All-Arthroscopic Suprapectoral Biceps Tenodesis

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Abstract: Biceps tenodesis is a common treatment for pathology of the long head of the biceps tendon. Several authors have described various arthroscopic and open techniques for biceps tenodesis. Open techniques have been associated with complications such as wound infection and nerve injury. Previously described arthroscopic techniques have placed the tenodesis site within the bicipital groove, which may lead to persistent pain. We describe an all-arthroscopic suprapectoral biceps tenodesis technique that places the tenodesis site distal to the bicipital groove. This technique potentially avoids the complications associated with open tenodesis surgery while still removing the biceps tendon from the bicipital groove.

Tendinopathy of the long head of the biceps brachii tendon is a well-recognized cause of anterior shoulder pain. In cases in which conservative management fails, surgical treatment with biceps tenodesis or tenotomy is indicated (Table 1).[1] Biceps tenodesis is often preferred to tenotomy especially in younger, more active patients because it avoids some of the complications from tenotomy such as the Popeye deformity and arm cramping, while maintaining the length-tension relation for the biceps musculotendinous unit.[2]

Many recent reports have examined various open[3-5] and arthroscopic[6-9] techniques of biceps tenodesis and the optimal location of the tenodesis. Traditional arthroscopic techniques place the tenodesis site proximally within the bicipital groove. However, disadvantages of these techniques include significant screw reaction, tenosynovitis, and persistent anterior shoulder pain.[10] In addition, there is a higher reported revision rate for proximal tenodesis locations compared with tenodesis sites distal to the bicipital groove.[11]

Mazzocca et al.[3] described a mini-open tenodesis technique in which the tenodesis is performed directly underneath the pectoralis major tendon, distal to the bicipital groove. However, open tenodesis techniques have 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.

Given the disadvantages of traditional arthroscopic proximal tenodesis techniques and the possible increased risk of complications associated with open and mini-open subpectoral techniques, we have adopted an all-arthroscopic suprapectoral biceps tenodesis technique. Similar to the technique described by Lutton et al.,[7] our arthroscopic technique places the tenodesis site distal to the bicipital groove, which avoids the aforementioned complications associated with proximal biceps tenodesis.

Surgical Technique

The patient is placed in the beach-chair position with adequate clearance of the posterior shoulder. The entire arm is sterilely prepared so that it can be freely manipulated during surgery. Alternatively, a limb positioner may be used for control of the arm. The Biceptor Tenodesis Repair System (Smith & Nephew, Andover, MA) is used in this technique (Table 2).

A standard posterior portal is established 2 cm inferior and 1 cm medial to the posterolateral corner of the acromion. A 30° arthroscope (Arthrex, Naples, FL) is inserted into the glenohumeral joint, and a diagnostic arthroscopy is performed. With this technique, all concomitant rotator cuff and other pathology can be addressed arthroscopically before or after the tenodesis. Our preference is to perform the biceps tenodesis before

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Table 1. Indications

Symptomatic partial-thickness tear (>25%) of LHB
Medial subluxation of LHB
Subluxation of LHB with subscapularis tear
Type IV or symptomatic type II SLAP tear
Failed SLAP repair
Chronic pain from LHB tendonitis
Symptomatic LHB tendonitis with inflamed LHB seen on diagnostic arthroscopy

LHB, long head of biceps.

any other concomitant rotator cuff procedures because there is less swelling and fluid extravasation; this allows for easier visualization of the biceps tendon in the bicipital groove and also ensures that the biceps is not captured during the rotator cuff repair (Video 1).

The standard rotator interval anterior portal is established to address intra-articular pathology. A probe is used to evaluate the biceps tendon for tears, inflammation, or other pathology necessitating tenodesis. Once the decision is made to proceed with tenodesis, the biceps tendon is released from its attachment at the superior labrum with an arthroscopic biter (Smith & Nephew) through the anterior portal (Fig 1). After completion of the tenotomy, the arthroscope is introduced into the subacromial space using the previously established posterior portal. Next, a subacromial bursectomy is performed through a standard accessory lateral working portal (Fig 2). Subsequently, an anterior subdeltoid bursectomy is performed using the same lateral portal to aid in eventual visualization of the bicipital groove (Table 3). Next, 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 arm

Table 2. Steps and Key Points

Step	Key Point
Arthroscopic biceps tenotomy	Visualize the LHB tendon and use an arthroscopic probe to evaluate the biceps tendon for tears, inflammation, or other pathology necessitating tenodesis.
Establishment of biceps portal	Using needle localization, establish the portal anteriorly between the subscapularis and pectoralis major at the level of the apex of the axillary fold.
Preparation of tenodesis site	Incise the transverse humeral ligament, remove the biceps tendon, and clear the soft tissue overlying the bone between the subscapularis and pectoralis.
Docking of LHB tendon in tenodesis site	After reaming the anterior cortex, use the tendon fork to dock the LHB into the tenodesis site and secure the tendon with an interference screw.

LHB, long head of biceps.

Fig 1. After diagnostic arthroscopy, a standard rotator interval anterior portal is created and an arthroscopic biter is used to cut the biceps insertion just distal to the attachment on the superior glenoid rim.

is placed into a forward flexed position to about 75°, and an accessory "biceps" portal is established using needle localization. It is located anteriorly, overlying the groove between the subscapularis and the pectoralis major at the level of the apex of the axillary fold (Fig 3). A probe is inserted through the biceps portal and used to identify the biceps tendon within the bicipital sheath using tactile sensation. The arthroscopic shaver is then inserted into the biceps portal, and with direct

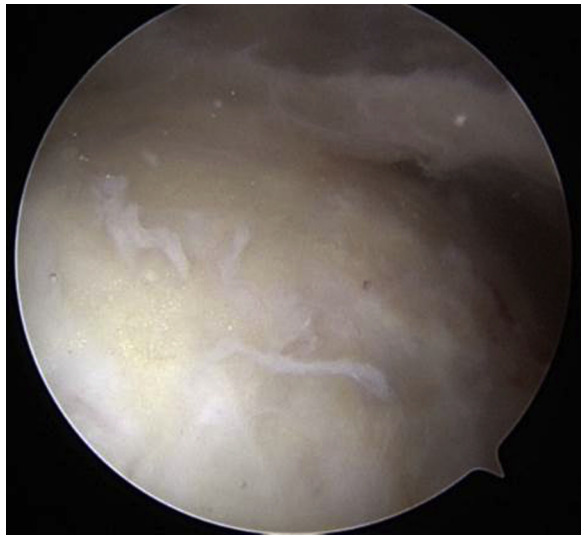

Fig 2. After intra-articular evaluation of the joint and tenotomy of the biceps insertion, the camera is moved into the subacromial space, and the surgeon performs a standard subacromial bursectomy while viewing from the posterior portal and working with an arthroscopic shaver through a lateral portal.

Table 3. Potential Pitfalls of All-Arthroscopic Suprapectoral Biceps Tenodesis Technique

Inadequate visualization of bicipital groove due to incomplete anterior subdeltoid bursectomy
Bicortical instead of unicortical reaming of humerus, which could lead to iatrogenic humeral fracture
Not tagging biceps tendon at tenodesis site before release, which may result in incorrect length-tension relation

visualization from the lateral viewing portal, the soft tissue overlying the bicipital sheath is removed (Figs 4 and 5).

The transverse humeral ligament is released, and the bicipital sheath is then bluntly incised using an arthroscopic grasper to retrieve the tendon stump to allow for preparation of the humeral bed for tenodesis (Figs 6-8). Next, the site for the tenodesis is prepared by clearing the soft tissue overlying the bone between the subscapularis and pectoralis major using an arthroscopic electrocautery device (Smith & Nephew) (Fig 9).

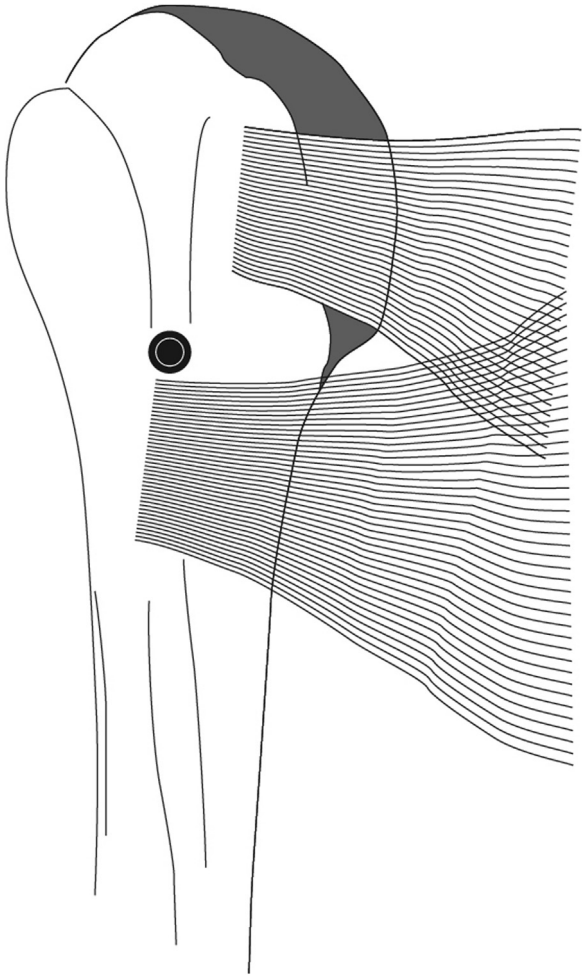

Fig 3. The biceps portal is located anteriorly, overlying the groove between the subscapularis and the pectoralis major at the level of the apex of the axillary fold.

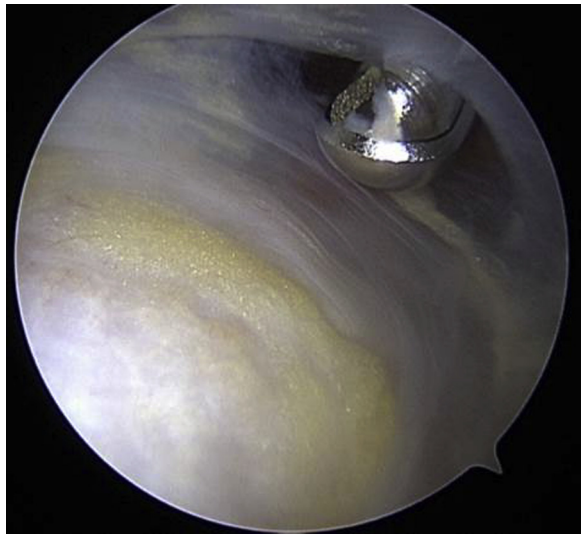

Fig 4. The arthroscope is moved to the lateral portal for visualization, and the optics are aimed distally toward the bicipital groove. The arm is in approximately 75° of forward flexion. An accessory biceps portal is created in the mid humerus just proximal to the pectoralis major insertion. The arthroscopic shaver is then inserted in the biceps portal and visualized through the arthroscope in the lateral portal. The soft tissue overlying the bicipital sheath is removed.

A unicortical 1.5-mm guide pin (Smith & Nephew) for the interference screw is inserted into the humerus just distal to the bicipital groove (Fig 10). The Endoscopic Drill XL (Smith & Nephew) is then used to perforate the anterior humeral cortex and create the tenodesis socket, with great care to ensure not to ream through the posterior cortex. After reaming, a combination of an arthroscopic shaver (Smith & Nephew) and electrocautery is used to clear any remaining soft tissue along

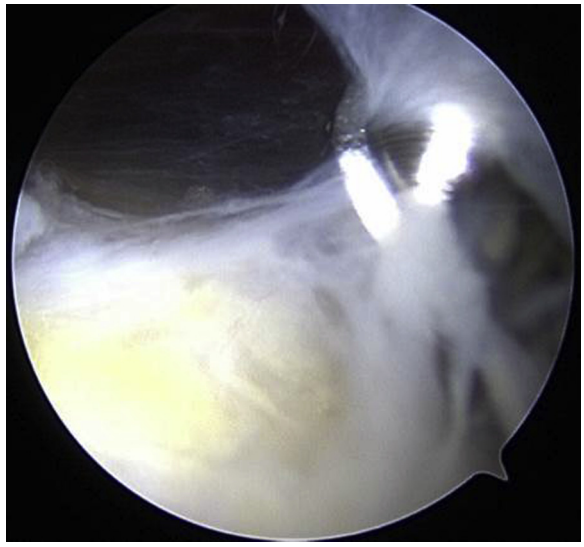

Fig 5. The subdeltoid bursa overlying the bicipital groove and transverse humeral ligament is removed.

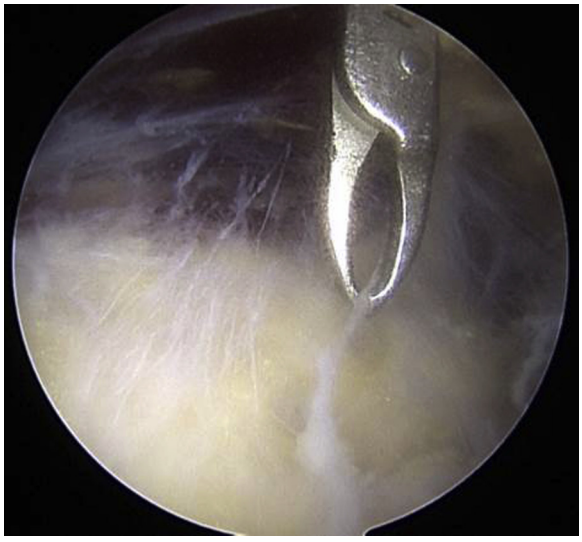

Fig 6. The bicipital groove is localized, and an arthroscopic suture retriever is used to probe the biceps as it is located in the groove.

Fig 8. The biceps tendon is grasped with an arthroscopic grasper through the standard anterior interval portal and is held out to length.

the periphery of the tenodesis site. Once the tenodesis socket site is thoroughly prepared, a tendon fork (Smith & Nephew) is introduced through the biceps portal. The biceps tendon is then brought into the 2 prongs of the tendon fork, which is then inserted into the tenodesis socket site (Fig 11). The tension on the tendon is set with the elbow flexed at 30°. Typically, 1.0 to 1.5 cm of proximal tendon is left over after the tendon is inserted in a doubled fashion into the socket. Alternative length-determination methods have been described.[12,13] Finally, the biceps can be tagged at the tenodesis site before release if needed so that the length can be re-established.

Once the biceps tendon is in place at the tenodesis socket site with appropriate tension, a 1.5-mm guide pin (Smith & Nephew) is introduced through the cannulation of the tendon fork to secure the tendon in place. The tendon fork is then removed, with the pin being left in place, securing the tendon in the tenodesis socket. An Biceptor PE Interference screw (Smith & Nephew) is introduced over the pin to secure the tendon in place (Fig 12). A size 8 interference screw is used in most clinical cases, although a size 9 screw is used in some cases depending on size of the tendon and density of the humeral bone. Lastly, the excess tendon that is protruding out of the tenodesis site is resected with an arthroscopic shaver, leaving a small cuff of 1 to 2 mm to ensure security of the fixation (Fig 13).

Postoperatively, a soft-tissue sling is prescribed for comfort and patients are instructed to discontinue use of the sling as tolerated (most patients tolerate complete removal within the first 2 weeks). The postoperative rehabilitation protocol includes passive range-of-motion exercises immediately after surgery, with

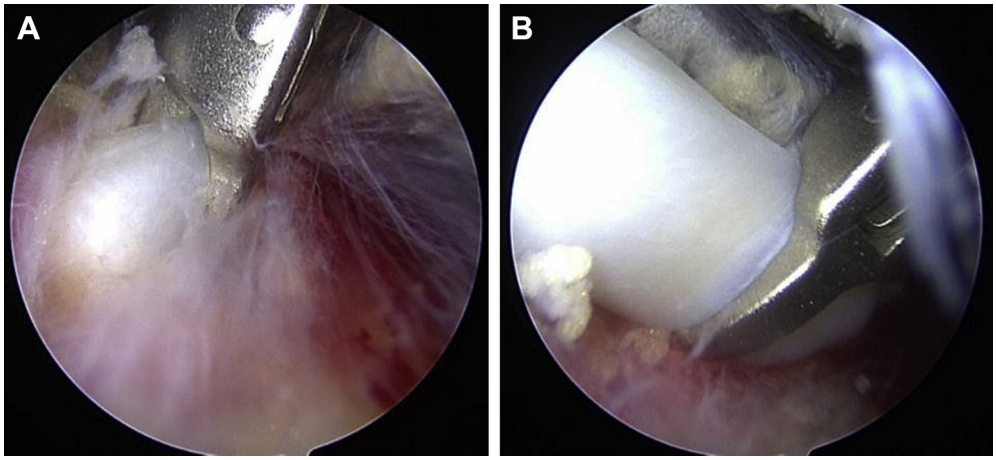

Fig 7. (A) A suture retriever is used to perforate the bicipital sheath bluntly. (B) The biceps tendon is grasped for retrieval out of the groove.

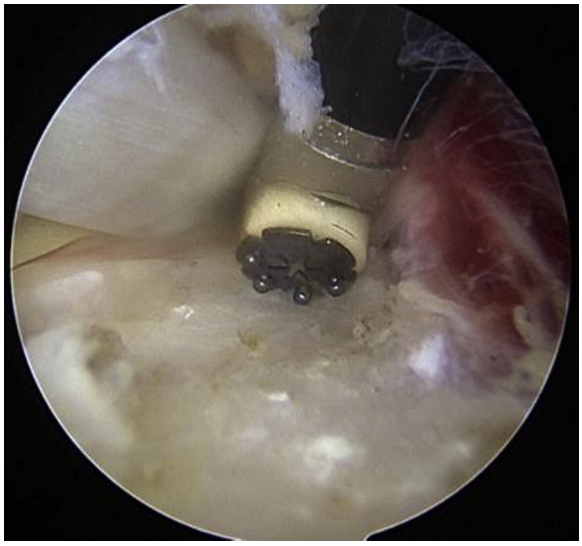

Fig 9. Arthroscopic electrocautery is used to prepare the footprint for the tenodesis just distal to the bicipital groove.

active range-of-motion exercises beginning 2 to 3 days postoperatively. Patients are instructed to begin resistance exercises at 7 weeks after surgery, followed by weight training at 8 weeks postoperatively. Full return to athletic activity is allowed at 3 months after the procedure. For patients who have undergone concomitant procedures at the time of tenodesis, additional restrictions may be placed on activity.

Discussion

We present an all-arthroscopic biceps tenodesis technique that places the tenodesis distal to the bicipital groove in the suprapectoral region. This potentially eliminates problems with traditional arthroscopic tenodesis techniques that place the tenodesis site within the bicipital groove while also avoiding potential complications associated with open techniques.

Biceps tenodesis techniques that place the tenodesis site within the bicipital groove have been associated with higher revision rates compared with techniques that place the tenodesis site distal to the groove.[11] Some authors have suggested that the bicipital groove may act as a "pain generator" in the shoulder, and removal of

Fig 10. A cannulated drill is used to drill a unicortical trough at the tenodesis site.

Fig 11. The surgeon uses the arthroscopic grasper to hold the tendon in place overlying the trough. An arthroscopic reducer is used to reduce the tendon into the tenodesis site. Great care is taken to ensure that approximately 1.5 to 2 cm of tendon stump is remaining to allow for an adequate length-tension relation. A guidewire is then placed through the reducer to hold the tendon in place.

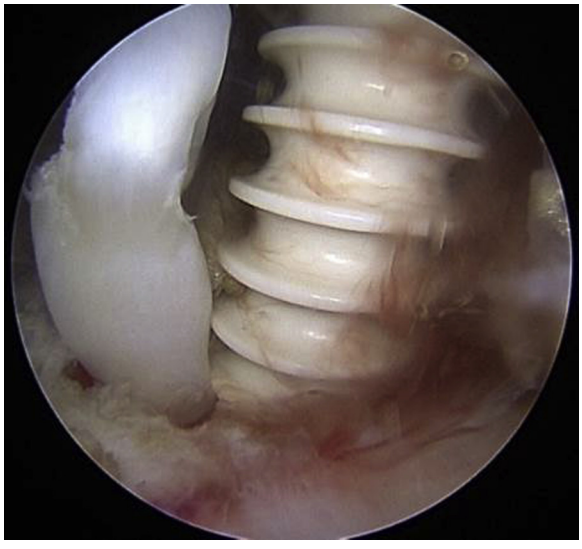

Fig 12. A cannulated PEEK (polyether ether ketone) Biceptor screw is placed for final fixation.

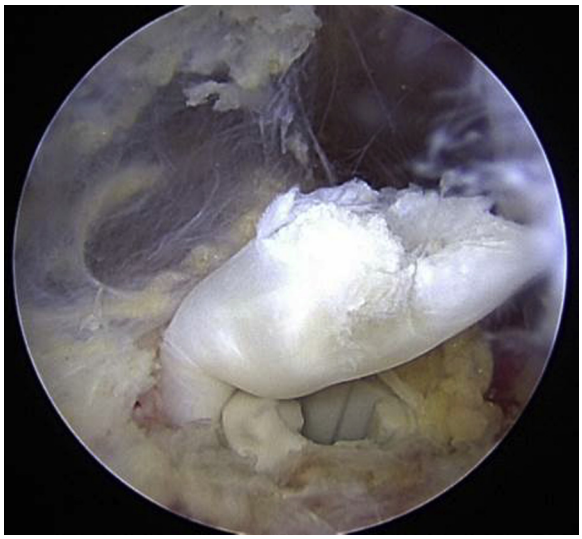

Fig 13. The tenodesis screw is shown in place, with approximately 1.5 to 2 cm of stump remaining.

the tendon from the groove may help to alleviate ongoing pain after the procedure.[4,10]

Reports of traditional open biceps tenodesis techniques have shown success for treatment of biceps pathology; however, many are associated with complications that are specific to open surgery.[14] For example, one large cases series of patients undergoing an open biceps tenodesis reported a case of musculocutaneous neuropathy due to the deep dissection, as well as a case of deep wound infection.[14] In addition, open surgery has the potential for increased blood loss and poor cosmesis because of the larger incision. Major advantages of the all-arthroscopic suprapectoral technique include the potential for a less invasive procedure, better cosmesis, and decreased blood loss compared with an open procedure. In contrast to previously described arthroscopic techniques, another advantage of the suprapectoral technique is that it allows removal of the tendon from the bicipital groove and thereby potentially decreases postoperative pain. A further advantage of our all-arthroscopic technique is that it can be performed in conjunction with other arthroscopic procedures such as rotator cuff or labral repair. The use of an open tenodesis technique in an otherwise all-arthroscopic surgical procedure would usually necessitate separate surgical trays for retractors and dissection instruments, as well as additional operating room time for closure of the incision.

Clinical and biomechanical testing of the all-arthroscopic suprapectoral biceps tenodesis technique have shown excellent results.[15] In a group of 49 patients, no surgical or postoperative complications were reported. At last follow-up, patients reported a mean American Shoulder and Elbow Surgeons score of 87.1 and a mean University of California, Los Angeles score of 30.2, which are comparable with or better than previously reported outcome scores for tenodesis.[15-17] Biomechanically, there was no significant difference in peak failure load, displacement at peak load, or displacement after cyclic testing between the arthroscopic suprapectoral technique and a mini-open subpectoral tenodesis technique.[15]

As with any new surgical technique, the major disadvantage of the all-arthroscopic biceps tenodesis technique is that there is a learning curve associated with this procedure. We recommend practice on a cadaveric shoulder before implementation into clinical practice. We believe that with proper surgical preparation and training, this technique may provide excellent outcomes.

In conclusion, there have been many different biceps tenodesis techniques described in the literature. Previously described all-arthroscopic techniques have placed the tenodesis site within the bicipital groove, which may lead to continued shoulder pain. Open techniques have been associated with the complications of open surgery including wound infection and nerve injury due to soft-tissue dissection. We believe our technique yields excellent clinical and biomechanical results while avoiding the complications of proximal tenodesis placement and open procedures.

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