



## CHAPTER

# Arthroscopic Treatment of Superior Labral Anterior Posterior (SLAP) Tears

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## DEFINITION

- Superior labral anterior posterior (SLAP) tears are characterized by injury to the superior glenoid labrum, with anterior to posterior detachment of the superior labrum.<sup>25</sup>
- Tears can occur acutely or over time and with or without involvement of the biceps tendon origin.<sup>5</sup>

## ANATOMY

- The superior glenoid labrum is composed of fibrocartilaginous tissue between the hyaline cartilage of the glenoid surface and the joint capsule fibrous tissue.
  - This fibrocartilaginous tissue serves as the attachment between the labrum and glenoid.
- The vascular supply of the glenoid labrum does not come from the underlying glenoid but rather from penetrating branches of the suprascapular, circumflex scapular, and posterior humeral circumflex arteries in the surrounding capsule and periosteal tissue.<sup>8</sup>
- There is histologic evidence that vascularity is decreased in the anterior, anterosuperior, and superior aspects of the glenoid labrum,<sup>5</sup> although no distinct vascular transition zone has been described.<sup>18</sup>
  - The inner portion of the glenoid labrum is avascular.

## PATHOGENESIS

- An intact labrum enhances concavity compression and increases the effective diameter of the glenoid, improving joint stability.<sup>18</sup>
- The long head of the biceps functions to depress the humeral head and serves as an adjunct anterior stabilizer of the shoulder.
- Disruption of the biceps anchor and the superior labrum, as seen in type II SLAP tears, can result in glenohumeral instability.
- The most common mechanisms for SLAP tears include forceful traction loads to the arm, direct compression loads, and repetitive overhead throwing activities.<sup>20</sup> Direct traction injury to the biceps tendon has also been linked with SLAP tears.<sup>5</sup>
  - However, there is evidence that up to a third of patients with SLAP lesions have no preceding trauma.<sup>21</sup>
  - Repetitive throwing motions cause anterior and superior translation of the humeral head that must be resisted by the anterior joint capsule. This motion causes shearing forces on the capsule, which partially inserts into the superior anterior labrum. Over time, repetitive shearing forces lead to degenerative tears.

- Snyder's original classification of SLAP tears is most commonly used.<sup>25</sup>
  - Type I: fraying of superior labrum with intact biceps anchor
  - Type II: detached superior labrum and biceps anchor
  - Type III: bucket-handle tear of superior labrum with intact biceps anchor
  - Type IV: bucket-handle tear of superior labrum with extension into the biceps tendon
- Snyder's classification has been expanded to reflect associated injury to the anterior labrum and other structures.

## PATIENT HISTORY AND PHYSICAL FINDINGS

- Traction and compression are the two primary mechanisms of injury for SLAP tears.
- A SLAP tear should be considered in a patient with a history of a traction or compression injury with persistent mechanical symptoms such as catching or locking.
- SLAP tears often occur with other shoulder injuries, resulting in no specific pain pattern.
- Several clinical tests have been described that focus on the examination of the biceps tendon anchor on the superior glenoid. The Speed, Yergason, O'Brien, Anterior Slide, and load-compression tests are commonly used.
  - Speed, Anterior Slide, and Yergason tests: Pain with the maneuvers suggests a SLAP tear.
  - O'Brien test: Pain with downward pressure applied to the internally rotated arm that is relieved with supination suggests a SLAP tear.
  - Load-compression test: Painful clicking or popping suggests a SLAP tear.
- Type II SLAP tears found in younger patients are commonly associated with instability and a Bankart lesion, whereas type II SLAP tears found in patients older than 40 years of age are often associated with rotator cuff pathology.<sup>19</sup>
- Although no single clinical test can predictably be used to diagnose a SLAP tear,<sup>15</sup> the examiner should use all of these tests, along with the history and a high clinical index of suspicion, to make the diagnosis of a SLAP tear.

## IMAGING AND OTHER DIAGNOSTIC STUDIES

- Although conventional radiographs (anteroposterior and supraspinatus outlet and axillary views) are the standard for initial evaluation of a patient with shoulder complaints, magnetic resonance imaging (MRI) is the most sensitive imaging tool for evaluating the superior glenoid labrum, with a sensitivity and specificity of about 90%.<sup>4</sup>

- The use of contrast arthrography MRI may improve the overall accuracy of MRI for diagnosing SLAP tears.
- Despite advances in imaging techniques, the gold standard for the diagnosis of a SLAP tear is arthroscopy.
- Clinical correlation is critical, as superior labral tears are commonly found in MRI imaging of asymptomatic shoulders.

### DIFFERENTIAL DIAGNOSIS

- Glenohumeral instability
- Rotator cuff pathology
- Acromioclavicular joint pathology
- Shoulder impingement syndrome
- Biceps tendinopathy

### NONOPERATIVE MANAGEMENT

- Physical therapy is the mainstay of nonoperative treatment of most shoulder injuries.
- In professional baseball players, about two-thirds of patients will respond to rehabilitation focused on postural correction and balancing exercises.<sup>11</sup>
- Selective intra-articular injections with local anesthetic and corticosteroids can be diagnostic and occasionally therapeutic.
- The rehabilitation program should focus on achieving and maintaining a full range of motion and strengthening the rotator cuff and scapula stabilizers.
- Although physical therapy may be useful for regaining range of motion and strength, a subset of patients with SLAP tears will continue to have symptoms despite physical therapy.
  - In particular, patients with history of trauma, mechanical symptoms, or high demand of overhead activities are more likely to fail conservative management.<sup>17</sup>

### SURGICAL MANAGEMENT

- Surgical treatment of SLAP tears should be considered for patients who have persistent symptoms despite appropriate conservative management.
- Contraindications for SLAP repair include patients who are high-risk surgical candidates (ie, the risk of anesthetic complications outweighs the possible benefits of successful repair).
- Surgical management of SLAP lesions can be separated into three broad groups<sup>16</sup>:
  - Patients with symptoms of instability after a traumatic event should undergo SLAP repair with or without biceps tenotomy/tenodesis based on age.
  - Patients with an overuse history without instability should be managed with a biceps tenotomy or tenodesis.
  - Throwing athletes should be managed preferentially with rigorous physical therapy focused on hip, core, and scapular exercise in addition to restoration of shoulder motion and rotator cuff balance.
    - If extensive rehabilitation fails, a diagnostic arthroscopy is performed to identify all abnormal pathology. Arthroscopic surgery should be meticulous and minimally disruptive in this patient population. Areas of common pathology are posterior inferior glenohumeral ligament scarring, hypermobility of posterior superior labrum, and partial infraspinatus tearing.
    - Platelet-rich plasma (PRP) is commonly used to adjunct surgery.

- The primary goal of any SLAP repair is to stabilize the biceps anchor and address any coexisting pathology.
- After a thorough diagnostic evaluation, SLAP lesions may be treated according to Snyder's classification<sup>25</sup>:
  - Type I SLAP tears can be treated using a motorized shaver to simply débride the degenerative or frayed tissue.
    - Care must be taken not to detach the biceps anchor from the superior glenoid.
  - Type II SLAP tears are the most commonly encountered SLAP tears.
    - They represent detachment of the biceps anchor from the superior glenoid labrum.
    - As such, the primary goal of any repair should be to securely reattach the superior labral tissue to the superior glenoid.
  - Type III SLAP tears are treated with simple débridement of the labral bucket-handle tear is because the biceps anchor is intact.
  - Type IV SLAP tears involve a bucket-handle tear of the superior labrum with a tear of the biceps tendon.
    - The biceps anchor may be detached as well.
    - Treatment is débridement of the labral tear and biceps tendon tear, with repair of the biceps anchor if needed, essentially converting the tear to a type II and then repairing the anchor detachment.
    - In an older patient with significant biceps tendon degeneration, biceps tenodesis should be considered.
    - Similarly, in a younger patient with a tear extending into the biceps tendon, repair of any tendon tears should be considered.

### Preoperative Planning

- Preoperative assessment of glenohumeral instability is paramount to understanding the pathophysiology of a patient's shoulder complaints.
- Associated instability and any other coexisting pathology must also be addressed at the time of SLAP repair.

### Positioning

- Beach-chair position
- Lateral decubitus position
  - This may be preferred for cases of suspected labral pathology, especially if associated with posterior instability, because this position allows improved visualization and access with distraction.
  - No more than 10 to 15 lb of traction should be used owing to increased risk of brachial plexus injuries.
  - A comprehensive exam under anesthesia should routinely be performed to assess for any instability.

### Approach

- Standard anterosuperior and anteroinferior portals are established.
  - Alternatively, a one anterior portal approach with percutaneous anchor placement can be used.
- Accessory portals may also be established depending on the location of the SLAP tear.

## REATTACHMENT OF THE SUPERIOR LABRAL TISSUE TO THE SUPERIOR GLENOID IN TYPE II SLAP TEARS

### Glenoid Preparation

- After identifying the detachment by direct probing (**TECH FIG 1A**), a 4.5-mm motorized shaver is used to gently débride any frayed or degenerative tissue.
- A motorized burr is used to débride the superior glenoid to exposed, bleeding bone (**TECH FIG 1B**).

### Accessory Portal Placement

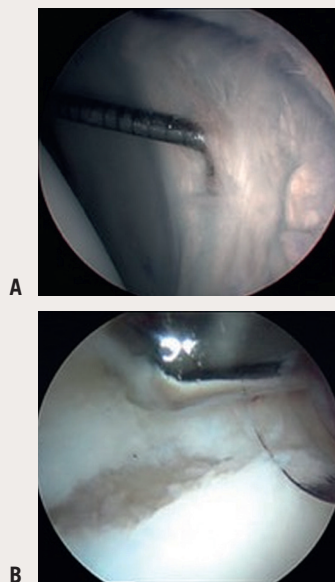
- An accessory transrotator cuff portal is made using an outside-in technique. No cannula is inserted because this portal will be used only to insert the anchor.
  - This portal may be adjusted anteriorly or posteriorly depending on the location of the SLAP tear.
  - A spinal needle is used to ensure that the correct trajectory is achieved to place the anchor at about a 45-degree angle to the glenoid face.
  - A no. 11 blade knife is used to make the skin incision, but a cannula is not inserted because this portal will be used only to insert the suture anchor drill guide and anchor after drilling.

### Suture Passage and Management

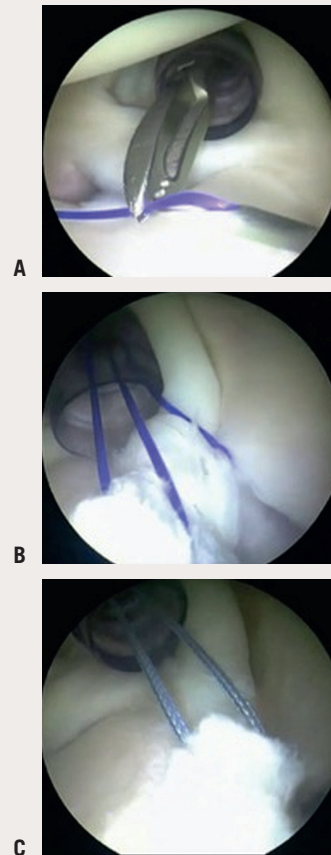
- Through the anterior cannula and starting at the posterior edge of the tear superiorly, the surgeon passes a suture passer

(Spectrum, ConMed Linvatec, Largo, FL) around the labrum (**TECH FIG 2A**).

- A 45-degree left-curved suture passer is used for a right shoulder SLAP tear (45-degree right-curved for the left shoulder) loaded with a no. 1 monofilament suture as a pull-through suture.
- An arthroscopic grasper inserted through the anterior cannula is used to grasp the monofilament passing suture, as it passes around the superior labrum, and the free end is pulled out through the cannula (**TECH FIG 2B**).
- A suture is then shuttled around the labrum using the monofilament passing suture (**TECH FIG 2C**).



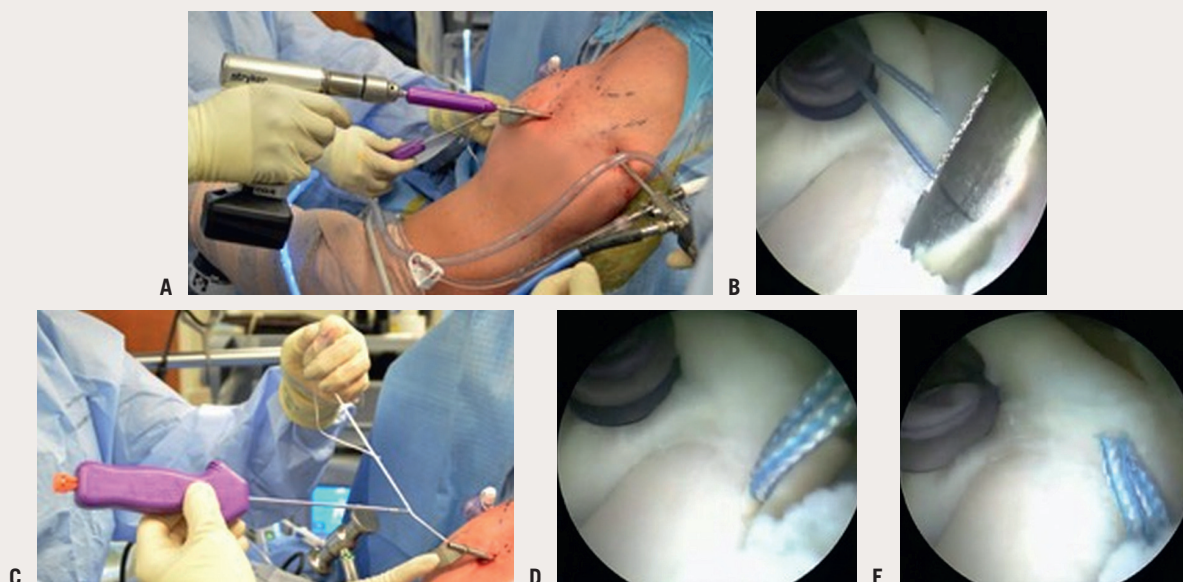
**TECH FIG 1** **A.** Arthroscopic view of type II SLAP lesion. **B.** Preparation of the superior glenoid with a burr to expose bleeding bone.



**TECH FIG 2** **A,B.** Use of shuttle relay system using a suture passer to pass a monofilament shuttle suture around the labrum. **C.** Final passage of the repair suture around superior labrum and collected through anterior cannula.

### Suture Anchor Placement

- The suture anchor drill guide is placed on the glenoid face and drilled at about a 45-degree angle to the face, ensuring that the anchor will be solidly in bone (**TECH FIG 3A,B**).
  - If more than one suture anchor is to be used, the surgeon starts the repair posteriorly and works anteriorly to aid in visualization.
- Both ends of the retrieved suture are then passed through a 2.5-mm PushLock suture anchor (Arthrex, Inc., Naples, FL) (**TECH FIG 3C**).
  - The PushLock is then introduced to the previously drilled bone socket on the glenoid and hammered into the socket completely (**TECH FIG 3D**).
  - This procedure is repeated until the biceps anchor has been securely reattached to the superior glenoid (**TECH FIG 3E**).
  - The surgeon should take care when securing the anterior aspect of the SLAP tears so that a normal labral foramen or an anterosuperior labral variant is not incorrectly identified, as a SLAP tear, causing inadvertent tightness and resulting in decreased range of motion.



**TECH FIG 3** A,B. External and intra-articular positioning of suture anchor drill. C. Passage of suture through a PushLock suture anchor. D. Introduction of the PushLock anchor. E. Completed labral repair with PushLock suture anchor.

## TECHNIQUES

### Pearls and Pitfalls

<b>Indications</b>	<ul style="list-style-type: none"> <li>• All associated pathology is identified and addressed (eg, instability, rotator cuff pathology, acromioclavicular joint disorders).</li> </ul>
<b>Planning</b>	<ul style="list-style-type: none"> <li>• Lateral decubitus positioning is considered if posterior labral pathology is suspected.</li> </ul>
<b>Portal Placement</b>	<ul style="list-style-type: none"> <li>• Proper technique must be used in placing portals at the beginning of the case, with attention to positioning of the portals both in the superoinferior plane and the mediolateral plane. Improperly placed portals can greatly increase the difficulty of this operation.</li> <li>• A spinal needle is used to judge the angle of approach for each portal before making the portal to ensure that the correct trajectory is obtained.</li> </ul>
<b>Suture Management</b>	<ul style="list-style-type: none"> <li>• When retrieving and handling anchor sutures, do not place tension on either limb and should maintain continuous visualization of the anchor–suture interface to ensure that the anchor is not unloaded.</li> <li>• Take care to avoid twists because these can place increased stress on a suture or knot and lead to breakage.</li> <li>• Place one anchor at a time and tie each suture or remove and replace the cannula and place the suture outside the cannula for suture storage to prevent tangles during tying.</li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>• Articular cartilage damage is avoided by firmly seating the drill guide on the edge of the glenoid and avoiding skiving onto the glenoid face.</li> </ul>



**TABLE 1 Results of Arthroscopic Superior Labral Anterior Posterior (SLAP) Lesion Repair**

Study	Surgical Procedure	Number of Patients	Results
Cohen et al <sup>6</sup>	Bioabsorbable tacks	39	14/39 return to play at preinjury level, 3.7-y follow-up; 27/39 good to excellent results
Coleman et al <sup>7</sup>	Bioabsorbable tacks	50	65% good to excellent results at 3.4-y follow-up
Enad et al <sup>10</sup>	Suture anchor fixation	27	24/27 good to excellent results
Funk and Snow <sup>12</sup>	Suture anchor fixation	18	95% return to play at preinjury level; 89% satisfaction
Yung et al <sup>26</sup>	Suture anchor fixation	16	87.5% good to excellent results
Boileau et al <sup>2</sup>	Suture anchor fixation	25 (2 groups: biceps tenodesis vs. SLAP repair)	13/15 satisfied tenodesis group; 4/10 SLAP repair group
Brockmeier et al <sup>3</sup>	Suture anchor fixation	47	41/47 good to excellent results at 2.7-y follow-up
Galano et al <sup>13</sup>	Suture anchor fixation	22	90% return to play at preinjury level
Neuman et al <sup>22</sup>	Suture anchor fixation	30	93.3% satisfaction rate
Sayde et al <sup>24</sup>	Bioabsorbable tacks, suture anchors, staples	506 (systematic review)	63% return to play at preinjury level
Provencher et al <sup>23</sup>	Suture anchor fixation	179 (type II tears in military personnel only)	Improvements in range of motion and all outcome measures but a 37% failure rate and 28% revision rate
Boesmueller et al <sup>1</sup>	Suture anchor fixation	11	11/11 return to play at preinjury level
Douglas et al <sup>9</sup>	Suture anchor fixation	73 baseball players	91.3% return to play and 78.3% return to play at preinjury level in position players; 80% return to play and 52.3% return to play at preinjury level in pitchers
Gilliam et al <sup>14</sup>	Suture anchor fixation	133 baseball players	76% return to play and 66% return to play at preinjury level in position players; 59% return to play and 43% return to play at preinjury level in pitchers

## POSTOPERATIVE CARE

- Rehabilitation timelines vary based on type of treatment (débridement vs. repair) and the presence of concomitant injury.
- For débridement, patients can remove the sling and begin range of motion exercises by time of first postoperative visit.
- Rehabilitation after repair remains individualized but generally follows a longer protocol.
  - 0 to 4 weeks: Sling at all times except for hygiene and exercises; active range of motion allowed in all planes except external rotation in abduction starting at 2 weeks
  - 4 weeks: Discontinue sling. Start passive range of motion with emphasis on posterior capsule stretching.
  - 6 weeks: external rotation in abduction allowed. Start strengthening.
  - 3 months: sports allowed except throwing (4 months)

## OUTCOMES

- **TABLE 1** summarizes outcomes from studies of SLAP tear repairs.

## COMPLICATIONS

- Infection (rare)
- Brachial plexus neuropathy secondary to traction of the arm in the lateral decubitus position
  - Care must be taken to ensure that the smallest amount of traction and distraction necessary is used, with close monitoring of the tension applied to neurovascular structures.
- Persistent pain
  - Healed repair: Biceps tenodesis should be considered for pain relief.
- Failed repair
  - Repeat arthroscopy should be considered with revision repair.
  - Biceps tenodesis should be considered for severely degenerative or intractable cases.

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