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ORIGINAL ARTICLE

Healing and functional outcome of a subscapularis peel repair with a stem-based repair after total shoulder arthroplasty

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Background: The purpose of this study was to evaluate functional outcome and healing of a subscapularis peel with a stem-based repair after total shoulder arthroplasty (TSA). The hypothesis was that the repair would lead to subscapularis healing in the majority of cases.
Methods: A prospective analysis was performed on a consecutive series of TSAs. Range of motion and functional outcome were assessed according to American Shoulder and Elbow Surgeons, Single Assessment Numeric Evaluation, Simple Shoulder Test, and visual analog scale scores at a minimum follow-up of 1 year. Belly-press and lift-off tests were also performed. An ultrasound evaluation assessed subscapularis healing at final follow-up.
Results: At a mean follow-up of 15 months, 60 patients (mean age, 64 years) were examined. Mean forward flexion improved from 115° to 137°. External rotation at the side improved from 27° to 52°, and internal rotation improved from L4 to L2 ($P < .05$). American Shoulder and Elbow Surgeons score improved from 34.3 to 79.8 ($P < .001$). Likewise, the Single Assessment Numeric Evaluation and Simple Shoulder Test scores showed significant improvement from 33.1 to 85.3 and 4.3 to 10.2, respectively ($P < .001$). The visual analog scale score for pain decreased from 5.8 to 0.7 ($P < .001$). On ultrasound examination, the subscapularis was healed intact in 55 cases (91.7%), attenuated in 3 cases (5%), and torn in 2 cases (3.3%).
Conclusion: A stem-based repair of a subscapularis peel after TSA leads to functional improvement in the majority of cases with >90% postoperative healing of the subscapularis.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Total shoulder arthroplasty; shoulder arthritis; subscapularis peel; short-stem shoulder implant; ultrasound evaluation; shoulder functional outcomes

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Subscapularis integrity after total shoulder arthroplasty (TSA) is important to maintaining glenohumeral joint stability and functional outcome. In recent years, increased emphasis has been placed on the management of the

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subscapularis during TSA. Options for management of the subscapularis during TSA include tenotomy, release of the tendon from the bone (peel technique), and lesser tuberosity osteotomy (LTO).

Several studies have demonstrated that subscapularis integrity is often impaired with a traditional tenotomy approach.[3,12] On the basis of these studies, a subscapularis peel and LTO approach have gained popularity.[5] Whereas an LTO has shown good biomechanical strength during placement of a standard-length humeral stem,[11] there has recently been a trend toward the use of shorter humeral stems that rely on proximal fixation. Given that LTO violates the proximal humeral bone integrity, this technique may be of concern during placement of a short humeral stem. Recently, a stem-based subscapularis peel repair technique using a short press-fit humeral stem that has biomechanical strength equivalent to repair of an LTO has been described.[2,8] However, no clinical studies have examined healing rates after this technique.

The purpose of this study was to evaluate functional outcome and healing of a subscapularis peel with a stem-based repair after TSA. The hypothesis was that the repair would lead to subscapularis healing in the majority of cases.

Materials and methods

A prospective evaluation was performed of patients who underwent a TSA between January 2014 and March 2015 at 2 centers. Inclusion criteria included a TSA, press-fit fixation of the humeral stem, a subscapularis peel repaired with a stem-based repair, and a minimum follow-up of 1 year. Exclusion criteria included hemiarthroplasty and revision shoulder arthroplasty surgery. A consecutive series of 30 patients at each center were evaluated at 1 year postoperatively for clinical and ultrasound assessment. A total of 60 TSAs were performed in 56 patients, all of whom were available for follow-up at a mean of 15 months postoperatively. There were 39 men (65%) and 21 women (35%) who were a mean age of 64 years at the time of surgery.

Surgical technique

Operations were performed by 2 authors. The surgical technique has previously been described in detail.[2] In brief, a standard deltopectoral approach was used. The biceps tenodesis was routinely performed. A subscapularis peel was used to gain access to the glenohumeral joint. An anatomic cut was used to osteotomize the humeral head, respecting anatomic inclination and version. The humeral canal was broached to accept a short press-fit humeral stem (Apex; Arthrex, Inc., Naples, FL, USA) (Fig. 1). Attention was turned to the glenoid, and an all-polyethylene glenoid was cemented into place. Attention was returned to the humerus. Before placement, the humeral stem was loaded with 6 sets of No. 2 suture (FiberWire; Arthrex, Inc.); 2 suture pairs were preplaced through holes in the lateral aspect of the stem, and 4 sutures pairs were preplaced through holes in the anterosuperior aspect of the stem beneath the metaphyseal collar. The 2 lateral suture pairs were shuttled through the humeral canal and out 2 drill holes in the bicipital groove. Then, the humeral stem was press-fit into the canal. The final humeral head was impacted into place, the joint was reduced, and the subscapularis peel was repaired. The 4 suture pairs beneath

Figure 1 Short press-fit humeral stem implant. The *circles* show suture fenestrations.

the collar were individually passed through the subscapularis tendon from inferomedial to superolateral to replicate the subscapularis footprint. An independent suture was passed between the superolateral corner of the subscapularis tendon and the anterior supraspinatus to reduce tension. The sutures were then tied sequentially, incorporating the lateral sutures in the bicipital groove as previously described. This repair results in a suture-bridging construct with the addition of 2 medial mattress sutures (Fig. 2).

Postoperatively, a consistent rehabilitation protocol was used. Patients were placed in a sling for 2 weeks with immediate passive forward flexion with a rope and pulley and passive external rotation as tolerated. After sling removal at 2 weeks, formal physical therapy was initiated with progression to active range of motion as tolerated. Strengthening was allowed at 6 weeks. Full release to activities was allowed at 16 weeks.

Functional outcome

Functional outcome was assessed preoperatively and at final follow-up. Active forward flexion and external rotation with the arm at the side were assessed by a goniometer. Internal rotation behind the back was estimated to the nearest spinal level. Belly-press and lift-off test results were graded as positive or negative. The American Shoulder and Elbow Surgeons, Single Assessment Numeric Evaluation, Simple Shoulder Test, and visual analog scale scores were recorded as well.

Subscapularis healing evaluation

At the final follow-up, an ultrasound examination was performed to evaluate postoperative integrity of the subscapularis tendon. All ultrasound examinations were performed and reviewed by a physician independent of the operating surgeon. The subscapularis was categorized as healed, attenuated, or torn[1] (Fig. 3).