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Total shoulder arthroplasty using a subscapularis-sparing approach: a radiographic analysis

David Y. Ding, MD[a,*], Siddharth A. Mahure, MD[b], Jaleesa A. Akuoko, BA[b], Joseph D. Zuckerman, MD[a], Young W. Kwon, MD, PhD[a]

[a]*Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, NY, USA*
[b]*Shoulder & Elbow Division, Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, NY, USA*

Background: Traditional total shoulder arthroplasty (TSA) involves releasing the subscapularis tendon for exposure. This can potentially lead to subscapularis insufficiency, compromised function, and dissatisfaction. A novel TSA technique preserves the subscapularis tendon by performing the procedure entirely through the rotator interval, allowing accelerated rehabilitation. However, early reports on this approach have noted malpositioning of the humeral component and residual osteophytes. In a randomized trial, we examined the incidence of humeral head malpositioning, incorrect sizing, and residual osteophytes on postoperative radiographs after subscapularis-sparing TSA compared with the traditional approach.

Methods: Patients were prospectively randomized to undergo TSA performed through the traditional or subscapularis-sparing approach. The operating surgeon was blinded to the randomization until the day of surgery. Anatomic reconstruction measurements included humeral head height, humeral head centering, humeral head medial offset, humeral head diameter (HHD), and head-neck angle. Two independent reviewers analyzed the postoperative radiographs to determine anatomic restoration of the humeral head and the presence of residual osteophytes.

Results: We randomized 96 patients to undergo either the standard approach (n = 50) or the subscapularis-sparing approach (n = 46). There were no significant differences in humeral head height, humeral head centering, humeral head medial offset, HHD, head-neck angle, and anatomic reconstruction index between the 2 groups. However, significantly more postoperative osteophytes ($P = .0001$) were noted in the subscapularis-sparing TSA group. Although the overall mean was not statistically different, further analysis of HHD showed that more patients in the subscapularis-sparing TSA group were outliers (mismatch >4 mm) than in the traditional TSA group.

Conclusions: Although anatomic restoration of the shoulder can be accomplished using subscapularis-sparing TSA, retained osteophytes and significant mismatch of the HHD raise concerns regarding long-term outcomes.

Approval for this study was received from the New York University Langone Medical Center Office of Science and Research Institutional Review Board (assigned study No. i13-01038).

*Reprint requests: David Y. Ding, MD, Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, 301 E 17th St, New York, NY 10003, USA.

E-mail address: David.Ding@nyumc.org (D.Y. Ding).

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Total shoulder arthroplasty (TSA) is a useful option to successfully treat patients with painful glenohumeral arthritis. When nonoperative treatments such as analgesics, nonsteroidal anti-inflammatory medications, and local cortisone injections fail to provide sufficient relief, TSA has been proved to reliably relieve pain and restore function.[2-4,12] Since the early descriptions of shoulder arthroplasty, TSA prostheses have undergone several modifications and design changes. The current third-generation modular prostheses can adjust for neck length, offset, and version.[17] As a result, restoring normal anatomy of the glenohumeral joint is more likely for each patient.

The exposure of the shoulder joint in traditional TSA involves releasing the subscapularis tendon and performing subsequent repair. Additional techniques have been described including double-row fixation[9] and lesser tuberosity osteotomy.[8] Despite these advances, subscapularis function after TSA is often compromised.[11] Walch and Boileau,[16] for example, reported a 40% rate of subscapularis insufficiency after TSA. Similarly, Miller et al[11] found that, after TSA, 67.5% of patients had an abnormal liftoff test and 66% had an abnormal belly-press maneuver, both suggesting subscapularis insufficiency, which—in turn—can lead to pain, compromised function, and patient dissatisfaction. A study by Ives et al[6] showed that in symptomatic patients after shoulder arthroplasty, more than 50% had subscapularis tears on ultrasonography. In comparison, only 9% of asymptomatic patients showed similar damage to the subscapularis.

In 2009, Lafosse et al[10] described a novel TSA technique that preserves the subscapularis tendon by performing the procedure entirely through the rotator interval. The benefit of this technique is that it does not violate the subscapularis or supraspinatus tendons. As a result, patients are allowed early active range of motion in all planes without restrictions, which can lead to potential advantages in their rehabilitation. In addition, because the subscapularis is never violated, the rate of post-TSA subscapularis insufficiency should be minimized.

Although the theoretical benefits of subscapularis tendon–sparing TSA are clear, the technique is also associated with certain limitations. Because the technique involves performing the operation through a small window in the rotator interval, visualization of the humeral head can be limited. Consequently, in their collection of 17 patients, Lafosse et al[10] noted that 6 patients had humeral head malpositioning, 8 had residual inferior osteophytes, and 5 had a humeral head size mismatch. Malpositioning of the humeral head can potentially lead to asymmetric long-term stress on the glenoid, resulting in glenoid erosion and loosening.[15] Therefore, we sought to examine our experience using subscapularis-sparing TSA with emphasis on assessing the accuracy of restoring the humeral head anatomy. Specifically, in comparison with TSA performed through the standard approach, we sought to test the hypothesis that the incidence of humeral head malpositioning, incidence of incorrect sizing, and presence of residual osteophytes on immediate postoperative radiographs after subscapularis-sparing TSA differ significantly.

Methods

Patient population

Starting in 2010, approval was obtained from the New York University Institutional Review Board to conduct a prospective randomized trial on subscapularis-sparing TSA versus standard TSA performed by the senior authors (J.D.Z. and Y.W.K.). The inclusion criteria included advanced glenohumeral osteoarthritis with failure of nonoperative treatments. The exclusion criteria included significant deformity of the proximal humerus and significant medial erosion of the glenoid (lateral edge of the greater tuberosity being medial to the lateral edge of the acromion). Enrolled patients were randomized to 1 of 2 groups based on the surgical approach. One group was treated with TSA through the traditional subscapularis tenotomy approach, whereas the other group was treated with the subscapularis-sparing TSA technique. Informed consent was obtained from all enrolled patients, and they remained blinded to the surgical technique. The operating surgeon was blinded to the randomization until the day of surgery. To date, 96 patients have been enrolled in the trial: 46 were randomized to undergo the subscapularis-sparing approach and 50 were treated with traditional TSA. In 7 patients randomized to undergo the subscapularis-sparing approach, the surgical procedure was converted to a traditional approach at the discretion of the operating surgeon. This was done if there was difficulty obtaining adequate exposure without damaging the surrounding structures. The mean age at the time of surgery was 69 years for the subscapularis-sparing TSA group and 67 years for the traditional TSA group. Immediate postoperative radiographs were available for all patients.

Surgical procedure

All procedures were performed with the patient in the beach-chair position. For the standard TSA technique, a standard deltopectoral