

An All-Arthroscopic Simple Double 360° Lasso Loop Technique for Suprapectoral Biceps Tenodesis



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Abstract: In many shoulder joint diseases, there is often a combination of long head biceps tendon (LHB T) pathology. Biceps pathology is one of the main causes of shoulder pain, and it is effectively managed with tenodesis. Biceps tenodesis can be performed in a variety of ways with different fixation and at different locations. This article introduces an all-arthroscopic suprapectoral biceps tenodesis technique with a 2-suture anchor. Double 360° Lasso Loop is used to fix the biceps tendon, and only one puncture of the biceps tendon was required, which caused little damage to the tendon and was not easy for the suture to slip and fail.

Introduction

The long head biceps tendon (LHBT) has been implicated as a pain generator in the shoulder.¹ There are several reasons, including SLAP lesions, tenosynovitis, tendinopathy, instability and tendon tears. Both biceps tenotomy and tenodesis procedures could be used to reduce shoulder symptoms when biceps pathology is observed intraoperatively. 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 the less frequently observed Popeye sign.² Undoubtedly, for younger patients and esthetic considerations, biceps tenodesis is superior.³

The purpose of this Technical Note is to describe the step-by-step technique to perform a novel arthroscopic double 360° lasso loop for suprapectoral biceps

tenodesis. A single 2-suture anchor with 4 strands is used to provide double 360° lasso loop fixation by puncturing the tendon just once. Finally, two knots are made on either side of the LHBT; this neutralizes the pull forces on both sides of the tendon, making the fixed tendon more stable and firmer. This novel double 360° lasso loop technique is simple and reliable.

Surgical Technique (With Video Illustration)

Patient Positioning and Portal Location

The patients underwent general anesthesia combined with brachial plexus block, and the surgical position is lateral decubitus. The surgical portal location is shown in Fig 1. The posterior portal is used to visualize the glenohumeral joint cavity, the anterior and anterolateral portals are used as operational approaches, and the posterolateral portal is used as operational approach and subacromial visual portal. The technique requires an anterior and inferior accessory portal, which is the suprapectoral-biceps portal, located at the level of the apex of the axillary fold, for the placement of the anchor and the operation process of the biceps tenodesis.

Arthroscopic Examination and Cleaning

The arthroscope is accessed from the posterior portal, and the instrument was accessed from the anterior portal to evaluate the degeneration and injury of the LHBT. If the LHBT is determined to require tenodesis, an anterolateral portal is established by transferring the arthroscope from the glenohumeral joint space to the subacromial in the posterior portal, and subacromial space cleaning and acromial plasty are performed from

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the anterolateral portal. After the establishment of the lateral approach, the arthroscope is transferred from the posterior viewing portal into the lateral portal, and the arthroscope optics are aimed distal and anterior toward the bicipital groove. The arthroscopic shaver (Stryker) and electrocautery device (Stryker) are used to expose the LHBT in the bicipital groove, from the transverse ligament proximally to the upper margin of the pectoralis major distally.

Placement of the Anchor and Suture Management

Viewed from the lateral portal, the suprapectoral-biceps portal is positioned using a no. 16 spinal needle at the level of the tip of the axillary fold. The spinal needle is close to the upper margin of the pectoralis major muscle, directly pointing at the LHTB (Video 1). Through this portal, a 4.5-mm 2-suture anchor (Depuy, Healix) is placed at the upper margin of the pectoralis major, and slightly posterior to the bicipital groove (Fig 2A). The different strands of the two sutures are placed on each side of the biceps tendon with a probe or suture grasper (Smith & Nephew) (Fig 2B, Video 1).

One puncture of the LHBT and Construct Two Suture Loops Above the LHBT

Through the suprapectoral-biceps portal, puncture the biceps tendon near the proximal position above the anchor with a penetrating suture grasper (Smith & Nephew) (Fig 2C). This is to avoid excessive tension in the tendon fixation. The biceps tendon can be lifted through the anterior portal with a suture grasper (Smith & Nephew) to facilitate puncture. After the tip of the penetrating suture grasper (Smith & Nephew) passed through the midportion of the biceps tendon, one of the two sutures on each side of LHBT with

different colors is retrieved by using the jaw of the penetrating suture grasper (Smith & Nephew), respectively (Fig 2D, Video 1). Then, pull out the captured two sutures, but not completely through, leaving two loops of suture exiting the superior surface of the tendon (Fig 2E).

Create Double 360° Lasso Loop

Through the anterolateral portal, a suture grasper (Smith & Nephew) is passed through the two loops from the rear to grasp the free end of the suture in front of the biceps tendon, which is the same suture limb used to create the loops (Fig 2F, Video 1). The suture limb is pulled through the double loops. Then, we do the same procedure through the suprapectoral-biceps portal. The suture grasper (Smith & Nephew) is passed through the double loops from the front to grasp another free limb of the suture behind of the biceps tendon, which is another strand used to create the loops (Fig 2G, Video 1). Also, the strand is pulled through the double loops. Finally, the ends of all four sutures are tightened, and the double 360° lasso loop is created (Fig 2H).

Tie knots and Perform Biceps Transaction

Through the suprapectoral-biceps portal, the same color of the suture strands are captured by using a suture grasper (Smith & Nephew). Then, a nonsliding knot is tied on one side of the biceps tendon. After that, the surgeon grasps another couple of strands and ties a knot on the other side of the biceps tendon. The double 360° lasso loop configure is achieved (Fig 2I). Stability and tension of the biceps tendon fixation are examined with a probe. The final step, the arthroscope is entered into the glenohumeral joint via the posterior portal, and the biceps tendon is transected from superior glenoid insertion using the electrocautery device (Stryker) (Video 1).

A summary of the tenodesis technique described in this Technical Note is illustrated in Fig 3, A-H.

Postoperative Rehabilitation

The shoulder is protected by a sling for 4 weeks after operation, and the shoulder could be exercised passively in different directions. It is important to avoid active elbow flexion and extension for 4 weeks. The sling is removed after 4 weeks, and active motion exercises for shoulder and elbow joints are started. The advantages and limitations of the technique are shown in Table 1, and tips and tricks are shown in Table 2.

Discussion

Both biceps tenotomy and tenodesis are effective options for biceps tendinopathy.^{4,5}

The complications of biceps tenotomy are cosmetic failure, "the Popeye sign" and reduced muscle strength



Fig 1. Location of arthroscopic portals (right shoulder). Suprapectoral biceps portal is at the level of the apex of the axillary fold (red arrow).

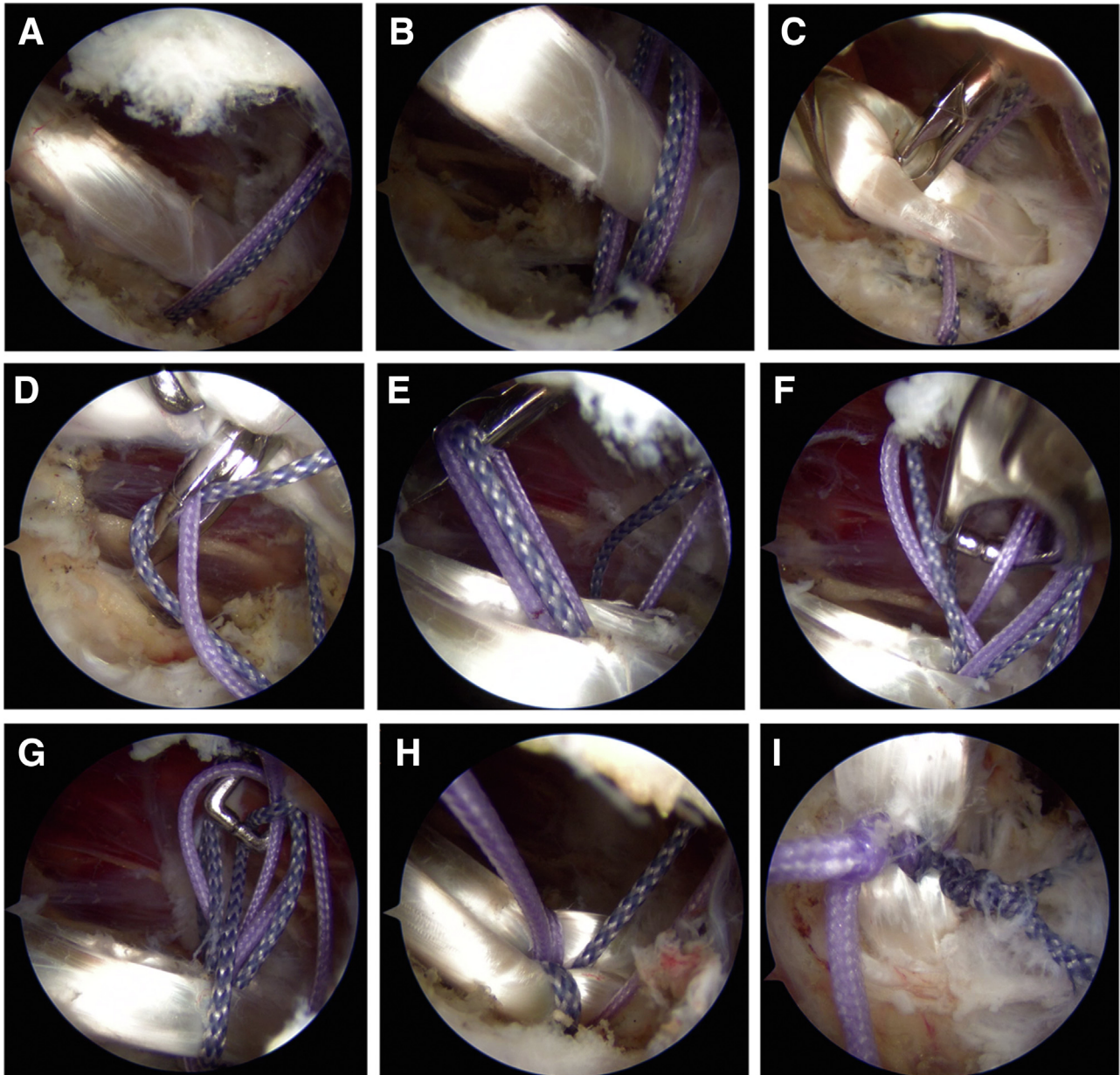


Fig 2. (A-I) Patient's right shoulder positioned in the lateral decubitus and viewing through a lateral portal. (A) Through the suprapectoral-biceps portal a 4.5-mm 2-suture anchor (Depuy, Healix) is placed at the upper margin of the pectoralis major and slightly posterior to the bicipital groove through the suprapectoral biceps portal. (B) The different strands of the two sutures are placed on each side of the biceps tendon with a probe or suture grasper (Smith & Nephew) from the suprapectoral-biceps portal. (C) From the suprapectoral-biceps portal a penetrating grasper (Smith & Nephew) is used to puncture the biceps tendon near the proximal position above the anchor. (D) After the tip of the penetrating grasper passed through the midportion of the biceps tendon, one of the two sutures on each side of LHBT with different colors is retrieved by using the jaw of the penetrating suture grasper (Smith & Nephew), respectively. (E) Pull out the captured two sutures, but not completely through, leaving two loops of suture exiting the superior surface of the tendon. (F) A suture grasper (Smith & Nephew) is passed through the two loops from the anterolateral portal to grasp the free end of the suture in front of the biceps tendon, which is the same suture limb used to create the loops. The suture limb is pulled through the double loops. (G) Repeated the same procedure from the front of the double loops to grasp another free limb of the suture behind the biceps tendon through the suprapectoral-biceps portal, which is another strand used to create the loops. (H) The ends of all four sutures are tightened. (I) After two nonsliding knots are tied on both side of the biceps tendon, the double 360° lasso loop configuration is achieved.

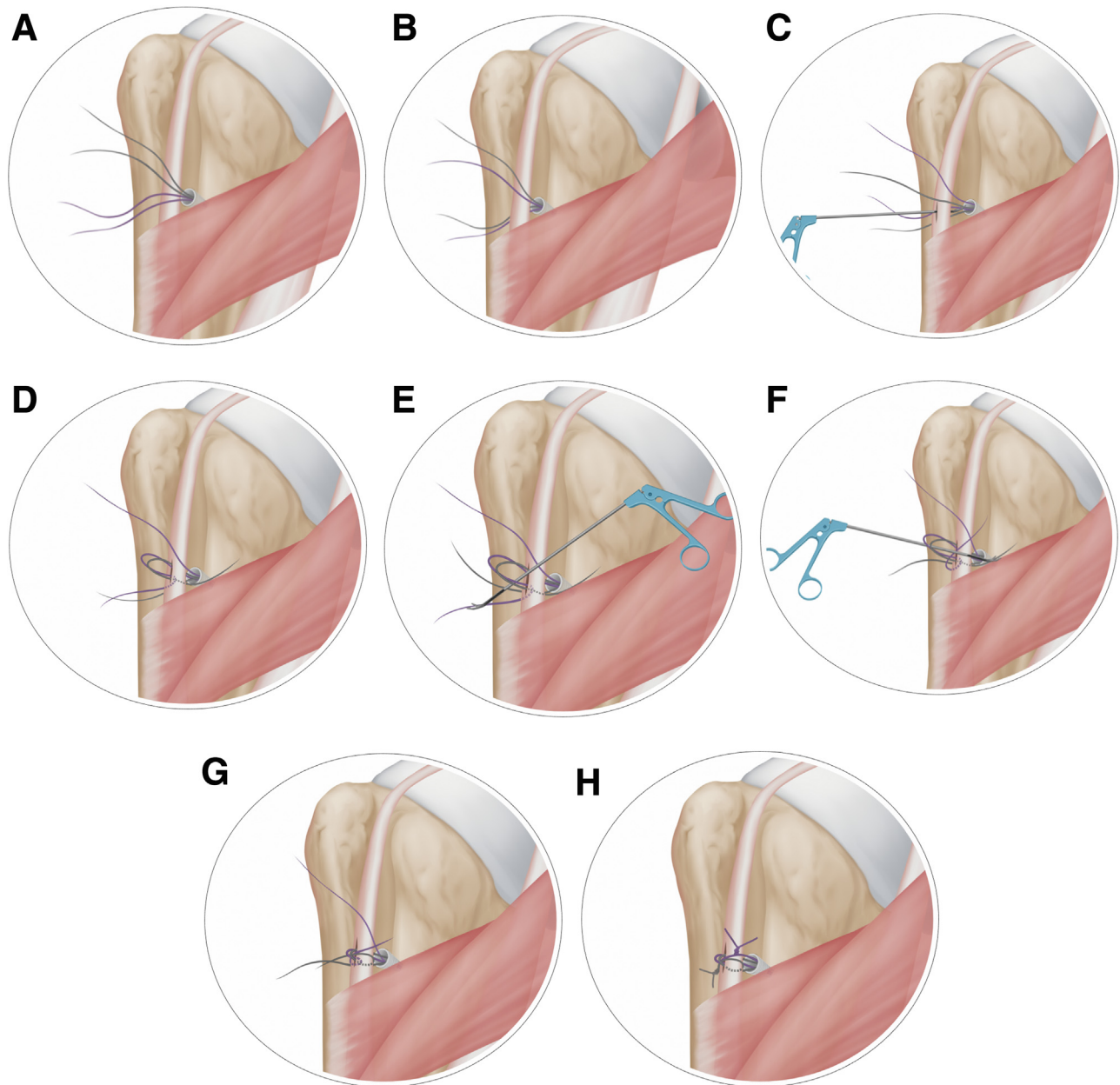


Fig 3. (A-H) Illustrations summarizing the steps required to create the double 360° lasso loop. (A) A 4.5-mm 2-suture anchor is placed at the upper margin of the pectoralis major and near the bicipital groove. (B) The different strands of the two sutures are placed on each side of the biceps tendon. (C) A penetrating grasper is used to puncture the biceps tendon near the proximal position above the anchor. (D) One of the two sutures on each side of LHBT with different colors is retrieved by using the jaw of the penetrating suture grasper, respectively. And leaving two suture loops above the surface of the tendon. (E) A suture grasper is passed through the two loops from the front of the double loops to grasp the free end of the suture behind the biceps tendon, which is the same suture limb used to create the loops. The suture limb is pulled through the double loops. (F) The same procedure is done from the rear of the biceps tendon to grasp another free limb of the suture in front of the biceps tendon, which is another strand used to create the loops. (G) The ends of all four sutures are tightened. (H) Tied two nonsliding knots on both sides of the biceps tendon, the double 360° lasso loop is finished.

and muscle cramps.⁶ However, biceps tenodesis can avoid these problems. It is important to note that during biceps tenodesis, it is necessary to avoid overtensioning of the tendon fixation, otherwise, it may cause post-operative pain.³ There is no doubt that biceps tenodesis

is a better option for younger patients and esthetic considerations.^{7,8}

Biceps tenodesis techniques that place the tenodesis site within the bicipital groove have been associated with more complications and higher revision rates

Table 1. Advantages and Limitations

Advantages	Limitations
<ul style="list-style-type: none"> • This technique is simple and reproducible. • All-arthroscopic operation • Minimally invasive • Excellent visualization of tenodesis location and technique • Only punctures the biceps tendon once, with less damage to the tendon • The “double 360° lasso loop” configuration is achieved with one anchor, which is cost-effective • The knots are tied and fixed on each side of the biceps tendon, and this structure neutralizes the pull forces on both sides of the tendon. 	<ul style="list-style-type: none"> • Only nonsliding knots can be used to tie the tenodesis knots. • Circumflex humeral artery branches may be injured during the exposure of the biceps tendon. • It is difficult to assess the tension of tendon fixation during surgery, so there is a risk of overtensioning.

Table 2. Tips and Tricks

<ul style="list-style-type: none"> • Using spinal needle localization, establish the suprapectoral-biceps portal at the level of the apex of the axillary fold. Arthroscopically, the needle tip is located at the junction of the superior margin of the pectoralis major and the biceps groove. • The position for anchor placement should be posterior to the biceps groove. • When puncturing the biceps tendon with a penetrating grasper, the biceps tendon can be lifted up with another suture grasper through the anterior portal to create more space for maneuvering • The puncture site should be located proximal to the biceps tendon from the anchor position to avoid overtensioning during the tendon fixation. • After tendon fixation, the biceps tendon is transected from superior glenoid insertion within the glenohumeral joint.

compared with techniques that place the tenodesis site distal to the groove.^{9,10}

Open tenodesis technique is performed directly underneath the pectoralis major tendon, distal to the bicipital groove. However, it has the potential for complications associated with open surgery, such as increased rates of blood loss, wound infection, nerve injury, and cosmetic deformity from the scar.¹¹ In contrast, all arthroscopic tenodesis technique at the suprapectoral zone of the tendon addresses extra-articular sources of pain, while limiting the potential pitfalls of open surgery.¹² Therefore, we prefer the all-arthroscopic suprapectoral biceps tenodesis technique. It has to be mentioned that when we perform all-arthroscopic suprapectoral biceps tenodesis technique, we need to establish a suprapectoral-biceps portal at the level of the apex of the axillary fold, which can make our surgical procedure simpler and more convenient. Fixation can be performed using screws, various anchors, cortical buttons and so on. Stapleton et al.¹³ used a PDS suture that assists in passing a braided suture through both the biceps tendon and the subscapularis to allow for the desired tenodesis. Moreover, some fixation methods can be combined. Chevallier et al.¹⁴ showed a technique for combined bioabsorbable screw and suture anchor fixation of the biceps tendon. It can be selected according to the surgeon's preference.

In this Technical Note, we perform the biceps tenodesis using a 2-suture anchor with 4 strands. This method is simple and easy to learn. Biceps tenodesis can be performed within a few minutes after the biceps tendon is sufficiently exposed on the upper margin of the pectoralis major muscle. The double 360° lasso-loop is performed by puncturing the tendon only once,

which can get a firm ligature of the biceps tendon. This technique avoids repeated puncture of the biceps tendon causing tendon lesion, which can affect the overall stability of the knots after fixation. This fixation creates a 360° lasso loop on each side of the tendon. Finally, tie a knot on each side of the tendon, so that the pull forces on both sides of the tendon neutralize each other, making the fixed tendon more stable and firmer. After the double 360° lasso loop biceps tenodesis is completed, the biceps tendon is transected from superior glenoid insertion using the electrocautery device. If the tendon retracts distally after cutting, it may become self-locked in the biceps groove at the position of the transverse ligament, creating a second spontaneous tendon fixation point.

Since Lafosse et al.¹⁵ first described the single "lasso-loop" tenodesis technique in 2006, many surgeons have proposed a variety of modified double "lasso-loop" tenodesis techniques.¹⁶⁻¹⁸ These fully demonstrate the "lasso-loop" tenodesis technique is simple, repeatable, and solid, which is popular among shoulder surgeons.

This novel double 360° lasso loop technique has many advantages, such as simple operation, easy to learn, repeatable, and less damage to the biceps tendon. However, further clinical and biomechanical studies are needed to evaluate the reliability of this tenodesis technique.

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