SHOULDER/ELBOW

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# Percutaneous SLAP Lesion Repair Technique Is an Effective Alternative to Portal of Wilmington

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## Abstract

Athletes with superior labral tear from anterior to posterior (SLAP) lesions place large demands on their rotator cuff and often have partial articular-sided rotator cuff tears as part of an internal impingement process. A percutaneous technique that facilitates SLAP repair may decrease the rotator cuff morbidity associated with establishment of the standard Wilmington portal. The current study reports the clinical outcome of patients with SLAP lesions treated with a percutaneous repair technique. Twenty-two patients with SLAP lesions underwent percutaneous repair. Mean patient age was 26.9 years. Standard posterior viewing and anterior working portals were used. Anchor placement and suture passing were performed with a 3-mm percutaneous and transtendinous approach to the superior labrum. Knot tying was performed via the standard anterior working portal. Clinical outcomes were assessed with validated shoulder evaluation instruments. Mean follow-up was 31.1 months (±6.6 months). Improvement of shoulder evaluation scores from pre- to postoperative were as follows: American Shoulder and Elbow Surgeons score improved from 49.5 to 83.6, visual analog scale improved from 5.4 to 1.5, and Simple Shoulder Score improved from 6.4 to 11.0. All were significant improvements ($P<.05$). There was no significant difference in functional scores between Type II lesions versus combined lesions, or between patients with or without a concurrent low-grade rotator cuff tear. Ninety percent of athletes were able to return to sport at pre-injury level of function. Percutaneously-assisted arthroscopic SLAP lesion repair may minimize surgical morbidity to the rotator cuff and provides excellent results.

Superior labral tears extending anterior to posterior (SLAP tears) have gained much attention in shoulder arthroscopy since their initial description by Andrews et al[1] in 1985. The surgical treatment of these lesions has evolved with the advances in arthroscopic techniques and instrumentation. Early studies reported debridement of these unstable lesions and demonstrated only short-term improvement with deteriorating outcomes over time.[2-4] Surgical repair is the more current treatment recommendation for unstable type II SLAP lesions. Multiple fixation methods have been used, including transosseous sutures, staples, screws, bioabsorbable tacks, and suture anchors.[2,5-13] The use of tacks has decreased substantially as reports of synovial inflammation and severe joint destruction due to broken or prominent implants have emerged.[14,15] Therefore, the most recent recommendations are for surgical repair with suture anchors.[16-21] Despite advancements, reported outcomes of SLAP lesion repair have been variable especially with regard to athletes resuming their previous activity level. Reported outcomes of arthroscopic SLAP repair range from 63% to 100% good to excellent,[2,5-13] but 9% to 55% are unable to return to their prior level of athletic activity.[3,7-10,12,13]

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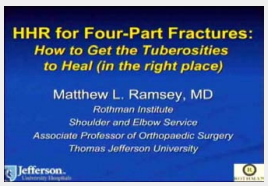


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In addition to the standard anterior rotator interval and posterior arthroscopic portals, various options exist for instrumentation and repair of SLAP tears. These include a high anterolateral portal through the rotator interval, Neviaser's portal, as well as various transrotator cuff portals. In 1998, Morgan et al[22] described a posterolateral acromial portal used for suture anchor repair of posterosuperior component of these labral injuries, which they coined "Port of Wilmington." For more anterosuperior labral work, an anterolateral acromial portal called an "accessory transrotator cuff portal" may be established. Both of these portals involve establishing a working cannula through the tendon of the supraspinatus.[8,22-25] Recent attention has been drawn to the potential rotator cuff morbidity associated with this portal and some studies have reported inferior results when this portal is used.[12,26] This may have an even greater impact on throwers and contact athletes who commonly develop SLAP lesions, have large demands on their rotator cuff, and require optimal rotator cuff function. Many of these overhead athletes fall under the spectrum of internal impingement as well, which often includes articular-sided rotator cuff pathology in combination with SLAP tears.[27] For these reasons, a percutaneous technique of suture anchor insertion and suture passing to minimizing morbidity to the rotator cuff is important. This article reports the clinical outcomes for a cohort of patients treated with the percutaneous SLAP repair technique. The authors hypothesized that the results would be as good, if not better than those demonstrated with transrotator cuff portal SLAP repairs, with respect to validated shoulder measures as well as return to sports.

## Materials and Methods

Institutional review board approval was obtained for this study. A retrospective hospital database review was performed to search for patients who underwent SLAP lesion repair by a single surgeon (C.S.A.) from the initiation of the technique. The study period was from January 2006 to January 2008. The technique was first used because a patient had concurrent SLAP and rotator cuff tears. The diagnosis of a SLAP lesion was made by a history of shoulder pain localized to the anterosuperior or posterosuperior aspects of the shoulder.

All patients had physical examination findings suggesting a SLAP lesion including a positive active compression test,[28] tenderness over the biceps in the bicipital groove, and apprehension-relocation testing for posterior-superior shoulder pain. Magnetic resonance imaging and/or magnetic resonance arthrography (MRA) were used to support the diagnosis and all SLAP lesions were confirmed at arthroscopy. Concomitant procedures, including anteroinferior and/or posteroinferior labral repair, or partial rotator cuff tear debridement. Patients were excluded from the study if they experienced a frank shoulder dislocation, were diagnosed with external impingement requiring subacromial decompression, or had a rotator cuff tear that required repair.

Preoperatively, patients filled out American Shoulder and Elbow Surgeons (ASES) questionnaire, visual analog scale (VAS) of pain, and Simple Shoulder Test (SST). All patients were examined at last follow-up with the operating surgeon, and ASES, VAS, and SST data were again obtained with a questionnaire.

Statistical significance between mean pre- and postoperative values was determined with Wilcoxon signed-rank test. By using this test, we avoided the assumption of a normal distribution of values. Subgroup comparison was performed using Mann-Whitney *U* test. A significant *P* value was regarded as anything less than .05, thereby corresponding to less than a 5% chance that the null hypothesis was rejected incorrectly.

## Surgical Technique

Anesthesia consisted of interscalene block and the patient was placed in a lateral decubitus position. Examination under anesthesia was performed and then 5 to 10 pounds of traction was applied to the operative arm. Standard posterior (viewing) and anterior (working) rotator interval portals were established. Diagnostic arthroscopy consisted of evaluation of all aspects of the labrum with visualization and probing (Figure 1). The glenoid surface area of labral detachment was prepared using a motorized shaver introduced through the anterior working portal.

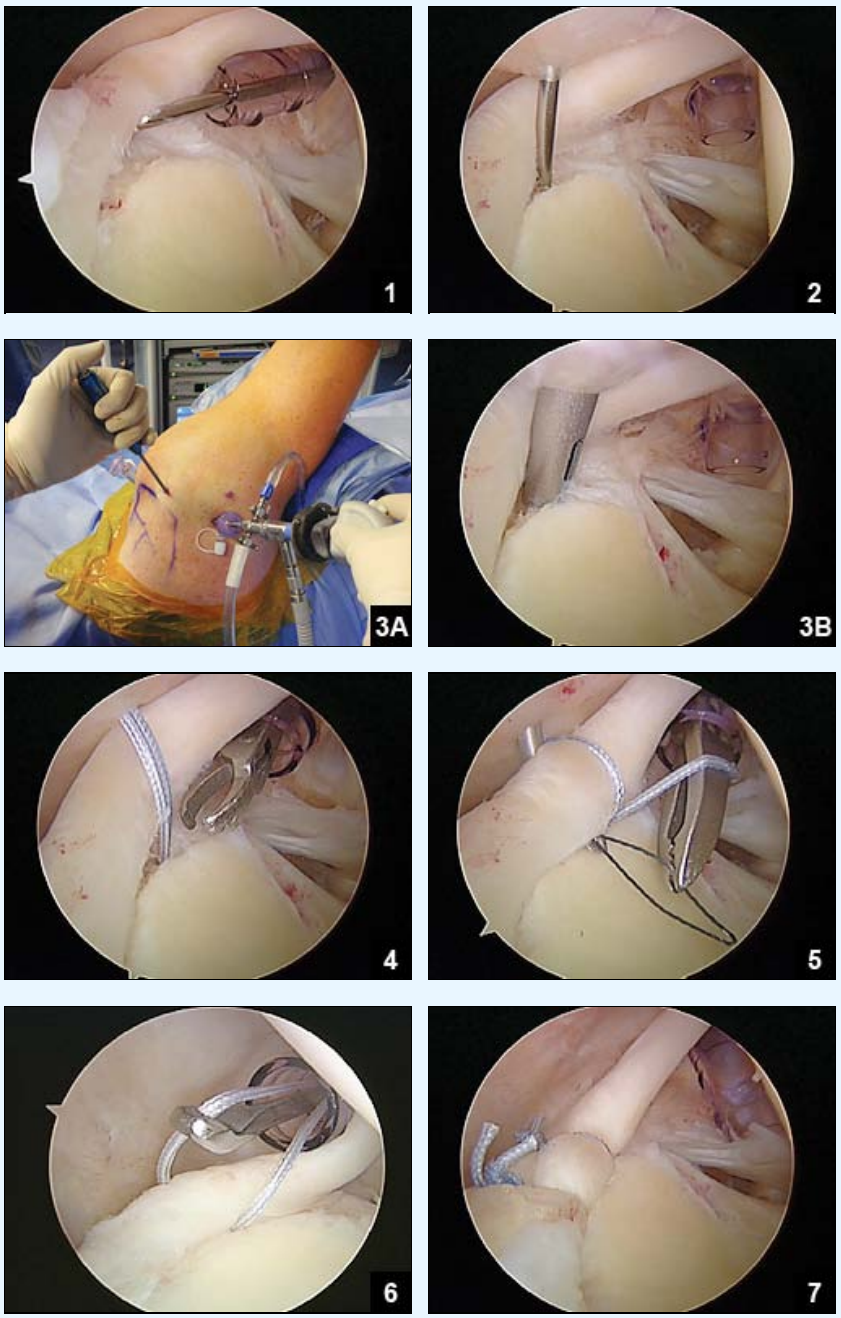


Figure 1: Type II labral tear demonstrated with probe. Figure 2: Spinal needle localization for subsequent anchor insertion. Figure 3: External (A) and arthroscopic (B) views of percutaneous insertion of the drill guide. Figure 4: Percutaneously inserted suture anchor. Figure 5: Suture passer introduced percutaneously. Figure 6: Knot tying with cannula positioned behind biceps. Figure 7: Final repair.

A spinal needle was then positioned percutaneously at the lateral edge of the acromion at its posterior one-third and directed to the desired anchor placement (Figure 2). A 3-mm percutaneous incision was then made and the drill guide with a blunt obturator penetrated the supraspinatus at its musculotendinous border and placed onto the glenoid (Figure 3).

The guide was angled 45° to the articular margin. The tunnel was drilled and the anchor inserted through the guide (Figure 4; Biosuture Tac; Arthrex, Naples, Florida). The suture limb passed through the labrum was then retrieved out the anterior cannula. A 90° suture passer (Suture Lasso; Arthrex) was inserted through the same percutaneous incision, through the supraspinatus, and then passed through the labrum

(Figure 5). The suture was shuttled through the labrum and both suture limbs were then retrieved out the anterior cannula with the cannula placed posterior to the biceps tendon.

Knot tying was then performed with 5 alternating half-hitches with the cannula posterior to the biceps tendon (Figure 6). In meniscoid type labrums, the 2 suture limbs from each suture were placed in a vertical fashion with 4 mm of tissue-bridge between the 2 passed sutures to achieve a more anatomic repair. Knot tying was performed with the goal of keeping the knots on the medial aspect of the labrum and away from the glenohumeral articulation (Figure 7).

The first anchor was placed posterior to the biceps anchor. Subsequent anchors were placed 5 mm more posterior as necessary on the glenoid to achieve complete fixation posteriorly. When the anterior aspect of the biceps insertion and labrum is detached, repair is also performed in this area. The drill guide was introduced percutaneously through the rotator interval just lateral to the anterior working cannula. The anchor was placed and the suture to be shuttled through the labrum was retrieved out the anterior cannula. The suture passer was introduced percutaneously through the same incision and passed through the labrum. Shuttling was performed and the sutures were retrieved out the anterior cannula where knot tying was performed. The repair was inspected with a probe and the portals are closed in a routine fashion.

Postoperatively, the shoulder was protected in a sling for 6 weeks. The patient began elbow, wrist, and hand exercises immediately postoperatively. Passive and active assisted range of motion exercises were started at 2 weeks postoperatively. Strengthening exercises for the rotator cuff, scapular stabilizers, and deltoid were initiated with the goal of restoring full range of motion at 6 weeks. Biceps strengthening was begun 8 weeks postoperatively. Running and aggressive strengthening activities were implemented after 3 months. At 4 months, throwing athletes began an interval throwing program on a level surface. A stretching and strengthening program was continued, with particular emphasis on posteroinferior capsular stretching. At 6 months, contact and collision athletes returned to their sport. At 7 months pitchers were allowed maximal effort throwing from the mound.

## Results

Based on the inclusion and exclusion criteria, 29 patients were identified. Among these, 22 patients were available for follow-up (75.9% follow-up rate). Mean patient age at the time of surgery was 26.9±9.7 years and mean follow-up was 31.1±6.6 months. Mean ASES score improved from 49.5±22.4 preoperatively to 83.6±17.3 postoperatively, VAS improved from 5.3±2.7 to 1.5±1.8, and the SST improved from 6.4±3.8 to 11.0±1.8. All of these improvements were statistically significant ($P<.001$).

Mean forward elevation increased from 174° to 176° pre- to postoperatively and external rotation increased from 75° to 79°, although these improvements were not statistically significant ($P>.05$). There were 11 high school level, 9 recreational, and 2 college athletes. There were 16 males and 6 females. Twenty of 22 patients (90%) were able to return to pre-injury level of athletic activities. Of the 2 patients that were not able to return to pre-injury level, 1 had a significant concomitant chondral injury on the posterior superior aspect of the humeral head (5×8 mm) with several associated loose bodies that required chondroplasty and microfracture, and the other had recovered well postoperatively but then sustained a discrete new injury to the shoulder. There were 13 overhead athletes (3 swimmers, 3 weightlifters, 2 baseball players, 1 softball player, 2 javelin throwers, 1 basketball player, and 1 volleyball player), 12 of whom (90%) were able to return to pre-injury level of activity. There were also 3 contact athletes (football), all of which returned to pre-injury activity level.

Thirteen of the patients had a labral tear that extended below the equator of the glenoid. Four had labral tear extension anterior-inferiorly (so-called type V), 2 had a posteroinferior component (type VIII), and 7 patients had a combined anteroinferior and posteroinferior labral injury (type IX). The mean number of suture anchors used in the repair was 3.5±2.0. One of the type II patients required 3 anchors. The postoperative ASES, Simple Shoulder, and VAS scores for patients with simple type II SLAP tears were 81.9, 11.0, and 2.1, and these scores for combined tears were 84.7, 10.8, and 1.2, respectively. None of these outcome measures showed a significant difference between type II and combined SLAP tear types ($P>.05$).

Six patients had a concomitant low-grade partial-thickness rotator cuff tear, typically as part of an internal impingement process, all of whom underwent debridement. The postoperative ASES, Simple Shoulder, and VAS scores for patients with concomitant rotator cuff tears were 80.0, 10.7, and 2.0, and these scores for patients without concomitant rotator cuff tears were 84.9, 11.1, and 1.4, respectively. There was no significant difference in these outcome measures between those with rotator cuff tears versus those without ($P>.05$). No patients had surgical complications and none required additional surgery to their shoulder.

## Discussion

The technique of percutaneous anchor placement for SLAP repair is a minimally invasive technique designed to reduce trauma to the rotator cuff that is incurred by inserting a large posterolateral cannula (portal of Wilmington), and to enhance exact placement of the suture anchors and suture passing devices. While several studies report encouraging results with SLAP repair that uses placement of a transtendon cannula, other reports have raised concerns.[8,12,26] Interestingly, Oh et al[29] concluded transrotator cuff portals were safe by demonstrating improved ASES (89.86), Constant, UCLA, and Simple Shoulder Scores (9.45) at 1 year in 58 patients, but 2 articular-sided rotator cuff tears were not present preoperatively, and 3 patients had postoperative subacromial contrast leakage on imaging indicating persistent defects at the cannula insertion site.

Cohen et al[12] supported the avoidance of a transrotator cuff portal with the demonstration of significantly lower ASES scores in patients who had SLAP repairs with a transrotator cuff portal compared to those repairs that did not use this portal. In addition, the majority of the transrotator cuff portal patients in their series experienced postoperative night pain whereas patients treated without a transrotator cuff portal did not. In another case series presented by Hurt et al,[26] five patients who underwent arthroscopic SLAP repair developed symptomatic rotator cuff tears that were attributed to the portal of Wilmington.

Many athletes, in addition to SLAP lesions, also have rotator cuff tendinitis, partial, or full-thickness tears. Walch et al[27] initially described internal impingement as when the posterosuperior rotator cuff contacts the posterosuperior glenoid labrum and can be pinched between the labrum and greater tuberosity. Excessive contact of the undersurface of the rotator cuff and the superior labrum during overhead activity can lead to the combination of partial-thickness rotator cuff tears and SLAP lesions.[30-33] Therefore labral tears and undersurface rotator cuff lesions commonly coexist in overhead athletes.

Andrews et al[34] noted that labral tears were present in 100% of 36 competitive athletes with articular-sided partial-thickness rotator cuff tears, of whom 64% were baseball pitchers. Guidi et al[35] found superior labral fraying in 90% of patients with partial-thickness rotator cuff tears. Six of the patients in our series had partial articular-sided rotator cuff tears, which likely occurred as part of internal impingement etiology. In the setting of an existing rotator cuff injury, the percutaneous technique has the advantage of minimizing further rotator cuff trauma.

Several recent technique papers have described repairing SLAP tears using the standard posterior and anterior (rotator interval) portals by placing the suture anchors percutaneously, followed by suture-shuttling through the labrum using a spinal needle in the area of Neviaser's portal.[16,19] Crockett et al[36] have detailed a needle localization technique, followed by percutaneous anchor insertion and instrumentation, similar to the procedure followed in the current study. These studies cite less rotator cuff trauma, as well as easier maneuverability and more accurate anchor placement as rational for their percutaneous techniques. None of these studies however have reported significant follow-up on a cohort of patients undergoing these procedures.

Reports on return to pre-injury level of activity have been variable with 1 study reporting only 41% being able to return.[12] Our patients were able to return to pre-injury physical activity level 90% of the time; overhead athletes returned 90% of the time, while contact athletes returned 100% of the time. A study of 18 professional rugby players who underwent arthroscopic SLAP repair demonstrated 89% "satisfaction" with 95% of patients returning to contact sports at 6-month follow-up.[17]

This study has limitations. While preoperative and postoperative outcome measures were obtained that show comparable results to existing reports, a direct comparison of a transrotator cuff portal technique to a percutaneous technique was not made. Furthermore, this study reports early results and not medium- or long-term results. The follow-up period is consistent with previous reports; however and the study design with a single surgeon helps control technique variation. The study group also represented a highly active and athletic population, typical of those patients that sustain SLAP lesions and have high shoulder demands that challenge their outcome. The patient population however is not homogeneous with regard to type of sport. Some were throwing athletes and others were contact athletes. Another limitation is the small number of patients in the current study, so it is hard to generalize that a high percentage of all athletes would be able to return to extremely competitive activity following this technique. The study group represents a typical shoulder surgeon's experience and has been reported in this fashion previously.[8,9,12,13,20,21,29,37] Lastly, postoperative imaging was not performed to definitively assess the healing of the lesion. This would require MRAs for the best accuracy, which would be invasive and has not been done in previous reports.

## Conclusion

Percutaneous SLAP repair minimizes trauma to the rotator cuff while maximizing technical placement and

management of suture anchors, and represents a viable and effective alternative to large transrotator cuff portals. The current study demonstrates the clinical effectiveness of this percutaneous technique, although a prospective, randomized study would be required to demonstrate superiority over the standard transrotator cuff portal technique.

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