Technical Note

Ultrasound-Guided Suprapectoral Tenodesis of the Long Head of the Biceps Brachii

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Abstract: When the long head of the biceps tendon is diseased, tenodesis is an appropriate treatment strategy. The specific technique used is dependent on visualization, fixation method and hardware, and tenodesis location. For suprapectoral tenodesis techniques, those that fix the tendon within or below the bicipital groove can be challenging owing to the transverse humeral ligament covering the groove. To accurately identify the biceps tendon in this area, the ligament often requires resection. Ultrasound provides surgeons with a safe and noninvasive tool to visualize the biceps tendon as it exits the bicipital groove, negating the need for unroofing and other pitfalls associated with traditional techniques. This technical note describes an ultrasound-guided suprapectoral biceps tenodesis procedure.

Numerous biceps tenodesis procedures have been described in the literature, and these procedures can vary based on the method of visualization, tenodesis location with respect to the bicipital groove and pectoralis major, and hardware.[1-4] Techniques that fix the long head of the biceps tendon (LHBT) at any position above the pectoralis major are typically performed arthroscopically, whereas a subpectoral tenodesis is an open or mini-open procedure.[1-4] For arthroscopic procedures performed in a suprapectoral manner, exposing the location in or below the groove can be challenging. The tissue layer overlying the bicipital groove (transverse humeral ligament) makes exposure of the tendon within the groove the greatest challenge using arthroscopy. For a suprapectoral tenodesis, the surgeon must visualize the biceps tendon arthroscopically in the joint and tag the transverse humeral ligament at the top of the groove. In the subacromial space, this tag suture is used as the reference point to start unroofing the biceps, taking down the transverse humeral ligament and exposing the biceps within the groove.

Intraoperative use of ultrasound avoids these pitfalls. Ultrasound allows surgeons to accurately identify the LHBT as it exits the bicipital groove instead of going through the joint and unroofing the tissue layer above the groove. Ultrasound is an inexpensive, nonirradiating, and noninvasive modality that can be easily used to visualize soft-tissue structures in real time. In this technical note, we describe ultrasound-guided suprapectoral tenodesis of the LHBT (Video 1, Table 1).

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Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Ultrasound should be used to find the distal edge of the bicipital groove and the superior border of the pectoralis major to identify the safe and appropriate location for tenodesis.	Without ultrasound, medially plunging may damage the adjacent neurovascular structures.
An 18-gauge spinal needle should be placed percutaneously and superior to the medial suprapectoral portal to hold the biceps tendon to the side and protect it while drilling.	Without ultrasound, the musculocutaneous nerve may be mistaken for a medially subluxated LHBT and undergo tenodesis inappropriately.
The instrumentation should be placed through the medial suprapectoral portal, and the arthroscope should be placed through the lateral suprapectoral portal.	Placing the instrumentation through the lateral suprapectoral portal risks significant complications if the instrumentation were to pass the target location for fixation or plunge medially.
The tagged end of the LHBT should be pulled to the anterior cannula where originally tagged to set tension and length.	Under- or over-pulling the tagged end of the LHBT can cause a length-tension mismatch for tendon and muscle.

LHBT, long head of biceps tendon.

Surgical Technique

We prefer to place the patient in the beach-chair position, but the lateral decubitus position can also be used. A diagnostic arthroscopy is performed to evaluate the LHBT and other intra-articular pathologies (Fig 1). If a tenodesis is to be performed, the LHBT is tagged with a suture using a 90° SutureLasso (Arthrex, Naples, FL) and a FiberStick (Arthrex) (Fig 2). The suture is passed directly in front of the anterior cannula: This will act as a landmark when tensioning later in the procedure. The LHBT is then tenotomized (Fig 3). Other pathologies are addressed as needed.

A linear ultrasound probe (M-Turbo; Fujifilm Sonosite, Bothell, WA) is preferred for this procedure and is prepared by placing it in a sterile cover and using sterile ultrasound gel. With the probe in short axis to the LHBT, the bicipital groove is identified where the LHBT can be found resting (Fig 4). With the groove in view, placement of the portals and tenodesis would be too proximal. The probe can be scanned distally to bring the pectoralis major into view as it crosses over the LHBT (Fig 5). This area is too distal for portal and tenodesis placement. The LHBT can be identified in short axis with the tendon centered in the image just as the tendon exits the distal end of the bicipital groove and still above the pectoralis major (Fig 6). With this area identified, the medial suprapectoral (SPM) and lateral suprapectoral portals are created approximately 1 cm medial and lateral to the center of the probe (Fig 7). Once the skin incisions are made, a closed, curved Kelly clamp is inserted into the portals; pushed down to bone; oriented toward the opposing portal; and then opened and spread to create a space to work under the deltoid and above the biceps tendon. This technique is performed through both portals (Fig 8).

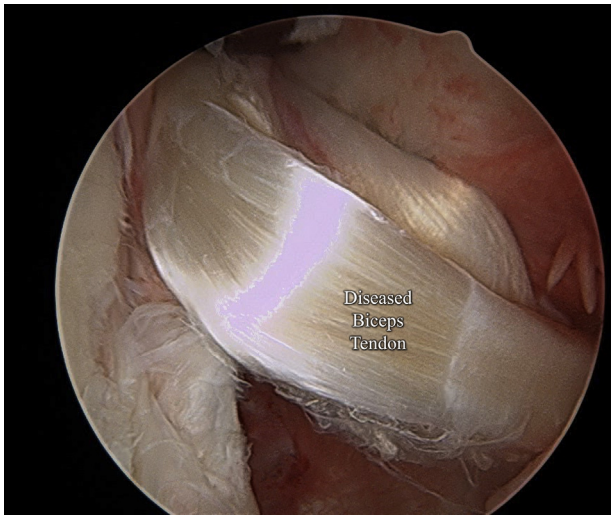

Fig 1. Through an arthroscopic view of the right shoulder via the posterior portal using a 30° arthroscope with the patient in the beach-chair position, the long head of the biceps tendon can be seen. Tenodesis is indicated for this tendon because it is frayed and shows obvious signs of disease.

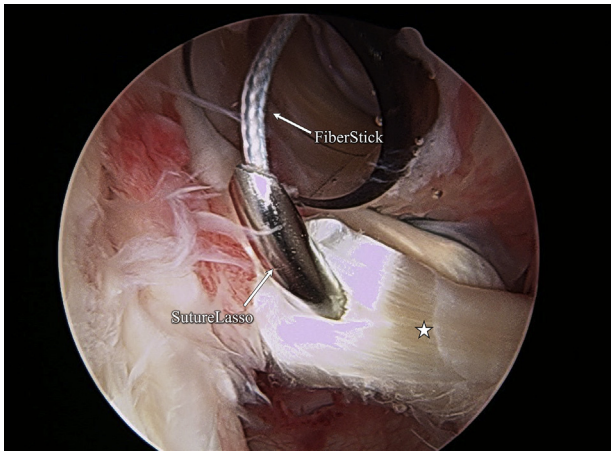

Fig 2. Through an arthroscopic view of the right shoulder via the posterior portal using a 30° arthroscope with the patient in the beach-chair position, a 90° straight SutureLasso, placed through the midsubstance of the long head of the biceps tendon (star), can be seen. A FiberStick is subsequently passed through the SutureLasso and is used to tag the proximal tendon. The tendon is tagged directly in front of the cannula, which will allow for the proper tensioning of the biceps when the tenodesis is fixed in place.

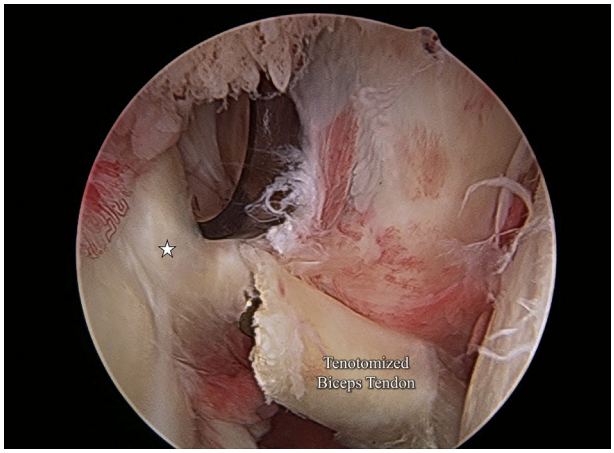

Fig 3. Through an arthroscopic view of the right shoulder via the posterior portal using a 30° arthroscope with the patient in the beach-chair position, the long head of the biceps tendon can be seen being tenotomized. The tenotomy is performed proximal to the tagged portion of the tendon at the insertion to the labrum (star).

A 30° arthroscope is placed in the lateral supra-pectoral portal, and instrumentation is placed in the SPM portal. Instrumentation is specifically placed in the SPM portal and oriented laterally to avoid neuro-vascular complications of the medial structures of the proximal arm (axillary nerve, musculocutaneous nerve, or brachial artery) if the instrumentation were to pass the target location for fixation or plunge. Because the site of tenodesis is not within a contained cavity, the arthroscope is used with a pump (50 mm Hg) to control bleeding. A shaver and ablation wand are used to clear the tissue between the deltoid and LHBT, as well as between the deltoid and anterior humerus, stopping at the superior border of the pectoralis major. Care is taken because the ascending branch of the anterior humeral circumflex artery runs lateral to the biceps tendon and often needs to be cauterized. The ablation wand is used when cleaning the tissue around the biceps and anterior to the humerus in preparing the bone and tendon for tenodesis. The biceps tendon is mobilized medially and held to the side with an 18-gauge spinal needle (Fig 9). A 7.5-mm Pilot Headed Reamer (Arthrex) is used to create a socket for the tenodesis below the groove and above the pectoralis major (Fig 10). The reamer should be angled perpendicular to the bone surface and along the course in which the LHBT runs anatomically. Because the biceps can potentially be subluxated medially, drilling a hole where the LHBT sits for a given patient may not represent the proper location for a tenodesis.

The spinal needle is removed, and the stay suture in the proximal biceps is pulled (Fig 11). The LHBT will return to its anatomic location just distal to the bicipital groove and will need to be tensioned appropriately. The stay suture should be pulled so that it reaches the anterior cannula where it was originally tagged to achieve proper tension and length; pulling the suture proximal to this landmark will cause over-tensioning, and anchoring the LHBT with the stay suture distal to the cannula will result in inadequate tension. A 7.0 × 19.5—mm Forked Tip BioComposite SwiveLock Tenodesis screw (Arthrex) is used to fix the tendon into the socket (Figs 12 and 13). One end of the stay suture is pulled to detach it from the proximal tendon, which will now be located in the groove extra-articularly. The residual tendon superior to the tenodesis can be left in place or resected as desired. This completes the ultrasound-guided suprapectoral biceps tenodesis (Fig 14).

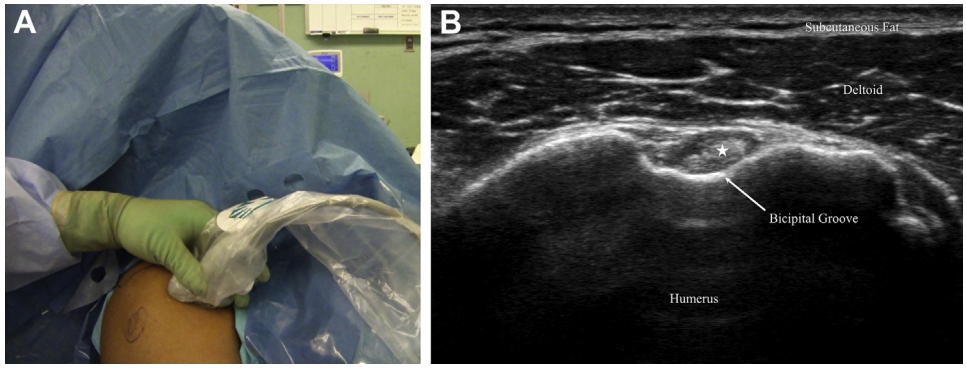

Fig 4. (A) External view of the linear ultrasound probe (M-Turbo), placed on the anterior aspect of the right shoulder with the patient in the beach-chair position, in short axis to the long head of the biceps tendon. The ultrasound is used to first identify the bicipital groove where the long head of the biceps rests. (B) Ultrasound image of the long head of the biceps tendon in short axis (star), resting in the bicipital groove. With the bicipital groove in view, placement of the portals and tenodesis in this location would be too proximal. The ultrasound probe can be scanned distally to identify the appropriate region for the suprapectoral tenodesis.

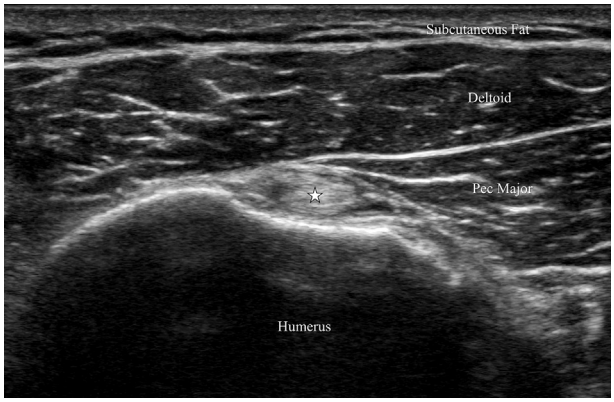

Fig 5. Ultrasound view of the long head of the biceps tendon in short axis (star) and resting on the humerus. The pectoralis (Pec) major can be seen to the right of and crossing over the biceps tendon. This area would be too distal for placement of the portals and tenodesis.

Discussion

Technical aspects of biceps tenodesis procedures can vary significantly based on attachment location, open versus arthroscopic visualization, and suture fixation methods.[1-4] Tenodesis procedures can be broadly categorized into 2 main types: suprapectoral and subpectoral. The former can be further subcategorized depending on the location of fixation with respect to the bicipital groove: above, within, or below the groove. The multitude of techniques have generally produced good to excellent clinical results,[5-7] and the specific technique used largely depends on surgeon preference.

For arthroscopically performed suprapectoral tenodesis techniques, accurate visualization of the LHBT when performing fixation within or below the bicipital groove is a challenge. To see the LHBT properly, surgeons must resect the transverse humeral ligament that covers the bicipital groove. This unroofing procedure carries risk and can prove to be technically difficult. To combat this challenge, ultrasound is used to easily identify the LHBT as it exits the groove, negating the need for unroofing (Table 2).

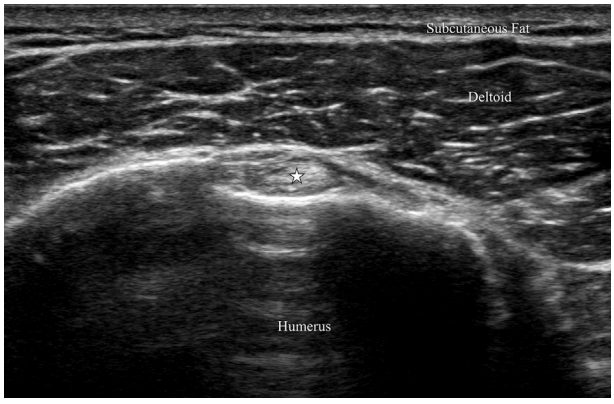

Fig 6. Ultrasound view of the long head of the biceps tendon in short axis (star) and resting on the humerus. Neither the bicipital groove nor the pectoralis major tendon can be seen in this view, indicating this location to be appropriate for portal placement and subsequent tenodesis.

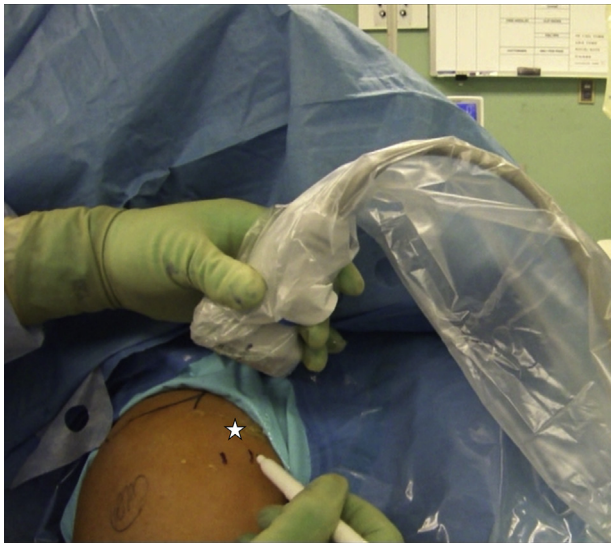

Fig 7. External view of the right shoulder in preparation for tenodesis with the patient in the beach-chair position. The appropriate locations for the portals and subsequent tenodesis have been identified using the linear ultrasound probe. Markings for portal placement (star) are made approximately 1 cm medial and lateral to the center of the probe when the biceps tendon is centered on the monitor. The markings denote the locations of the medial and lateral suprapectoral portals.

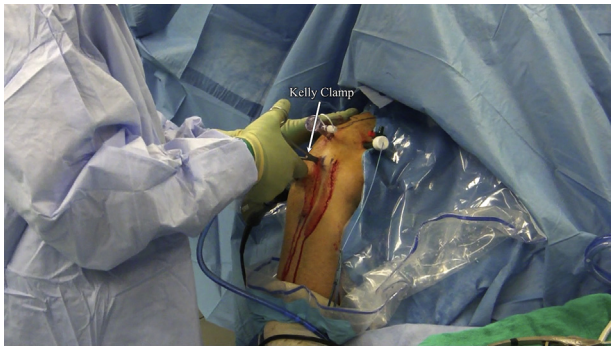

Fig 8. External view of the right shoulder with the patient in the beach-chair position. The medial and lateral suprapectoral portals have been created based on the optimal locations identified via ultrasound. In preparation for tenodesis, a closed, curved Kelly clamp is first inserted and pushed down to bone. The Kelly clamp is subsequently oriented toward the opposing portal and then opened and spread to create a working space under the deltoid and above the biceps and humerus. The Kelly clamp is in the lateral suprapectoral portal in this image; however, this technique should be performed through both portals.

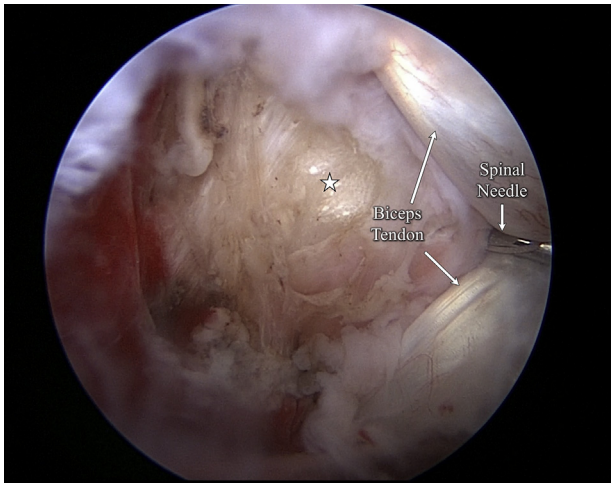

Fig 9. Arthroscopic view of the right shoulder through the lateral suprapectoral portal using a 30° arthroscope with the patient in the beach-chair position. With the tissue cleared and the bone bed prepared (star), the long head of the biceps tendon is mobilized and held medially using an 18-gauge spinal needle, placed percutaneously and superior to the medial suprapectoral portal.

Appropriate portal placement is an important factor for the safety of tenodesis procedures. Portals placed too superior or inferior to the site of tenodesis would require angulation of the instrumentation. Particularly when one is drilling a socket, perpendicularity to the bone surface is imperative to prevent skiving or plunging. Ultrasound allows surgeons to intraoperatively and noninvasively mark the appropriate portal locations to ensure instrumentation will be directed perpendicular to the bone surface, which is unreliable when performed blindly.

When a biceps tenodesis is performed blindly with no way to visualize the LHBT prior to creating an incision,

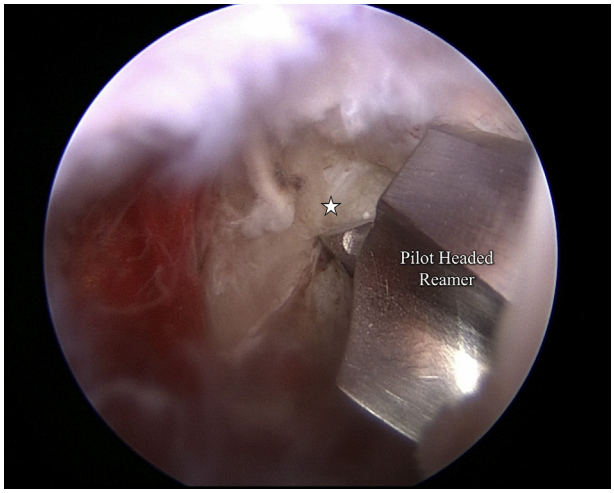

Fig 10. Arthroscopic view of the right shoulder through the lateral suprapectoral portal using a 30° arthroscope with the patient in the beach-chair position. The long head of the biceps tendon has been mobilized medially and is held in place with an 18-gauge spinal needle. Through the medial suprapectoral portal, a 7.5-mm Pilot Headed Reamer is angled perpendicular to the bone surface and used to drill a socket into the anterior humerus at the location identified and prepared for tenodesis (star). This location should be along the anatomic course of the long head of the biceps tendon, should be distal to the bicipital groove, and should remain above the pectoralis major.

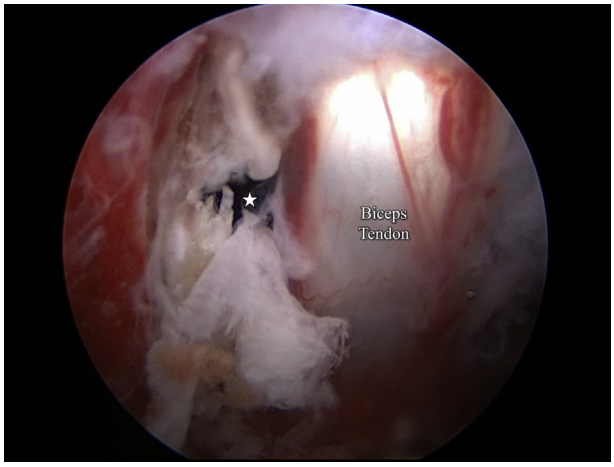

Fig 11. Arthroscopic view of the right shoulder through the lateral suprapectoral portal using a 30° arthroscope with the patient in the beach-chair position. With the socket created (star), the spinal needle can be removed, and the original stay suture can be pulled. The stay suture should be pulled so that it reaches the anterior cannula where the tendon was originally tagged. These 2 acts return the biceps to its normal position and set the biceps tendon and muscle to the appropriate tension and length.

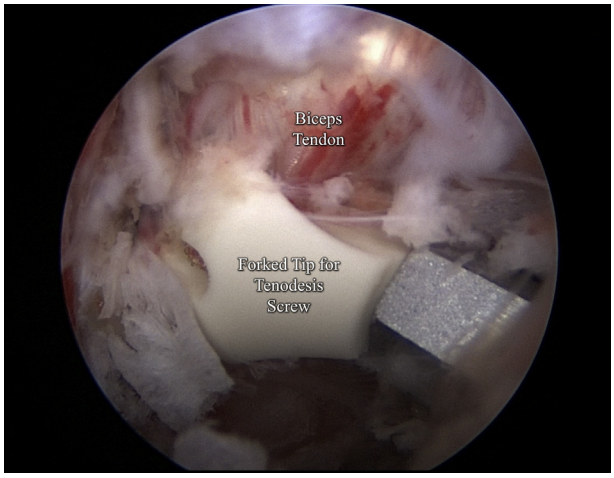

Fig 12. Arthroscopic view of the right shoulder through the lateral suprapectoral portal using a 30° arthroscope with the patient in the beach-chair position. Through the medial suprapectoral portal, the Forked Tip BioComposite SwiveLock Tenodesis screw is used to capture and set the biceps tendon into the socket.

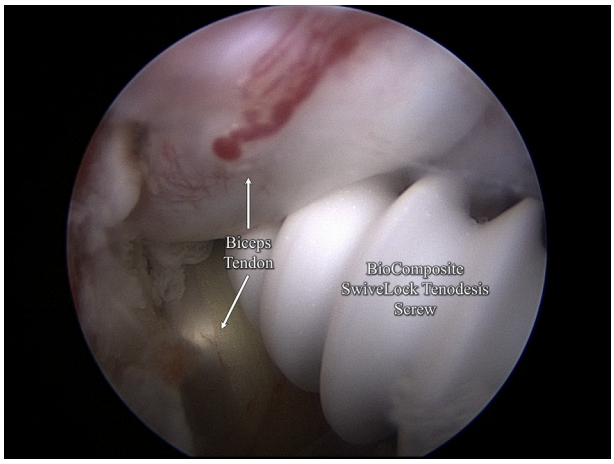

Fig 13. Arthroscopic view of the right shoulder through the lateral suprapectoral portal using a 30° arthroscope with the patient in the beach-chair position. Through the medial suprapectoral portal, the 7.0-mm Forked Tip BioComposite Tenodesis screw can be seen securing the biceps tendon into the socket.

procedural risk is elevated when attempting to find the LHBT arthroscopically. In the case of a medially subluxated LHBT, locating the tendon can prove even more challenging. Surgeons must subsequently search through the tissue of the upper arm to find the LHBT. This creates the potential for medial or lateral plunging into the surrounding neurovascular structures, such as the musculocutaneous or axillary nerves, as well as the cephalic or brachial arteries and veins. Being able to quickly and easily identify the LHBT before creating incisions and inserting instrumentation helps to avoid these potential complications.

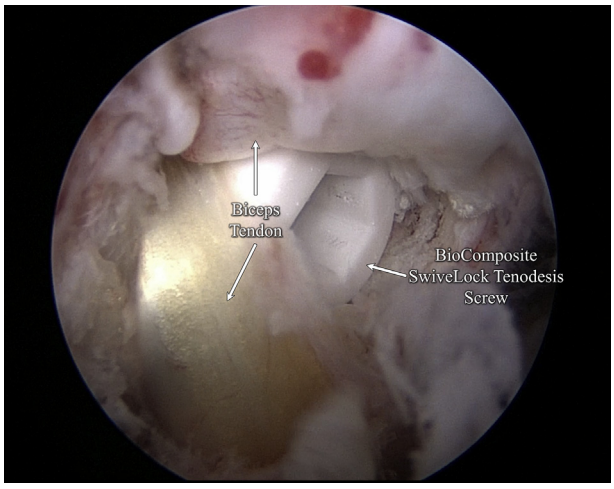

Fig 14. Arthroscopic view of the right shoulder through the lateral suprapectoral portal using a 30° arthroscope with the patient in the beach-chair position. The 7.0-mm Forked Tip BioComposite Tenodesis screw can be seen secured in place and flush with the humerus. The stay suture is removed from the proximal tendon. The residual tendon superior to the screw may be left in place or resected as desired. This completes the ultrasound-guided suprapectoral biceps tenodesis procedure.

Table 2. Advantages and Limitations

Advantages
Use of ultrasound intraoperatively allows for accurate, noninvasive identification of the LHBT as it exits the bicipital groove.
Ultrasound avoids the need to resect the transverse humeral ligament.
Ultrasound can quickly identify a medially subluxated LHBT, reducing operative time.
Using the anterior cannula as a reference point for suture tagging of the LHBT enables easy and correct tensioning of tendon and muscle.
Limitations
Ultrasound requires some proficiency.
If the LHBT is significantly frayed or compromised, the tendon may not be able to hold the tag suture.

LHBT, long head of biceps tendon.

To combat the challenges associated with traditional suprapectoral LHBT tenodesis procedures, we developed the described ultrasound-guided technique. Use of ultrasound intraoperatively avoids unnecessary risks, can cut down on surgical time, and can limit potential iatrogenic damage. The benefits of this procedure make it our preferred technique for suprapectoral biceps tenodesis.

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