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Subscapularis tenotomy versus lesser tuberosity osteotomy during total shoulder replacement: a comparison of patient outcomes

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Background: Two different techniques to release the subscapularis during total shoulder replacement (TSR) have been described: tenotomy and osteotomy. We review the clinical outcomes of a sequential series of patients in whom a TSR for primary osteoarthritis had been performed by either technique at our institution. Subscapularis function was tested by a new graded belly-press test.

Materials and methods: All patients who underwent surgery between January 2002 and January 2010, and met the eligibility criteria, were included for analysis. Subscapularis function was assessed postoperatively with a range of functional assessments, including the graded belly-press test and lift-off test, as well as assessment of each patient's range of movement.

Results: A total of 36 shoulders in 36 patients were subsequently reviewed, 10 of whom underwent tenotomy and 26 of whom underwent osteotomy. Patients who had undergone osteotomy of the lesser tuberosity had a more favorable outcome overall. These patients showed a trend toward a better range of movement, although no statistical significance was shown. They had a better grade (grade 1) on the belly-press test compared with the tenotomy group ($P = .026$). All patients (osteotomy and tenotomy) with a grade 1 belly-press test had a better clinical outcome with data showing statistical significance.

Conclusion: Our results indicate that in this single-surgeon sequential series, patients who underwent osteotomy of the lesser tuberosity during TSR for osteoarthritis had a better functional outcome than those who had a subscapularis tenotomy as assessed by the graded belly-press test.

Level of evidence: Level III, Retrospective Case-Control Study, Treatment Study.

Keywords: Total shoulder replacement; lesser tuberosity; tenotomy; osteotomy; subscapularis

Release of the subscapularis tendon is essential to gain surgical access to the glenohumeral joint for total shoulder replacement (TSR). However, because the subscapularis muscle plays a major role in maintaining shoulder stability and is an important internal rotator of the shoulder, it is essential that its function is preserved.[2,3]

The 2 main techniques for releasing the subscapularis that have been described are tenotomy and osteotomy of the lesser tuberosity.[4,7] There is no clear consensus in the literature as to which technique is superior in maintaining the function of the subscapularis, with only 1 published report comparing surgical outcomes of the 2 techniques.[9]

No institutional review board or ethical committee approval was necessary.

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Until December 2005, patients undergoing TSR at our institution underwent tenotomy of the subscapularis. The senior author changed his practice after observing adverse outcomes in some patients because of insufficiency of the subscapularis, and noted favorable results using osteotomy of the lesser tuberosity published in the literature.[4]

The purpose of this study was to review our experience after TSR in a nonrandomized sequential series of patients who underwent osteotomy of the lesser tuberosity and compare their outcomes with our own historical cohort of patients who underwent TSR via subscapularis tenotomy by the same surgeon. The patients in whom the surgeon had observed subscapularis insufficiency were included in this series.

Materials and methods

Between January 2002 and January 2010, 110 patients (117 shoulders) underwent shoulder replacement surgery at our center, all of whom were operated on by the senior author (T.H.). All patients had shoulder joint disease associated with pain and disability that did not respond to conservative measures. Only patients who had an intact rotator cuff, as confirmed on the preoperative magnetic resonance imaging scan, were included in the study.

Patients with conditions that could potentially compromise subscapularis function such as rheumatoid arthritis (n = 4) and those who had undergone previous rotator cuff repair (n = 11) were excluded. We also excluded patients who underwent reverse TSR (n = 17), revision surgery (n = 8), hemiarthroplasty (n = 30), resurfacing (n = 15), and other procedures (glenoid erosion, n = 1; humeral allograft, n = 1). Some patients fell into more than 1 exclusion group.

Forty-one shoulders in forty patients fulfilled the criteria for study inclusion. Of these 40 patients, 4 were excluded for the following reasons: One patient with bilateral shoulder replacements died of unrelated causes, two were lost to follow-up (geographic reasons), and one had upper limb weakness due secondary to cervical disc pathology. Thus the outcomes of 36 shoulders in 36 patients were included in the final analysis; 10 patients had a subscapularis tenotomy, whereas 26 had an osteotomy of the lesser tuberosity.

In all patients in the tenotomy group and over 80% of those in the osteotomy group, DePuy Global Advantage prostheses (Warsaw, IN, USA) were used, whereas DePuy Global AP prostheses were used in the rest of the osteotomy group. We considered the difference between prosthesis designs too minor to affect the outcome of subscapularis function. The surgical approach was identical in both groups of patients except for the subscapularis release.

Tenotomy approach

Through a deltopectoral approach, the cephalic vein was retracted medially. The rotator interval was identified, tenotomy of the long head of the biceps was performed, and the circumflex humeral artery was ligated.

The lower border of the subscapularis was identified, and the subscapularis tendon underwent tenotomy 1 cm medial to the lesser tuberosity.

Subcoracoid adhesions were released, the coracohumeral ligament was divided from the base of the coracoid, and the remaining attachments to the capsule were released to yield a complete 360° mobilization of the subscapularis. An anterior and inferior glenohumeral capsulectomy was then performed.

After the joint replacement was performed, the subscapularis was reattached in a 2-row manner; the medial row was made through a drill hole in the lesser tuberosity osseous neck, and the lateral row was a tendon-to-tendon suture. Typically, 3 to 4 separate sutures were used for each row. The lateral-row sutures were looped around the medial row to lock it (Fig. 1).

Osteotomy approach

Through a deltopectoral approach, the cephalic vein was retracted medially. The rotator interval was identified, tenotomy of the long head of the biceps was performed, and the circumflex humeral artery was ligated.

The lower border of the subscapularis was identified, and the lesser tuberosity was osteotomized from the rotator interval down to the lower border of the subscapularis, exiting medially just lateral to the articular margin. Two No. 2, high-tension, nonabsorbable sutures (FiberWire; Arthrex, Naples, FL, USA) were looped around the humeral prosthesis. These 4 strands were used as the medial row and were passed through the osteotendinous junction of the lesser tuberosity. These were then tied to constitute the medial row. These same sutures were then re-rooted over the lesser tuberosity, through drill holes lateral to the osteotomy site, out through the lateral cortex of the humerus, and then tied, thus constituting the lateral row. The lateral 1 cm of the rotator interval was then closed with No. 2 FiberWire. No cutout of the FiberWire through the lateral humeral cortex was observed (Fig. 2).

The postoperative rehabilitation was similar in both groups, with passive movement limited to 90° of flexion, no extension, and avoidance of external rotation beyond neutral for the first 6 weeks. Thereafter an active-assisted rehabilitation protocol was carried out for a further 6 weeks. Lifting loads was not permitted until 6 months.

At follow-up, all the patients were examined by an investigator who was blinded to the type of surgery that had been done. Subscapularis function was assessed by the lift-off test, the patient's ability to tuck in his or her shirt or vest under a belt, and a graded modification of the belly-press test.

The graded belly-press test was performed while the patient was standing, with the arm at the side and the elbow flexed to 90°. The patient was asked to press his or her palm against his or her belly while the examiner resisted internal rotation of the patient's shoulder. The extent to which the elbow moved in relation to the mid−axillary line was noted. If the elbow moved in front of the mid−axillary line, it was considered grade 1, indicative of strong internal rotation by the subscapularis muscle (Fig. 3, *A*). If the elbow moved up to the mid−axillary line but not in front of it, it was considered grade 2, suggesting some impairment of subscapularis function (Fig. 3, *B*). If the elbow remained posterior to the body, it was considered grade 3, with no effective function of the subscapularis muscle (Fig. 3, *C*). This test was designed with 3 grades before the study