

The “Sandwich Tenodesis”: An Arthroscopic Technic for Combined Soft-Tissue and Bony Fixation of the Long Head of the Biceps



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Abstract: Pathology of the long head of the biceps can contribute to substantial shoulder pain. After nonoperative treatment has failed, either open or arthroscopic tenotomy or tenodesis can be recommended depending on age, occupation, function, and cosmetic preference. While classic tenodesis techniques rely on tendon-to-bone fixation, multiple studies have shown superior healing results for fixation between similar types of tissue, such as tendon-to-tendon. In this technique, we present the “sandwich technique,” performed entirely arthroscopically. A single 4-strand anchor with bioabsorbable screw is used to provide 2 types of fixation. Two strands are first used to lasso-loop the long head of the biceps to the bicipital groove, providing bone-to-tendon fixation. The other strands are then used to anchor rotator interval tissue to the tendon, providing a similar tissue or tendon-to-tendon patch augmentation.

Introduction (With Video Illustration)

Pathology of the long head of the biceps (LHB) tendon can contribute to substantial shoulder pain in adults and often is managed with either arthroscopic tenotomy or tenodesis when conservative treatment fails.^{1,2} Although simple tenotomy provides good results for shoulder pain, tenodesis may achieve superior results in terms of strength, pain reduction, muscle cramps, and cosmesis due to less the frequently

observed Popeye sign.³ In addition, tenodesis has the advantage of maintaining the length–tension relationship of the biceps muscle, which likely reduces muscle spasms.^{4,5} Biceps tenodesis often is used for the treatment of partial LHB tendon tears, tenosynovitis, and in conjunction with other shoulder pathologies, such as instability and SLAP tears.

There are multiple arthroscopic techniques for LHB tenodesis, depending on surgical approach, fixation method, and anatomic location.^{6–9} The tenodesis can be performed directly to bone at the level of the bicipital groove, in the supra- or subpectoral region, or it can be performed by soft-tissue attachment, directly to the conjoint or pectoralis major tendons. The optimal option is still debated. Fixation can be performed using screws, various anchors, cortical buttons or sutures alone.

In the literature, several studies have demonstrated that healing between 2 different tissue types is inferior than between 2 similar tissue types.^{10–12} For example, a tendon-to-tendon repair is more likely to heal than a bone-to-tendon repair. Given these findings, we favor tendon-to-tendon fixation to allow for improved healing.^{13,14} In this technique report, we present a simple alternative method for an all-arthroscopic tenodesis using 1 anchor with 4 strands (Video 1). One strand is passed through the LHB and fixed with a lasso loop providing bone-to-tendon fixation. The second strand is passed through the rotator interval cuff and LHB, providing like-tissue or tendon-to-tendon fixation.

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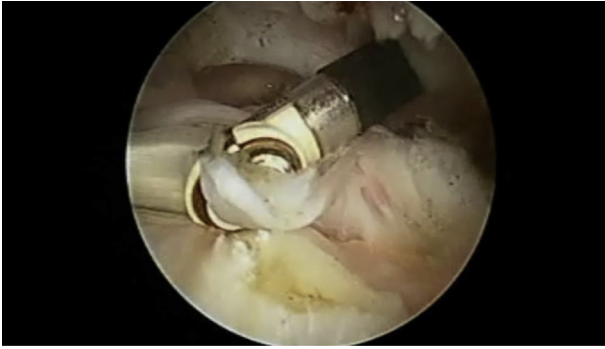


Fig 1. Posterolateral arthroscopic view of a right shoulder. The patient is in a slight beach chair position. Synovitic tissue is removed with radiofrequency ablation to better visualize the rotator cuff and interval.

Surgical Technique

Clinical Diagnosis and Imaging

The patient may present with anterior shoulder pain, aggravated with pronosupination motions. Infrequently, we observe loss of strength. We reserve tenodesis for young, active patients who require maximal strength recovery for their occupation, such as construction workers. Magnetic resonance imaging typically shows synovitis of the tendon with increased fluid, appreciated on T2-weighted imaging. In more severe pathology, the LHB may be dislocated from the bicipital groove. Computed tomography arthrogram shows similar findings.

Patient Positioning

General anesthesia and a brachial plexus block are used if the patient does not have any contraindications, such as previous nerve injury. The patient is placed supine with slight beach chair inclination. This positioning avoids cerebral hypofusion and allows for hypotensive anesthesia, which helps with decreased bleeding and better arthroscopic visualization. An

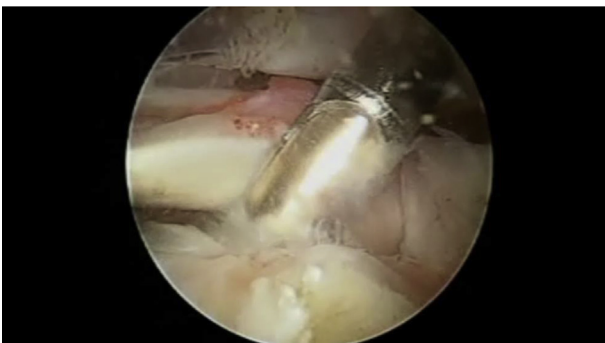


Fig 2. Posterolateral arthroscopic view of a right shoulder. The patient is in a slight beach chair position. A 4.5-mm shaver is used to debride the bicipital groove down to bleeding subchondral bone. Be careful not to damage the long biceps at this stage.

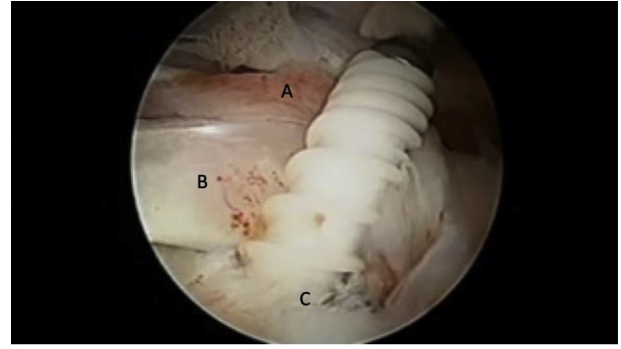


Fig 3. Posterolateral arthroscopic view of a right shoulder. The patient is slight beach chair position. A 4-strand, 3.4-mm bioabsorbable screwed anchor is secured under the LHB in the bicipital groove. (A) Rotator cuff interval tissue. (B) Long biceps. (C) Hole in the bicipital groove. (LHB, long head of the biceps.)

alcohol preparation is used for sterility. Traction of the arm is facilitated with an arm-holder (Spider; Smith & Nephew, Andover, MA). The shoulder is positioned in approximately 30° of forward flexion with neutral rotation, which may be changed throughout the procedure. All bony prominences are well-padded, avoiding compression points.

Arthroscopic Diagnosis

In the present case, the biceps lesion was associated with a massive cuff tear. Posterolateral and instrumental rotator interval portals are made in standard fashion. Diagnostic arthroscopy includes inspection of labrum; glenoid; supra-, middle, and infra-glenohumeral ligaments; rotator cuff; and humeral head. The long head of the biceps is synovitic, inflamed, and has partial tearing indicative of dislocation. After thorough inspection, a tenodesis is performed.



Fig 4. Posterolateral view of a right shoulder. The patient is in a slight beach chair position. A clever Hook (MiTek) is used to perform a lasso loop around the LHB using the blue thread. One strand is passed through the LHB doing a lasso, and the other is passed just under the LHB. (A) Lasso loop procedure. (LHB, long head of the biceps.)

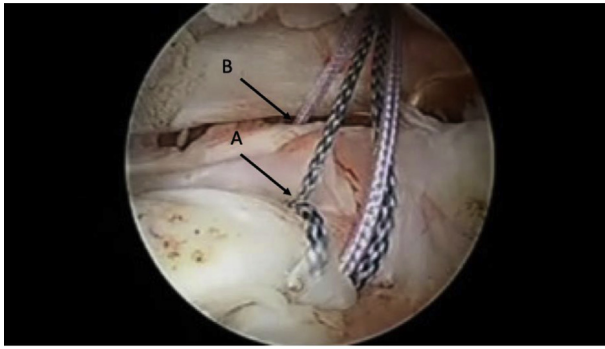


Fig 5. Posterolateral arthroscopic view of a right shoulder. The patient is in a beach chair position. The 2 purple strands are placed on either side of the biceps tendon. The anterior strand is passed through the rotator interval tissue with a clever hook. The posterior one is left just posterior from the LHB. (A) Lasso loop procedure. (B) Purple thread passed through the rotator interval cuff tissue. (LHB, long head of the biceps.)

Arthroscopic Biceps Tenodesis: Sandwich Technique

Synovial tissue is debrided with radiofrequency ablation (Fig 1). Attention is then turned to bony preparation of the proximal bicipital groove. The groove is debrided just underneath the LHB using a 4.5-mm shaver (Smith & Nephew) until bleeding subchondral bone is exposed to allow for an optimal healing surface (Fig 2).

Afterwards, a 4-strand 3.4-mm anchor with a bioabsorbable screw (Healix Transtend; MiTek, Chesterfield, MO) is secured into the bicipital groove just lateral from the junction between humeral head cartilage and sclerous bone (Fig 3). Careful attention is required to avoid injury to the LHB.

The 4 strands are separated according to their paired colors. A clever hook (MiTek) is introduced through the instrument portal. One blue thread is passed through the LHB using the clever hook and then lasso-looped around the tendon (Fig 4).

One purple thread is then passed underneath the LHB to have each purple thread on each side of the LHB. The



Fig 6. Posterolateral arthroscopic view of a right shoulder. The patient is in a beach chair position. The blue threads are tied first, establishing a bone-to-tendon fixation.

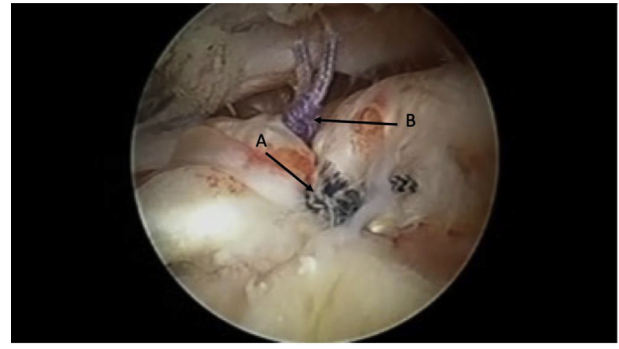


Fig 7. Posterolateral arthroscopic view of a right shoulder. The patient is in a beach chair position. The 2 threads are well tied. The blue threads show bone-to-tendon healing between the LHB and bicipital groove. The purple threads show fixation between the LHB and rotator interval tissue, providing like-tissue fixation. (A) Purple knot allowing a tendon-to-tendon fixation. (B) Blue knot allowing a bone-to-tendon fixation. (LHB, long head of the biceps.)

more anterior thread is then passed through the rotator interval tissue (Fig 5).

The 2 blue strands are then retrieved through the instrument portal, secured, and then tied over the tendon (Fig 6), providing bone-to-tendon fixation. Classically, fixation of the LHB is stopped here with suprapectoral approaches.

The 2 purple strands are then retrieved from the instrument portal with a magic hook. The purple strands are then tied with a sliding Nice knot, ensuring tendon-to-tendon fixation (Fig 7). This like-tissue fixation augments the isolated primary bone-to-tendon fixation seen in standard suprapectoral tenodesis and may allow for increased cicatrization as the tenodesis scars in place. Upon satisfactory inspection of the construct, the portal holes are closed with absorbable suture.

Postoperative Rehabilitation

A shoulder sling without an abduction pillow is used and applied in the operating room. Following satisfactory postanesthesia evaluation, the patient is discharged as an outpatient procedure. The sling is worn for 3 weeks with a 2- to 3-lb weight limitation. Gentle passive motion in all planes and pendulums are encouraged immediately. After 3 weeks, the sling is removed and the patient can begin active motion. When maximum passive and active motion is achieved, strengthening commences. Weight-bearing limitations are generally lifted 8-weeks postoperatively. The advantages and disadvantages of the technique are shown in Table 1, and pearls and pitfalls are shown in Table 2.

Discussion

LHB tendinitis is one of the most common causes of shoulder pain and is rarely seen in isolation. It may

Table 1. Advantages and Disadvantages

| Advantages | Disadvantages |
|---|--|
| <ul style="list-style-type: none"> • Good visibility • Minimally invasive • Use of bioabsorbable device that does not require removal in setting of revision • Rotator interval tissue augments healing | <ul style="list-style-type: none"> • May be technically challenging • Requires increased arthroscopic operative time • Will obscure future bicipital groove visualization |

result from overuse, impingement, instability, or trauma. Either tenotomy or tenodesis may be indicated when medical treatment fails. While studies show near-equivalent outcomes between the 2 procedures,^{1,4,15,16} these studies are limited quality of study and confounding factors, such as concomitant rotator cuff tear. Despite these studies, the literature reveals a few general trends. First, tenodesis may avoid cosmetic deformity,⁴ the “Popeye sign.” Second, tenotomy may be associated with a shorter surgical time, accelerated recovery, and faster pain relief, which may make the procedure favorable for patients older patients who have to cosmetic preference.^{15,17} In contrast, tenodesis may be favored for younger patients seeking to maintain their strength and avoid muscle cramps.¹⁸

The tenodesis technique we report here can be done either arthroscopically or open. Multiple studies have compared all-arthroscopic versus open approaches and have failed to identify differences in long-term functional outcomes, including but not limited to American Shoulder and Elbow Surgeons Score, patient satisfaction, Popeye deformity, return to sport, and arm cramping.^{6,19,20} However, these studies have reported greater rates of infection and musculocutaneous neuropathy with open technique due to the invasiveness of the procedure.²¹ One advantage of an all-arthroscopic procedure is that it can be performed in conjunction with other arthroscopic procedures, such as rotator cuff tear or labral repair. When performed arthroscopically, several tenodesis techniques have been described. The tenodesis can be secured in or below the bicipital groove as well as supra- or subpectoral. However, techniques that place the tenodesis within the bicipital groove have been associated with greater revision rates

Table 2. Pearls and Pitfalls

| Pearls | Pitfalls |
|---|--|
| <ul style="list-style-type: none"> • The footprint within the bicipital groove needs to be well-debrided • A lasso-loop procedure is used to secure the LHB to the groove • Tie knots before cutting LHB | <ul style="list-style-type: none"> • This procedure may be challenging due to poor visibility of bicipital groove in setting of non-ruptured rotator cuff tear • Avoid cutting LHB before finishing the tenodesis, as this will make reestablishing correct length and tension difficult |

LHB, long head of the biceps.

compared with more distal placement.²² However, in our experience, we find that placement in the bicipital groove is faster and technically less difficult without added complication rates.

Although most studies on tenodesis technique fix the LHB directly to the bone through an anchor,^{23,24} we present a simple all-arthroscopic technique that combines both bony and soft-tissue fixation. The LHB is first fixed to the bicipital groove and then augmented with rotator interval tissue. This may be advantageous because it allows for healing between two similar types of tissue.²⁵ Previous studies have shown superior healing between 2 homogenous or similar types of tissue compared with 2 heterogeneous or unlike types of tissue.¹⁰⁻¹² Further, a rat model of biceps tenodesis showing superior results of tendon-to-tendon healing compared to tendon-to-bone. The major disadvantage of this technique is the learning curve associated with this procedure as well as the short but additional time needed to secure the second point of fixation.

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