Shoulder injuries, including tears of the superior labrum, are common in the active-duty military population. When sufficiently symptomatic, repairs may be undertaken using arthroscopic techniques. Currently, repair of unstable tears generally involves the use of suture anchors and arthroscopic suture passage and tying. Surgical repair of unstable superior labrum anterior and posterior (SLAP) lesions is predictably successful in the majority of patients with most able to return to their preinjury level of function including active military duty.


**KEYWORDS** SLAP, superior labrum, arthroscopy, military, superior labrum anterior posterior

The evolution of shoulder arthroscopy saw the discovery of previously unappreciated shoulder pathology. Principle among these discoveries is disruption of the superior labrum. The initial description by Andrews and coworkers described the arthroscopic findings in 73 overhead athletes. They described the continuity of the biceps-labrum complex and the apparent avulsion of the anterior-superior labrum. In a review of 700 shoulder arthroscopies, Snyder and coworkers identified 27 superior labral injuries and subclassified them into 4 types. They described these lesions of the superior labrum as extending from anterior to posterior and coined the term “SLAP.” The type I lesion has fraying at the superior labral margin. The type II lesion has a detached biceps anchor (Fig. 1). The type III lesion has a bucket-handle tear of the superior labrum (Fig. 2). The type IV lesion has a labral split that extends into the biceps tendon (Fig. 3). Maffet and coworkers added 3 additional combined types.

The type V lesion is a type II combined with a Perthes/Bankart lesion. The type VI lesion is a combination of types II and III. The type VII lesion involves superior labral detachment with extension under the middle glenohumeral ligament.

Surgical management of SLAP lesions usually entails arthroscopic debridement or repair. In general, repairs are performed with either an absorbable tack or with suture repair. Each approach has its unique set of advantages and disadvantages. Current implant designs and advances in arthroscopic techniques have made suture repair technically less daunting, effectively offsetting the relative ease of absorbable tack insertion.

Shoulder problems in active-duty military patients are common. This unique patient population engages in extremely strenuous activities that can rival many high-end athletes. As such, superior labral injuries are not uncommon. In addition to the standard medical concerns, our patient population has the added burden of returning to full duty as a productive member of the armed services. Return to full-duty success, therefore, is often synonymous with surgical outcome.

**Clinical Evaluation**

The patient with a SLAP tear will frequently complain of deep, nonspecific pain. Often they will localize the pain posteriorly. Symptom onset may be related to trauma, repetitive overuse, or may be insidious in nature. In addition to complaints of pain, patients may relate feelings of instability, catching, grinding, or weakness. SLAP lesions may coexist with other shoulder disorders including impingement, rota-
tor cuff tears, instability, acromioclavicular arthrosis, and perilabral cysts. The nonspecific nature of the complaints juxtaposed with other associated pathologies combine to make diagnosis by history difficult.

Physical examination is equally problematic. Numerous examination maneuvers have been described including Speed’s biceps tension test, Yergason’s test, the apprehension test, the O’Brien maneuver,\textsuperscript{20} the crank test,\textsuperscript{21} Kim’s biceps load test,\textsuperscript{22} and the Jobe relocation test.\textsuperscript{23} A study by Guanche and Jones\textsuperscript{24} found only the O’Brien maneuver, the Jobe relocation test, and the apprehension sign to correlate with the presence of a SLAP tear found at arthroscopy. Even combined, none of these showed diagnostic specificity. It is recommended that multiple maneuvers be performed when examining a shoulder with a suspected SLAP tear, and the combined results may be suggestive but not definitively diagnostic.

Imaging, like history and physical examination, can be suggestive but not completely sensitive. Plain radiographs, although indicated in the evaluation, are generally noncontributory. Magnetic resonance imaging, especially when performed with intra-articular gadolinium, can aid in the diagnosis (Fig. 4). Sensitivity is approximately 80% with specificity over 95%.\textsuperscript{25} In short, the diagnosis of SLAP tears through all means can be a challenge. When history, examination, and imaging all suggest the diagnosis, then it is reasonable to pursue definitive treatment via arthroscopy.

**Surgical Indications**

Surgery is indicated in patients with the presumptive diagnosis of a SLAP tear and in whom the symptoms interfere with their activities such that they are willing to undergo surgery and commit to the postoperative rehabilitation. A trial of conservative management is reasonable but not required. Nonoperative treatment before surgery may help op-

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**Figure 1** Two images of a type II SLAP tear in the same patient viewed from the posterior portal in a right shoulder. Patient is in the beach chair position. (A) Arm in the late-cocking position showing a “peel-back” phenomenon with exposure of subchondral bone (*). (B) Superior labrum probed with arm at the side also exposing subchondral bone (*). SL, superior labrum; G, glenoid rim. (Color version of figure is available online.)

**Figure 2** A type III SLAP tear viewed from the posterior portal in a right shoulder. Patient is in the beach chair position. SL, superior labrum; B, biceps tendon; G, glenoid; H, humeral head. (Color version of figure is available online.)

**Figure 3** A type IV SLAP tear viewed from the posterior portal in a left shoulder. Patient is in the beach chair position. Note the tear extension into the biceps (B) and the glenoid (G) visualized through the defect. (Color version of figure is available online.)
timize surgical outcome; however, nonoperative treatment is of no proven definitive value and the patient need not have failed conservative treatment before surgical intervention.26

**Operative Technique**

The initial operative evaluation involves an examination under anesthesia. The shoulder is examined to assess passive range of motion, inferior sulcus translation compared with the contralateral side, and presence of asymmetric anterior or posterior load and shift at 0° and 90° of forward elevation in the scapular plane.27 A diagnostic arthroscopy is performed next. Arthroscopy may be performed in either the beach chair or lateral decubitus position. The glenohumeral joint is evaluated via a standard posterior viewing portal and an anterior rotator interval working portal. Areas to be probed and visualized include the articular surfaces, the biceps tendon, the glenoid labrum, and the rotator cuff.28 The biceps tendon, biceps anchor, and superior labrum are probed for areas of fraying or instability. An unstable or type II SLAP tear is present when the superior labrum can be displaced with a probe beyond the articular cartilage margin of the glenoid, thereby exposing underlying subchondral bone. Areas of fraying are debrided. Portals are established through which repair of an unstable SLAP is performed. Most repairs are performed through the anterior-superior rotator interval portal combined with a posterior-lateral portal of Wilmington (Fig. 5).12 After debridement of labral fraying, the glenoid neck and rim are abraded with a burr or shaver. Suture anchors are inserted through the working portals at an angle of approximately 45° onto the glenoid rim. Suture anchors are placed at the 10, 11, 1, or 2 o’clock positions on the glenoid depending on the anterior and posterior extent of superior labral detachment. Typically, 2 or 3 anchors are used per repair.

A single vertical stitch from each suture anchor is placed around the inner edge of the labrum centrally and through the capsulolabral tissue peripherally using an arthroscopic piercing instrument loaded with a shuttle suture (Linvatec Inc, Largo, FL) or using a suture lasso (Arthrex, Naples, FL). A sliding arthroscopic knot reinforced with alternating half-hitches is used to secure the labrum to the glenoid (Fig. 6). After the SLAP repair, any associated pathology is addressed as appropriate.

For patients with SLAP tears that are not amenable to repair (some SLAP III and SLAP IV tears), consideration should be given to either biceps tenodesis or biceps tenotomy. If a high-grade SLAP tear is suspected preoperatively, the patient should be informed of the relative risks and benefits of each treatment strategy. In young, active patients such as military personnel, a biceps tenodesis is usually recommended. However, patients should be cautioned about the potential risk of biceps rupture, fixation failure, “Popeye” deformity (a portion of the biceps migrating distally to the elbow joint), decreased forearm supination strength, and potential additional elbow and shoulder difficulties, including continued pain. There are a variety of techniques for tenodesis of the long head of the biceps tendon that is beyond the scope of this article.

Postoperatively, patients participate in a detailed rehabilitative protocol under the supervision of a physical therapist. Sling immobilization with pendulum, elbow, and wrist exercises are initiated during the first 3 to 6 weeks. At 3 to 6 weeks, passive and active-assisted range-of-motion exercises are begun. After 6 weeks, progressive strengthening of the rotator cuff and the scapular stabilizers is initiated. Three months after the operation, patients progress to an aggressive exercise program. Full participation in throwing sports is allowed after 6 months. Patients are returned to full active duty when at least 80% of motion and strength are regained and when they are able to confidently perform the physical requirements of their military occupational specialty.

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**Figure 4** A T2 coronal MRI of the right shoulder with white arrow indicating the torn superior labrum. This patient was discovered to have a bucket-handle or type III tear at arthroscopy.

**Figure 5** Working portals for a SLAP repair of the right shoulder in the beach chair position. The green cannula is the high anterior rotator interval portal. The spinal needle is marking the location for the posterolateral portal of Wilmington. (Color version of figure is available online.)
Results

In general, unstable SLAP tears are best treated with repair. Debridement alone of unstable lesions does not achieve lasting results. Early repair techniques have shown the superiority of repair over debridement. In 1993, Field and Savoie reported universally successful results in 20 patients repaired with a transosseous repair of the superior labrum. Yoneda and coworkers achieved 80% good to excellent results at 24 months after repair of type II SLAP lesions using a metal staple. At second-look arthroscopy for hardware removal, all repairs had healed.

To avoid the need for hardware removal, repairs evolved toward bioabsorbable implants. Several studies have reported on the use of an absorbable tack to repair the superior labrum. Pagnani and coworkers repaired 22 unstable SLAP tears with an absorbable tack. Nineteen of 20 were satisfied with their outcome at a minimum follow-up of 1 year. Twelve of 13 were able to return to sports. Samani and coworkers used absorbable tacks to repair type II SLAP lesions in 25 patients. At minimum 24-month follow-up, their mean UCLA and American Shoulder and Elbow Surgeons (ASES) shoulder scores were significantly improved (32 points and 92 points, respectively). Segmüller and coworkers reported 83% good results in 17 patients with unstable SLAP lesions repaired with an absorbable tack; however, only 53% returned to preinjury level of activity. Warner and coworkers used absorbable tacks to treat 7 patients with type V SLAP lesions and had uncomplicated success in 5 of the patients.

Snyder and coworkers reported the results of 140 patients with SLAP lesions over the course of 8 years. Treatment spanned from debridement to suture anchor repair. Early in the study, type II lesions were treated with labral debridement and glenoid abrasion. Subsequently, absorbable tacks and then suture anchors were used to repair unstable tears. Based on second-look arthroscopy of 18 patients, 3 of 5...
treated with debridement and abrasion had healed, 4 of 5 treated with absorbable anchor had healed, and 5 cases of tack repair required removal of loose fragments.

More recent studies reveal that suture anchors have supplanted tacks as the preferred fixation method for unstable SLAP tears. Morgan and coworkers\(^\text{12}\) repaired type II SLAP lesions in 102 patients using suture anchors. At 1-year follow-up, 97% of patients had good or excellent UCLA rating, including 46 of the 53 overhead athletes with excellent results. Kim and coworkers\(^\text{13}\) reported 34 unstable SLAP tears with suture anchors. At a mean 33-month follow-up, 94% had good or excellent result, 91% regained their preinjury level of function, and the mean UCLA score was 33.4 points. Kartus and coworkers\(^\text{16}\) used a double-looped suture anchor to repair type II SLAP tears in 15 patients. Eleven of 15 patients returned to their preinjury level of sport at a mean 24-month follow-up. Ide and coworkers\(^\text{17}\) reported the results of 40 overhead athletes with type II SLAP lesions repaired with suture anchors. At a mean 41-month follow-up, the average Rowe score was 92.1 points and 95% of patients returned to their previous sport.

A recent review of 27 active-duty military patients who underwent arthroscopic SLAP repair by the senior authors (C.A.K. and J.G.E.) found successful results with bioabsorbable suture anchors.\(^\text{18}\) A total of 97% (26/27 patients) returned to full duty at an average of 4.4 months (range, 2-7 months). At a minimum 2-year follow-up, mean UCLA scores improved from 20.8 points preoperatively to 30.4 points postoperatively \((P < 0.0001)\). The mean postoperative ASES score was 86.9 points. The authors found that arthroscopic SLAP repair with bioabsorbable anchors was safe and effective in returning military patients to full active duty and sports.

### Conclusions

Shoulder injuries including tears of the superior labrum are common in the active duty military population. When sufficiently symptomatic, unstable SLAP tears can be successfully treated by arthroscopic repair using suture anchors. In some cases of unrepairable SLAP lesions, a biceps tenodesis or tenotomy should be entertained. Results of SLAP repair are predictably good, and the vast majority of patients will be able to return to their preinjury level of function including return to the rigorous activities of full duty in the United States military.

### References