

## SLAP Lesion Repair

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### **Abstract**

SLAP lesion, which stands for Superior Labrum Anterior and Posterior, is a detachment tear of the superior labrum that originates posteriorly to the tendon of the long head of the biceps and extends anteriorly. There are four types of SLAP lesions which occur from both acute and chronic stresses, including both compression and traction forces placed on the shoulder. In a healthy shoulder, the glenoid labrum provides sufficient stability as it deepens the articulation between the humeral head and the glenoid fossa. However, SLAP lesions alter the biomechanics of the movement at the glenohumeral joint and result in decreased stability at the shoulder joint as a torn labrum creates a more shallow socket for the humeral head to move in. Depending on the patient's age, severity of tear, and the patient's goals, treatment for this type of injury will include a more conservative rehabilitation approach or surgical repair focused on restoring normal anatomy and dynamic stability. Rehabilitation often includes strengthening the glenohumeral and scapulothoracic musculature, taking anti-inflammatory medications, and cortisone shots. Specifically for Type II lesions, surgical repair is done using an arthroscopic suture method. With the help of Dr. Brad Raphael, MD, RSM Medical Associates, a case study is presented for a construction worker who suffered an acute blow to the shoulder on the job. This case includes special weight bearing and range of motion precautions and considerations of the patient post surgery as well the typical post-surgical rehabilitation protocol for patients who undergo this type of surgical repair.

### **Anatomy of a Healthy Superior Labrum**

The ball-and-socket articulation at the glenohumeral joint is between the convex humeral head and the concave glenoid fossa of the scapula. The overall design of this joint allows it to be quite mobile. However, this leaves the issue of instability. The glenoid labrum is one of several passive mechanisms at the glenohumeral joint that promotes stability. This stability can be disrupted due to a common injury to the labrum called a SLAP lesion, which stands for Superior Labrum Anterior and Posterior.<sup>1</sup> A SLAP lesion is a detachment tear of the superior labrum; the tear originates posterior to the tendon of the long head of the biceps and extends anteriorly.<sup>2</sup> This injury can alter the

normal biomechanics of the shoulder and in certain circumstances surgery may be required.

In a healthy individual, the glenoid labrum is a strong, fibrocartilage ring that surrounds the glenoid fossa and accounts for approximately 50% of the concavity of the fossa, allowing for more surface contact of the humeral head.<sup>3</sup> The anatomy of the superior and inferior labrum is quite different. The superior labrum is attached more loosely to the glenoid rim, and at the most superior part of the rim, the labrum inserts into the tendon of the long head of the biceps brachii. Half of the originating fibers for this tendon come from the labrum, while the other half come from the supraglenoid tubercle.<sup>4</sup> The anatomical structure of the labrum increases stability of the glenohumeral joint by deepening the glenoid socket and holding the humeral head steady, acting almost like a wedge to restrict glenohumeral translation. Also, due to the insertion of the labrum into the tendon of the long head of the biceps, the biceps can actively limit translation by producing tension and developing compressive forces across the joint to physically hinder translation. Furthermore, the biceps is indirectly connected to the superior capsule through its connection to the labrum, so a contraction of the biceps can cause a tightening of the capsule and can prevent translations as well.<sup>5</sup>

### **Types of SLAP lesions**

SLAP lesions are categorized into four different types. Type I lesions are the most common and are characterized by a worn down, deteriorated superior labrum that is still intact with the glenoid rim and a normal bicep attachment. A type II lesion refers to a disconnection of both the superior labrum and biceps insertion from the glenoid rim.

Type III lesions are known as “bucket handle type tears”, in which the tissue of the torn labrum flaps into the joint and can cause locking or popping, but the biceps tendon is still normally attached. Type IV lesions are similar to type III tears, but the tear extends vertically into the tendon of the biceps.<sup>2</sup>

### **Mechanisms of SLAP lesion Injury**

A tear to the labrum causes instability and this injury can occur from both acute and chronic stresses; it is commonly seen in individuals who have fallen or have experienced severe trauma to the shoulder and in overhead throwing athletes. Although the exact cause of the SLAP lesion remains unknown, a few mechanisms have been put forth as contributors to this injury.

Mechanisms that create acute stress on the superior labrum include both compression and traction injuries. Examples of compressive injuries include falling on an outstretched hand and receiving a direct blow to the shoulder. Falling onto an outstretched hand in slight arm flexion and abduction transmits a compressive force from the hand to the superior labrum while forcing the humeral head superiorly. As with falling on an outstretched hand, a direct blow to the shoulder also creates a compressive force on the superior labrum that may lead to the tearing of the superior labrum.<sup>4</sup>

Furthermore, traction forces at the shoulder place acute stress on the shoulder. A traction force injury may occur when there is a sudden pull on the arm. A SLAP lesion traction injury may occur in multiple directions, such as in an inferior, anterior, or upward direction.<sup>4</sup>

In addition to acute stress on the superior labrum, chronic stress on the labrum can contribute to a SLAP lesion injury. For instance, SLAP lesions are common in baseball players, as they repetitively perform overhand throws. In the follow-through phase of an overhand throw, tensile overload of the bicep tendon occurs. As the elbow quickly extends during this phase, the biceps actively contracts to decelerate the elbow, causing a sudden tensile load with the potential to tear the biceps tendon or labral complex.<sup>4</sup>

During the late cocking and acceleration phase of an overhand throw, the shoulder is positioned in 90 degrees of abduction and maximum external rotation. When the shoulder is placed in this position, the undersurface of the posterosuperior rotator cuff makes contact with the posterosuperior glenoid labrum. Thus, the area between the labrum and the greater tuberosity may become pinched.<sup>6</sup> The intra-articular impingement that may occur is described as the Internal Impingement Theory.<sup>7</sup>

In addition to the mechanisms described above that contribute to acute and chronic stress on the superior labrum, an additional mechanism has been specifically noted in the development of Type II lesions. As already mentioned, a Type II lesion is characterized by a disconnection of both the superior labrum and biceps insertion from the glenoid rim. Burkhart and Morgan<sup>8</sup> believe that Type II lesions occur when an acquired posterior and inferior capsular contracture develops. As a result of the contracture, the humeral head changes its position. It experiences a posterosuperior shift when the shoulder is placed in the internal impingement position, 90 degrees of abduction and fully externally rotated. However, the new position of the humeral head allows the shoulder to go into extreme abduction and external rotation. Now, the biceps

tendon assumes a more vertical and posterior angle that produces a twist. This twist then transmits a torsional force to the posterior superior labrum and may cause the labrum to rotate internally and “peel back” from the superior glenoid.

### **Biomechanical Analysis of SLAP Injury**

SLAP lesions change the biomechanics of the movement at the glenohumeral joint by decreasing stability. In a study by Pagnani et al<sup>5</sup>, Type II lesions resulted in increased translations at the glenohumeral joint in the anteroposterior and superoinferior directions during elevation of the shoulder. This is due to the fact that separation of the labrum creates a more shallow socket for the humerus head to move in. Also, attached to the superior labrum are the superior and middle glenohumeral ligaments and the superior portion of the joint capsule. When the labrum is detached, it creates instability by affecting these stabilizing structures and allows for an increase in translation. Natural action of the biceps relies on an anchored superior labrum and stable attachment to the supraglenoid tubercle. SLAP lesions tend to increase the length of the proximal biceps tendon, resulting in an increase in excursion and therefore reduction in force production. Pain from the injury may also reduce force or inhibit contraction of the biceps brachii. Overall, SLAP lesions reduce the stability of the glenohumeral joint by increasing translation of the humeral head and rehabilitation or surgical repair is focused on restoring normal anatomy and dynamic stability.

### **Treatment Course of Action**

Once a patient has been diagnosed with a Type II SLAP lesion, an appropriate course of action must be determined. Whether to opt for surgery or to take a more

conservative rehabilitation approach depends on the patient's age, severity of the tear, and the goals of the patient. In discussion with Dr. Brad Raphael, MD, in October 2014 of RSM Medical Associates, he recommended that patients over 30 years of age forgo surgery, due to a low success rate. On the other hand, patients younger than 30 have experienced a higher rate of success and should get the surgery. However, the patient's lifestyle must be taken into account when making a decision. If a patient plays a sport or has a job where a large amount of stability is needed, surgery may be the best option.

In almost all instances, a rehabilitation approach is attempted before surgery. The goals of this treatment include reducing pain and inflammation, improving stability at the joint, and improving range of motion.<sup>8</sup> These goals are often accomplished by strengthening the glenohumeral and scapulothoracic musculature, taking anti-inflammatory medications, and cortisone shots (B Raphael, MD, oral communication, October 2014). If these treatments prove to be ineffective, surgery is the next option.

### **Surgical Repair**

A type II SLAP lesion is most commonly repaired surgically using an arthroscopic suture method. The goal of this treatment is for the patient to fully return to their daily activities. The first step in this surgical intervention is breaking up any fibrous adhesions using a motorized shaver. This is followed by an abradement of the bony attachment area on the glenoid and the repair surface of the labrum to create a bleeding bed and to facilitate healing. Suture anchors are then used to secure the biceps tendon and superior labrum to the glenoid. It is most common to use two anchors, however more or less could be used depending on the magnitude of the tear. When two anchors are used, they are positioned so that they split the difference between the normal insertion

of the labrum and the long head of the biceps tendon, and they are subsequently placed between the cortical bone and articular cartilage of the glenohumeral joint. One end of each suture is then passed through the labrum and a knot is tied. Knots are generally tied from posterior to anterior.<sup>9</sup>

This surgical technique generally results in a decrease in range of motion at the shoulder due to the tightening of the glenoid labrum. This has led to some variations in preference for what type of treatment overhead throwers should receive. Dr. Brad Raphael stated his preference for baseball pitchers to undergo a simple debridement, rather than the arthroscopic suture anchor repair described above. He stated that the decreased range of motion will severely alter a pitchers mechanics and cause several negative consequences such as other injuries and poor performance. Conversely, others believe that overhead throwers should have the surgery after undergoing a rehabilitation program focusing on range of motion and strengthening prior to the surgery.<sup>10</sup>

### **Rehabilitation Protocol**

In general, a conservative rehabilitation approach is tried first. This can include physical therapy and cortisone injections. However, if these procedures are ineffective the patient may undergo surgery for repair. The rehab protocol following surgery is broken into six phases.

In the first phase, immediately following the surgery, the shoulder is immobilized with a sling for approximately three weeks.<sup>8</sup> Precautions during this immobilization phase include full range of motion restrictions and weight lifting restrictions. Dr. Brad Raphael suggested telling patients not to lift more than the weight of a coffee cup.

Simple interventions such as electrical stimulation and cryotherapy can be used to control inflammation in the area. In addition, wrist and elbow range of motion exercises may be performed immediately in order to maintain presurgical range of motion. Passive range of motion is performed in this time period with an extreme emphasis on not stressing the biceps tendon. In addition, submaximal deltoid isometric exercises can be performed if the patient's symptoms allow it.<sup>8</sup>

In the second phase of rehab, which lasts approximately 3-6 weeks after surgery, the patient can stop using the sling when tolerated. During this phase the patient can begin active assisted shoulder flexion exercises. The patient also may begin active assisted external rotation, but this movement is limited to about 30 degrees until 6 weeks post surgery. The patient may also begin internal and external rotation isometric exercises at a submaximal intensity in order to strengthen the rotator cuff, which is essential before progressing to scapular elevation, depression, protraction, and retraction.<sup>8</sup>

Phase three of the rehab protocol lasts from weeks 6-8, and involves the continued strengthening of the rotator cuff and scapular muscles, in addition to increasing range of motion at the glenohumeral joint. Active-assisted ROM is performed for flexion and external rotation exercises. Once the rotator cuff strength is deemed sufficient, resisted shoulder flexion and extension can be performed. Strengthening of the latissimus dorsi also begins in this phase, which can be accomplished through the use of elastic resistance. Upper body ergometry may be prescribed to improve the patient's muscular endurance. It is crucial to limit the patient to less than 90 degrees of

shoulder flexion in this exercise to avoid excessive stretching of the rotator cuff before the patient is able to tolerate the stretch.<sup>8</sup>

Phase four of the rehab protocol lasts from weeks 8-10. The goal of this phase is for range of motion to be fully restored upon completion, and for further strengthening of the shoulder musculature. Strengthening of the biceps brachii also begins during this phase under careful supervision by the therapist.<sup>8</sup>

In phase five which lasts from weeks 10-14, flexibility is fully restored and rehab is focused on endurance training and further strengthening. The particular focus is on movements that the patient is most likely to have to perform at his or her occupation or daily routine.<sup>8</sup>

Phase six of recovery involves the patient's return to activity. When the patient returns to normal activity, it is crucial that he or she gradually returns to preoperative workload as opposed to immediately returning previous levels of activity. It was also very important for the patient to maintain flexibility and strength.<sup>8</sup> This can be accomplished by prescribing stretches and resistance exercises that the patient can perform at home. By following this rehab program, patients should be able to return to modified activity within about three months and be fully functional in six months.

## **Conclusion**

SLAP lesion is an injury that promotes instability at the glenohumeral joint, by altering the normal biomechanics of the shoulder. The four types of SLAP lesions occur by different mechanisms of injury, which include both acute and chronic stresses placed on the shoulder. Depending on the severity of tear, the patient's goals, and the patient's age, a conservative rehabilitation protocol or a surgical approach is taken.

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