Technical Note

Arthroscopic Recognition and Treatment Options for Biceps Subluxation

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Abstract: Instability of the long head of the biceps tendon is a common pathologic condition that may be difficult to identify using history, physical examination, advanced diagnostic imaging, and even arthroscopic diagnostic inspection. The goal of this technical article is to showcase important anatomic features, intra-articular arthroscopic assessment, and commonly associated pathologies that should raise concern for biceps instability. Techniques to address concurrent biceps and subscapularis lesions are also described.

Understanding of long head of the biceps tendon (LHBT) pathology has evolved since it was first described as a potential pain generator by Monteggia in 1829. Neer[1] noted that pathology of the biceps tendon was associated with impingement from the anterior acromion and coracoacromial ligament and often occurred concomitantly with rotator cuff tears. Neer described inspection of the bicipital groove and removal of osteophytes, but the biceps was left intact because Neer regarded the LHBT as a major contributor to joint stability. Although the purpose of the LHBT is debated, it restrains anterosuperior humeral head translation and acts synergistically with the remainder of the rotator cuff complex to secure the humeral head within the glenoid during range of motion.[2,3] The LHBT originates varyingly at the supraglenoid tubercle and superior labrum, courses distally in the bicipital groove between the bony structures of the greater and lesser tuberosities, and is secured in this groove by adjacent soft tissues. These soft-tissue restraints have also been referred to as a "sling" or "reflection pulley" because they secure the LHBT within its intertubercular tract. This pulley is thought to be more important than the bony architecture in stabilizing the LHBT within the groove during movement.[4] The sling is made up of the coracohumeral ligament and superior glenohumeral ligament, as well as the tendinous fibers of the supraspinatus and infraspinatus. The coracohumeral ligament and superior glenohumeral ligament have historically been thought of as the exclusive contributors to the sling. However, Gleason et al.[5] performed an anatomic study that showed that the soft-tissue roof and floor of the LHBT's tract through the bicipital groove were predominantly made up of fibers of the subscapularis tendon, with some additional fibers originating from the supraspinatus tendon. If this soft-tissue sling is disrupted, it can lead to progressive instability of the LHBT during glenohumeral joint range of motion, causing further damage to both the tendon and its surrounding structures, including the subscapularis and supraspinatus tendinous footprint insertions.

Because the aforementioned structures, including the biceps, are thought to act synergistically with the rotator cuff complex in stabilizing the humeral head, abnormal translational forces due to rotator cuff dysfunction or deficiency can lead to shear on the biceps pulley soft-tissue restraints and produce a windshield-wiper effect, causing minor subluxation of the LHBT as it courses through the bicipital tract.[6] Anterosuperior impingement of the shoulder has also been described as a potential cause of LHBT instability because the LHBT and subscapularis contact the anterosuperior glenoid rim in forceful adduction, internal rotation, and forward elevation of the shoulder.[6] As the LHBT courses through the bicipital groove, it lies approximately 30° retroverted relative to the glenoid face (and humeral head plane). This anatomic relation,

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along with the LHBT's role in resisting anterosuperior humeral head translation, makes the lesser tuberosity and medial biceps pulley susceptible to these abnormal forces, thus creating pathologies within the sling, as well as to the adjacent, confluent subscapularis footprint.[7] Furthermore, the LHBT's intra-articular nature predisposes it to poor healing potential.[8] Because LHBT instability negatively and progressively impacts subscapularis tendon continuity, other structures such as the supraspinatus tendon, superior labral anchor origin of the LHBT, and the LHBT itself can become significant pain generators, and these structures should be thoroughly evaluated as well.

Surgical Technique

The patient is placed supine on the operating table, all bony prominences are padded, and general anesthesia is induced. The patient is then placed into the beach-chair position because the senior author (L.D.F.) prefers this position for rotator cuff—related arthroscopic surgery. The operative extremity is prepared and draped in sterile fashion, a locking arm holder (Trimano Fortis; Arthrex, Naples, FL) is used to secure the extremity, and the bony landmarks are marked.

A standard posterior portal is created and a thorough diagnostic arthroscopy performed. Careful assessment of the orientation of the LHBT is then carried out. The more acute the angle between the vertically oriented glenoid face and the LHBT axis, the greater our suspicion that LHBT instability is present and that accompanying subscapularis pathology may be encountered (Video 1, Fig 1). The LHBT's origin at the superior glenoid tubercle and the LHBT are also inspected (Fig 2). An anterosuperior working portal is established using a spinal needle for guidance, and a 5-mm disposable cannula (Smith & Nephew, Memphis, TN) is inserted. A probe, introduced into the glenohumeral joint via the anterior portal, is placed superior to the biceps tendon and then used to push the biceps inferiorly (Fig 3A). This maneuver draws much more of the LHBT into the glenohumeral joint, allowing for inspection of this additionally visible portion of the LHBT (Fig 3B). This maneuver also can expose more subtle biceps instability by causing or exacerbating medial LHBT subluxation if the restraining LHBT structures are incompetent. Both LHBT fraying and instability may not be recognized if this maneuver is not performed because that portion of the LHBT that typically rests within the biceps groove is not visible to the surgeon. If evidence of either biceps fraying or subscapularis tendon pathology is identified, then we routinely excise a portion of the rotator interval tissue to maximize our ability to more thoroughly visualize and accurately assess the subscapularis insertion and LHBT (Fig 4A). If an upper-border subscapularis tendon tear is identified that requires repair, then 1 or more suture anchors are inserted into the abraded lesser tuberosity (Fig 4B). The senior author (L.D.F.) sometimes prefers to also use an accessory anterosuperior portal placed to aid with suture management (Table 1). After the

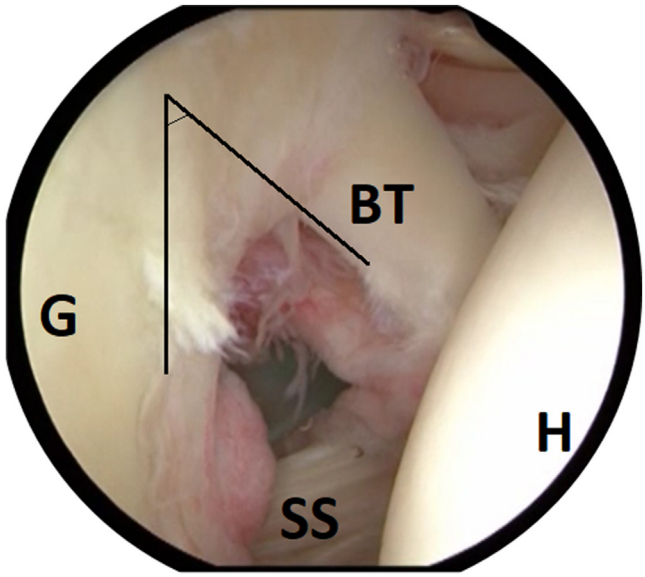

Fig 1. As viewed from the posterior portal in the beach-chair position, a right shoulder image shows the verticality of the long head of the biceps tendon (BT) due to medial subluxation (represented by the relatively acute angle measured between the glenoid [G] face and tendon axis). (H, humeral head; SS, subscapularis tendon.)

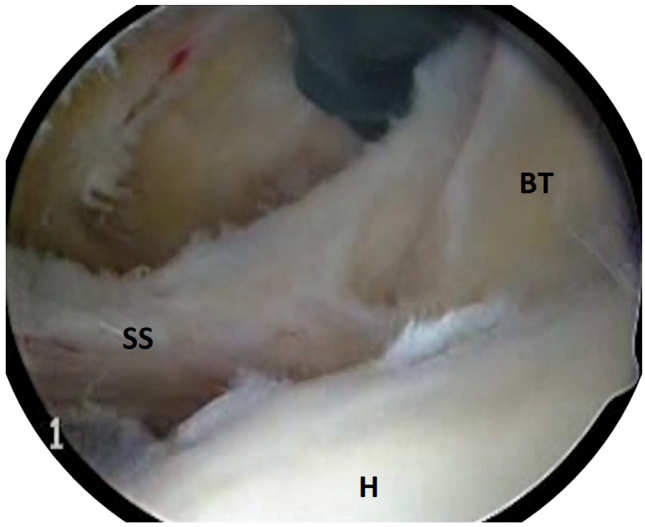

Fig 2. As viewed from the posterior portal in the beach-chair position, a right shoulder image shows the confluence of the subscapularis tendinous structure with the medial sling of the biceps. It should be noted that the biceps is subluxated, and the sling is "wallowed" out. (BT, biceps tendon; H, humeral head; SS, subscapularis tendon.)

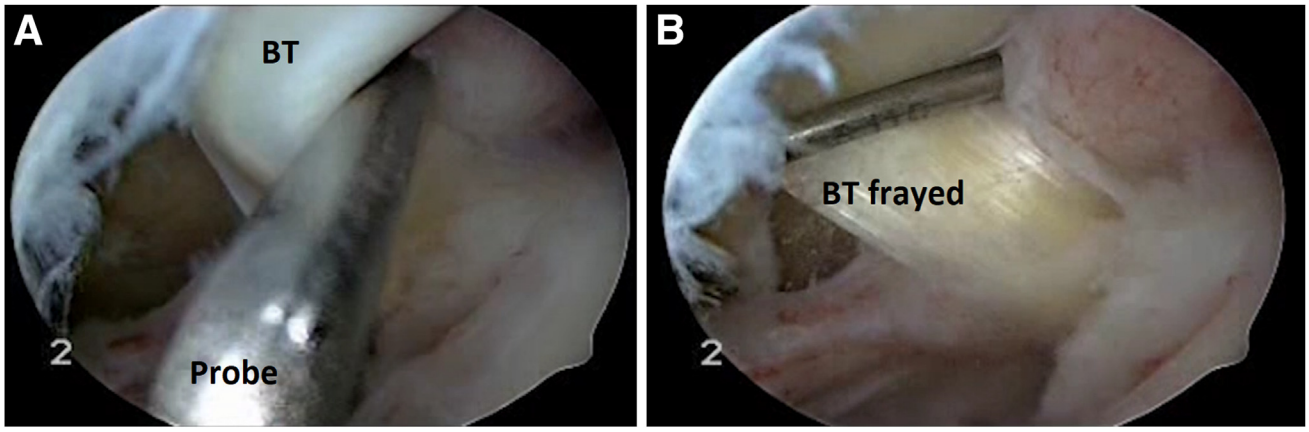

Fig 3. Right shoulder viewed from posterior portal in beach-chair position. (A) A probe is shown on a normal-appearing long head of the biceps tendon (BT). (B) Once the biceps is translated into the glenohumeral joint, the BT shows a frayed appearance.

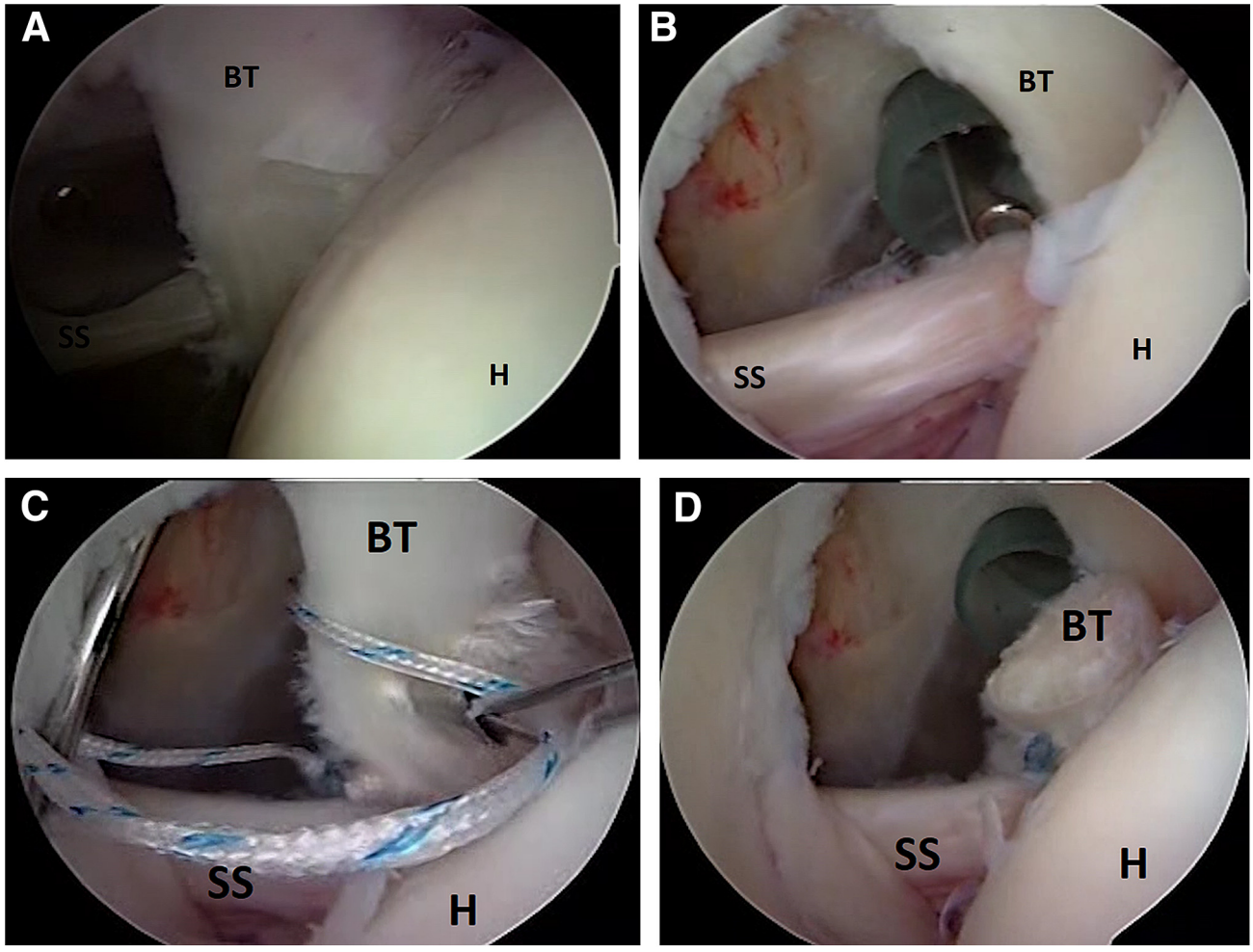

Fig 4. Right shoulder viewed from posterior portal in beach-chair position. (A) A vertically appearing long head of the biceps tendon (BT) is shown. (B) The subscapularis is secured to the lesser tuberosity using suture anchor fixation with the knot pusher tensioning the knot. (C) The ends of the previously tied subscapularis suture anchor sutures are left uncut and are being repurposed to perform tenodesis of the BT. A retrograde disposable suture-retrieving device is used to pierce the long head of the BT. (D) Completed tenodesis of long head of BT, as well as subscapularis fixation, using aforementioned suture anchor suture. (H, humeral head; SS, subscapularis tendon.)

Table 1. Pearls and Pitfalls of LHBT and Subscapularis Inspection and Management Method

Pearls
An accessory superior-lateral portal greatly aids in suture management during fixation.
Pitfalls
If the rotator interval capsular tissue is debrided for visualization, adjacent soft-tissue swelling may be increased, potentially complicating arthroscopic procedures that may need to be carried out.

LHBT, long head of biceps tendon.

subscapularis tendon is secured to its anatomic footprint, the tails of 1 or more of the sutures are initially left uncut and are repurposed to perform tenodesis of the LHBT (Fig 4C) if the tendon is symptomatic preoperatively or if arthroscopic assessment shows significant partial tearing or instability. After tenodesis, knot tying is completed, and the biceps tendon is transected proximal to the tenodesis location. A motorized shaver is then used to excise any retained LHBT that remains attached to the superior glenoid (Fig 4D).

In an alternative method, the subscapularis is repaired and LHBT tenodesis is performed using separate anchors. We prefer this method especially when the subluxated biceps tendon obscures adequate visualization of the subscapularis insertion site and lesser tuberosity. After the biceps is tenotomized in such cases—and the subscapularis insertion becomes adequately visible for assessment and repair—a suture anchor is inserted into the abraded lesser tuberosity and the repair is completed using standard arthroscopic techniques (Fig 5A). After subscapularis repair, the biceps is identified and undergoes tenodesis more distally within the bicipital groove while viewing and working within the subacromial space (Fig 5B).

Discussion

In a study by Adams et al.,[9] only 36% of subscapularis tears found intraoperatively were identified preoperatively by magnetic resonance imaging. In a study of 200 patients with rotator cuff tears, Lafosse et al.[10] found that 45% of these patients had concomitant LHBT instability. Fifty-eight percent of the biceps instability cases in their study were also found to have a subscapularis tear. In addition, Lafosse et al. reported that the LHBT appeared normal in 15% of the cases of instability. Therefore, it is important to intraoperatively assess the biceps even if it appears normal when arthroscopically observed.

This technical note points out what we term "relative verticality" of the biceps tendon on intra-articular inspection with beach-chair positioning and viewing from the posterior portal, although this has not been formally described in the literature. A slightly vertical LHBT orientation may be very subtle but is evidence to support some degree of LHBT medial subluxation, thus warranting careful and thorough assessment of the LHBT and its stabilizing structures. On inspection using

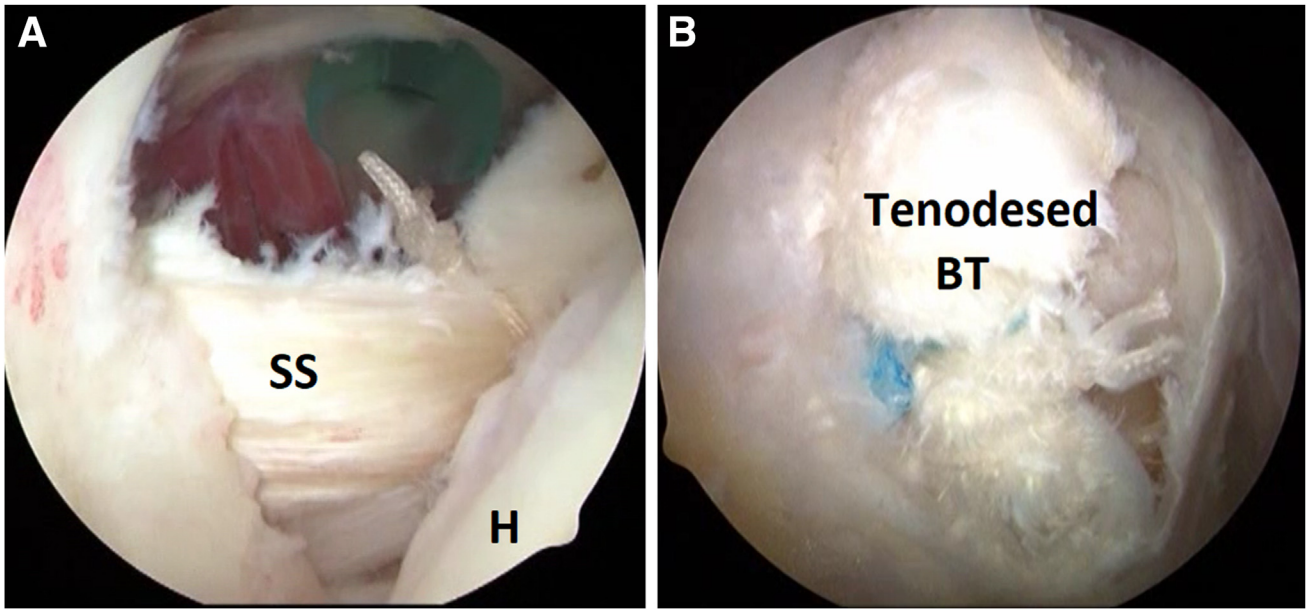

Fig 5. Alternative method for biceps fixation in right shoulder in beach-chair position. (A) Repaired subscapularis tendon (SS) using dedicated suture anchor, viewed intra-articularly from posterior portal. (B) Long head of biceps tendon (BT) after undergoing tenodesis in bicipital groove using additional suture anchor, viewed from lateral portal within subacromial space. (H, humeral head.)

Table 2. Advantages and Disadvantages of LHBT and Subscapularis Inspection and Management Method

Advantages
Thorough inspection of the LHBT will expose concurrent subscapularis tears that may appear normal or fail to demonstrate the degree of detachment.
Biceps assessment can be performed quickly and easily using these techniques.
Commonly used portals are placed, without the need for additional portals.
The surgeon's ability to accurately assess the biceps and subscapularis tendons can be significantly improved.
Disadvantages
Additional arthroscopic surgical time is required to perform biceps instability assessment.
Thorough assessment may necessitate debridement of a portion of the rotator interval to allow for optimal viewing.
Parameters such as relative vertical position apply to the beach-chair position, so different terminology may need to be applied to accurately represent the LHBT orientation in the lateral decubitus position.

LHBT, long head of biceps tendon.

a probe, downward force applied to the LHBT may cause it to subluxate from its groove, which is highly indicative of an upper-border detachment of the subscapularis.[10,11] As we have shown, such a lesion can be repaired by several techniques. When biceps subluxation limits the surgeons' ability to adequately assess or repair the subscapularis tendon, it is routinely tenotomized, and after subscapularis tendon assessment and management, it is identified at a more distal location within the bicipital groove and undergoes tenodesis (Table 2).

Disclosures

Both authors (W.W.D., L.D.F.) 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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