulder arthroplasty (TSA) is predictive of poorer clinical and radiographic outcomes. Predominately seen in the context of inflammatory arthropathy, large full-thickness tears can disrupt force couples, alter joint biomechanics, and increase the risk for component instability and loosening.^{4,9,15,20,34} Fatty infiltration of cuff musculature is a marker of chronic dysfunction and has negative prognostic implications for rotator cuff repair,^{16,19,21,29} but little work has been done in the setting of arthroplasty.⁶ As such, few data exist to guide surgeons on the prevalence and treatment of rotator cuff pathology in patients undergoing TSA for primary osteoarthritis.

Computed tomography (CT) arthrogram has been used to assess rotator cuff integrity preoperatively in these patients.^{6,16} In some cases, fatty degeneration of muscle has been noted even in the absence of tendon tearing.⁶ No study, however, has used magnetic resonance imaging (MRI) to determine the prevalence and effect of preoperative rotator cuff pathology, particularly in the absence of full-thickness tearing, on outcomes. The purpose of this study was to report the prevalence and prognostic effect of partial tendon tears and muscular degenerative changes, as determined by preoperative MRI, on outcomes after TSA for glenohumeral osteoarthritis.

Methods

Study design

This study reviewed imaging and medical records of patients who underwent TSA in the treatment of primary glenohumeral osteoarthritis and who also had a preoperative MRI study. Patient-reported outcome data were prospectively collected.

Participants

The patients underwent TSA for primary glenohumeral osteoarthritis by 4 fellowship-trained shoulder surgeons at 1 institution during a 4-year period (2009-2013). There were 73 patients identified with minimum 2-year follow-up and preoperative MRI scan to evaluate the condition of the rotator cuff.

Data

We reviewed the records of the patients who had undergone anatomic TSA by 4 shoulder surgeons. The operative note was reviewed to confirm the primary diagnosis and the procedure performed. The MRI study of each patient was independently reviewed, and the preoperative status of the rotator cuff tendon and musculature was



Figure 1 Example of a tangent sign. The tangent line (red line) is drawn from the superior border of the scapular spine to the superior margin of the coracoid process. A positive tangent sign, indicating severe atrophy of the supraspinatus muscle, is when the superior border of the muscle falls below the tangent line. A negative sign is when the muscle belly of the supraspinatus and the tangent line intersect.

determined. The cuff was classified as no tear, partial-thickness tear of <50% thickness, or partial-thickness tear of >50% thickness. The analysis excluded 3 patients with full-thickness tears.

The quality of the tissue was measured using the Goutallier classification as modified by Fuchs et al.¹⁰ This classification is a qualitative measure that allows clinicians to estimate the fat content-to-viable muscle ratio. The classification involves 5 stages scored 0 to 4: stage 0, no fat; stage 1, muscle contains some fatty streaks; stage 2, there is more muscle than fat; stage 3, the amount of fat equals the amount of muscle; and stage 4, more fat than muscle is present. Stage 2 or greater is often associated with high percentages of fat vs. viable muscle and is analogous to computerized assessments used within the literature.¹³

The tangent sign was assessed on the most lateral image on the sagittal view of a T2-weighted MRI study, where the scapular spine is in contact with the scapular body. The tangent line is made by drawing a line from the superior border of the scapular spine to the superior margin of the coracoid process. In a normal supraspinatus muscle, the muscle content should cross superior to the tangent line. The patient had a positive tangent sign (indicating severe atrophy) if the superior border of the muscle fell below the tangent line (Fig. 1). The patient had a negative sign when the muscle belly of the supraspinatus and the tangent line intersected.³⁷

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