



Arthroscopic Repair of Inferior Labrum Anterior to Posterior Lesions of the Shoulder Using a Combined “Double-Pulley” Simple Knot Technique

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Abstract: Inferior labrum anterior to posterior lesions as an isolated injury or as part of an extensive traumatic labral tear are uncommon and may present as multidirectional instability of the shoulder. These lesions are hard to visualize radiographically and many times are diagnosed only during surgery. Arthroscopic repair of these lesions requires advanced arthroscopic skills and is required for restoration of glenohumeral stability. We report a combined double-pulley simple knot technique that anatomically reconstructs the inferior labrum while overcoming the typical technical challenges, providing a large footprint for healing along the inferior glenoid rim and minimizing the amount of suture material in direct contact with the articular cartilage and the risk of knot migration.

The correlation between capsulolabral tears and shoulder instability has been studied extensively in particular regarding anterior labral tears,¹⁻³ posterior labral tears,⁴⁻⁶ and combined lesions.^{7,8} Recently, several studies have focused on inferior labrum anterior to posterior (ILAP) lesions as an isolated injury⁹ or as part of traumatic multidirectional instability.¹⁰ Inferior labral tears are uncommon lesions that can be a cause of pain and instability. Arthroscopic repair of ILAP lesions is an effective technique to restore glenohumeral joint stability and reduce pain but can be technically challenging.⁹ Because the inferior labrum is involved, it is impossible to create an appropriate angle to place an inferior anchor at the 6-o'clock position without placing the axillary nerve in unacceptable danger. Moreover, it is often impossible to place anchors close enough around the 6-o'clock position as

recommended in traditional labral repairs of other areas.¹¹ This creates a larger-than-desired gap between the points of fixation at the inferior labral repair. Other technical challenges are the tight working space of the inferior glenohumeral joint and the angle of knot tying, which many times results in a knot placed at the articular side of the labrum and interposed between the humeral head and the glenoid, which can cause articular cartilage damage and knot loosening.¹²

We report a combined double-pulley simple knot technique for arthroscopic fixation of inferior labral tears. The technique overcomes the aforementioned surgical technical difficulties by incorporating several advantages of this hybrid fixation method.

Surgical Technique

This technique combines simple vertical suture fixation of the inferior labrum at the 5- and 7-o'clock positions using 2 double-loaded suture anchors with a double-pulley horizontal suture configuration for inferior capsulolabral tear repair in the gap between the 2 anchors (Video 1, Table 1).

Portal Placement and Diagnostic Arthroscopy

The patient is placed in the beach-chair position using a Spider Limb Positioner (Tenet Medical, Calgary, Alberta, Canada) to hold the arm in the desired position. A 30° arthroscope (Smith & Nephew, Andover, MA) is introduced into the glenohumeral joint through a standard posterior portal. An anterior portal is established low in the rotator interval region using a

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Table 1. Step-by-Step Combined Technique for Inferior Labrum Anterior to Posterior Lesion Repair in a Right Shoulder

1. Position the patient in the beach-chair position.
2. Perform diagnostic arthroscopy through the anterior and posterior portals (place an 8.5-mm cannula in both portals).
3. Use a spinal needle and No. 11 blade knife to place a trans-cuff portal medial to the rotator cuff cable while viewing from the posterior portal (a 5.5-mm Smith & Nephew smooth cannula may be placed over a switching stick into the joint).
4. Use a rasp and 4.5-mm shaver to prepare the inferior glenoid rim and inferior labrum.
5. Through the posterior portal, place a Suturefix 1.9-mm double-loaded anchor at the 7-o'clock position.
6. Use a shuttling device to retrieve one arm of the suture from the anchor through the posterior-inferior labrum and the posterior band of the inferior glenohumeral ligament.
7. Through the posterior portal, use an arthroscopic simple vertical knot-tying technique to fix the posterior-inferior labrum and reconstruct the posterior band of the inferior glenohumeral ligament.
8. Through the posterior portal, use a shuttling device to retrieve the 2 arms of the other suture on the anchor through the posterior-inferior labrum anterior to the posterior band of the inferior glenohumeral ligament.
9. Through the anterior portal, place a second Suturefix 1.9-mm double-loaded anchor at the 5-o'clock position.
10. Use a shuttling device to retrieve one arm of the suture from the anchor through the anterior-inferior labrum and the anterior band of the inferior glenohumeral ligament.
11. Through the anterior portal, use an arthroscopic simple vertical knot-tying technique to fix the anterior-inferior labrum and reconstruct the anterior band of the inferior glenohumeral ligament.
12. Through the anterior portal, use a shuttling device to retrieve the 2 arms of the other suture on the anchor through the anterior-inferior labrum posterior to the anterior band of the inferior glenohumeral ligament.
13. Retrieve the 4 limbs through the posterior portal.
14. Through the posterior cannula, tie the sutures from the 2 anchors using a double-pulley technique.

spinal needle by an outside-in technique. The needle is replaced with an 8.25-mm Smith & Nephew Clear-Trac threaded arthroscopic shoulder cannula.

Complete diagnostic arthroscopy of the glenohumeral joint is performed. Associated intra-articular pathology is documented and addressed as indicated. Then, by use of a probe, the ILAP tear is confirmed (Fig 1). Once the lesion is verified, a trans-rotator cuff portal is created medial to the rotator cuff cable (at the musculotendinous junction) using a spinal needle as described by O'Brien et al.¹³

Technical Procedure

Viewing through the trans-rotator cuff portal, the surgeon uses a 4.5-mm shaver (Smith & Nephew) through the anterior and posterior portals to debride the inferior glenoid rim to bleeding bone and the edge of the inferior labrum as indicated. It is extremely important at this stage of the procedure to keep the

shaver on the glenoid rim to avoid risk to the axillary nerve, which crosses the glenoid neck. Through the posterior portal, a Smith & Nephew Suturefix 1.9-mm double-loaded anchor is placed on the glenoid rim at the 5-o'clock position for a left shoulder. Three suture arms are retrieved through the anterior portal, with one suture end being left in the posterior portal. Viewing through the trans-rotator cuff portal, for a left shoulder, the surgeon uses a 45° right lasso-loop device (Arthrex, Naples, FL) through the posterior portal to shuttle the remaining suture arm through the posterior-inferior labrum and the posterior band of the inferior glenohumeral ligament. An arthroscopic simple vertical knot-tying technique is used through the posterior portal to fix the labral tear and restore the ligament tension (Fig 2). The 45° right lasso-loop device is used again through the posterior portal to penetrate the posterior-inferior capsulolabral complex anterior to the posterior band of the inferior glenohumeral ligament. The other 2 arms of the second suture on the anchor are shuttled through the inferior capsulolabral complex. By use of the anterior portal, a second Suturefix 1.9-mm double-loaded anchor is placed on the glenoid rim at the 7-o'clock position. Three suture arms are retrieved through the posterior portal, with one suture end being left in the anterior portal. Viewing through the trans-rotator cuff portal, the surgeon uses a 45° left lasso-loop device through the anterior portal to shuttle the remaining suture arm through the anterior-inferior labrum and the anterior band of the inferior glenohumeral ligament. An arthroscopic simple vertical knot-tying technique is used through the anterior



Fig 1. Viewing through the trans-cuff portal in a left shoulder, the inferior labrum anterior to posterior lesion (arrow) is confirmed using a probe.

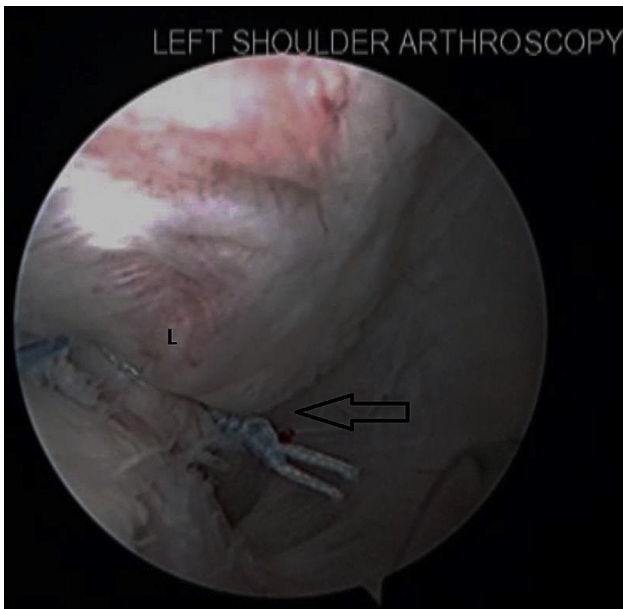


Fig 2. Viewing through the trans-cuff portal in a left shoulder, the posterior-inferior labrum (L) is fixed and the posterior band of the inferior glenohumeral ligament is reconstructed using an arthroscopic simple vertical knot (arrow).

portal to fix the labral tear and restore the ligament tension (**Fig 3**). The 45° left lasso-loop device is used again through the anterior portal to penetrate the anterior-inferior capsulolabral complex posterior to the anterior band of the inferior glenohumeral ligament. The other 2 arms of the second suture on the anchor are shuttled through the inferior capsulolabral complex.

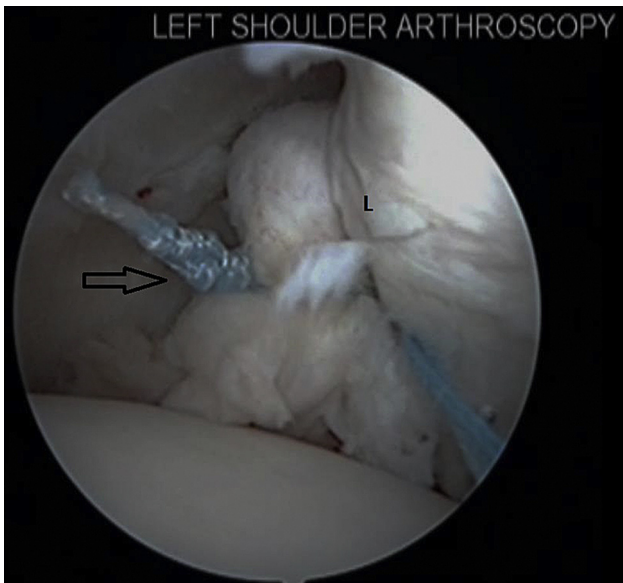


Fig 3. Viewing through the trans-cuff portal in a left shoulder, the anterior-inferior labrum (L) is fixed and the anterior band of the inferior glenohumeral ligament is reconstructed using an arthroscopic simple vertical knot (arrow).

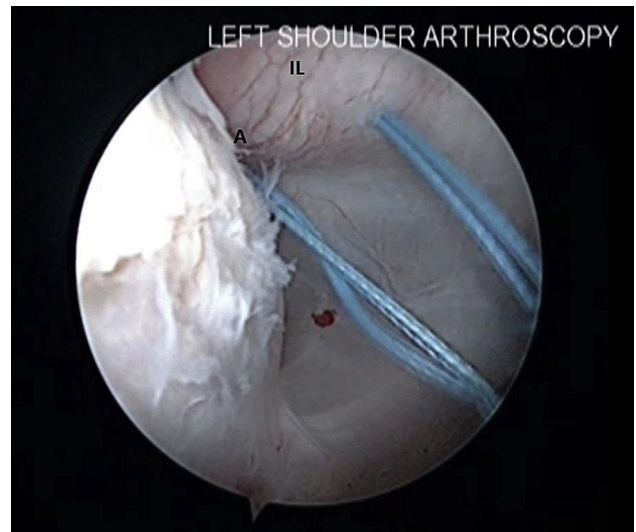


Fig 4. Viewing through the trans-cuff portal in a left shoulder, the 4 limbs of the 2 sutures are retrieved through the posterior portal, paying attention to retrieve the suture limbs from the anterior anchor (A) inferior to the inferior labrum (IL).

By use of a suture manipulator, the 4 limbs of the 2 sutures are retrieved through the posterior portal (**Fig 4**). One suture limb for each anchor is chosen to be coupled in a double-pulley configuration (**Fig 5**). Once the double pulley is completed, fixation of the inferior capsulolabral complex is completed with tightening of nonsliding knots on the remaining suture limbs of each anchor (**Fig 6**). At the end of the procedure, the adequacy of the repair is confirmed using a probe (**Fig 7**). The shoulder is taken through a full range of motion to rule out tension on the repair that can lead to stiffness.

Postoperative Protocol

The postoperative protocol consists of neutral-rotation immobilization for 6 weeks, and formal physical therapy is begun within 2 weeks for all patients. Early distal range-of-motion exercises involving the elbow, wrist, and hand are initiated immediately.

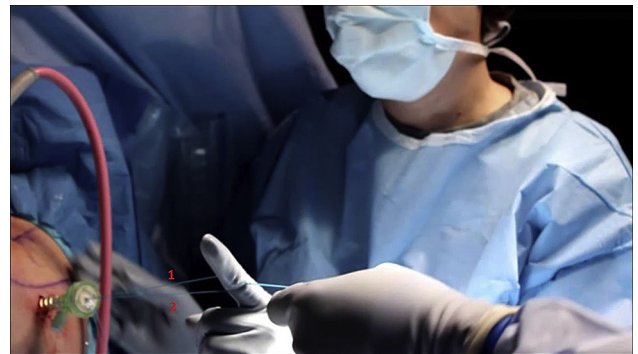


Fig 5. One suture limb for each anchor (1, 2) was chosen to be coupled in a double-pulley configuration.



Fig 6. Fixation of the inferior labrum anterior to posterior lesion is completed with tightening of nonsliding knots on the remaining suture limbs of each anchor. As viewed from the trans-cuff portal in a left shoulder, the completed double-pulley construct secures the inferior labral tear (L) between the 2 anchors (1, 2).

Passive range of motion of the shoulder should be started during the first 2 weeks postoperatively, with a gradual progression of forward flexion from 90° to 150° over a period of 6 weeks. Horizontal adduction and internal rotation are avoided for the first 10 weeks to protect the posterior capsulolabral repair. External rotation is limited to 30° for the first 6 weeks to protect the anterior repair. Active range of motion of the shoulder starts at 6 to 8 weeks after the operation. A progressive strengthening program starts at 12 weeks. Return to unrestricted activities, including vigorous sports, is permitted at 6 months postoperatively, and physician clearance is required.

Discussion

Labral tears that encompass the inferior hemisphere can be isolated lesions between the 4- and 8-o'clock position (ILAP)⁹ or can be part of a 270° lesion⁷ or 360° lesion⁸ in traumatic multidirectional instability.¹⁰ These tears destabilize the inferior labrum along with the corresponding anterior and posterior bands of the inferior glenohumeral ligament, creating multidirectional shoulder instability. Previous studies have shown the importance of diagnosing and incorporating the inferior labral and glenohumeral ligament repair in the surgical reconstruction.⁷⁻⁹ Inferior labral lesions are hard to visualize radiographically; the magnetic resonance imaging appearance is less obvious in comparison with other locations of labral injury, and

many times the first detection of the lesions is at the time of surgery.⁹

Fixation of the inferior labrum can be challenging, especially when the beach-chair position is used, because of the inability to place an anchor at the 6-o'clock position without risking the axillary nerve. The combined double-pulley simple knot technique overcomes this challenge by incorporating several advantages of a hybrid fixation method.

Anchor placement at the 5- and 7-o'clock positions is similar to anchor placement during anterior and posterior Bankart lesion repair. This anchor placement does not endanger the axillary nerve and is relatively easy to establish. On each anchor, one of the sutures is used in a simple vertical knot configuration to reproduce the tension of the anterior band and posterior band of the inferior glenohumeral ligament, respectively, and to produce strong stable initial fixation to the anterior-inferior and posterior-inferior labrum.¹⁴

The double-pulley technique is used to repair the inferior labrum between the anterior and posterior bands of the inferior glenohumeral ligament (Table 2). There are 3 main advantages to using the double-pulley technique in this setting (Table 3). First, it securely fixes the inferior labrum and capsule between the 2 suture anchors, thus providing a large footprint of healing along the inferior glenoid rim and creating a seal, which should prevent recurrence of inferior paralabral cysts.^{15,16} Second, it allows for easy control of the amount of inferior capsular tensioning if needed, and the tension is distributed evenly. Finally, the horizontal configuration of the double-pulley technique minimizes the amount of suture material in

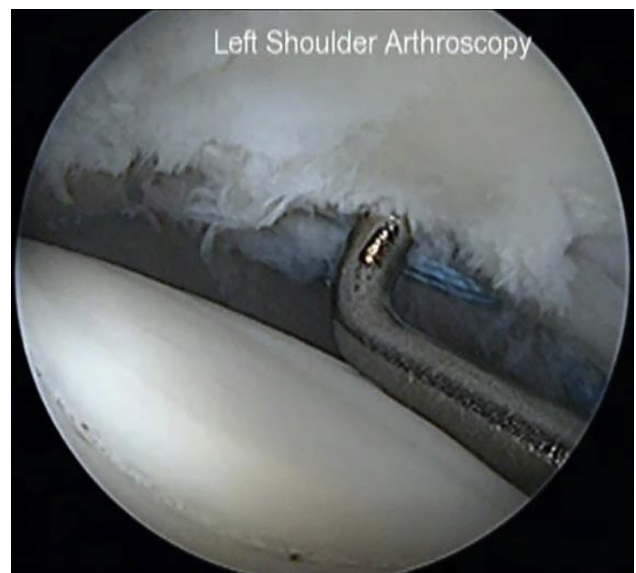


Fig 7. At the end of the procedure, the adequacy of the repair is confirmed using a probe, viewing through the trans-cuff portal in a left shoulder.

Table 2. Indications and Contraindications of Arthroscopic Inferior Labrum Anterior to Posterior Lesion Repair

Indications
Symptomatic inferior labrum anterior to posterior lesions (4- to 8-o'clock position)
Traumatic multidirectional instability due to extensive labral tear (180° to 360° tears that include inferior hemisphere)
Contraindications
None

direct contact with the articular cartilage and the risk of knot migration.

This technique can be performed while the patient is in the beach-chair or lateral decubitus position. It is simple and does not add to the complexity level, cost, or surgical time of the currently used techniques. Moreover, the surgeon can easily convert back to traditional techniques at any stage of the surgical procedure if needed.

There is no consensus regarding the use of a trans-rotator cuff portal during arthroscopic inferior shoulder stabilization surgery (Table 4). The combined double-pulley simple knot technique can be performed as described or without the use of the trans-rotator cuff portal based on surgeon preference.

A limitation of the described technique is that failure of one of the anchors will cause total failure of the double-pulley fixation. More research on the biomechanical advantages of this technique is required, but it

Table 3. Advantages and Disadvantages of Arthroscopic Inferior Labrum Anterior to Posterior Lesion Repair

Advantages
The technique can be performed while the patient is in the beach-chair or lateral decubitus position.
It is simple and does not add to the complexity level, cost, or surgical time of the currently used techniques.
The surgeon can easily convert back to traditional techniques at any stage of the surgical procedure if needed.
Placement of anchors at the 5- and 7-o'clock positions does not endanger the axillary nerve and is relatively easy to establish.
The double-pulley technique provides secure fixation of the inferior labrum in the gap between the 2 suture anchors (5- to 7-o'clock positions).
The double-pulley technique provides a large footprint of healing along the inferior glenoid rim.
A "watertight" repair of the inferior labral periosteal sleeve is created; this is especially important when a paralabral cyst is present.
The horizontal configuration of the double-pulley technique minimizes the amount of suture material in direct contact with the articular cartilage and the risk of knot migration.
The technique is suitable for large and complex inferior labral tears.
Disadvantages
The procedure is longer with higher costs when compared with single-anchor repair.
Failure of one of the 2 anchors will lead to total failure of the double-pulley fixation.

Table 4. Pearls and Pitfalls of Arthroscopic Inferior Labrum Anterior to Posterior Lesion Repair

Pearls
Use a spinal needle in an outside-in technique to place the trans-rotator cuff portal medial to the supraspinatus cable to avoid damage to the tendon.
Verify that both sutures slide easily before performing the double-pulley part of the technique.
Pitfalls
Be aware of the axillary nerve location and proximity to avoid injury.
When drilling the glenoid rim for the anterior anchor placement, be careful not to drill into the posterior anchor.

holds promise in trying to simplify the surgical reconstruction and improve the clinical outcome and rate of return to previous levels of activity in patients with inferior shoulder instability.

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