Superior labrum anterior-posterior lesions are a common cause of shoulder pain. The diagnosis, classification, and indications for surgical intervention remain controversial, and mixed outcomes are associated with primary repair. Given the increasing prevalence of primary superior labrum anterior-posterior repairs in the United States, more surgeons will need to treat patients with poor primary results. A retrospective review of prospectively collected data was performed on patients who underwent subpectoral biceps tenodesis for failed type II superior labrum anterior-posterior repair by a single surgeon between January 2008 and December 2011. Primary outcome variables included pain via the visual analog scale, American Shoulder and Elbow Surgeons score, and Short Form 12 score. Secondary outcome variables included the Simple Shoulder Test and Single Assessment Numeric Evaluation scores. Demographic and intraoperative information was recorded for each patient. A paired t test statistical analysis was performed with a P value less than .05 considered statistically significant.

A total of 11 patients met the inclusion criteria. Of these patients, 9 (82%) completed postoperative surveys at a mean 26-month follow-up. Mean visual analog scale scores improved from 4.1 to 2.5 (P = .03), Simple Shoulder Test scores from 5.4 to 9.3 (P = .005), American Shoulder and Elbow Surgeons scores from 54.5 to 78.0 (P = .002), and Single Assessment Numeric Evaluation scores from 42.5 to 70.4 (P = .001). Mean SF-12 (physical component) improved from 35.5 to 47.9 (P = .018). No failures or peri or postoperative complications occurred. No patients required additional surgery. The findings suggest that subpectoral biceps tenodesis as a salvage for failed type II superior labrum anterior-posterior repair demonstrates improved results. Larger scale comparative studies are required to justify this technique.

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Andrews et al first reported lesions of the superior labrum in 1985 in 73 baseball pitchers. Snyder et al2 later coined the term SLAP to mean a superior labrum lesion with anterior and posterior extension, and categorized this lesion into 4 distinct subtypes: type I involves fraying of the superior labrum; type II demonstrates an unstable separation between the superior labrum biceps anchor and the glenoid; type III maintains an intact biceps anchor but an associated bucket handle tear of the superior labrum; and type IV involves a displaced superior labral tear that extends into the biceps.2 Although management is controversial, debridement is generally accepted as the treatment of choice for type I and most type III lesions, fixation is generally accepted for type II and IV lesions, and it is generally acceptable to possibly add a tenotomy, tenodesis, or both for type IV lesions when the biceps tendon is significantly damaged. Despite this classification, decision making on the optimal treatment has remained challenging due to significant inter- and intraobserver diagnostic variability.3 Furthermore, patient satisfaction rates vary after SLAP repair depending on age, activity level, athletic status (overhead vs nonoverhead throwing athlete), and workman’s compensation status.

Managing a patient with a persistently painful shoulder following SLAP repair is a significant challenge. Options include rehabilitation with pain management, revision repair, debridement with or without subacromial decompression or acromioplasty, biceps tenotomy, and biceps tenodesis.4-6 Few reports in the literature describe the outcomes of patients undergoing revision surgery for a failed SLAP repair. Boileau et al5 reported that patient satisfaction and return to previous level of sport were significantly better in patients undergoing primary biceps tenodesis compared with SLAP repair. In that study, 3 of the 6 patients who were not satisfied with their SLAP repair were converted to a biceps tenodesis and were able to return to full previous activity. This led the authors to suggest that biceps tenodesis represents a salvage procedure for failed SLAP repair.

The purpose of this study was to evaluate the outcomes of patients undergoing subpectoral biceps tenodesis as a salvage intervention for a failed type II SLAP repair. The authors hypothesized that patients would demonstrate an overall improvement in outcomes at an average 2-year follow-up.

**MATERIALS AND METHODS**

This study was a retrospective review of prospectively collected data from a consecutive series of patients who underwent subpectoral biceps tenodesis for failed type II SLAP repair between January 2008 and December 2011 by a single board-certified shoulder and elbow surgeon (A.A.R.). The institutional review board approved this study. The records for all patients who underwent open subpectoral biceps tenodesis were reviewed. Inclusion criteria was patients with persistent pain who were unsatisfied at least 1 year following arthroscopic type II SLAP repair. The authors defined this as a failure. All patients failed conservative treatment, including activity modification, nonsteroidal anti-inflammatory drugs, and physical therapy. In addition, all patients had arthroscopic evidence of a previous SLAP repair. Intraoperative reports from the index procedure were reviewed to confirm the diagnosis and treatment of a type II SLAP lesion. All intraoperative reports for the revision surgery were reviewed to confirm that previous anchor placement occurred exclusively in the superior portion of the glenoid rim and the sutures were passed through the superior labrum and bicipital anchor complex. Exclusion criteria were patients who underwent major concomitant surgery, such as rotator cuff repair, revision SLAP repair, or arthroplasty.

Data were gathered prospectively. Primary outcome variables were the visual analog scale (VAS) for pain relief (0=no pain, 10=worst possible pain), American Shoulder and Elbow Surgeons (ASES) score, and physical and mental component summaries of the Short Form 12 (SF-12). Secondary outcome variables included the Simple Shoulder Test (SST) and the Single Assessment Numeric Evaluation (SANE) score. Intraoperative assessment of labral healing was also assessed and recorded for each patient. Pertinent demographic information, including patient age, occupation, athletic activity, and workman’s compensation status, was gathered for each patient.

**Statistical Analysis**

The mean, range, and SD of each outcome variable were calculated. A paired 2-tailed t test was performed, assuming a normal distribution of parametric data. A P value less than .05 was considered statistically significant.

**Surgical Technique**

All open subpectoral biceps tenodesis procedures were performed by the senior surgeon (A.A.R.). Patients were placed in either the beach-chair or lateral position. A thorough diagnostic arthroscopy was performed through a standard posterior visualization portal and anterior interval instrumentation portal. After confirming a previous SLAP repair (confirming the presence of sutures, anchors, or both), labral debridement was performed if indicated, including removal of the prominent anchors and sutures. The biceps was tenotomized at the bicipital-labral junction with an arthroscopic scissor or basket. A shaver was used to debride the stump at the biceps anchor to a smooth surface. The subacromial space was then evaluated. A subacromial bursectomy, acromioplasty, or acromioclavicular joint resection was performed if indicated by the patient’s history, physical examination, and intraoperative findings.
Once the arthroscopic procedures had been completed, open subpectoral biceps tenodesis was performed. A 4-cm longitudinal incision was made in line with the anterior axillary fold and centered over the palpable inferior border of the pectoralis major tendon. The fascia overlaying the coracobrachialis and biceps was incised in line with the inferior border of the pectoralis tendon. Deep retractors were placed to protect the pectoralis tendon laterally and the neurovascular structures medially. The tendon of the long head of the biceps was identified adjacent to the medial edge of the pectoralis major tendon insertion. The tenotomized proximal tendon was pulled out of the wound and secured with a locking suture starting at the musculotendinous junction and extending proximally. Any excess proximal tendon was excised.

An 8-mm reamer was used to make a unicortical hole over a guide pin. One limb of the locking stitch was subsequently tied, providing an added layer of fixation. The musculotendinous junction can be seen beneath the inferior border of the pectoralis tendon with the arm extended to confirm appropriate tensioning of the biceps. The area was then irrigated and closed with standard layered wound closure, including dermabond, for the superficial layer of skin.

Postoperatively, the arm was placed in a sling and patients were allowed to perform full active elbow range of motion with no resistance. At 4 weeks, patients were advanced to light isometrics with the arm at the side for rotator cuff and deltoid strengthening in addition to scapular strengthening exercises. Sports-related rehabilitation began at 3 months, including advanced conditioning with eccentrically resisted motions and plyometrics. Maximum medical improvement, including full return to work or sport, was usually obtained approximately 6 months postoperatively.

### RESULTS

A total of 589 patients underwent open subpectoral biceps tenodesis between January 2008 and December 2011. Ten patients met the inclusion criteria. Of these patients, 9 (90%) completed postoperative surveys, and 8 (80%) completed pre- and postoperative surveys at a mean of 26 months (range, 5-49 months) follow-up. Average age at the time of tenodesis was 40 years (range, 22-55 years). Three women and 6 men were included. Three (33%) patients were involved in workman’s compensation cases (Table 1). Arthroscopic evaluation of the prior repair site demonstrated partial healing in 3 (33%) patients and complete healing in 6 (67%). The most common associated procedure was labral debridement following biceps tenotomy (all cases). Two (22%) patients had a concomitant acromioplasty (Table 2).

Mean VAS scores improved from 4.1 to 2.5 ($P=.03$), mean SST improved from 5.4 to 9.3 ($P=.005$), mean ASES score improved from 54.5 to 78.0 ($P=.002$), and mean SANE score improved from 42.5 to 70.4 ($P=.001$). Mean SF-12 phys-
ical component summary improved from 35.5 to 47.9 ($P = .02$), and mean mental component summary improved from 44.8 to 51.8 ($P = .27$) at a mean of 26 months (range, 6-30 months) postoperatively (Table 3). No failures or peri- or postoperative complications occurred, and no patients required additional surgery.

**Discussion**

This study was a retrospective series of prospectively collected data on patients undergoing subpectoral biceps tenodesis for failed type II SLAP repairs. Overall, patients demonstrated improvement in pain, function, and subjective and objective outcome measures. Furthermore, the change in scores for VAS pain, ASES, and SST exceeded the reported minimally clinical important differences, suggesting that this intervention provided meaningful improvement for the patients. No complications occurred, and no patients needed additional operative interventions. These data support the authors’ hypothesis that patients will demonstrate an improvement in outcomes following subpectoral biceps tenodesis for a failed type II SLAP repair. Although improved, pain and limited function remained a part of the postoperative course for patients. This knowledge provides a significant contribution to the current paucity of literature on the results of biceps tenodesis for failed SLAP repairs.

Initially, SLAP tears were thought to be an uncommon cause of shoulder pain, with a reported incidence of between 4% and 6% of all shoulder arthroscopies. However, more recent studies have reported a higher incidence when including all types of SLAP lesions (up to 26% of shoulder arthroscopies). Onyekwelu et al reported that the incidence of SLAP repairs has outpaced the recent increase in ambulatory shoulder surgeries, which suggests an increase in the number of failed SLAP repairs that may require future operative intervention.

Studies evaluating primary repair have reported a spectrum of outcomes. Denard et al reported a 91% patient satisfaction rate and an 82% return to proactivity sporting level in patients who underwent type II SLAP repair. Friel et al reported that 76% of patients had a good or excellent outcome after type II SLAP repair. However, other studies have reported less successful results, especially if the endpoint was return to overhead activities. Coleman et al reported that 65% of patients who underwent isolated type II SLAP repair had good or excellent satisfaction. Verma et al reported that although pain scores improved after SLAP repair, all patients maintained significant postoperative pain scores. Furthermore, 37% of worker’s compensation patients undergoing type II SLAP repairs were able to return to their previous level of work. Alpert et al reported that 14% of young patients with isolated SLAP repairs would not have the same surgery again. Kim et al reported that overhead athletes had significantly lower shoulder function scores compared with nonoverhead athletes. Boileau et al reported low rates of patient satisfaction (40%) and return to previous level of sport (20%).

The etiology of failed SLAP repair may be multifactorial, resulting from incorrect diagnosis, poor surgical technique, or treatment ineffectiveness. In a study comparing 5 commonly used physical examination tests, Cook et al reported that no single test or combination of tests could predictably diagnose a SLAP lesion. Furthermore, in an analysis of inter- and intraobserver reliability for the arthroscopic diagnosis and treatment of SLAP tears according to the Snyder classification system, Gobezie et al reported that significant variability existed among experienced arthroscopic shoulder surgeons. These difficulties in diagnosing, recognizing, and treating SLAP lesions may lead to poor outcomes.

Given the controversy behind the diagnosis and indications for primary operative intervention, the decision on how to manage a patient with a poor outcome following primary repair adds further complexity to the treatment equation.
Options for failed SLAP repair include the removal of sutures, anchors, or both with bicipital-labral debridement, revision repair, biceps tenotomy, or biceps tenodesis. However, the data on the outcomes of such treatments are limited.

It is difficult to predict which patients will benefit from revision surgery. In a recent case series, Katz et al. reported that 71% of patients with a poor outcome after primary SLAP repair were dissatisfied with conservative treatment only, whereas 62% were satisfied after revision surgery. In a case series of 12 patients, Park and Glousman reported that arthroscopic revision repair had worse outcomes than that of primary repair reported in the literature, which demonstrates the need to evaluate the outcomes of alternative treatment strategies for failed SLAP repairs, such as biceps tenodesis.

The majority of patients in the current study demonstrated a healed superior labrum-bicipital complex at the time of arthroscopy. These data suggest that failure of the SLAP lesion to heal to the glenoid may not be the cause of persistent pain in patients with SLAP repairs. Persistent pain may result from altered glenohumeral mechanics or inflammation involving the biceps tendon more distally in the bicipital groove.

Currently, few reports in the literature describe the outcomes of subpectoral biceps tenodesis as a revision treatment for failed SLAP repair. The current study provides useful insight on this topic, suggesting that subpectoral biceps tenodesis is an effective treatment modality for failed type II SLAP tears. Additional strengths of this study include its prospective data collection by an independent observer, mean 2-year follow-up, and use of validated outcome instruments. Weaknesses include its small sample size, retrospective data evaluation, older nonthrowing patient population, and lack of physical examination data. In addition, a few patients underwent concomitant procedures (ie, acromioplasty) at the time of tenodesis, which could have accounted for the improved outcomes.

**CONCLUSION**

Given the current and predicted increase in type II SLAP repairs, particularly in older patients, the need for revision surgery will also increase. Therefore, surgeons need to be prepared to face this diagnostic and therapeutic dilemma. Subpectoral biceps tenodesis appears to be an effective treatment option. Further studies including randomized, controlled trials are crucial to determine the appropriate means by which to manage such patients.

**REFERENCES**


