Arthroscopic Biceps Tenodesis Compared With Repair of Isolated Type II SLAP Lesions in Patients Older Than 35 Years

PATRICK J. DENARD, MD; ALEXANDRE LÄDERMANN, MD; B. K. PARSLEY, MD; STEPHEN S. BURKHART, MD

Abstract

This study compared arthroscopic biceps tenodesis with biceps repair for isolated type II superior labrum anterior and posterior (SLAP) lesions in patients older than 35 years. The authors identified isolated type II SLAP lesions that were surgically managed over a 5-year period. Minimum 2-year follow-up data were available for 22 patients who underwent biceps repair (repair group) and for 15 patients who underwent a primary biceps tenodesis (tenodesis group). Mean age at surgery was 45.2±5.5 years in the repair group and 52.0±8.0 years in the tenodesis group. In the repair group, functional outcome improved from baseline to final follow-up using the American Shoulder and Elbow Surgeons (ASES) (47.5 to 87.4, respectively; \(P<.0001\)) and University of California, Los Angeles (UCLA) scores (18.5 to 31.2, respectively; \(P<.0001\)). In the tenodesis group, similar findings were observed for the ASES (43.4 to 89.9, respectively; \(P<.0001\)) and UCLA scores (19.0 to 32.7, respectively; \(P<.0001\)). No difference was found in functional outcome between the groups. Full range of motion recovery was delayed by approximately 3 months in the repair group compared with the tenodesis group (\(P=.0631\)). Two patients in the repair group required a secondary capsular release. Seventy-seven percent of patients in the repair group and 100% of patients in the tenodesis group were satisfied and returned to normal activity (\(P=.0673\)). In the current study, individuals older than 35 years with an isolated type II SLAP lesion had a shorter postoperative recovery, a more predictable functional outcome, and a higher rate of satisfaction and return to activity with a biceps tenodesis compared with a biceps repair. Based on these observations, biceps tenodesis is preferable to biceps repair for isolated type II SLAP lesions in nonoverhead athletes older than 35 years.
Superior labrum anterior and posterior (SLAP) lesions were initially described by Andrews et al in 1985 and then classified into 4 subtypes by Snyder et al in 1990. The type II subtype, which is characterized by disruption of the superior labrum and biceps anchor, is the most common variant of SLAP lesions.

Anatomic arthroscopic repair with suture anchors has been the standard of care for type II SLAP lesions refractory to nonoperative management. However, some reports have indicated that return to activity and patient satisfaction are inconsistent following SLAP repair. In addition, repair requires an extensive postoperative rehabilitation and is associated with a risk of postoperative stiffness. Although anatomic repair is desirable in young adults and overhead athletes, these concerns have led to an interest in primary biceps tenodesis or tenotomy as an alternative to arthroscopic repair in older adults.

The purpose of the current study was to compare arthroscopic biceps tenodesis with biceps repair of isolated type II SLAP lesions in patients older than 35 years. The authors hypothesized that biceps tenodesis would lead to improved patient satisfaction and functional outcome compared with biceps repair in this patient population.

Materials and Methods

Study Population

This study retrospectively examined all surgically managed isolated type II SLAP lesions (defined as detachment of the superior labrum and biceps anchor, as categorized by Snyder et al) between November 2003 and February 2009. Institutional review board approval was obtained prior to commencing the study. Inclusion criteria were age older than 35 years, surgical management of a type II SLAP lesion diagnosed arthroscopically, and minimum 2-year follow-up. Exclusion criteria included revision SLAP, concomitant rotator cuff repair, concomitant debridement for glenohumeral arthritis, calcific tendinitis, and concomitant anterior or posterior labral repairs. A total of 30 arthroscopic repairs (repair group) and 17 primary biceps tenodesis (tenodesis group) for isolated type II SLAP lesions were performed during this period. Overall, follow-up was available for 37 patients (22 in the repair group and 15 in the tenodesis group). Follow-up averaged 63.2±14.5 months in the repair group and 41.1±19.8 months in the tenodesis group. Baseline patient characteristics are summarized in Table 1.

Surgical Technique

The decision to perform repair vs tenodesis was based on patient factors, including age, activity level, and worker’s compensation status. During the study period, a gradual transition was observed from performing repairs to more often performing a primary biceps tenodesis in older adults (Figure). Initially, repair was performed almost exclusively for type II SLAP lesions. In the middle of the study period, the authors began performing a primary tenodesis in patients with worker’s compensation claims, particularly for those who were older and not overhead athletes. By the end of the study period, primary tenodesis had become the procedure of choice, with repair reserved for those patients older than 35 years with substantial overhead activity, such as throwers.

The surgical technique did not change substantially during the study period and has previously been described in detail for both repair and biceps tenodesis. The senior author (S.S.B.) performed all surgeries arthroscopically with patients in the lateral decubitus position. Five to 10 pounds of balanced suspension were used with the arm in 20° to 30° of abduction and 20° of forward flexion (Star Sleeve Traction System; Arthrex Inc., Naples, Florida). Following diagnostic arthroscopy through a posterior viewing portal, anterior (SLAP only) and anterosuperolateral portals were established. Arthroscopic criteria for the diagnosis of a type II SLAP lesion included a superior sublabral sulcus greater than 5 mm in depth, a bare superior labral footprint, a displacable biceps root, or a positive peel-back sign.

Superior labrum anterior and posterior repairs were performed with dou-

### Table 1

Baseline Characteristics for Patients with Type II SLAP Lesions

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Repair Group (n=22)</th>
<th>Tenodesis Group (n=15)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y, mean±SD</td>
<td>45.2±5.5</td>
<td>52.0±8.0</td>
<td>.0049</td>
</tr>
<tr>
<td>Sex, no. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14 (64)</td>
<td>12 (80)</td>
<td>.4657</td>
</tr>
<tr>
<td>Female</td>
<td>6 (36)</td>
<td>2 (20)</td>
<td></td>
</tr>
<tr>
<td>Dominant extremity, no. (%)</td>
<td>13 (59)</td>
<td>11 (73)</td>
<td>.3729</td>
</tr>
<tr>
<td>Workers’ compensation claim, no. (%)</td>
<td>5 (23)</td>
<td>2 (13)</td>
<td>.6767</td>
</tr>
<tr>
<td>Forward flexion, mean±SD</td>
<td>179.8°±1.1°</td>
<td>177.0°±9.2°</td>
<td>.3559</td>
</tr>
<tr>
<td>VAS pain, mean±SD</td>
<td>6.3±1.7</td>
<td>6.9±1.8</td>
<td>.2693</td>
</tr>
<tr>
<td>UCLA score, mean±SD</td>
<td>18.5±4.5</td>
<td>19.0±3.7</td>
<td>.7544</td>
</tr>
<tr>
<td>ASES score, mean±SD</td>
<td>47.5±15.3</td>
<td>43.4±15.9</td>
<td>.4491</td>
</tr>
</tbody>
</table>

Abbreviations: ASES, American Shoulder & Elbow Surgeons; SLAP, superior labrum anterior and posterior; UCLA, University of California Los Angeles; VAS, visual analog scale.
ble-loaded suture anchors (BioSutureTak or BioFASTak; Arthrex, Inc.), with an average of 1.9 anchors used. The number and placement of anchors was determined by the extent and location of pathology. Anchors anterior to the biceps root were placed via an anterosuperolateral portal, whereas anchors posterior to the biceps root were placed percutaneously via a Port of Wilmington portal 1 cm lateral and 1 cm anterior to the posterior border of the acromion. Simple sutures were passed, and all knots were tied arthroscopically using a Surgeon’s Sixth Finger Knot Pusher (Arthrex, Inc.).

Biceps tenodesis was performed intra-articularly high in the bicipital groove using a BioTenodesis screw (Arthrex, Inc.). The primary working portal was an anterosuperolateral portal established with an 8.25-mm threaded clear cannula (Arthrex, Inc.). Two half-racking No. 2 FiberWire (Arthrex, Inc.) sutures were placed as traction sutures in the biceps tendon and then a tenotomy was performed. Next, the biceps was exteriorized and secured with a whipstitch beginning 5 mm from the proximal tendon edge. One of the half-racking stitches was removed and 1 was left in place. The leading edge of the biceps tendon was tapered to ease insertion and the tendon was sized. A guide wire was placed through the anterosuperolateral portal to determine the appropriate position for tenodesis.

A cannulated drill equal in diameter to the biceps tendon (usually 7 or 8 mm) was reamed to a depth of 25 mm to prepare a bone socket for a 23-mm BioTenodesis screw (Arthrex, Inc.). The bone socket was cleared of debris to ensure an unobstructed path for the biceps tendon. After the FiberWire tails from the biceps whipstitch were passed through the BioTenodesis screwdriver, the biceps was guided into the bone socket and the screw was advanced down the shaft of the screwdriver to achieve tendon-to-bone interference fixation. A suture from the whipstitch was arthroscopically tied to a suture from the remaining half-racking stitch and repeated for the second set of sutures; this step maximized fixation by ensuring that the entire construct would have to fail for the tendon to lose fixation.

In the repair group, concomitant procedures included 22 (100%) subacromial decompressions, 13 (59.1%) distal clavicle excisions, 4 (18.2%) posterior capsular releases, 2 (9.1%) spinoglenoid cyst debridements, and 2 (9.1%) other procedures. In the tenodesis group, concomitant procedures included 14 (93.3%) subacromial decompressions, 8 (53.3%) distal clavicle excisions, 2 (13.3%) posterior capsular releases, 1 (7.7%) spinoglenoid cyst debridement, and 3 (20.0%) other procedures. The high prevalence of associated procedures was likely due to the older age of the study group. However, in all cases, the only lesion that required repair or tenodesis was the SLAP lesion.

Rehabilitation
In cases of repair, patients were immobilized in a sling for 4 weeks postoperatively. During this period, passive external rotation was allowed as tolerated. Active elbow flexion and extension were allowed with the arm at the side. If a posterior release had been performed, sleeper stretches were initiated immediately postoperatively. At 4 weeks postoperatively, the sling was discontinued and passive forward flexion was allowed. Strengthening was initiated at 6 weeks postoperatively. At 3 months postoperatively, patients were allowed to work out in a gym. For throwing athletes, an interval throwing program was started at 4 months postoperatively. Full return to activity was allowed at 7 months postoperatively, including all overhead sports activities.

In cases of biceps tenodesis, patients were immobilized in a sling for 6 weeks postoperatively. Active elbow flexion and extension and passive forward elevation and external rotation were allowed immediately as tolerated. Strengthening was delayed until 12 weeks postoperatively. Full return to activity was allowed when strength was regained, usually at 4 months postoperatively.

Clinical Assessment and Functional Outcome
Preoperative function was determined by a retrospective review of prospectively collected outcomes data obtained preoperatively. Preoperative University of

Figure: Bar graph showing the trend in repair vs biceps tenodesis during the study period for isolated type II superior labrum anterior and posterior (SLAP) lesions in patients older than 35 years. This graph includes all surgeries performed for isolated type II SLAP lesions, including patients without long-term follow-up.
In the tenodesis group, mean ASES improved by 39.9 points, from 6.3 to 32.7 points (P<.0001). The rate of patient satisfaction, return to normal sports or work activity, and any complications or additional surgery.

**Statistical Analysis**

Continuous data were described by mean and standard deviations. Statistical analyses were conducted using SAS version 9.2 software (Cary Institute, Cary, North Carolina). A paired t test, sign test, or Wilcoxon rank sum were performed (depending on variable distribution) to analyze the difference in pre- and postoperative scores for flexion, strength, pain, ASES score, and UCLA score and to compare these values between the groups. Chi square tests were conducted for categorical outcomes of interest: final outcome (as good or excellent vs fair or poor), return to activity, and overall satisfaction, with Fishers exact P values reported for sparse data. Two-tailed P values less than .05 were considered significant.

**RESULTS**

**Functional Outcome**

In both groups, functional outcome was statistically improved from baseline compared with final follow-up. In the repair group, mean ASES improved by 39.9 points, from 47.5 to 87.4 points (P<.0001), and mean UCLA score improved by 13.7 points, from 19.0 to 32.7 points (P<.0001). No difference was observed in functional outcome between the groups (Table 2).

According to the UCLA grading system, 7 excellent, 13 good, 0 fair, and 2 poor results were reported in the repair group and 6 excellent, 9 good, and 0 fair or poor results were reported in the tenodesis group. Both poor outcomes in the repair group occurred in cases involving workers’ compensation claims. No statistically significant difference was found in the percentage of good and excellent results at final follow-up between the groups (P=.5054).

**Range of Motion**

In the repair group, mean active forward flexion and external rotation were not statistically different from baseline (178.9° and 67.7°, respectively) compared with final follow-up (176.4° and 65.8°, respectively; P=1.0). Similarly, in the tenodesis group, mean active forward flexion and external rotation were not statistically different from baseline (177° and 64.3°, respectively) compared with final follow-up (175° and 65.4°, respectively) (P=.10). No difference was found in final forward flexion or external rotation between the repair and tenodesis groups (P=.3547 and .5990, respectively). However, restoration of full range of motion was delayed in the repair group, occurring at a mean of 6.5±4.0 months compared with 3.7±1.8 months in the tenodesis group. This difference trended toward, but did not reach, statistical significance (P=.0631).

**Pain**

In both groups, VAS scores for pain improved significantly from baseline compared with final follow-up. In the repair group, mean VAS improved by 4.9 points, from 6.3 to 1.5 points (P<.0001). In the tenodesis group, mean VAS improved by 5.7 points, from 6.9 to 1.2 points (P<.0001). No statistically significant difference was found in pain at final follow-up between groups (P=.3246).

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**Table 2**

**Comparison of Functional Outcome of Repair Versus Biceps Tenodesis for Type II SLAP Lesions**

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Repair Group (n=22)</th>
<th>Tenodesis Group (n=15)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative ASES</td>
<td>47.5</td>
<td>43.4</td>
<td>.4491</td>
</tr>
<tr>
<td>Postoperative ASES</td>
<td>87.4</td>
<td>89.9</td>
<td>.8719</td>
</tr>
<tr>
<td>ASES improvement</td>
<td>39.9</td>
<td>46.5</td>
<td>.2345</td>
</tr>
<tr>
<td>Preoperative UCLA</td>
<td>18.5</td>
<td>19.0</td>
<td>.7544</td>
</tr>
<tr>
<td>Postoperative UCLA</td>
<td>31.2</td>
<td>32.7</td>
<td>.4423</td>
</tr>
<tr>
<td>UCLA improvement</td>
<td>12.7</td>
<td>13.7</td>
<td>.6046</td>
</tr>
<tr>
<td>UCLA good/excellent</td>
<td>90.9%</td>
<td>100%</td>
<td>.5054</td>
</tr>
<tr>
<td>SANE</td>
<td>88.7</td>
<td>91.2</td>
<td>.8909</td>
</tr>
</tbody>
</table>

**Abbreviations:** ASES, American Shoulder & Elbow Surgeons; SANE, Single Assessment Numeric Evaluation; SLAP, superior labrum anterior and posterior; UCLA, University of California Los Angeles.
was 86.3% in the repair group and 100% in the tenodesis group (P=.2568). Similarly, return to normal sport or activity was reported by 86.3% of patients in the repair group and 100% of patients in the tenodesis group (P=.2568). In the repair group, 77.3% of patients were both satisfied and returned to normal activity compared with 100% in the tenodesis group (P=.0673).

Complications

No instances of postoperative infection or implant failure were observed in the entire cohort. Two patients in the repair group required a subsequent capsular release for persistent postoperative stiffness. One of these patients had a UCLA score of 18 points at final follow-up and did not return to normal activity, whereas the other patient had a UCLA score of 30 points at final follow-up and returned to normal activity; neither patient was satisfied with the surgery.

Discussion

The ideal surgical management of type II SLAP lesions for older adults and non-overhead recreational athletes has recently been questioned. Although anatomic repair has been the standard of care for many years, and remains such for young patients and overhead athletes, biceps tenodesis or tenotomy has been advocated for older individuals. Advantages to biceps tenodesis may include less postoperative stiffness, higher rates of return to activity, and higher patient satisfaction. Furthermore, in non-throwing patients, the proximal biceps root likely plays a less important biomechanical role in the shoulder. For these patients, a tenodesis or tenotomy is functionally acceptable and may lead to a more predictable outcome. This may particularly be the case in patients with worker’s compensation claims; it is notable that the 2 poor results in the repair group occurred in such cases. It is possible that in these cases the accelerated rehabilitation program following biceps tenodesis promotes earlier return to work and the worker’s subjective interpretation of health. However, further study is needed to evaluate outcomes of repair vs biceps tenodesis in this patient population.

Brockmeier et al prospectively evaluated the arthroscopic repair of 47 isolated type II SLAP lesions with an average follow-up of 2.7 years. Although the median ASES scores improved from 62 to 97 points at final follow-up (P<.05), refractory postoperative stiffness occurred in 9% of the patients. Among 41 type II SLAP repairs, Cohen et al reported that 9% of patients lost slight external rotation and 61% of patients had some degree of internal rotation loss. In the current study, 2 of 22 patients in the SLAP repair group required a secondary capsular release, whereas no secondary procedures were required in the tenodesis group. Furthermore, return to full range of motion was delayed by approximately 3 months in the repair group compared with the tenodesis group; this difference trended toward statistical significance. These data imply that rehabilitation is simplified after tenodesis compared with repair. However, surgical technique also bears consideration because anchors anterior to the biceps root may limit external rotation. In the Brockmeier et al study, the majority of patients had anchors placed both anterior and posterior to the biceps root, and in the current study an average of 1.9 anchors was used for repair. However, in a recent study an anchor anterior to the biceps root only limited external rotation by 1° to 2°, suggesting that anterior anchor placement alone is not to blame for stiffness following SLAP repair.

Return to activity has varied following repair of type II SLAP lesions. Goranita et al conducted a systematic review of 12 studies reporting arthroscopic repair of type II SLAP lesions. Overall, return to activity ranged from 20% to 94%. The method of repair varied in these studies and included several reports of bioabsorbable tacks, which have fallen out of favor. Furthermore, average patient age in the majority of the reports was younger than 35 years. Nonetheless, the inconsistent return to activity is concerning, particularly when extrapolated to an older population of non-throwers in which the biomechanical role of the biceps root is less important.

Boileau et al were the first to compare repair and biceps tenodesis in a non-randomized study of type II SLAP lesions. Ten patients with an average age of 37 years underwent an arthroscopic repair and 15 patients with an average age of 52 years underwent an arthroscopic biceps tenodesis. Patient satisfaction and return to activity were only 60% and 20%, respectively, in the repair group compared with 93% and 87%, respectively, in the tenodesis group. In the current study, patient satisfaction and return to activity were also lower in the repair group, although the authors did not observe such a dramatic difference between the groups. One explanation for the higher return to activity and patient satisfaction in patients who underwent tenodesis is that there may be a decreased healing potential of SLAP lesions in mature adults compared with younger individuals.

Another consideration in older patients with type II SLAP lesions is the high rate of associated pathology. In a descriptive analysis of 139 patients with SLAP lesions, Kim et al noted an increased prevalence of rotator cuff tears and osteoarthritis in patients older than 40 years. In a level I study, Franceschi et al compared arthroscopic repair to biceps tenotomy for type II SLAP lesions in 56 patients older than 50 years who also underwent a rotator cuff repair. At a mean follow-up of more than 5 years, patients in the tenotomy group had higher UCLA scores (32 vs 28 points, respectively; P<.05) and improved forward flexion (166° vs 139°, respectively; P<.05). In the current study, the exclusion criteria were used to attempt to limit the variable of associated pathology. In the current study, even
without significant associated pathology, patient satisfaction and return to activity trended toward being higher for patients older than 35 years who underwent biceps tenodesis rather than repair for a type II SLAP lesion.

The major limitations the current study were the retrospective collection of preoperative patient characteristics and the nonrandomized study design. As noted, the authors attempted to limit the variable of associated pathology with the exclusion criteria. Many patients had undergone additional procedures that did not require repair, such as acromioplasty or distal clavicle excision, which the authors believe reflects an age older than 35 years as an inclusion criteria. The authors did not correlate physical examination findings, radiographic findings, or mechanism of injury with functional outcome. The relatively low number of patients in the groups also limited statistical analysis and left potential for type II error. Due to a change in practice pattern over the study period, the follow-up was longer in the repair group than in the tenodesis group. In addition, the authors did not compare biceps tenotomy versus tenodesis for type II SLAP lesions. They prefer performing biceps tenodesis over tenotomy for patients younger than 70 years due to the risk of cosmetic deformity and persistent pain with tenotomy alone. Finally, mean age in the tenodesis group was higher than that in the repair group. Despite this difference, the preoperative function of the 2 groups was comparable.

**Conclusion**

In the current study, individuals older than 35 years with an isolated type II SLAP lesion trended toward a more predictable functional outcome, a quicker recovery, and a higher rate of satisfaction and return to activity after a biceps tenodesis compared with repair. Based on these observations, biceps tenodesis is preferable to repair for isolated type II SLAP in this patient population.

**References**