Identifying and Exposing the Proximal Biceps in Its Groove: The "Slit" Technique

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Abstract: Proximal biceps tendon pathology is a common source of shoulder symptoms. Thus, visualization of the entire extent of the biceps tendon is often required for both diagnostic and therapeutic purposes. Accurately recognizing the presence and extent of biceps pathology intraoperatively is made more difficult, however, due to the extra-articular location of a significant portion of the biceps tendon as it courses within the bicipital groove. Unfortunately, identification of the biceps groove in the subacromial space is often challenging due to the lack of visual and tactile landmarks. A technique that facilitates efficient and reliable bicipital groove identification and biceps tendon visualization along its entire course within the groove is presented.

While the functional role of the long head of the biceps tendon is not clearly understood, it is a well-accepted source of shoulder pain.[1-3] The etiologies of biceps symptoms are varied and include conditions such as tendonitis, tendinosis, partial or full-thickness biceps tears, and subluxation. In addition, biceps-generated symptoms, while occasionally presenting as an isolated condition, more commonly occur concomitantly with other shoulder pathologies such as rotator cuff tears and superior labral tears.

Conservative management is the preferred initial treatment for a symptomatic biceps using therapeutic interventions such as rest, activity modification, physical therapy, and nonsteroidal anti-inflammatory medications.[1-3] Corticosteroid injections within the bicipital tendon sheath can also be used to confirm the diagnosis and as a therapeutic intervention.[1]

The preferred surgical treatment for proximal biceps pathology is highly debated and primarily focuses on 2 primary issues: whether or not to tenodese the biceps and, if so, what tenodesis technique to employ. Tenotomy is an accepted intervention in certain clinical situations, but cosmetic deformity, weakness, fatigue, and muscle belly cramping have been reported following tenotomy.[1,2,4,5] While the tendon will frequently remain entrapped within the bicipital groove following tenotomy, the "Popeye sign" has been reported in up to 70% of patients, with fatigue occurring in 38% and biceps cramping in 8%.[1]

Many techniques have been described to perform open and arthroscopic biceps tenodesis.[1-12] Published studies comparing open subpectoral with arthroscopic tenodesis have shown mixed results.[13-15] However, a recent systematic review[3] demonstrated no significant differences when techniques were compared. Even for surgeons who prefer open subpectoral tenodesis, the described technique for identification and exposure of the proximal biceps tendon can still offer potential benefits as it facilitates both visual assessment of the entire course of the biceps and subsequent externalization of the biceps tendon by allowing for release of biceps adhesions within the groove.

Many arthroscopic bony tenodesis techniques require exposure of the extra-articular portion of the biceps tendon within the bicipital groove.[11,12] Alternatively, an open, subpectoral tenodesis technique can be used.[1-3,6,13,15] Proponents of the open subpectoral technique argue that it eliminates the risk of residual tenosynovitis by completely removing the tendon from the biceps groove. Reported complications using this open subpectoral technique, however, include infection, nerve injury, and fracture.[2,13]

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When arthroscopic visualization of the biceps tendon within the bicipital groove is to be accomplished for either diagnostic or therapeutic purposes, such as when arthroscopic suprapectoral tenodesis is planned, localization of this more distal portion of the biceps tendon can often be difficult to achieve due to the overlying transverse humeral ligament that obscures the anatomic location of the bicipital groove. A reliable, efficient, and reproducible technique that facilitates identification of the bicipital groove and the tendon within it is described.

Surgical Technique

This technique can be employed in either the beach chair or lateral position. The authors preferred position is beach chair due to the ease at which the arm can be manipulated; no changes in technique are made when this procedure is performed in the lateral position. A standard posterior glenohumeral joint viewing portal is created initially, and a 30° arthroscope is used throughout the case. Next, a standard anterosuperior working portal that is centered within the rotator interval is made. A thorough diagnostic arthroscopy is then completed. The biceps tendon is carefully evaluated by probing the superior labrum and proximal origin of the biceps tendon and by palpating the biceps tendon. Also, as much of the biceps tendon as possible is pulled into the glenohumeral joint using this probe in an effort to assess the tendon for fraying, tearing, synovial reaction, and instability. If the entire proximal biceps tendon requires visualization, either due to concern about pathology within the more distal portion of the biceps tendon that cannot be visualized by pulling the tendon into the glenohumeral joint or when a suprapectoral tenodesis is planned, the authors' "slit" technique is routinely employed (Table 1). This technique simply and reliably exposes the location and vertical orientation of the bicipital groove while still allowing the arthroscope to remain within the glenohumeral joint using standard arthroscopic equipment (Table 2). First, an 18 gauge spinal needle is inserted into the anterior shoulder approximately 3 cm lateral to the previously placed anterosuperior portal cannula and advanced until the spinal needle is arthroscopically identified within the bicipital groove at the location where the biceps exits the glenohumeral joint (Fig 1). This spinal needle location and trajectory are then used as a guide to allow the surgeon to direct a percutaneously placed standard knife handle loaded with a no. 11 scalpel blade through the skin and then advanced through the anterior soft tissues in a parallel path until the tip of the scalpel blade is identified as it perforates the proximal aspect of the transverse humeral ligament overlying the bicipital groove (Fig 2). This scalpel blade is then directed distally, while viewing arthroscopically from the posterior portal, following the course of the biceps tendon to create a split or slit in the transverse humeral ligament. In addition, care is taken to avoid damage to the biceps tendon as this slit is created and enlarged. Slight forward flexion of the shoulder can sometimes improve visualization within the biceps groove as the incision proceeds more distally. Typically, 2 to 3 cm of the overlying transverse humeral ligament is easily incised (Fig 3). Care should be taken to minimize iatrogenic damage to the underlying biceps tendon as the slit is extended. This incision in the

Table 1. Basic Steps of the Slit Technique

1.	An 18 gauge spinal needle localizes biceps in rotator interval viewing from glenohumeral space.
2.	A no. 11 blade follows needle trajectory to release the intra-articular portion of sheath and create the initial slit.
3.	Partial release of biceps tendon with arthroscopic scissors.
4.	Locate the slit in the subacromial space.
5.	Release extra-articular portion of biceps sheath with no. 11 blade viewing from lateral portal.
6.	Now is it possible to further evaluate biceps and address any pathology.

Table 2. Equipment Necessary for Technique

1.	An 18 gauge spinal needle any brand
2.	A no. 11 scalpel blade any brand
3.	Arthroscopic suture scissors, any brand
4.	Arthroscopic probe, any brand
5.	Arthroscopic grasper, any brand
6.	Suture anchor or alternative biceps tenodesis device (double loaded 4.5 mm Smith and Nephew Healicoil Regenabsorb anchors used in this case)

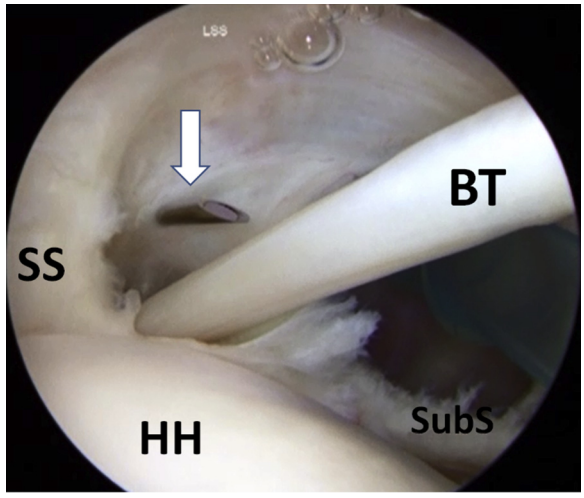

Fig 1. An 18 gauge spinal needle (white arrow) is seen percutaneously localizing the biceps tendon (BT) in this left shoulder in the beach chair position as viewed from the posterior portal. This spinal needle penetrates the most proximal aspect of the tissue overlying tendon as it enters the bicipital groove. (HH, humeral head; SS, supraspinatus; SubS, subscapularis.)

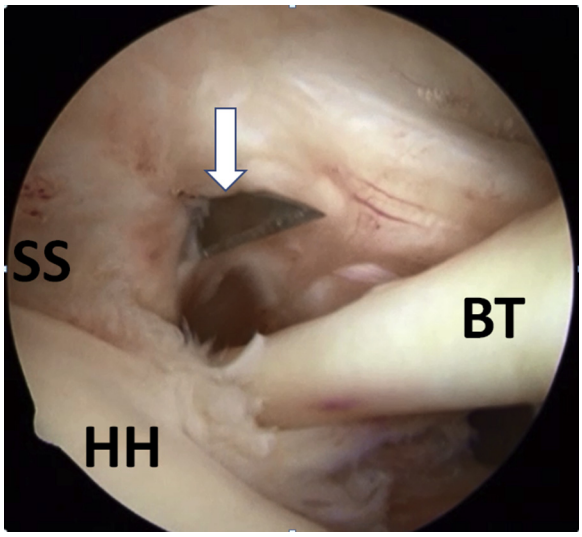

Fig 2. The tip of the no. 11 scalpel blade (white arrow) is advanced through the tissue overlying the proximal aspect of the bicipital groove in a left shoulder in the beach chair position as viewed from the posterior portal. (BT, biceps tendon; HH, humeral head; SS, supraspinatus.)

transverse humeral ligament will then be easily and reliably identified arthroscopically once the arthroscope is subsequently redirected into the subacromial space.

When arthroscopic suprapectoral biceps tenodesis is to be carried out, the authors generally employ suture anchor fixation by impacting a suture anchor into the bicipital groove while viewing from the subacromial space. However, prior to transferring the arthroscope to the subacromial space, the most proximal aspect of the biceps tendon is released from its origin except for a very small, residual portion of the biceps tendon that is left intact (Fig 4) until the suture anchor sutures are

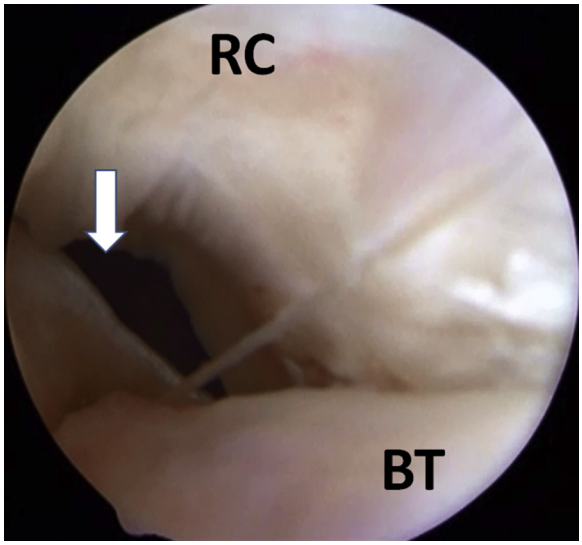

Fig 3. The incised tissue or slit (white arrow) in the proximal aspect of the transverse humeral ligament overlying the bicipital groove is seen in a left shoulder in the beach chair position as viewed from the posterior portal. (BT, biceps tendon; RC, rotator cuff.)

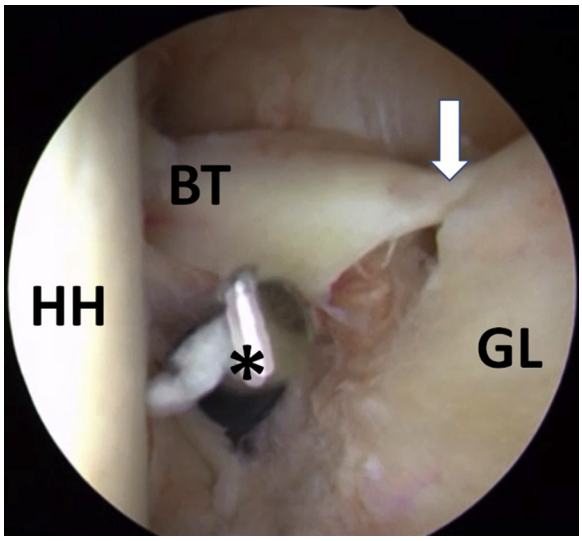

Fig 4. The proximal biceps tendon (BT) is nearly, but not completely, released prior to biceps tenodesis as seen in a left shoulder in the beach chair position viewing from the posterior portal. Leaving a very limited amount of residual tendinous tissue intact (white arrow) ensures that the anatomic length of the biceps is preserved during tenodesis using a suture anchor technique at the bicipital groove. Following completion of the tenodesis, the remaining tendon is then freed usually by simply tugging on the biceps. (GL, glenoid/labrum; HH, humeral head; *arthroscopic suture scissors.)

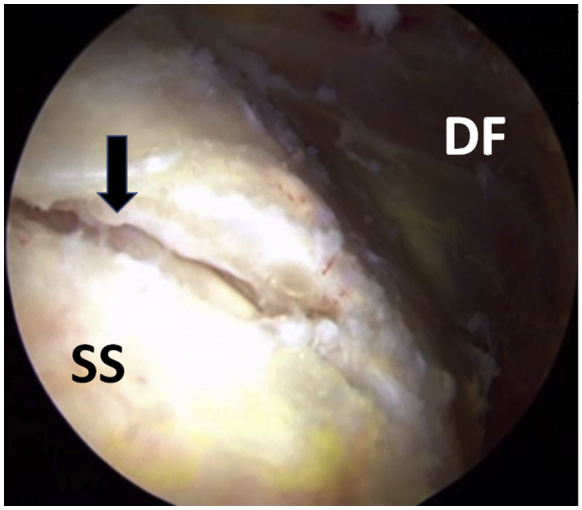

Fig 5. The slit (black arrow) is easily located while viewing from the lateral portal in the subacromial space after a standard bursectomy is performed in a left shoulder in the beach chair position. (DF, deltoid fascia; SS, supraspinatus.)

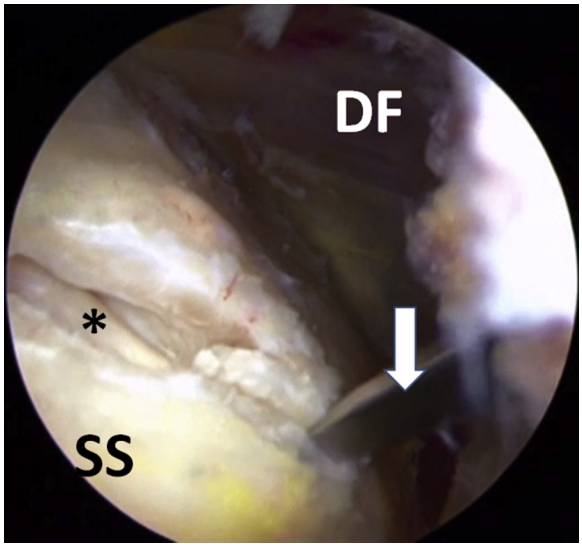

Fig 6. While viewing from the lateral portal in the subacromial space in a left shoulder in the beach chair position, the no. 11 blade (white arrow) is used to incise the more distal tissue overlying the biceps (*) until the tendon is completely unroofed and exposed. (DF, deltoid fascia, SS, supraspinatus.)

passed through the biceps tendon and tied. Following arthroscopic knot tying, detachment of this small residual intact portion of the biceps tendon is completed, often with a gentle distal tug on the tendon using a standard arthroscopic grasper. These few fibers of the proximal biceps are intentionally left intact by the authors so as to preserve anatomic biceps length until the tenodesis is completed.

Following the completion of this partial release of the proximal biceps tendon, the arthroscope is then transferred to the standard posterior subacromial portal site. Next, a lateral subacromial working portal is created and used to accomplish a thorough subacromial bursectomy. The arthroscope is then moved to this lateral subacromial portal site, and, with slight external rotation of the glenohumeral joint, the previously placed slit incision the transverse humeral ligament along with the exposed biceps tendon can be clearly visualized (Fig 5). The no. 11 blade scalpel (Fig 6) or an arthroscopic shaver blade can then be used to incise the more distal portion of the transverse humeral ligament and other tissue overlying the biceps tendon so as to expose along the length of the biceps. A probe can then be used to manipulate the biceps and further assess it for synovial reaction, fraying, or partial tearing (Fig 7).

Once the biceps tendon has been thoroughly evaluated, the surgeon can then proceed with suprapectoral tenodesis using the fixation method of choice. Again, the authors' preferred tenodesis technique uses a double- or triple-loaded suture anchor (4.5 mm Healicoil Regenesorb; Smith & Nephew, Andover, MD) inserted into the bicipital groove followed by passage of these sutures through the biceps tendon using a locking-loop construct (Fig 8).

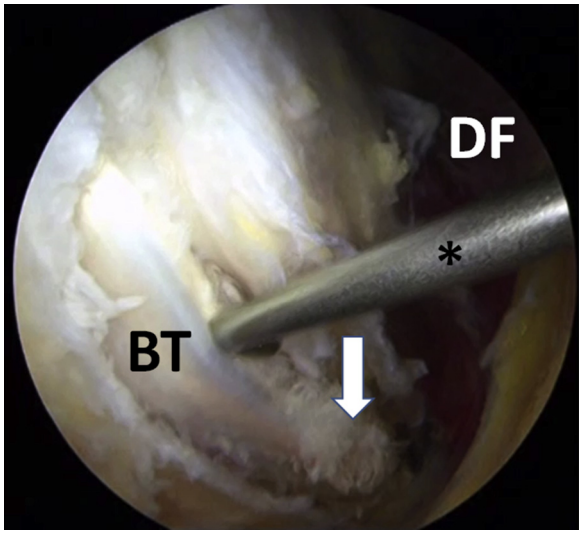

Fig 7. Visualizing and probing (*) the entire biceps tendon (BT) is carried out after the incision of the tissue overlying the biceps is completed. Note the significant fraying (white arrow) of the very distal aspect of the biceps tendon that was not able to be identified when visualized intra-articularly. This image is taken of a left shoulder in the beach chair position while viewing from the lateral portal in the subacromial space. (DF, deltoid fascia.)

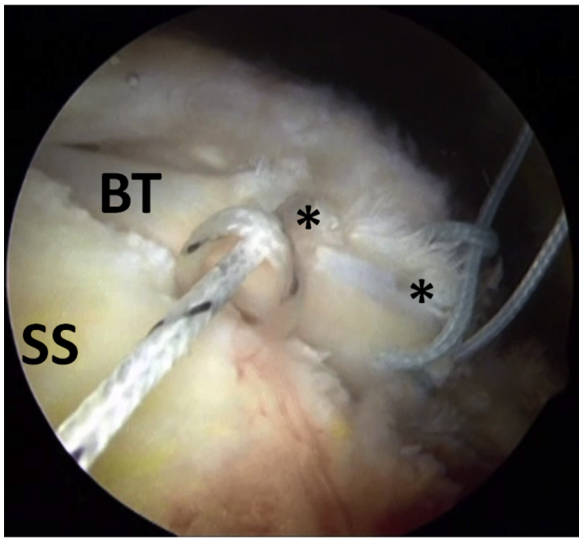

Fig 8. This image is taken of a left shoulder in the beach chair position while viewing from the lateral portal in the subacromial space. The suture anchor sutures have been passed, but not yet tied, in a locking-loop pattern (*). Note that biceps tendon (BT) length and tension are maintained during this suture passage phase. (SS, supraspinatus.)

Table 3. Advantages and Disadvantages of Slit Technique

Advantages	Disadvantages
1. Easily locates biceps tendon in groove while also giving orientation and course using standard equipment. 2. The percutaneous accessory portal made to perform the slit technique is beneficial for viewing, anchor placement, and suture management if tenodesis is being performed. 3. Allows accurate, nontraumatic release of tendon sheath for evaluation of extra-articular portion of biceps in cases with no obvious intra-articular pathology. 4. Has a short learning curve and does not require specialized equipment.	1. Risk of iatrogenic damage to biceps or surrounding structures when percutaneously inserting the no. 11 scalpel blade. 2. Scalpel blade could potentially become dislodged from the knife handle.

Discussion

Visualization of the entire biceps is often necessary when biceps tendon pathology is suspected and when an arthroscopic tenodesis is to be carried out. This previously described slit technique for localization and visualization of the biceps tendon along its extra-articular course within the bicipital groove has proved itself reliable, technically easy, reproducible, safe, and efficient.

This slit technique does offer several potential advantages compared with other techniques designed to identify the location and orientation of the bicipital groove (Table 3). While other described techniques, such as using a marking suture (or spinal needle left in place within the bicipital groove) to mark the subacromial location of the bicipital groove, do effectively allow for identification of the most proximal location of the biceps groove, only the slit technique also clearly exposes the orientation and course of the groove. The authors have often found that if a marking suture or spinal needle is employed to localize the most proximal aspect of the biceps groove, unnecessary iatrogenic damage can sometimes be caused as we attempt to find the course of the bicipital groove more distally due to the limited information that this single point of reference provides the surgeon. This necessitates that the surgeon make an "educated guess" and incise tissue distal to this marking suture that he or she hopes will actually be overlying the biceps tendon. If our "best guess" is incorrect, unnecessary iatrogenic injury is created. This best-guess approach to identifying the course of the bicipital groove is obviated by the slit technique since biceps tendon direction and orientation have already been clearly identified under direct arthroscopic visualization at the time that the slit is made. In addition, if biceps tenodesis is planned, the accessory portal incision that was created by percutaneously advancing the knife effectively serves as a valuable viewing and/or suture management access site. Finally, complete exposure of the biceps tendon within its groove may reveal additional tenosynovitis or even partial biceps tendon tearing. Complete exposure of the biceps is important since research has shown that extensive release of the biceps tendon, carried out at the time of tenodesis has been associated with lower revision rates.[14]

The described slit technique has a few potential disadvantages. While the learning curve is relatively short as it uses surgical skills common to arthroscopic surgeons, there is risk of iatrogenic injury to the biceps tendon due to the close proximity of the scalpel blade when incising the tissue overlying the biceps (Table 4). Furthermore, there is potential risk that the knife could be misdirected during its percutaneous advancement toward the bicipital groove, which could result in inadvertent injury to adjacent soft tissues or even potentially neurovascular structures. Finally, while the authors have not experienced this potential complication, the scalpel blade could become disengaged from the knife handle, resulting in a sharp, foreign object free within the shoulder soft tissues or joint.

Table 4. Pearls and Pitfalls of Slit Technique

Pearls	Pitfalls
1. Near complete sectioning of the biceps from its attachment on the superior labrum helps keep accurate tension when preforming tenodesis. 2. Accurate trajectory of the spinal needle in all planes is key for both creating a good slit and for having a functioning accessory portal. 3. Slight forward flexion of the arm can help visualization while extending the slit distally when viewing from the joint in the posterior portal.	1. Not accurately following the path of a well-placed spinal needle with the scalpel can cause iatrogenic damage to surrounding structures. 2. Care should be taken not to overpenetrate with the scalpel when creating the slit to avoid damaging the underlying tendon.

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