

Arthroscopic Extra-articular 2-Position Fixation of the Long Head of the Biceps



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Abstract: Disorders of the long head of the biceps (LHB) are common conditions that lead to an impediment of shoulder function. Fixation of the LHB is an effective way to alleviate LHB-related symptoms while maintaining its muscular function. However, fixation failure usually occurs after LHB tenodesis with routine 1-position fixation. To reduce the fixation failure rate, we introduce a 2-position LHB fixation technique. This includes locating the extra-articular part of the LHB efficiently, thorough debridement of the anterior subdeltoid space and the region around the LHB, and 2-position fixation with knotless suture anchors at the superior edge of the pectoralis major and at the proximal end of the bicipital groove. Our clinical experience indicates that this procedure can be performed safely and effectively when certain guidelines are followed. We believe that the introduction of this technique will provide a special fixation option for patients with LHB disorders.

Disorders of the long head of the biceps (LHB) are common clinical conditions for which LHB tenotomy and tenodesis are effective methods to relieve symptoms.¹ Compared with isolated LHB tenotomy, simultaneous tenotomy and tenodesis reduce the occurrence of Popeye deformity, allowing the LHB to exert power force. Regarding the number of positions of LHB tenodesis in a single case, 1-position fixation is the most reported method. However, fixation or healing failure after LHB tenodesis is a common phenomenon, especially after routine 1-position fixation.² Thus, for young active patients, we believe that a 2-position LHB fixation may be better to increase the fixation strength and the healing potential of the LHB to the humerus. Regarding the position of LHB fixation, great variations

exist, from a site proximal to the proximal end of the bicipital groove to a site inferior to the pectoralis major.³⁻⁷ In our clinical practice, we find that it is more convenient to conduct LHB tenodesis at a position proximal to the pectoralis major than at a position distal to it. Thus, we introduce this special LHB tenodesis technique. We believe that the introduction of this technique will provide more valuable options for LHB fixation.

Indications

In our clinical practice, the indications for LHB tenodesis include severe inflammation of the LHB in case of frozen shoulder, degeneration and partial tears of the LHB, LHB instability or dislocation, and SLAP lesions (Table 1). Severe inflammation of the LHB is always accompanied by an inflammatory tendon sheath or bicipital groove, which limits reciprocal movement between the 2 structures as well as movement of the glenohumeral joint. LHB tenotomy or tenodesis can

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The authors report the following potential conflicts of interest or sources of funding: Funding was provided by the National Natural Science Foundation of China (grants 31972923 and 81772341). Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received April 22, 2020; accepted July 11, 2020.

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2212-6287/20757

<https://doi.org/10.1016/j.eats.2020.07.015>

Table 1. Indications for 2-Position Fixation of LHB

Indications for LHB fixation
Severe inflammation of LHB in case of frozen shoulder
Degeneration and partial tear of LHB
LHB instability or dislocation
SLAP lesion
Indications for 2-position LHB fixation
Young patients, aged < 55 yr
Active patients who need forceful elbow flexion in daily activities and sports

LHB, long head of biceps.

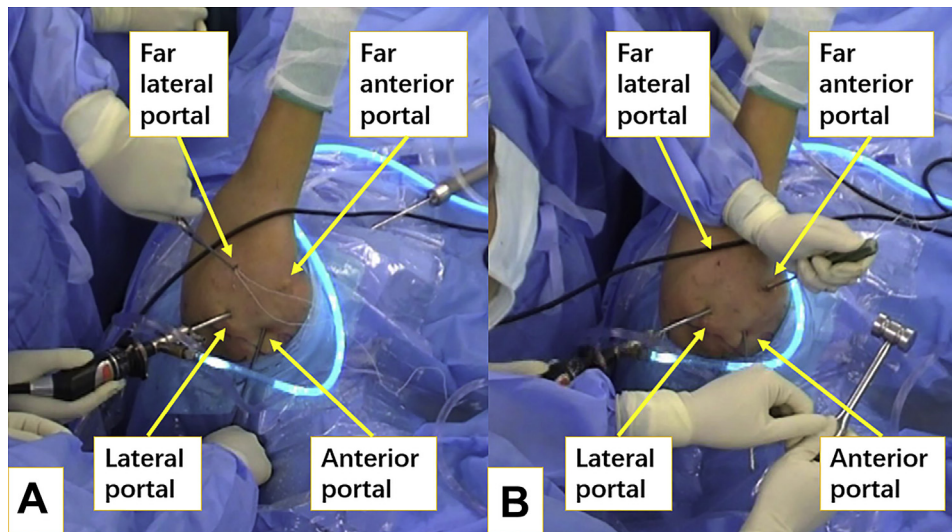


Fig 1. Four portals used for fixation of long head of biceps brachii (superior view of left shoulder in lateral decubitus position). The long head of the biceps is ligated through the far-lateral portal (A) and fixed through the distal anterior portal (B). The anterior portal is used to place a switching stick to elevate the anterior deltoid. The lateral portal is used to place the arthroscope.

eliminate movement and related irritation, relieve symptoms, and facilitate restoration of the range of motion of the shoulder after release. LHB degeneration (longitudinal split and sandglass change) and partial rupture may also cause symptoms when the LHB slides in the bicipital groove. Tenodesis is a direct procedure to eliminate the sliding movement. In case of LHB instability or dislocation, LHB tenodesis can stabilize the LHB. In case of a SLAP lesion, LHB tenodesis can lead to a predictable satisfactory outcome. The special indications for 2-position LHB fixation include young patients (aged < 55 years) and active patients who need forceful elbow flexion in daily activities and sports.

Table 2. Step-by-Step Procedure for 2-Position Fixation of LHB

1. A switching stick is placed into the anterior subdeltoid space to elevate the anterior deltoid.
2. The arthroscope is placed into the anterolateral subdeltoid space.
3. A far-lateral portal is created.
4. A shaver is placed to perform debridement in the anterolateral subdeltoid space.
5. The proximal edge of the insertion of the pectoralis major is detected, and the LHB that goes to the inferior side of the pectoralis major is found.
6. The proximal extension of the aponeurosis of the pectoralis major and the transverse humeral ligament are opened.
7. A far-anterior portal is created over the anterior route of the LHB.
8. The anterior subdeltoid space is debrided.
9. Synovial tissue around the LHB is removed, and the LHB is fully exposed.
10. The LHB is ligated at the proximal edge of the pectoralis major and at the proximal end of the bicipital groove.
11. The LHB is pulled off the humerus to freshen the bone bed underneath.
12. The LHB is fixed with 2 knotless suture anchors at the proximal edge of the pectoralis major and at the proximal end of the bicipital groove.
13. The intra-articular portion of the LHB is removed.

LHB, long head of biceps.

Surgical Technique

Patient Position and Portals

The patient is placed in the lateral decubitus position, with the arm in 30° of abduction and subjected to 10 lb of traction. Routine posterior, anterior, and lateral portals are first fashioned. Intra-articular examination and subacromial debridement are performed. For

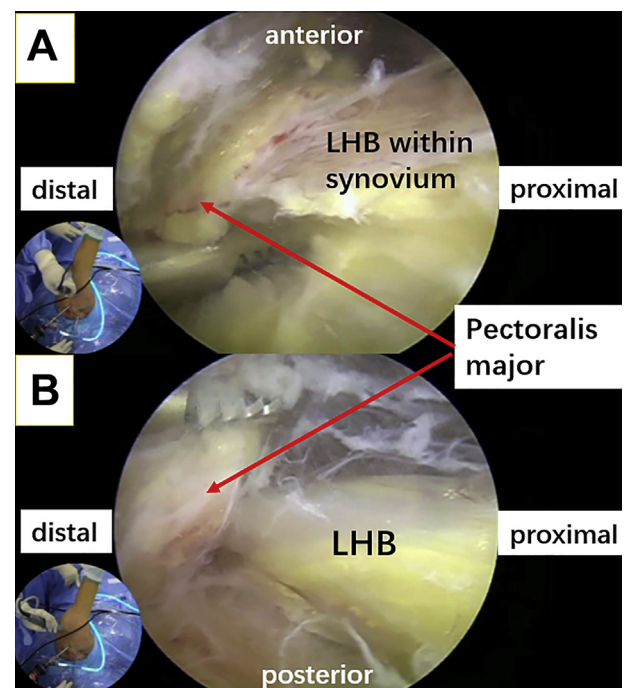
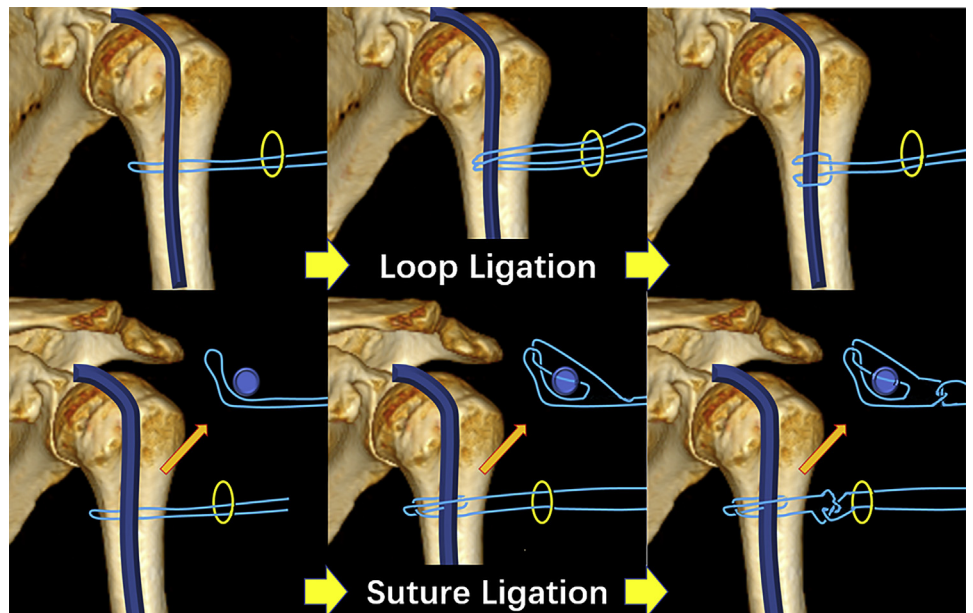


Fig 2. The long head of the biceps brachii (LHB) is found at the proximal edge of the pectoralis major (B) with a sliding movement of the shaver (A) (arthroscopic view of anterolateral subdeltoid space in left shoulder through lateral portal).

Fig 3. Two manners of ligation of long head of biceps brachii.



2-position fixation of the LHB, additional far-lateral and far-anterior portals as well as routine anterior and lateral portals are used (Fig 1, Table 2).

Elevation of Anterior Deltoid

With the arthroscope placed into the subacromial space for observation, a switching stick is first placed

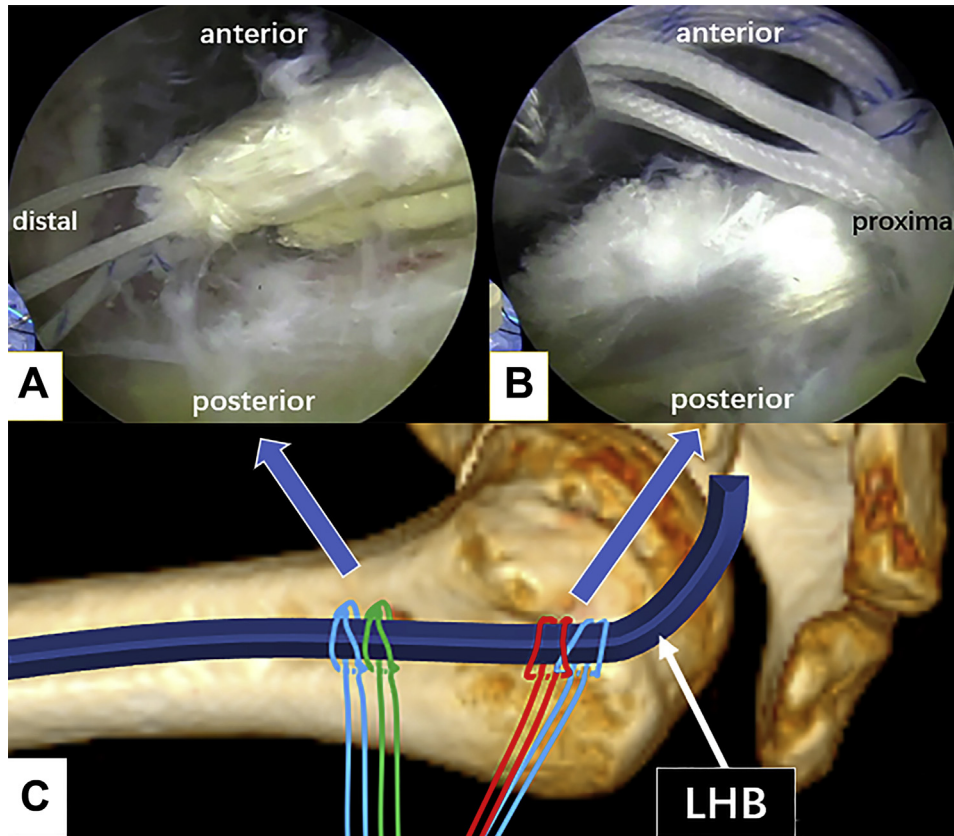


Fig 4. (A-C) Ligation of the long head of the biceps brachii (LHB) is performed at the proximal edge of the pectoralis major and at the proximal end of the bicipital groove (arthroscopic view of anterolateral subdeltoid space in left shoulder through lateral portal).

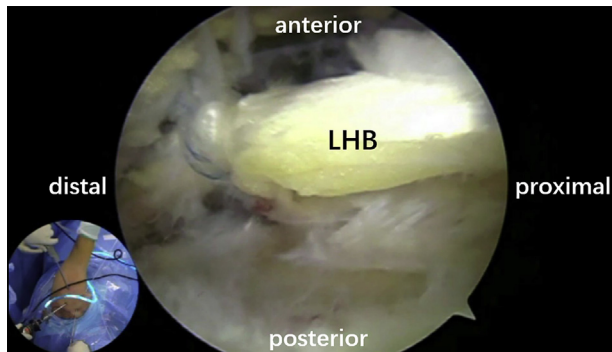


Fig 5. The long head of the biceps brachii (LHB) is lifted off the humerus for bone bed freshening (arthroscopic view of anterolateral subdeltoid space in left shoulder through lateral portal).

into the subacromial space and later introduced into the anterior subdeltoid space. The anterior deltoid is elevated using the switching stick to enlarge the anterior subdeltoid space. The arthroscope is turned to be placed into the anterolateral subdeltoid space through the lateral portal (Video 1).

Locating LHB at Proximal Edge of Pectoralis Major

On the lateral midline of the upper arm, a far-lateral portal is created at a distance of 7 cm from the lateral edge of the acromion. A shaver is placed in the far-lateral portal to perform debridement in the anterolateral subdeltoid space.

The shaver is used to press against the humerus to perform proximal-to-distal sliding, from the lateral to the anterolateral side of the humerus. The proximal edge of the insertion of the pectoralis major is detected when resistance is felt during this maneuver. At this position, the LHB is found inferior to the pectoralis major insertion (Fig 2). The proximal extension of the aponeurosis of the pectoralis major and the transverse

humeral ligament are opened with a shaver to expose the LHB.

Debridement in Anterior Subdeltoid Space and Around LHB

A far-anterior portal is created over the anterior route of the LHB, facing a point medial to the proximal end of the bicipital groove and the superior edge of the pectoralis major. A shaver is placed into the anterior subdeltoid space to remove all inflammatory or hypertrophied synovial tissues. After the synovial tissues around the LHB have been removed, the LHB becomes fully exposed from the proximal end of the bicipital groove and the proximal edge of the pectoralis major.

Fixation of LHB at 2 Extra-articular Positions

At the proximal edge of the pectoralis major, the LHB is ligated with 2 No. 2 ultrahigh-molecular-weight polyethylene sutures (Smith & Nephew, Andover, MA), in a 1-loop manner when the LHB is thin or a 1-suture manner when the LHB is thick (Fig 3). At the proximal end of the bicipital groove, the LHB undergoes loop ligation with 2 No. 2 ultrahigh-molecular-weight polyethylene sutures, both by the 1-loop ligation method, with adjacent rotator cuff tissue included in the suture loops (Fig 4).

The ligating sutures are retrieved from the far-anterior portal. The LHB is pulled off the humerus. The bone bed underneath is freshened with a burr along the route of the LHB (Fig 5). After hole creation with a punch, the LHB is fixed with 2 knotless suture anchors at the proximal edge of the pectoralis major and at the proximal end of the bicipital groove using the corresponding ligating sutures (Figs 6 and 7).

Removal of Intra-articular Part of LHB

With the scope placed into the joint through the posterior portal, the intra-articular portion of the LHB is

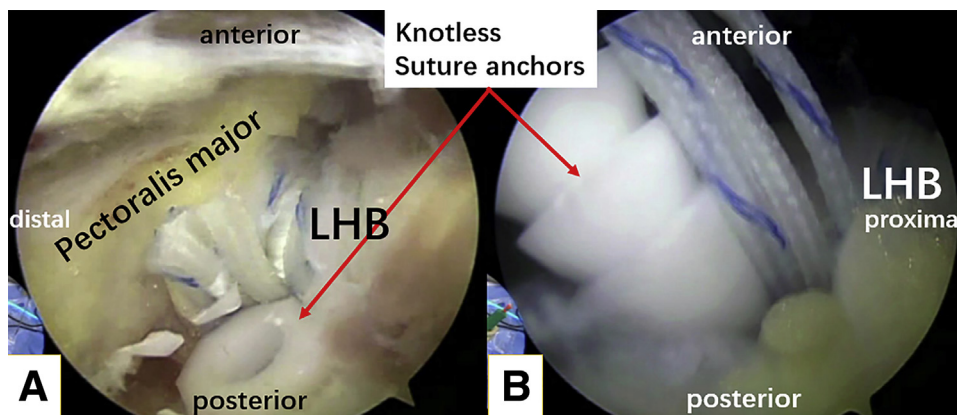


Fig 6. Fixation of the long head of the biceps brachii (LHB) at the proximal edge of the pectoralis major (A) and at the proximal end of the bicipital groove (B) (arthroscopic view of anterolateral subdeltoid space in left shoulder through lateral portal).

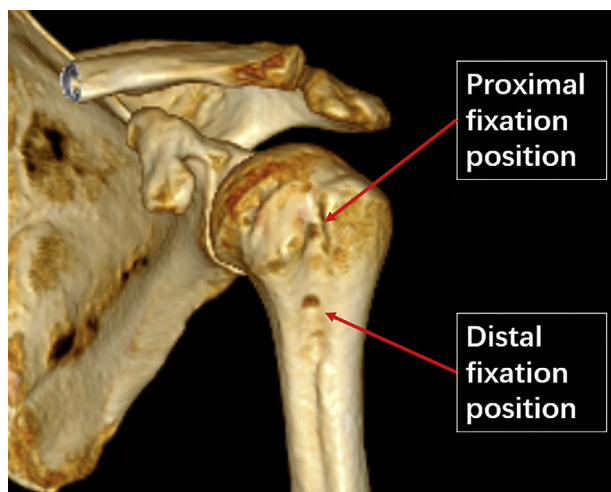


Fig 7. Postoperative computed tomography scan showing 2 fixation positions of long head of biceps (left shoulder).

removed with a radiofrequency probe placed through the anterior portal.

Rehabilitation

Non-weight-bearing elbow movement is allowed immediately after the operation. Weight-lifting elbow flexion begins 6 weeks after the operation. Shoulder rehabilitation depends on the combined lesions treated.

Discussion

In the treatment of LHB disorders, tenotomy of the LHB tendon is associated with a high rate of cosmetic deformity of the arm, cramping or soreness in the biceps muscle, and strength deficits in elbow flexion and supination. Although tenodesis of the LHB tendon

reduces the adverse events specifically related to tenotomy, loss of fixation resulting in cosmetic deformity and resistant anterior shoulder pain still need concern.⁸ Various methods have been used to increase time-zero fixation strength.⁹ However, the best methods are still being pursued. We believe that the described 2-position fixation method may shed some light on the treatment of LHB disorders.

Clinically, LHB tenodesis is not so popular because LHB tenotomy alone can result in satisfactory clinical outcomes in most cases and LHB tenodesis is time-consuming. However, in our clinical practice, LHB tenodesis is a common procedure. This is because it usually takes 10 to 15 minutes to perform an LHB tenodesis, and we believe that 2 functional heads of the biceps after LHB tenodesis are superior to 1 functional head after LHB tenotomy alone.

As for the position of LHB tenodesis, we prefer a site proximal to the pectoralis major for 2 reasons: First, debridement of the anterior subdeltoid space is a routine procedure to treat various shoulder conditions and reduce anterior shoulder pain. Second, we can remove the inflammatory tissue around the LHB when fixation is conducted at a position proximal to the pectoralis major.

The pearls and pitfalls of this procedure are listed in Table 3. The most critical step in the procedure is to locate the LHB at the superior edge of the pectoralis major in 1 minute. With the sliding-detecting maneuver, this goal can be easily achieved.

The advantages and disadvantages of this procedure are listed in Table 4. The main advantage of this procedure is that it can be performed easily and effectively. One disadvantage of this procedure is that the cephalic

Table 3. Pearls and Pitfalls of 2-Position Fixation of LHB

1. Compared with the middle deltoid, the anterior deltoid lies against the humeral head. Thus, there is no working space under the anterior deltoid. Using an instrument to lever the anterior deltoid away from the humeral head can enlarge the working space and facilitate manipulation within it.
2. During creation of the far-lateral portal, care should be taken to avoid injury to the axillary nerve. The far-lateral portal in this procedure is located at a point 7 cm distal to the lateral edge of the acromion because the axillary nerve remains 5 mm away from it. The further the location of this portal, the safer it is; however, a distal location will reduce the usability of this portal.
3. For 2-position fixation of the LHB, the far-anterior portal should be neither too proximal nor too distal. Otherwise, it is difficult to complete fixation at the 2 positions through this single portal.
4. To locate the LHB in an extra-articular position, the most important manipulation is to locate the proximal edge of the humeral insertion of the pectoralis major. Instrument sliding along the humerus is the most effective way. It usually takes 1 min to locate the proximal edge of the pectoralis major insertion and find the LHB. Sometimes, the aponeurosis of the pectoralis major extends proximally and is merged with the transverse humeral ligament, resulting in complete coverage of the LHB by fibrous tissue. This aponeurosis as well as the transverse humeral ligament should be opened to fully expose the LHB.
5. Debridement within the anterior subdeltoid space is a critical step. On the one hand, the inflammatory synovial tissue can be removed to alleviate symptoms. On the other hand, more space is created for subsequent biceps ligation and fixation. However, the target of debridement is just the inflammatory hypertrophied synovium. Excessive debridement should be avoided because the axillary nerve passes at the underside of the deltoid and may be endangered.
6. Bone bed freshening is important to enhance tendon-bone adhesion.
7. In case of severe osteoporosis, LHB fixation at the proximal edge of the pectoralis major may result in a fracture of the humerus around the anchor hole. A proximal location of the distal fixation position to a site within the bicipital groove can reduce this danger.
8. To maintain normal tension of the LHB, it is proposed to fix the LHB first and perform proximal tenotomy afterward.

LHB, long head of biceps.

Table 4. Advantages and Disadvantages of 2-Position Fixation of LHB**Advantages**

- The LHB can be found quickly.
- Two-position fixation may enhance time-zero fixation strength and long-term tendon-bone healing.
- Combined lesions can be treated within the anterior subdeltoid space.

Disadvantages

- The cephalic vein may be lacerated.
- For surgeons who are not familiar with manipulation in the anterior subdeltoid space, debridement may medially cross the conjoined tendon and endanger the nerve and vascular structure there.
- LHB fixation at the proximal edge of the pectoralis major may result in a fracture of the humerus in case of osteoporosis.

LHB, long head of biceps.

vein may be lacerated because the far-anterior portal is along its passage. Another disadvantage of this procedure is that LHB fixation at the superior edge of the pectoralis major may result in a fracture of the humerus around the punched hole of the suture anchor.

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