

An All-Arthroscopic, Length-Tensioned Suprapectoral Biceps Tenodesis Technique



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Abstract: Biceps tenodesis remains a popular choice for treating anterior shoulder pain in the setting of primary biceps tendinitis or biceps pain due to concomitant glenohumeral joint pathology. A variety of surgical approaches and fixation construct options are available for biceps tenodesis. The advantages of an all-arthroscopic biceps tenodesis include anatomic maintenance of the length-tension relation with strength preservation and improved cosmetic results. This technique can be technically challenging but allows for a minimally invasive approach to anchor the biceps. In this Technical Note, we describe a suprapectoral biceps tenodesis using an all-arthroscopic approach in the setting of concomitant rotator cuff repair. This technique offers a viable alternative to the open subpectoral biceps tenodesis.

The long head of the biceps tendon (LHB) is a common source of pain and is associated with multiple glenohumeral pathologies such as tendinitis, biceps instability, biceps tears, biceps ruptures, SLAP tears, and rotator cuff tears.^{1,2} Primary bicipital tendinitis makes up a small portion of biceps pain, whereas most biceps pain is attributed to secondary tendinitis, with inflammation occurring in conjunction with surrounding glenohumeral tissue pathology.¹ The bicipital groove is commonly the primary location of pain in patients with biceps tendinitis.¹

Patients with biceps pain become surgical candidates once conservative management for approximately 3 months has failed¹ or once they have secondary

biceps tendinitis with concomitant pathology needing to be addressed surgically. Tenotomy and tenodesis are the 2 main options for surgical intervention of the biceps, with controversy over which results in better outcomes. Although technically simple to perform, a tenotomy has several disadvantages including potential muscle fatigue, cramping pain with use, and Popeye deformity.^{1,3} Biceps tenodesis is technically more complex, with many surgical options including an open versus arthroscopic approach, as well as soft-tissue or osseous fixation, and many fixation constructs including interference screws, suture anchors, and all-suture anchors, in addition to an anatomic location of fixation.^{1,4} Despite the increased surgical skill required to perform a tenodesis over a tenotomy, advantages include better cosmetic results and the potential to restore biceps strength.¹ Restoring the length-tension relation by appropriately placing the biceps tenodesis is critical in preserving biceps strength and cosmesis, especially in young active patients.

We describe a suprapectoral biceps tenodesis with an all-arthroscopic approach in the setting of concomitant rotator cuff repair. A summary of clinical pearls is provided in [Table 1](#), and a summary of the technique is provided in [Video 1](#).

Surgical Technique

Surgical Setup and Examination Under Anesthesia

The patient is placed in the lateral decubitus position using a traction arm holder (Biomet Zimmer, Warsaw, IN). All bony prominences are well padded, and an

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Table 1. Clinical Pearls and Pitfalls of All-Arthroscopic Supraperectoral Biceps Tenodesis

Benefits of biceps tenodesis include pain relief, maintenance of the length-tension relation with strength preservation, and improved cosmetic results.

The arthroscopic technique allows for a minimally invasive approach that may reduce morbidity associated with open techniques.

Fixation of the tendon before surgical detachment allows for accurate length-tension relation preservation.

Removal of the bicipital groove tissue eliminates an important source of anterior shoulder pain.

Proximal supraperectoral placement of anchors takes advantage of the cortical bone and may decrease the risk of postoperative fracture.

Tagging the biceps before surgical detachment makes removal of tendon material from the joint more efficient.

All-arthroscopic tenodesis is technically more challenging than open techniques.

The accessory biceps tenodesis portal allows for an arthroscopic subscapularis repair as well.

axillary roll is placed. Examination under anesthesia is performed, showing no instability with anterior-superior, anterior-middle, and anterior-inferior load-and-shift testing, as well as posteriorly. A complete examination under anesthesia including passive range of motion, anterior and posterior load-and-shift testing, and the sulcus sign should be performed before preparation and draping.

Diagnostic Arthroscopy

A mid-posterior glenoid portal is established, followed by an anterior rotator interval portal. Diagnostic arthroscopy is performed, examining the biceps tendon and anchor, rotator interval, middle glenohumeral ligament, subscapularis and subscapularis recess, superior glenohumeral ligament, humeral head, glenoid surface,

rotator cuff, inferior glenohumeral ligament, and capsule. Diagnostic arthroscopy is notable for an intact but frayed subscapularis. The biceps tendon is subluxating over the otherwise intact subscapularis. Labral fraying anteriorly, superiorly, inferiorly, and posteriorly is also noted. The articular cartilage has minimal chondromalacia-related changes. There is a 4 × 4-cm rotator cuff tear of the supraspinatus.

Biceps Tenodesis

The biceps tendon is tagged with absorbable suture using a spinal needle that is introduced at the anterolateral corner of the acromion and placed through the biceps tendon (Fig 1). The free end of the suture is grasped through the rotator interval portal, and the remaining free end of the suture is then brought out of the rotator interval cannula with a crochet hook. Half-hitches are tied

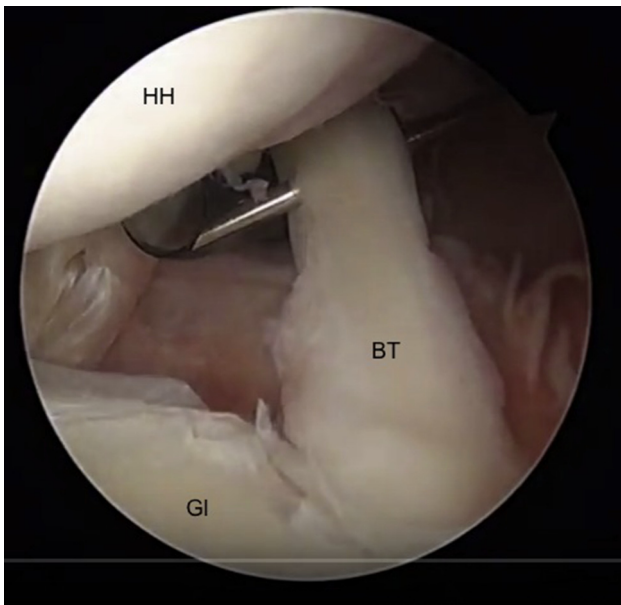


Fig 1. Viewing from the midglenoid portal and using the anterior rotator interval portal in the left shoulder, a spinal needle is introduced at the anterolateral corner of the acromion and placed through the biceps tendon (BT). The free end of the suture is grasped through the rotator interval portal, and the remaining free end of the suture is then brought out of the rotator interval cannula with a crochet hook. (HH, humeral head; Gl, glenoid.)

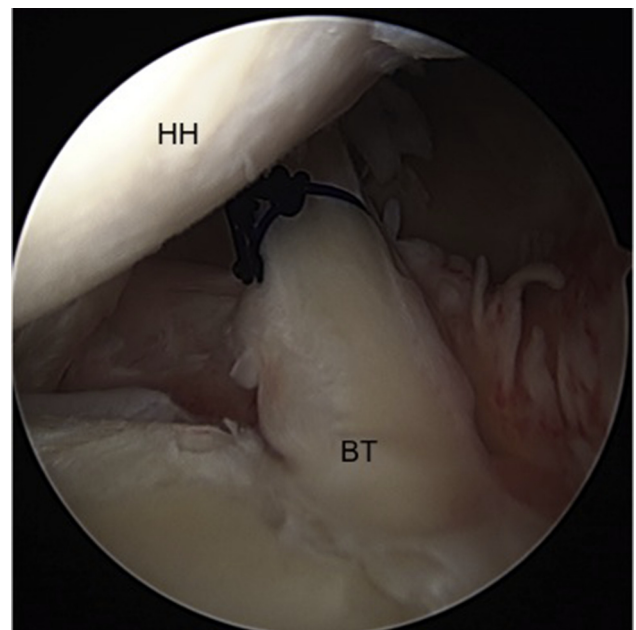


Fig 2. Viewing from the midglenoid portal and using the anterior rotator interval portal in the left shoulder, the biceps tendon (BT) is tagged with absorbable suture and then left attached to the superior tubercle of the glenoid. This is performed using a percutaneous spinal needle for lateral identification. (HH, humeral head.)

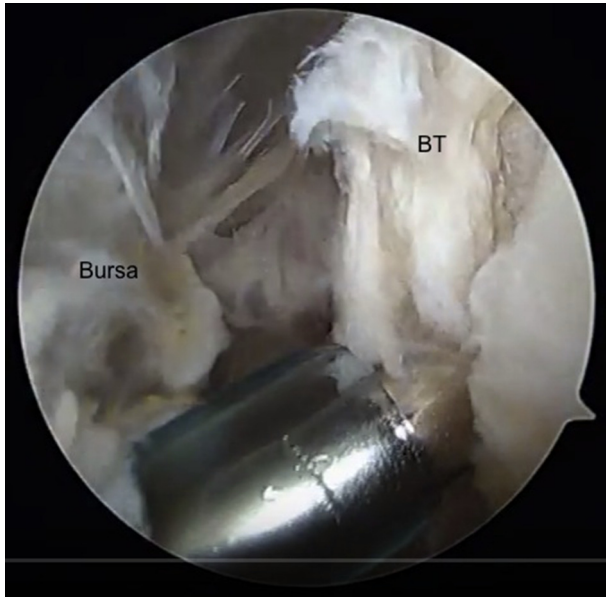


Fig 3. Viewing through the lateral portal and using an accessory biceps portal in the left shoulder, the subacromial space is entered to perform a full anterior bursectomy to locate the long head of the biceps tendon (BT). (Bursa, subacromial bursa.)

in the biceps tendon, followed by a suture ligature stitch around the biceps, after which more half-hitch stitches are placed. The biceps is left attached to the superior

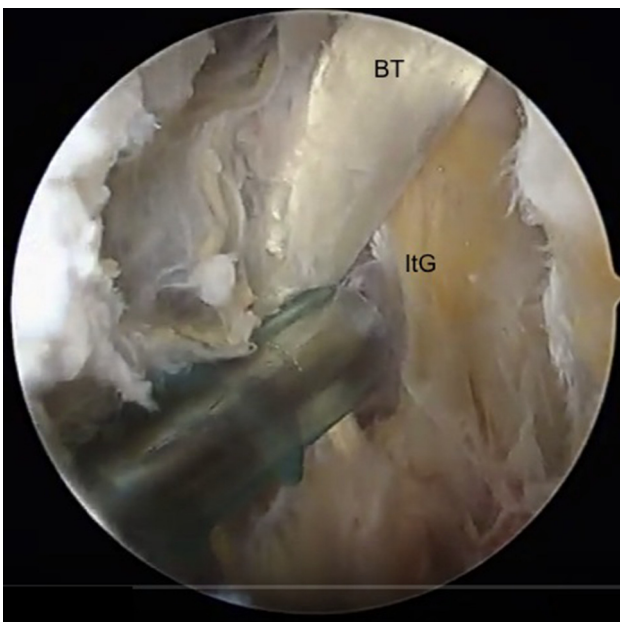


Fig 4. Viewing through the lateral portal and using an accessory biceps portal in the left shoulder, subacromial bursectomy is continued, debriding the biceps tendon (BT) inferiorly and laterally and then working superiorly to allow for complete denervation of the biceps long head vincula, as well as removal of loose bodies or debris. (ItG, intertubercular groove.)

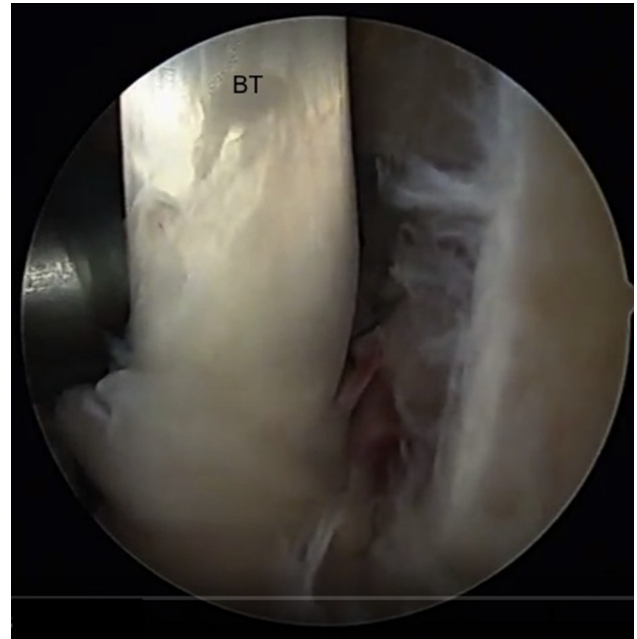


Fig 5. Using the lateral and accessory biceps portals in the left shoulder, an anchor guide is placed through the accessory portal medial to the biceps tendon (BT) and a drill is used to create a pilot hole for an anchor.

tubercle of the glenoid (Fig 2). The subacromial space is then entered. Viewing through the lateral portal, the surgeon establishes an accessory biceps portal. This portal is located 3 fingerbreadths inferior and lateral to the rotator interval portal (Fig 3). A full anterior bursectomy is first performed to locate the LHB. The biceps long head is located inferior to the transverse ligament by palpation using a full-radius shaver during the bursectomy. The transverse ligament is taken down with the shaver blade starting inferior to the transverse ligament and lateral to the biceps tendon to avoid neurovascular structures medial to the LHB. Starting the debridement inferiorly and laterally and then working superiorly allows for complete denervation of the biceps long head vincula as well as removal of loose bodies or debris that may have collected in this region from the glenohumeral joint (Fig 4). Once the biceps tendon has been freed of tenosynovium, the tendon is grasped through the rotator interval portal with a large loop grasper and pulled anteriorly to create a working space between the biceps and intertubercular groove. The intertubercular groove is then lightly decorticated with the shaver. Next, suture anchors are placed sequentially by use of two 1.7-mm SutureFix anchors (Smith & Nephew, Andover, MA). Through the biceps accessory portal, the anchor guide is placed medial to the biceps tendon and the drill is used to create a pilot hole, followed by placement of the anchor (Fig 5). Next, 1 of the suture limbs is shuttled lateral to the biceps so that a limb of suture from the anchor is placed on each side of the biceps tendon. At this point, the biceps

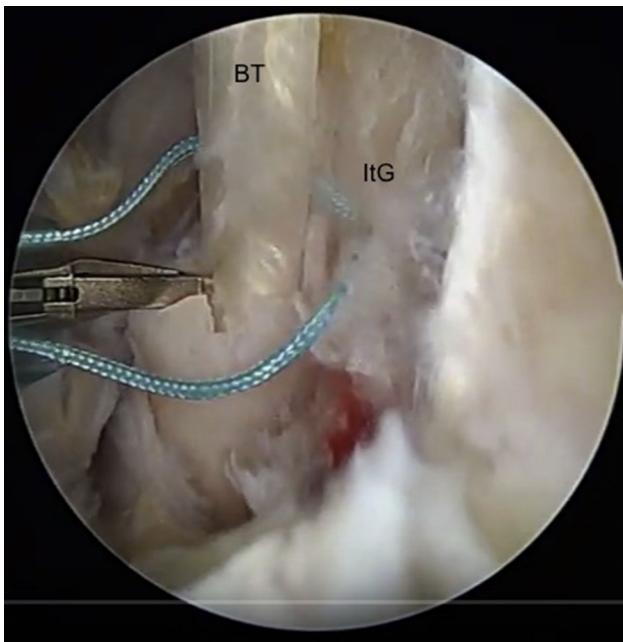


Fig 6. Using the lateral and accessory biceps portals in the left shoulder, the biceps tendon (BT) is now pulled away from the bone enough to create space for a tissue penetrator to be passed through the BT. Once through the BT, the suture limb is pulled out of the end of the cannula enough to allow for the corresponding limb to be placed through the hole that was created by the tissue penetrator. (ItG, intertubercular groove.)

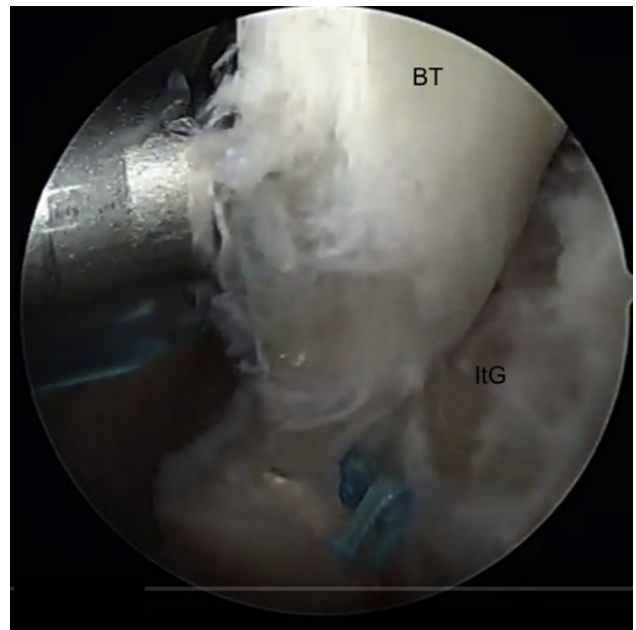


Fig 8. Using the lateral and accessory biceps portals in the left shoulder, a second anchor is placed superior to the first in a similar manner. A suture limb is placed on each side of the biceps tendon (BT), and a suture is then passed through the biceps with a tissue penetrator. With the second anchor, instead of a medial stitch, a lateral stitch is passed to create the noose slipknot to offset the tissue encapsulated in the knot. (ItG, intertubercular groove.)

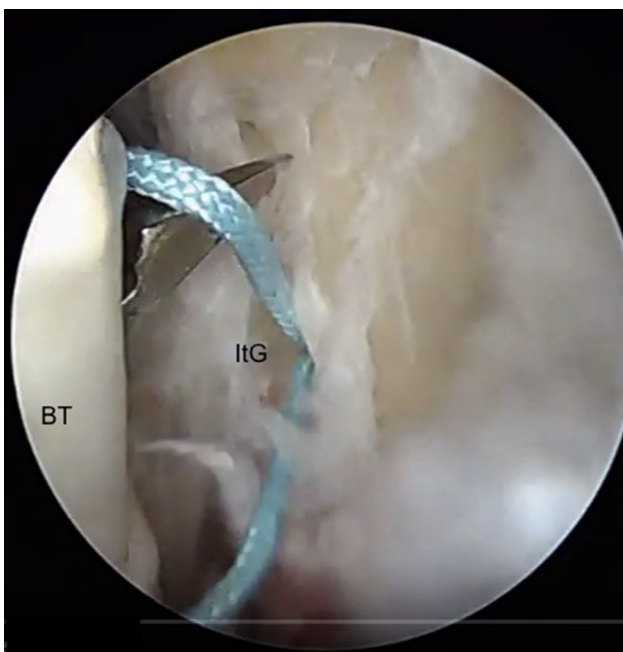


Fig 7. Using the lateral and accessory biceps portals in the left shoulder, the suture is anchored on the medial half on the biceps tendon (BT). This medial limb is then tied to the lateral remaining limb of suture from the suture anchor. (ItG, intertubercular groove.)

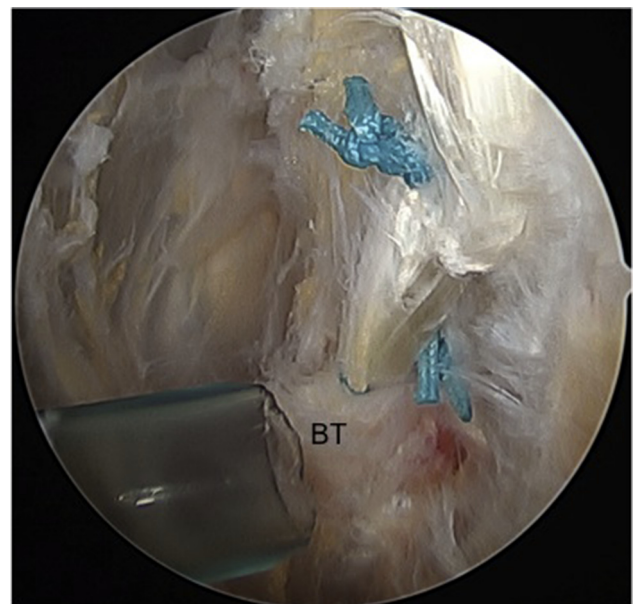


Fig 9. Using an accessory biceps portal in the left shoulder, 2 suture anchors are used for the biceps tenodesis while maintaining tension on the biceps tendon (BT) with an absorbable suture held by an assistant. This allows for an appropriately length-tensioned tenodesis.

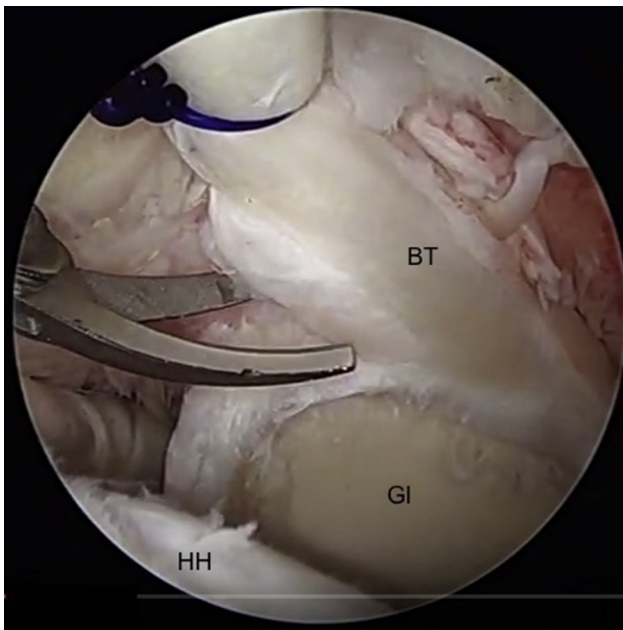


Fig 10. Using the lateral and accessory biceps portals in the left shoulder, the biceps tendon (BT) is cut proximal to the onlay tenodesis, leaving it anatomically correct in terms of its length-tendon relation. The BT is then removed from the superior portion of the labrum. (HH, humeral head; Gl, glenoid.)

tendon is pulled away from the bone enough to create space for a tissue penetrator to be passed through the biceps tendon using the biceps accessory portal and grabbing a suture (Fig 6). The suture limb loop is pulled out of the end of the cannula enough to allow for the corresponding limb to be placed through the hole that was created by the tissue penetrator. The free end of the suture is pulled to create a noose slipknot around the medial half of the biceps (Fig 7). This medial limb is then tied to the lateral remaining limb of suture from the suture anchor, and the suture is cut.

A second anchor is placed superior to the first in a similar manner (Fig 8). A suture limb is placed on each side of the biceps tendon, and a suture is then passed through the biceps using the tissue penetrator. Instead of a medial stitch, a lateral stitch is passed to create a noose slipknot stitch to offset the tissue encapsulated in the knot. This is done to increase security of the tendon to the bone (Fig 9). The biceps tendon is then cut proximal to the “onlay” tenodesis, leaving it anatomically correct in terms of its length-tendon relation (Fig 10). The biceps tendon is removed from the superior portion of the labrum. The biceps origin is resected through the rotator cuff tear in this case with the camera in the lateral portal, although if there is no cuff tear, the proximal tendon resection can be performed by returning to the glenohumeral joint with the camera and using the rotator interval portal to cut the biceps proximally with arthroscopic scissors.

Postoperative Rehabilitation

Postoperatively, patients who undergo only a biceps tenodesis are allowed to begin passive range of motion of the shoulder, progressing to active-assisted and active range of motion as tolerated. Strengthening of the shoulder is allowed as well. For 8 weeks, only active elbow flexion is allowed. After 8 weeks, elbow flexion is gradually progressed with resistance as tolerated. After 10 weeks, patients may return to overhead work and sports if they have no pain, have good range of motion and strength, and have no other contraindications.

Discussion

In this Technical Note, we describe a technique for a suprapectoral biceps tenodesis with an all-arthroscopic approach in the setting of concomitant rotator cuff repair. For the young active patient, preserving the anatomic length-tension relation of the LHB is critical for good cosmetic results and maintaining maximum elbow flexion force.¹ It also decreases early muscle fatigue, biceps deformity, cramping associated with under-tensioning, and the risk of fixation failure owing to pullout forces that are associated with over-tensioning.⁵ The approach outlined in this article allows for the LHB to be fixated in situ in the suprapectoral location before the tendon is cut proximally. Unlike other techniques in which the biceps is cut at the supraglenoid tubercle of the scapula before fixation, thus requiring placement of the tendon-anchor interface to be estimated, our all-arthroscopic technique ensures the tendon is fixed in the appropriate anatomic position before disrupting the tendon proximally. This allows the surgeon to confidently maintain the length-tension relation of the LHB (Table 2).

Our technique allows for a more proximal suprapectoral placement of the fixation construct while preserving the length-tension relation. Placement of the anchors in a suprapectoral fashion allows for several key components. This technique takes advantage of the

Table 2. Advantages and Disadvantages of All-Arthroscopic Suprapectoral Biceps Tenodesis

Advantages	
Precise biceps length-tension relation preservation	
Uses dense cortical bone of proximal humerus	
Potentially decreased postoperative fracture risk because of smaller implant size	
With use of all-suture implant, no need to remove implant in revision cases	
Minimally invasive	
Disadvantages	
Technically challenging	
Increased arthroscopic time leading to swelling and fluid extravasation	
No difference in functional or cosmetic outcomes compared with open techniques	

Table 3. Risks and Benefits of All-Arthroscopic Supraperacrotal Biceps Tenodesis

Risks
Iatrogenic rotator cuff damage from portal placement
Benefits
Reduced risk of accidental fixation of musculocutaneous nerve
Removal of all bicipital groove tissue
Decreased postoperative anterior shoulder pain
Improved cosmesis
Avoidance of biceps tendon exteriorization

dense cortical bone at the distal end of the bicipital groove. In addition, it is thought that placing the anchors more proximally may be beneficial because metaphyseal bone is more forgiving than the diaphyseal bone encountered with a subpectoral tenodesis location regarding the risk of postoperative fracture. De Villiers et al.⁶ conducted a biomechanical study on biceps tenodesis placement with fourth-generation composite humeri and found a trend toward decreased maximum torque before failure with distal placement of interference screws compared with screws placed at the distal end of the bicipital groove. Suture anchors require smaller cortical holes than interference screws, which may also decrease the risk of postoperative fracture. Beason et al.⁷ compared the torsional fracture forces of intact humeri versus humeri subjected to subpectoral biceps tenodesis with both 6.25- and 8.0-mm interference screws. They found higher maximum torque loads in the intact humeri compared with the intervention, although no difference was found in maximum torque loads between screw sizes. It can be hypothesized that using a 1.7-mm suture anchor, as used in our technique, could minimize cortical weakness, resulting in higher torsional loads before fracture, as compared with conventional interference screws. In addition, an “all-suture” anchor offers the advantage that if further arthroplasty surgery is needed, there is no implant in the canal of the proximal humerus.

Removal of all the biceps tissue from the bicipital groove is key in mitigating postoperative anterior shoulder pain. Bicipital pain originates from sensory fibers located in the intra-articular and bicipital groove portions of the biceps tendon.⁸ By placing the fixation construct just distal to the bicipital groove and stripping the tendon of the vincula, this sensitive tissue is removed and may prevent recurrent anterior shoulder pain. Tagging the biceps before surgically cutting it allows for ease of removal of the amputated biceps tissue through the portal.

Multiple studies have compared the open versus all-arthroscopic approach to tenodesis of the LHB and have failed to identify differences in long-term functional outcomes between the 2 approaches.^{9,10} Gombera et al.¹⁰ compared all-arthroscopic supraperacrotal biceps tenodesis and open subpectoral

tenodesis and found no difference in mean American Shoulder and Elbow Surgeons scores, patient satisfaction, Popeye deformity, return to sport, or arm cramping between groups at an average follow-up of 30.1 months. Although the difference between groups was not statistically significant, they reported open biceps tenodesis might have a higher complication rate because it is a more invasive technique. In addition, accidental fixation of the musculocutaneous nerve is prevented by continuous visualization of the biceps tendon (Table 3).

Biceps long head pathology is often seen in conjunction with subscapularis rotator cuff tears.¹¹ The all-arthroscopic supraperacrotal biceps tenodesis approach is performed through the biceps accessory portal and allows for excellent access to the subscapularis insertion. The surgeon may repair the tendon by viewing through the lateral portal while working through the standard rotator interval portal and the accessory biceps portal. These 2 anterior portals are positioned in a staggered manner that facilitates anchor placement and suture passage during a subscapularis repair.

Overall, the use of an all-arthroscopic approach for biceps tenodesis requires advanced training and experience for proper placement and fixation to properly restore the native length-tension relation and provide positive clinical outcomes. Despite the increased technique required for this procedure, potential benefits including anatomic preservation of the length-tension relation, removal of all bicipital groove tissue, decreased postoperative anterior shoulder pain, decreased postoperative fracture risk, and improved cosmesis may lead to greater effectiveness of LHB tenodesis for bicipital pain. Therefore, this technique offers a viable alternative to the open subpectoral biceps tenodesis.

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