Technical Note

Arthroscopic In Situ Biceps Tenodesis Using a Double Loop-and-Tack Knotless Suture Anchor

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Abstract: Arthroscopic biceps tenodesis is a safe and reliable treatment for managing intra-articular biceps tendon pathology. This Technical Note describes an arthroscopic biceps tenodesis technique with a single double loop-and-tack knotless suture anchor.

The long head of the biceps tendon (LHBT) is recognized as a significant source of anterior shoulder pain across a range of conditions, including superior labral tears, rotator cuff injuries, tendon tears, and tenosynovitis.[1] Although the functional role of LHBT remains a subject of debate, effective management of associated pathologies is crucial for alleviating pain and restoring proper function.[1] Nonoperative strategies for managing injuries to the LHBT include nonsteroidal anti-inflammatory medication, physical therapy, and activity modification.[1] However, operative intervention may be indicated if conservative measures fail to relieve symptoms adequately. Common surgical options for refractory biceps tendinopathy are biceps tenodesis (BT) and tenotomy.[2,3] Although both yield positive outcomes, BT is preferred for young and active individuals because of its superior cosmesis, reduced cramping, and minimized strength loss.[4,5]

Multiple techniques, varying in approach, placement, positioning, and fixation method, have been described for BT.[6-9] Important to the orthopaedic surgeon, similar outcomes have been reported across these diverse techniques. In a recent randomized controlled trial, no significant differences in clinical outcomes were found between arthroscopic suprapectoral and open subpectoral BT.[9] Similarly, a meta-analysis comparing onlay and inlay BT revealed no statistically significant differences in clinical outcomes and complications.[10] The following Technical Note describes an arthroscopic in situ BT using a double loop-and-tack knotless suture anchor and represents the senior author's preferred method for the performance of this surgical procedure.

Technique

Patient Positioning and Anesthesia

Patients are placed in the beach-chair position, with the operative shoulder prepared and draped in the customary sterile manner (Fig 1). The acromioclavicular joint and outline of the acromion are marked. Four portal sites are prepared and used: posterior, lateral, anterolateral, and anterior portal (Fig 2).

Surgical Technique

The procedure begins with a diagnostic arthroscopy. A detailed overview may be seen in Video 1. A posterior viewing portal is made 2 cm inferior and medial to the posterolateral corner of the acromion. During diagnostic arthroscopy, the biceps tendon is evaluated (Fig 3). A decision is made to perform tenodesis on the basis of the appearance and integrity of the biceps tendon. Significant fraying of the tendon, tenosynovitis, partial tear, or complete tear of the biceps tendon are all pathologic findings. An accessory anterior working portal is created 1 cm lateral to the coracoid, and an arthroscopic biter is used to transect the biceps tendon adjacent to its attachment on the labrum. Care

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Received May 11, 2024; accepted July 1, 2024.

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2212-6287/24786
https://doi.org/10.1016/j.eats.2024.103207

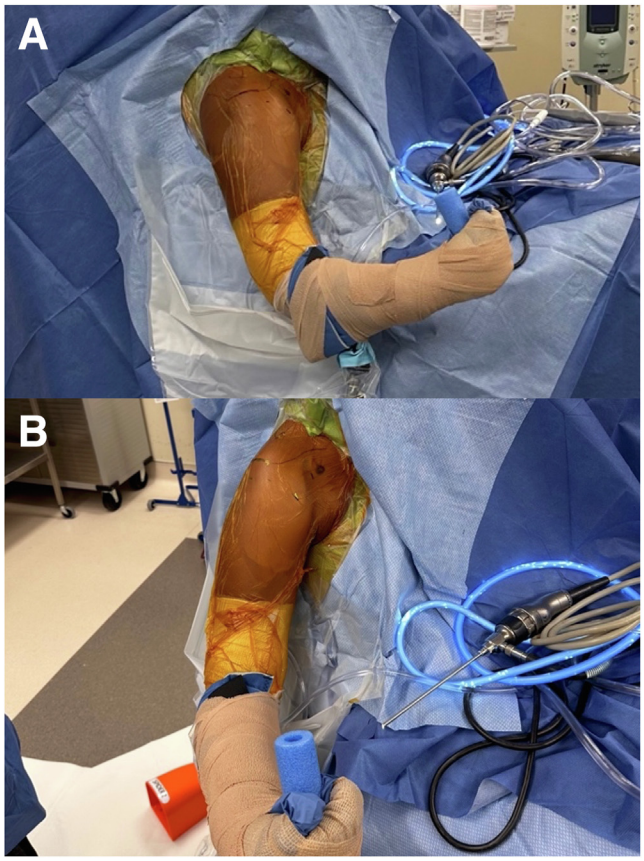

Fig 1. Right shoulder positioned in the beach-chair position. (A) Lateral view. (B) Anterior view.

is taken to preserve the superior labrum, and 1 to 2 mm of remnant biceps tendon tissue is left on the labrum.

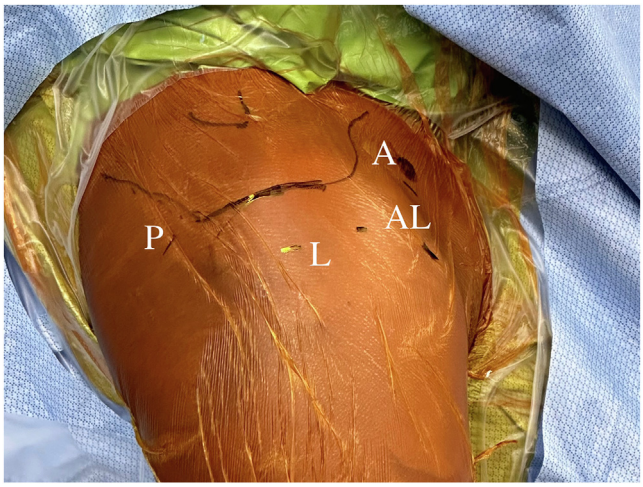

Fig 2. Right shoulder positioned in the beach-chair position. The acromioclavicular joint and outline of the acromion are marked. Four portals, the posterior portal (P), lateral portal (L), anterolateral portal (AL), and anterior portal (A), are used for arthroscopic in situ biceps tenodesis using a double loop-and-tack knotless suture anchor.

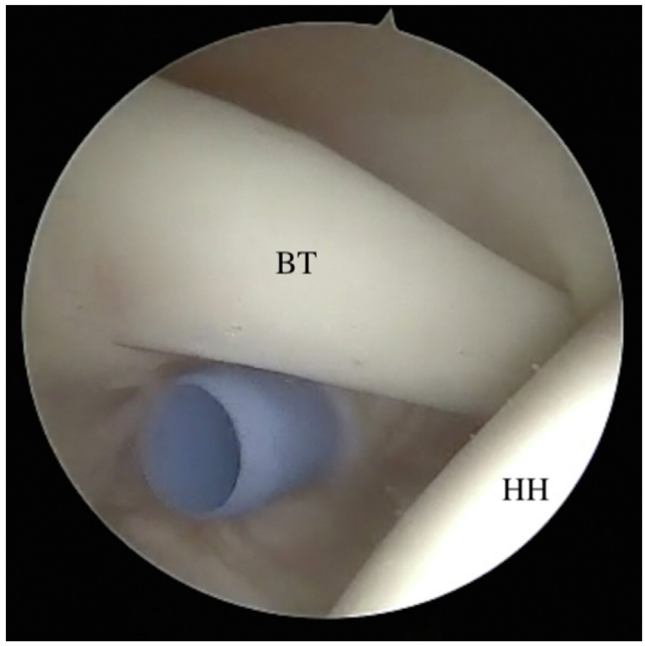

Fig 3. Diagnostic arthroscopy showing the long head of the biceps tendon. Glenohumeral view from the posterior portal in a right shoulder in the beach-chair position. (BT, long head of the biceps tendon; HH, humeral head.)

The subacromial space is entered via the posterior viewing portal. A lateral working portal is established 2 to 4 cm lateral to the midpoint of the lateral aspect of the acromion. A thorough bursectomy is performed with a 4.0-mm arthroscopic shaver. Once completed, the arthroscope is switched to the lateral portal in the subacromial space.

Viewing laterally, the arm is abducted and externally rotated 25° in both directions, providing improved visualization of the anterolateral aspect of the subacromial space, where the biceps tendon is found. An accessory anterolateral portal is created by identifying the midpoint between the aforementioned anterior and lateral portals and then establishing the portal 2 to 3 cm distally, thus forming a triangle with the 3 portals. An arthroscopic shaver is inserted into the anterolateral portal and the remaining bursa overlying the biceps tendon is removed. The biceps tendon is best located by tracing the leading edge of the supraspinatus tendon down the anterolateral aspect of the humerus. The bicipital groove is being identified anterior to the tendon in the lateral gutter.

Once the bursa is removed from the anterolateral gutter, the tendon sheath becomes easily identifiable, allowing for palpation with an arthroscopic probe before incising the sheath. The transverse fibers of the transverse humeral ligament may also serve as a helpful landmark. Using the accessory anterolateral portal, the biceps tendon sheath can be incised in line with its fibers using either electrocautery or a No. 11 blade (Fig

4). Care must be taken to ensure that the instrument has not penetrated too deep past the sheath and that the integrity of the tendon has not been compromised.

With the biceps tendon sheath incised, the tendon is be revealed. From the posterior portal, a large arthroscopic grasper (KingFisher; Arthrex, Naples, FL) is used to grasp the tendon and remove it from the sheath. The tendon is placed on tension and held by an assistant in a position far anterior to the bicipital groove, allowing access for anchor placement. Using the accessory anterolateral portal, a double loaded all-suture anchor (3.0-mm Knotless Biceps FiberTak; Arthrex) is placed in the bicipital groove 1 cm proximal to the location of the transverse humeral ligament, perpendicular to the bone (Fig 5).

An arthroscopic loop grasper (Suture Retriever; Arthrex) is inserted through the accessory anterolateral working portal. The blue suture tape is identified, grasped, and placed medial and anterior to the biceps tendon that the assistant is holding. The surgeon releases the blue suture tape, retrieves it on the lateral side of the biceps tendon, and shuttles it out of the anterolateral portal, forming a loop around the biceps tendon (Fig 6).

The surgeon retrieves the white suture and places it just medially to the biceps tendon. The assistant places the biceps tendon in line with the bicipital groove, with appropriate tension matching the native tension of the biceps. An arthroscopic penetrator (Penetrator Retriever; Arthrex,) is inserted through the anterolateral portal and pierced through the midsubstance of the biceps tendon (Fig 7). The white suture is retrieved with the penetrator and pulled laterally through the biceps tendon. The white suture tape is left in the subacromial space, forming a loop just lateral through the biceps tendon (Fig 8).

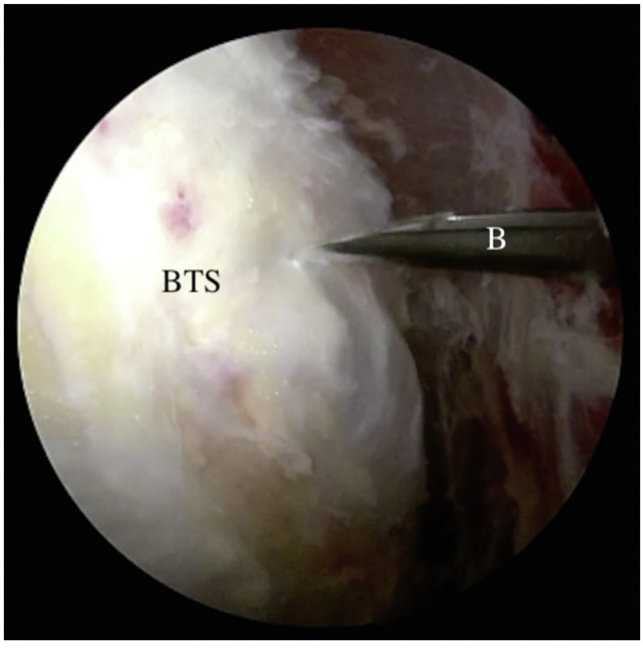

Fig 4. The biceps tendon sheath is incised to reveal the long head of the biceps tendon within the bicipital groove. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (B, blade; BTS, biceps tendon sheath.)

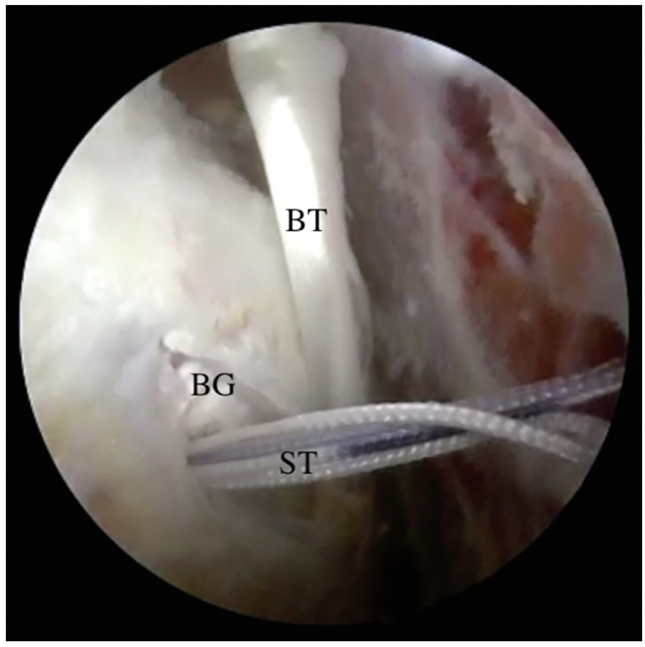

Fig 5. Placement of the double loaded all-suture anchor in the bicipital groove. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (BG, bicipital groove; BT, long head of the biceps tendon; ST, suture tape.)

A loop grasper is inserted through the anterolateral portal and is placed through the white suture tape loop from posterior to anterior and the blue suture tape is retrieved through the loop, out of the anterolateral portal (Fig 9). Tension is then applied to the white suture tape outside of the wound, synching the biceps tendon down into the groove.

Using an arthroscopic loop grasper, the blue suture tape and striped blue and white suture are both retrieved at the same time (Fig 10). Outside of the wound, the marked suture is placed through the prefabricated suture loop and shuttled through the wound. The knotless anchor is secured in the wound and synched down until the biceps tendon is firmly placed in the bicipital groove (Fig 11). An arthroscopic suture cutter is used to cut the sutures without leaving any tail. An arthroscopic shaver is used to debride the remnant biceps tendon down, leaving a 1.5- to 2-cm stump (Fig 12).

Postoperative Protocol

Concurrent procedures, such as rotator cuff or labral repair, may dictate the restrictions imposed on both

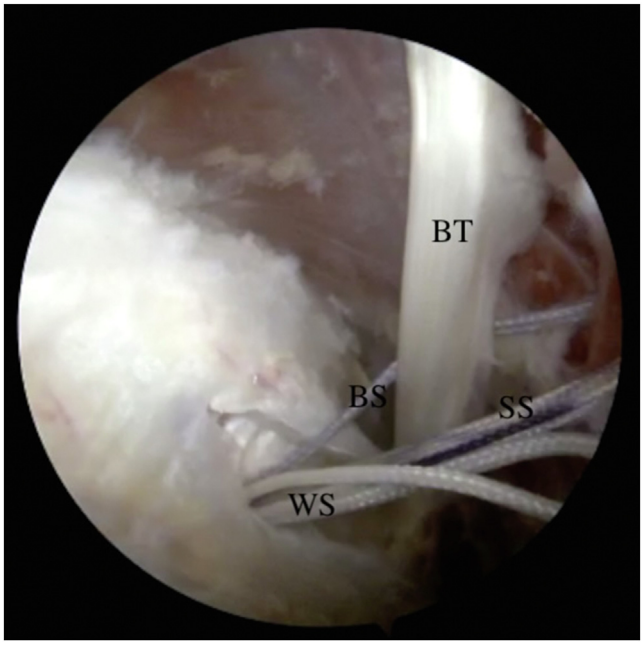

Fig 6. Retrieval of the blue suture tape from the lateral side of the long head of the biceps tendon with the use of an arthroscopic loop grasper through an accessory anterolateral portal. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (BS, blue suture; BT, long head of the biceps tendon; SS, striped suture; WS, white suture.)

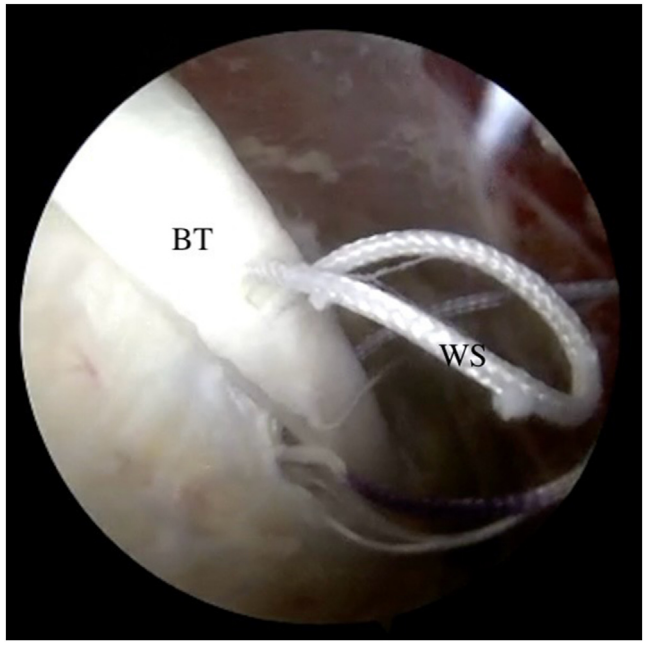

Fig 8. Loop of the white suture left in the subacromial space, created by pulling the white suture tape through the long head of the biceps tendon with an arthroscopic penetrator. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (BT, long head of the biceps tendon; WS, white suture.)

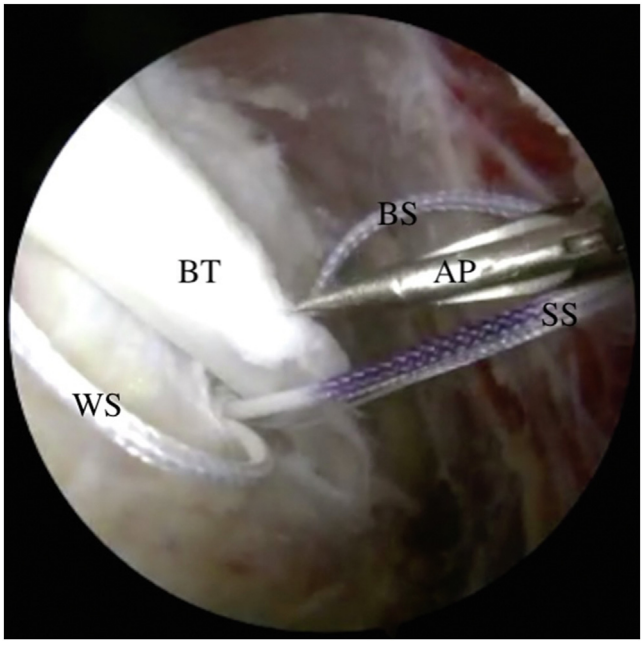

Fig 7. Penetration of midsubstance of the long head of the biceps tendon with the use of an arthroscopic penetrator, through the anterolateral portal. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (AP, arthroscopic penetrator; BS, blue suture; BT, long head of the biceps tendon; SS, striped suture; WS, white suture.)

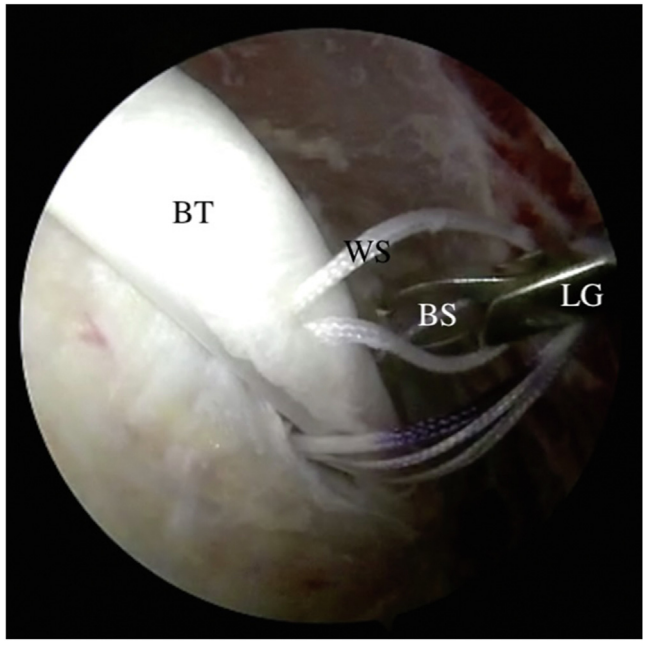

Fig 9. Retrieval of blue suture with a loop grasper, through the center of the loop created by the white suture. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (BS, blue suture; BT, long head of the biceps tendon; LG, loop grasper; WS, white suture.)

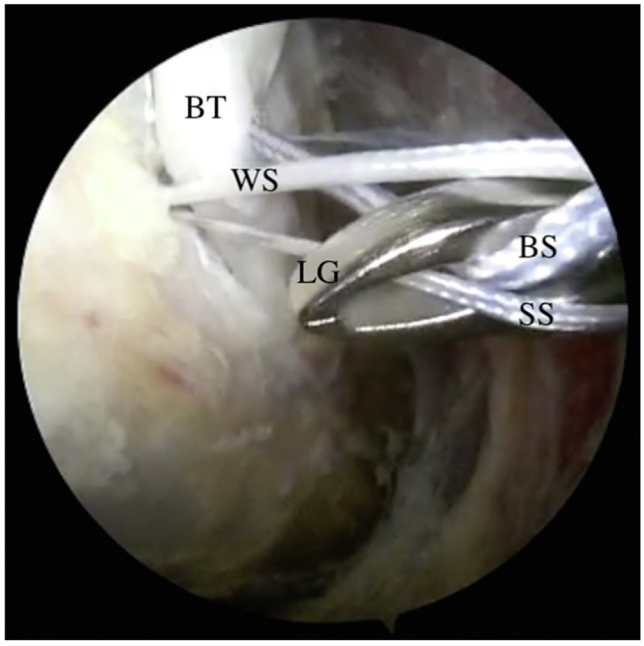

Fig 10. Simultaneous retrieval of both the blue suture and striped suture with a loop grasper, which are pulled out of the subacromial space through the wound, via the anterolateral portal. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (BS, blue suture; BT, long head of the biceps tendon; LG, loop grasper; SS, striped suture; WS, white suture.)

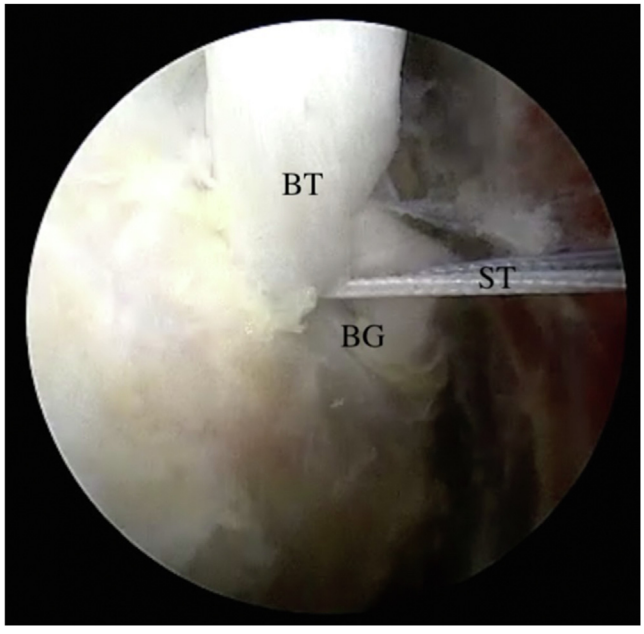

Fig 11. Knotless suture anchor is secured and synched down for firm placement of the long head of the biceps tendon within the bicipital groove. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (BG, bicipital groove; BT, long head of the biceps tendon; ST, suture tape.)

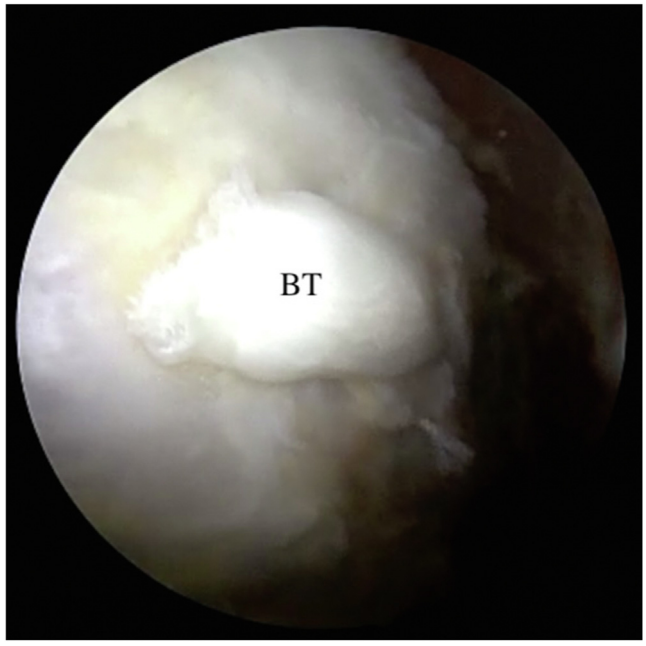

Fig 12. Remaining stump of the long head of the biceps tendon after debridement with an arthroscopic shaver. Subacromial view from the posterior portal in a right shoulder in the beach-chair position. (BT, long head of the biceps tendon.)

range of motion and weight-bearing. For isolated BT, a standard sling is provided for 4 weeks during the day and night, with removal for hygiene, dressing, and home exercise only. Ice therapy, through machines or packs, may be implemented for 45 minutes every 2 hours daily for 2 weeks. Exercises such as pendulums and active biceps flexion without resistance are initiated 24 hours after surgery. Resisted biceps activities are prohibited until postoperative week 8. Formal physical therapy begins 2 weeks after surgery. An unrestricted return to sport and activities is expected by 12 weeks postoperatively.

Discussion

Intra-articular biceps pathology typically progresses from tendon instability to tendinitis and tendinosis, ultimately leading to tearing of the long head of the biceps.[11] BT has garnered favor over tenotomy as a result of its cosmetic advantages, including no "Popeye" deformity, and reduced postoperative cramping.[12] Various techniques for BT have been described and vary by surgical approach, location, and type of fixation.

Open versus arthroscopic surgical approaches show no functional differences.[13] However, the open approach is more invasive, which may predispose to increased bleeding, nerve injury risk, and inferior cosmetic outcomes.[4,5,14] Conversely, the arthroscopic

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Abducting and externally rotating the extremity is crucial to improve visualization of the subacromial space.	Care must be taken to avoid a suture bridge at all times. This may affect suture shuttling.
A thorough bursectomy is essential to create appropriate visualization of the biceps tendon sheath and the transverse humeral ligament.	
The biceps tendon is best found slightly distally in the lateral gutter of the subacromial space.	

approach involves smaller incisions and a lower infection rate.[15]

Proximal or distal fixation in BT is established near the pectoralis major insertion on the lateral lip of the bicipital groove. Arthroscopic approaches typically secure the long head of the biceps suprapectorally, whereas open techniques use the inferior margin of the pectoralis major insertion; however, a recent randomized controlled trial comparing these methods found no functional advantage between them.[9] However, subpectoral approaches are associated with a greater incidence of nerve-related injuries, possibly as a result of the proximity to the radial and musculocutaneous nerves.[15]

In addition, the fixation method has also been studied in cadaveric and clinical studies. Although the authors prefer an all-suture anchor, no superiority, in ultimate load failure or clinical outcomes, has been demonstrated between the different fixation strategies available to date.[11,16]

It is hypothesized that interference screw fixation may irritate the tendon at the tendon-screw-interface, potentially compromising tendon quality and leading to failure.[17] Conversely, suture anchor fixation involves drilling a smaller hole, potentially reducing bone stress and fracture risk.[18]

Pearls and pitfalls, as well as advantages and disadvantages of the present technique, are detailed in Table 1 and Table 2, respectively.[14,18,19] Because of the potential anchor pull-out, anchor deployment should be confirmed and tested using the described technique.[20,21]

Given the aforementioned advantages, improved cosmetic outcome, and technical ease, suprapectoral arthroscopic all-suture anchor BT has become the preferred technique the senior authors employ. In summary, suprapectoral arthroscopic all-suture anchor BT stands out as a safe and dependable approach for addressing intra-articular biceps tendon pathology.

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Restores physiologic length-tension relationship of biceps tendon	Potential for persistent anterior shoulder pain
Reduced bone stress because of smaller drill hole	Difficult to assess extra-articular tendon pathology
Lower risk of nerve injury than a subpectoral approach	Possibility of lower cyclic displacement
Reduced scarring risk attributed to the use of a low-profile knotless construct	Potential for increased cramping if rotator cuff repair performed concomitantly
Avoidance of the need for open surgery or tendon externalization	Potential for greater pull-out rate
Great cosmetic outcomes	
Lower infection risk than open techniques	
Longer residual tendon that is amenable to revision, in case a revision is needed	
Quick recovery and return to activities	

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: J.P.S. reports board or committee member for American Shoulder and Elbow Surgeons; editorial or governing board of Arthroscopy; and other financial or material support from DJ Orthopedics and Stryker. W.E.H. reports employee of Globus Medical. J.C. reports board or committee member for the American Orthopedic Society for Sports Medicine, Arthroscopy Association of North America, and International Society of Arthroscopy, Knee Surgery, and Orthopedic Sports Medicine; paid consultant for Ossur; grant, compensation for services other than consulting, including serving as faculty or a as a speaker at a venue other than a continuing education program, support for education, and consulting fee from Arthrex; hospitality payments from Stryker and Medical Device Business Services; compensation from CONMED for serving as faculty or as a speaker for a nonaccredited and noncertified continuing education program; support for education, compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education program, travel and lodging, and consulting fee from Smith & Nephew; support for education, travel and lodging from Medwest Associates; consulting fees from DePuy Synthes Products; compensation from Linvatec for serving as faculty or as a speaker for a nonaccredited and noncertified continuing education program, consulting fees; and consulting fees from Vericel and RTI Surgical. All other authors (J.R.G., J.W-C., J.B.V-E.,

N.N.V.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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