Surgical treatment of isolated type II superior labrum anterior-posterior (SLAP) lesions: repair versus biceps tenodesis

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Background: It is still unclear which patients with isolated type II superior labrum anterior-posterior (SLAP) lesions benefit from either superior labral repair or biceps tenodesis. This study evaluates the indications and outcomes of patients with isolated type II SLAP lesions who have undergone either procedure.

Methods: A retrospective analysis was performed of patients who had surgery for an isolated type II SLAP lesion between 2008 and 2011. There were 25 patients: 15 underwent biceps tenodesis, with a mean follow-up of 31 months (range, 26-43 months), and 10 underwent SLAP repair, with a mean follow-up of 35 months (range, 25-52 months). The mean age was 47 years (range, 30-59 years) in the tenodesis group and 31 years (range, 21-43 years) in the repair group.

Results: At latest follow-up, both groups showed significant improvements in subjective shoulder value and pain score. No difference was observed in American Shoulder and Elbow Surgeons score (93.0 vs 93.5, \( P = .45 \)), patient satisfaction (93% vs 90%, \( P = .45 \)), or return to preinjury sporting level (73% vs 60%, \( P = .66 \)). Analysis of the indications for treatment showed that in the large majority, tenodesis was performed in older patients (>35 years) and patients who showed degenerative or frayed labrums whereas SLAP repairs were performed in younger and more active patients with healthy-appearing labral tissue. There was only 1 failure in the tenodesis group, and in the SLAP repair group, there were 2 cases of postoperative stiffness; all were treated nonoperatively.

Conclusion: In this study, we show that both biceps tenodesis and SLAP repair can provide good to excellent results if performed in appropriately selected patients with isolated type II SLAP lesions.

Level of evidence: Level III, Retrospective Cohort Study, Treatment Study.

Keywords: SLAP lesion; superior labral repair; biceps tenodesis; labrum
Since the original description by Andrews et al\(^2\) in 1985 and the subsequent classification by Snyder et al\(^{24}\) in 1990, there has been increasing recognition of superior labrum anterior-posterior (SLAP) lesions as a significant cause of shoulder pain, especially in the overhead athlete. Of the various types, type II SLAP lesions are the most common and are characterized by detachment of the superior labrum and biceps anchor from the superior glenoid.\(^{23,24}\) However, the management of type II SLAP lesions is still somewhat controversial because various factors have been shown to potentially influence the outcomes of treatment, such as patient age, activity level, quality of the labral tissue, and concomitant pathology.\(^{3,8,11,20,22}\)

The current surgical options for treatment of type II SLAP lesions commonly involve either superior labral repair or biceps tenodesis (or tenotomy). However, it is still unclear which patients would benefit from either procedure. Boileau et al\(^3\) compared the outcomes between SLAP repair and biceps tenodesis for isolated type II lesions and reported that approximately 80% of patients in the tenodesis group were subjectively satisfied compared with only 40% of patients in the repair group. Moreover, 87% of athletes returned to their previous sporting level in the tenodesis group compared with 20% in the SLAP group. On the other hand, several previous studies have shown good to excellent results in up to 97% of patients after repair of SLAP lesions.\(^{4,7,12,17}\) Interestingly, in a recent study, Denard et al\(^8\) reported that increasing age (>40 years) may be a factor associated with poorer outcomes after repair of type II SLAP lesions, and they suggested that biceps tenodesis may be the more appropriate operation in this age group. This is further supported by a large prospective study by Provencher et al\(^{20}\), who showed that type II SLAP repair in patients aged older than 36 years was associated with a significantly higher risk of failure. These results are in contradistinction to the results of Alpert et al\(^2\), who showed no difference in clinical outcomes after type II SLAP repair in patients aged older than and younger than 40 years.

Given the general lack of consensus on the appropriate management of isolated type II SLAP tears, the aim of this study was to evaluate the indications for either superior labral repair or biceps tenodesis and compare the clinical outcomes of patients who have undergone either procedure for an isolated type II SLAP lesion. We hypothesize that both procedures provide significant improvement in shoulder function if performed in appropriately selected patients.

**Methods**

**Patient selection**

A retrospective analysis was performed of all patients who had undergone a superior labral repair or biceps tenodesis for an isolated type II SLAP lesion by the senior author (J.J.P.W.) between January 2008 and March 2011. Patients were included in the study if they showed both clinical and radiologic evidence of an isolated type II SLAP lesion. Patients with other types of SLAP lesions, such as types I, III, and IV, were excluded from the study. In addition, patients who had a concomitant rotator cuff repair or an anterior or posterior labral repair were also excluded, as were those who had associated pathology such as biceps tendinopathy or glenohumeral arthritis. Only patients with a minimum of 24 months of clinical follow-up were included in this study.

During the study period, a total of 125 patients were identified as having had some form of labral repair of the anterior, posterior, or superior labrum by the senior author (J.J.P.W.). A further 449 patients had a biceps tenodesis, of whom 72 had a tenodesis for documented labral pathology. After a careful chart review and analysis of operative reports and intraoperative photographs and videos, a total of 31 patients were identified as having either a superior labral repair or biceps tenodesis for an isolated type II SLAP lesion. Eighteen patients underwent biceps tenodesis, and thirteen patients had a superior labral repair.

At the time of latest follow-up, 3 patients in the tenodesis group were lost to follow-up. This left 15 patients with a mean follow-up period of 31 months (range, 26-43 months). The mean age at the time of surgery was 47 years (range, 30-59 years). There were 14 men and 1 woman, and the dominant shoulder was involved in 12 shoulders (80%). In the labral repair group, 3 patients were lost to follow-up, leaving 10 patients with a mean follow-up period of 35 months (range, 25-52 months). The mean age at the time of surgery was 31 years (range, 21-43 years). In this group all patients were men, and the dominant shoulder was involved in 9 patients (90%) (Table I).

**Surgical technique**

The decision to perform either a biceps tenodesis or a superior labral repair was determined both preoperatively and after intraoperative assessment of the status of the superior labrum. All operations were performed by the senior surgeon (J.J.P.W.). Patients were placed on the operating table in the beach-chair position and underwent a diagnostic arthroscopy through a posterior viewing portal. Through an anterior portal, which was made through the rotator interval above the subscapularis tendon, a probe was then inserted to assess the superior labrum. The arthroscopic criterion for a type II SLAP lesion was the ability to show clear separation of the superior labrum from the supraglenoid cartilage rim or a positive “peel-back” sign, as described by Burkhart and Morgan.\(^5\)

The technique used for biceps tenodesis first comprised tenotomy of the biceps tendon at its superior labral attachment, followed by open subpectoral tenodesis by attaching the biceps tendon, at its musculotendinous junction, to the inferior aspect of the bicipital groove at the inferior margin of the pectoralis major tendon with a 2.9-mm suture anchor (Bioraptor; Smith & Nephew, Memphis, TN, USA). For the superior labral repair, in all cases, a trans-cuff portal was used to insert a double-loaded 2.9-mm suture anchor (Bioraptor) into the superior glenoid margin. Depending on tear configuration, the anchor was placed either beneath the biceps insertion or just posterior to it. One limb of each suture was then passed through the labrum with a 45° curved suture...
passer and shuttle relay technique with No. 1 PDS suture (Ethi-
con, Somerville, NJ, USA). Sutures were then tied medial to the
labral tissue, with sufficient tension so as not to strangulate the
labrum.

### Indications for repair versus tenodesis

The indications for either biceps tenodesis or superior labral
repair were based predominantly on the quality of the superior
labrum, as seen at the time of arthroscopy, as well as the age and
activity level of the patient. The operative reports were carefully
analyzed in all patients to determine the indications for either
procedure. Intraoperative photographs and videos of the diag-
nostic arthroscopy were assessed to document the status of the
superior labrum and confirm that the lesion was an isolated type
II SLAP tear. The quality of the labral tissue was described as
being either (1) degenerative and of poor quality (Fig. 1) or (2)
normal and of good quality (Fig. 2). This subjective assessment
took into account evidence of fraying and degenerative tearing,
as well as the thickness of the labrum and its relative elasticity
when probed.

### Postoperative protocol

After superior labral repair, patients are in a sling for 4 weeks but
commence gentle passive and active-assisted range-of-motion
exercises from day 1. Patients are advised to avoid isolated
biceps contractions during this period. After week 4, the sling is
discontinued and active range-of-motion exercises are commenced
in all planes. Strengthening begins after week 6, and patients are
allowed to return to full activity, including overhead sports, after
6 months.

After biceps tenodesis, patients are in a sling for 2 weeks and
are allowed to start both passive and active-assisted range-of-
motion exercises of the shoulder from day 1. Patients discontinue
using the sling after week 2, and active range of motion of the
elbow against resistance is avoided until week 4. Strengthening
begins at week 6, and return to full activities is expected by
week 10.

### Clinical and functional assessment

In all patients, the preoperative subjective shoulder value (SSV)
and visual analog scale score for pain were recorded within the
medical record. At latest follow-up, postoperative data were
collected through patient questionnaires and telephone in-
terviews. The data obtained through the questionnaires included
the overall pain score (visual analog scale), the presence of
bicipital groove pain, the American Shoulder and Elbow Sur-
gerons (ASES) score, and the time to return to work and the
patients’ previous level of sporting activities. Patients were also
asked to provide an SSV and rate their degree of overall satis-
faction using a 4-point scale (very satisfied, satisfied, dissatisfied,
or very dissatisfied).

### Statistical analysis

Values were expressed as mean ± standard deviation, and the
mean values were compared by use of the Student t test. P < .05
was considered statistically significant. All statistical analyses
were performed with the XLSTAT software package (version
2012.4; Addinsoft, Andernach, Germany).

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<table>
<thead>
<tr>
<th>Table I</th>
<th>Patient characteristics for SLAP repair and biceps tenodesis groups (N = 25)</th>
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<tr>
<td></td>
<td>SLAP repair</td>
</tr>
<tr>
<td>No. of patients</td>
<td>10</td>
</tr>
<tr>
<td>Age [mean (range)] (y)</td>
<td>31 (21-43)</td>
</tr>
<tr>
<td>Gender</td>
<td>10 men</td>
</tr>
<tr>
<td>Dominant arm</td>
<td>9 (90%)</td>
</tr>
<tr>
<td>Preoperative pain score (VAS) [mean (range)]</td>
<td>6.5 (3-10)</td>
</tr>
<tr>
<td>Preoperative SSV [mean (range)] (%)</td>
<td>51 (10-70)</td>
</tr>
<tr>
<td>Follow-up [mean (range)] (mo)</td>
<td>35 (25-52)</td>
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</tbody>
</table>

VAS, visual analog scale.

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**Figure 1** Arthroscopic photograph showing type II SLAP lesion with features of degenerative and frayed superior labrum.

**Figure 2** Arthroscopic photograph showing type II SLAP lesion with normal-appearing and healthy superior labrum, as deter-
dined by arthroscopic probing.
Results

Characteristics of superior labral repair and biceps tenodesis groups

In the biceps tenodesis group, 13 patients (87%) had clear intraoperative evidence of degenerative superior labrums. In the remaining 2 patients, the superior labrum appeared to be of reasonable quality and tenodesis was performed based on the patients’ ages (56 years and 59 years). Of the 15 patients, 13 (93%) were aged older than 35 years. Concomitant subacromial decompression was performed in 11 patients (73%), and 1 patient had a distal clavicle excision.

All patients in the labral repair group had normal and healthy labral tissue. Two patients had an associated paralabral cyst, 1 of whom had a resultant suprascapular neuropathy. In both patients, the cyst was decompressed arthroscopically from within the joint before superior labral repair, which was performed in the standard fashion. In the patient who had the suprascapular neuropathy, arthroscopic decompression of the nerve was performed. In addition to the SLAP repair, 2 patients underwent subacromial decompression and 1 patient had a distal clavicle excision. With respect to age, only 3 patients (30%) were aged older than 35 years. Of note, there were no patients in either group who were considered high-level athletes at the time of their surgery.

Clinical results

At the time of latest follow-up, the SSV in both groups significantly increased, from 44% to 85% \( (P < .001) \) in the tenodesis group and from 51% to 84% \( (P < .001) \) in the labral repair group (Fig. 3). The pain score also significantly improved in both groups, from 6.2 to 0.9 \( (P < .001) \) in the tenodesis group and from 6.5 to 0.8 \( (P < .001) \) in the labral repair group (Fig. 4). There was no significant difference in functional outcome scores between the 2 groups at the time of latest follow-up. The mean ASES score was 93.0 in the biceps tenodesis group compared with 93.5 in the SLAP repair group \( (P = .45) \) (Table II).

Complications

In the tenodesis group, there was 1 failure of the tenodesis, which presented as a clear “Popeye” deformity at latest follow-up. The patient was not aware of when this occurred and was completely asymptomatic; therefore, no further management was considered. In the SLAP repair group, postoperative stiffness occurred in 2 cases; it was treated conservatively with physical therapy and subsequently resolved. No patients were considered to have had a failure of their repair, with none showing clinical features of a recurrent SLAP lesion.

Return to sport and patient satisfaction

Of the 15 patients in the tenodesis group, 11 actively played some form of sport before their injury. At the time of follow-up, 8 patients (73%) had returned to their previous level of sporting activity at a mean time of 6.8 months. In the labral repair group, all patients actively played some form of sport. At latest follow-up, 6 patients (60%) had returned to their previous level at a mean time of 8.2 months. There was no significant difference between the 2 groups with respect to return to sporting activity \( (P = .66) \) or time to return \( (P = .37) \). In terms of overall satisfaction, 93% of patients in the tenodesis group (14 patients) were either very satisfied or satisfied with the outcome of the surgery, as compared with 90% in the SLAP repair group (9 patients) \( (P = .45) \) (Table II).
Discussion

In this study, we hypothesized that both superior labral repair and biceps tenodesis could provide significant improvements in functional outcome, pain, and overall satisfaction if performed in appropriately selected patients. It has been the senior author’s preference to perform arthroscopic SLAP repairs for patients who were generally younger (<35 years) and/or those in whom healthy labral tissue was found at the time of arthroscopy. In contrast, for patients who were generally older (>35 years) and/or those who with degenerative or frayed labrums, biceps tenodesis was preferred. On the basis of this simple treatment algorithm, we found that both superior labral repair and biceps tenodesis can provide significant improvements in functional outcome, pain, and overall patient satisfaction. In addition, we showed that there was no significant difference between the 2 groups in terms of outcome scores, return to sport, and SSV.

To our knowledge, there has only been 1 previous study in the literature, by Boileau et al, that has compared the results of biceps tenodesis and those of superior labral repair for isolated type II SLAP lesions. In their study, the indications for biceps tenodesis were older (>30 years) and less active patients, whereas superior labral repairs were performed in younger and more active individuals. Although these indications are similar to those used in our series, the status of the labral tissue at the time of arthroscopy was not a factor in the decision-making process. Boileau et al reported, among a group of 25 patients (10 with SLAP repair and 15 with biceps tenodesis), that biceps tenodesis resulted in significantly higher rates of patient satisfaction and return to previous level of sport compared with superior labral repair. Interestingly, no difference was seen between the 2 groups in terms of functional outcome.

The importance of the superior labral complex (including the long head of the biceps) in overall glenohumeral stabilization has been shown in several biomechanical studies. Furthermore, absence of the long head of the biceps has been shown to result in increased shoulder instability, especially in the anterosuperior and anterior planes. This has been recently supported by Patzer et al, who showed in a biomechanical study that the stabilizing effect of the superior labral complex is dependent on the attached long head of the biceps tendon, with bicep tenotomy and SLAP repair resulting in increased glenohumeral translation. As such, there has been a predominant emphasis on repairing lesions involving detachment of the superior labrum, especially in younger patients and high-level throwing athletes. However, whether this

<table>
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<th>Table II</th>
<th>Comparison of postoperative results between SLAP repair and biceps tenodesis groups</th>
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<tr>
<td></td>
<td>SLAP repair</td>
</tr>
<tr>
<td>SSV (mean ± SD)</td>
<td>84.0 ± 14.9</td>
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<tr>
<td>Pain score (VAS) (mean ± SD)</td>
<td>0.8 ± 1.3</td>
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<tr>
<td>ASES shoulder function score (mean ± SD)</td>
<td>93.5 ± 8</td>
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<tr>
<td>Satisfaction (satisfied or very satisfied)</td>
<td>90%</td>
</tr>
<tr>
<td>Return to preinjury level of sports</td>
<td>60%</td>
</tr>
<tr>
<td>Time to return to sports [mean (range)] (mo)</td>
<td>6.8 (3-27)</td>
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<tr>
<td>Follow-up [mean (range)] (mo)</td>
<td>35 (25-52)</td>
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VAS, visual analog scale.
true, as evidenced by the relatively low rate of return to preinjury level of play among high-level athletes. In our study, we showed that 76% of biceps tenodesis patients and 60% of SLAP repair patients returned to their preinjury level of sport, which is comparable to the published literature. Furthermore, in our series, the overall satisfaction rate was greater than 90% in both groups. We did not observe any significant difference between the 2 groups, which is in contrast to the results of Boileau et al., who reported substantially poorer rates of satisfaction and return to sport in patients who had arthroscopic SLAP repair compared with biceps tenodesis. We believe that this may be largely because of patient selection. In our series, the decision to perform a SLAP repair was predominantly based on the likelihood that the repair would heal, as well as the perceived benefit of restoration of the superior labral complex in glenohumeral motion. As a result, the indications were younger patients and patients who showed healthy-looking labral tissue. On the other hand, biceps tenodesis was preferred in older and/or less active patients who showed poorer-quality labrums. Intuitively, in this setting, one would expect that the probability of the superior labrum healing would be lower compared with younger patients with normal-appearing labral tissue. Although some studies have shown that SLAP repairs may be successful in older individuals, we believe that biceps tenodesis provides an excellent alternative, as shown by the clinical results of our study. Moreover, after biceps tenodesis, the recovery and rehabilitation period is significantly shorter, with potentially less risk of postoperative stiffness, which are important factors to consider especially in older patients.

The results of this study have significant implications, especially given the fact that 2 recent studies from the United States have reported an alarming increase in the number of arthroscopic SLAP repairs being performed, especially in older patients. Although the cause of this is likely to be multifactorial, it is probable that part of this may reflect a general lack of understanding as to the appropriate management of type II SLAP lesions and the various treatment options.

The potential limitations of this study are that it is a retrospective and nonrandomized study with a relatively small sample size. In this study, we particularly focused on isolated type II SLAP lesions, excluding patients with associated instability, rotator cuff lesions, or internal impingement. As a result, the small number of patients reflects the relative rarity of this condition in isolation. In the future, randomized controlled studies comparing biceps tenodesis with superior labral repair for isolated type II SLAP lesions should be performed, with results stratified according to patient age and activity level. However, from our study, it is evident that to sufficiently power the study, an exceedingly high number of patients would be required in both groups to determine whether a difference between the 2 procedures truly exists.

Conclusions

In this study, we have shown that both superior labral repair and biceps tenodesis can provide good to excellent results with high patient satisfaction if performed in appropriately selected patients. Hence, we believe that each patient must be considered individually when one is deciding the appropriate form of management. It is our current treatment algorithm that in younger patients (<35 years) who are active and/or show healthy-looking labral tissue at the time of arthroscopy, SLAP repair should be performed. For patients who are older (>35 years) and less active who exhibit a degenerative or frayed labrum, biceps tenodesis is the treatment of choice.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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Type II SLAP lesions: repair versus tenodesis


