Technical Note

How to Expose the Long Head of the Biceps Tendon in Shoulder Arthroscopy Efficiently: The Tubercle—Traction and Touch—Tendon Method

Wang Wei, M.D., Jianlong Ni, M.D., Qichun Song, M.D., Ruiying Li, M.D., Dazhi Wang, M.B.B.S., Zhihao Chen, M.B.B.S., Zenan Tian, M.B.B.S., and Zhibin Shi, M.D.

Abstract: Arthroscopic tenodesis of the long head of the biceps tendon (LHBT) is a common procedure in a series of bicipital tendinopathies, including tendinitis, SLAP lesions, and tendon instability. Locating and exposing the LHBT during arthroscopy present a technical challenge in tenodesis. Blind exploration of the subacromial space may result in inadvertent tendon transection and iatrogenic damage to surrounding structures, leading to increased patient trauma, bleeding, and operation time. Using the tubercle—traction and touch—tendon method facilitates a roadmap-style, accurate, prompt exposure of the LHBT, minimizing blind exploration-related damage to the subacromial bursal area and adjacent structures, which is conducive to early and rapid postoperative shoulder recovery for patients.

In the treatment of biceps tendinopathy, tenotomy and tenodesis stand as the 2 most commonly performed procedures. With its ability to mitigate postsurgical complications such as the Popeye deformity and cramping arm pain compared with tenotomy, tenodesis has gained traction as the preferred approach for addressing biceps tendinopathy.[1,2] Given the relatively complex anatomic structures of the shoulder joint, locating and identifying the long head of the biceps tendon (LHBT) in the subacromial space pose a technical challenge during shoulder arthroscopy. Blind exploration of the subacromial bursa often results in collateral damage to structures such as the subscapularis and supraspinatus tendons, as well as inadvertent transection of the LHBT, leading to heightened bleeding and prolonged operation times. The tubercle—traction and touch—tendon (TTT) method, characterized by the implementation of 3 pivotal steps, facilitates systematic and convenient exposure of the LHBT, reducing iatrogenic injuries caused by the tendon exposure process.

From the Department of Sports Medicine and Pediatric Orthopaedics, The Second Affiliated Hospital of Xi'an Jiaotong University, Xi'an Jiaotong University, Xi'an, China.

Received May 24, 2024; accepted July 18, 2024.

Address correspondence to Zhibin Shi, M.D., Department of Sports Medicine and Pediatric Orthopaedics, The Second Affiliated Hospital of Xi'an Jiaotong University, Xi'an Jiaotong University, No. 157, Xiwu Road, Xi'an 710004, Shaanxi, China. E-mail: zbshixjtu@163.com

2212-6287/24857
https://doi.org/10.1016/j.eats.2024.103219

Surgical Technique

The TTT method comprises 3 essential steps for efficiently and accurately locating the LHBT (Video 1).

Step 1: Tubercle

The initial step emphasizes accurately locating the tendon with reference to the position of the greater tubercle. After a general anesthetic is administered, the patient is placed in the lateral decubitus position with the surgical arm secured on an adjustable sterile arm holder (Fig 1). A standard lateral portal is established as the viewing portal, while the anterosuperolateral portal serves as the working portal[3] (Fig 2). The arthroscope is inserted into the subacromial bursa to achieve a "50-yard line view" from the lateral portal and then extends the 50-yard line to locate the greater tubercle. Once the greater tubercle is located, the lens is rotated 90° toward the front of the patient, perpendicular to the 50-yard line, and advanced along the bony prominence of the greater tubercle (Fig 3). When the edge of the bursa is reached, the anterior portion of the bursa is opened using a cautery device. A switching stick may be used as a strut to widen the operating space from the anterior portal. The anterior and inferior parts of the bursal incision reveal the parade area of the LHBT (Fig 4).

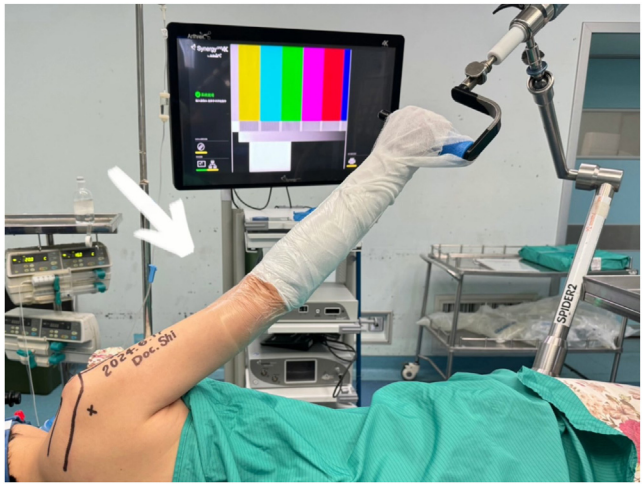

Fig 1. Patient placement in lateral decubitus position (arrow) with right arm secured on adjustable sterile arm holder.

Step 2: Traction and Touch

After complete exposure, traction and tactile sensation are significant for locating the bicipital groove and the LHBT position. A polydioxanone (PDS) suture (Ethicon, Somerville, NJ) is passed through the intra-articular portion of the LHBT in preparation for traction (Fig 5). After sectioning of the subacromial bursa, the LHBT is concealed beneath the transverse humeral ligament. Gentle and repetitive traction on the PDS suture facilitates observation of the LHBT sliding in the bicipital groove (Fig 6). Additionally, a probe is used to touch the synovium above to identify the location of the bicipital groove and the LHBT.

Step 3: Tendon

In the final step, after confirmation of the position of the bicipital groove and the LHBT, the biceps sheath is cautiously opened using a cautery device. Milky-white longitudinal tendon fibers running perpendicular to the circular fibers of the tendon sheath can be observed (Fig 7). Identification can be further confirmed by gently pulling the PDS suture, enabling observation of the sliding of the tendon fibers. The identity of the LHBT is confirmed once sliding of the tendon fibers is observed. Further dissection and exposure are performed cautiously to avoid tendon damage and to reveal the LHBT effectively.

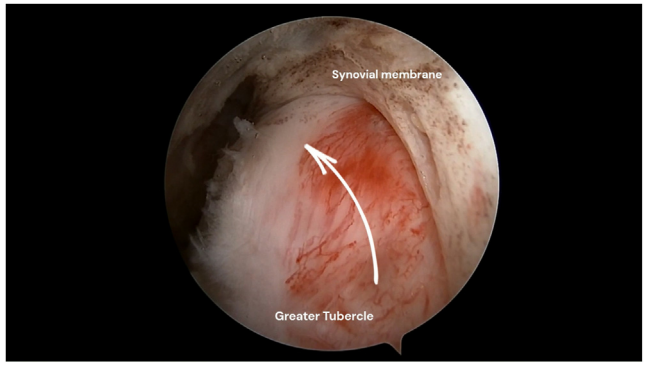

Fig 3. Arthroscopic view from lateral portal in right shoulder showing forward direction (arrow) with greater tubercle as starting point.

Discussion

The LHBT is susceptible to injury, especially during activities involving overhead sports, with increased tension observed during throwing movement.[4-6] Excessive activity and prolonged friction can lead to injury and inflammation in the LHBT and its sheath, resulting in anterior shoulder pain and restricted mobility.[7] Apart from direct tendon injury and inflammation, the sheath of the biceps tendon, considered an extension of the synovial lining of the glenohumeral joint, can be affected by the inflammatory processes of the rotator cuff tendons.[8] Moreover, several studies have shown a correlation between

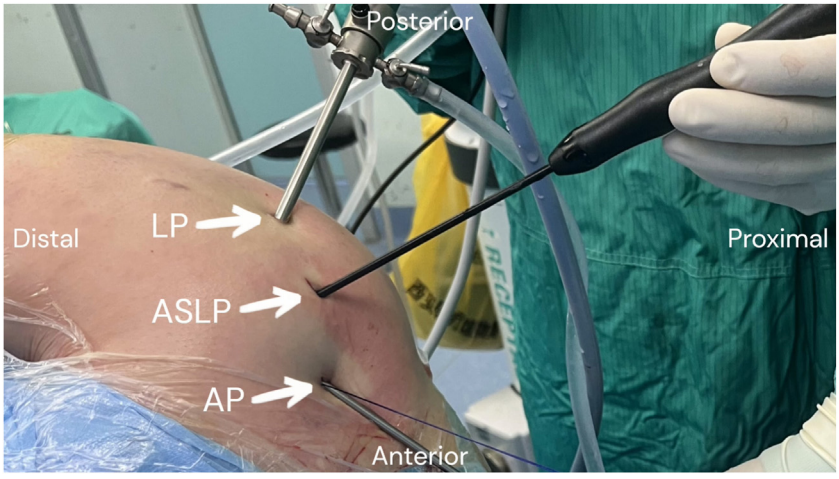

Fig 2. Required arthroscopic portals in right shoulder (arrows). The lateral portal (LP) serves as the viewing portal; the anterosuperolateral portal (ASLP) and the anterior portal (AP) serve as the working portals.

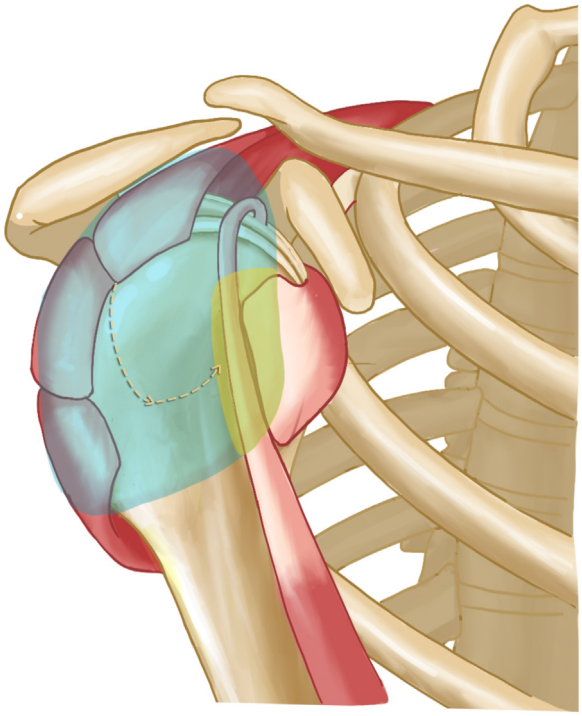

Fig 4. Long head of biceps tendon locating trajectory (arrow, red: muscles; blue: bursa; yellow: incision area; right shoulder). (Illustration by Ziyi Chang, M.Med.)

rotator cuff diseases and LHBT tendinopathy.[9-12] Conditions such as impingement syndrome and shoulder dislocation, resulting from structural damage or laxity leading to the abnormal position of the glenohumeral joint, can also contribute to secondary rotator cuff and LHBT injuries, resulting in shoulder dysfunction. Therefore, a considerable portion of LHBT issues require intervention.

Currently, the treatment of LHBT pathology in shoulder arthroscopy is primarily accomplished through tenodesis.[1,2,13,14] This procedure preserves the length-tension relation of the biceps muscle, offering

Fig 6. Identification of long head of biceps tendon by pulling polydioxanone suture (arrow, right shoulder, lateral decubitus position).

advantages over tenotomy in restoring biceps function, reducing muscle atrophy and fatigue cramping, and avoiding the occurrence of the Popeye sign.[8,15-17] Therefore, accurately and promptly locating the LHBT during surgery becomes an essential factor in minimizing patient trauma, reducing bleeding, and shortening operation time. The TTT method combines several effective technical points in locating the LHBT, enabling a roadmap-guided, rapid, precise exposure of the LHBT to facilitate further interventions.

The TTT method has several advantages and disadvantages (Table 1). Noteworthy benefits include operational convenience and reduced iatrogenic injuries. Furthermore, this technique provides a unique advantage for patients with adhesive capsulitis, in whom locating the LHBT can be particularly challenging owing to limited space. However, successful implementation of the technique requires familiarity with shoulder joint anatomy. Mispositioning and violent blind manipulation during the procedure risk damaging the subscapularis tendon and LHBT (Table 2).

In summary, the roadmap-style operational steps of the TTT method enable the LHBT to be rapidly and

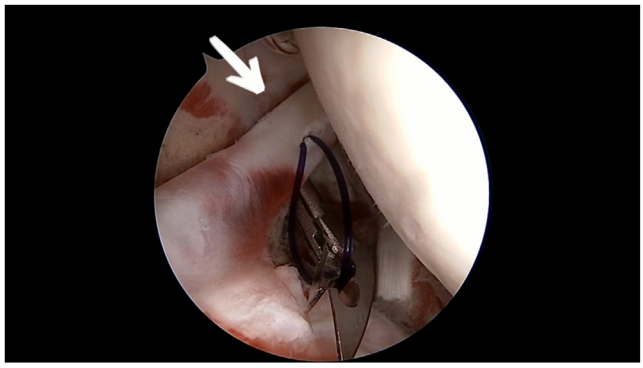

Fig 5. Arthroscopic view from lateral portal in right shoulder showing passage of polydioxanone suture through intra-articular portion of long head of biceps tendon (arrow) in preparation for traction.

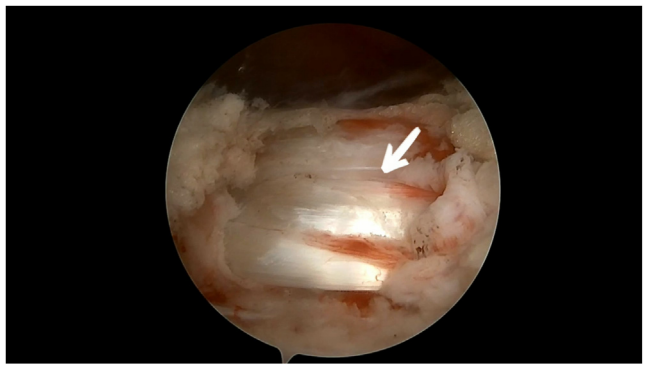

Fig 7. Arthroscopic view of visualization of long head of biceps tendon (arrow, right shoulder, lateral decubitus position, lateral portal) after sectioning of biceps sheath.

Table 1. Advantages and Disadvantages

Advantages
Simple operative procedure
Reduced operation time
Reduction in iatrogenic injuries from blind exploration
Particular advantages for patients with adhesive capsulitis
Disadvantages
Requires sufficient familiarity with shoulder anatomy
Potential risk of biceps tendon and subscapularis tendon injury when improperly performed
Possibility of SLAP injury due to violent traction

Table 2. Pearls and Pitfalls

Pearls
Using the 50-yard line view as a starting point will increase the success rate of locating.
The surgeon should ensure that forward exploration is based on the greater tubercle as the landmark.
A switching stick from the anterior portal can provide excellent operative visualization.
The position of the long head of the biceps tendon can be confirmed by traction on the PDS suture when uncertain.
Pitfalls
Dissection forward along the lesser tubercle will damage the subscapularis tendon when tubercle identification is incorrect.
Careful attention should be paid during the incision of the subacromial bursa to avoid inadvertent transection of the long head of the biceps tendon.
Gentle traction should be applied on the PDS suture to prevent SLAP injury.

PDS, polydioxanone.

precisely located through accurate identification of pivotal anatomic structures. This method prevents iatrogenic injuries to subacromial structures caused by blind exploration, promoting early and rapid postoperative shoulder recovery for patients.

Disclosures

All authors (W.W., J.N., Q.S., R.L., D.W., Z.C., Z.T., Z.S.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Corpus KT, Garcia GH, Liu JN, et al. Long head of biceps tendon management: A survey of the American Shoulder and Elbow Surgeons. *HSS J* 2018;14:34-40.
2. Werner BC, Brockmeier SF, Gwathmey FW. Trends in long head biceps tenodesis. *Am J Sports Med* 2015;43:570-578.
3. Lo IKY, Lind CC, Burkhart SS. Glenohumeral arthroscopy portals established using an outside-in technique: Neurovascular anatomy at risk. *Arthroscopy* 2004;20:596-602.
4. Barfield JW, Plummer HA, Anz AW, Andrews JR, Oliver GD. Biceps tendon changes in youth softball pitchers following an acute bout of pitching. *Int J Sports Med* 2018;39:1063-1067.
5. Thomas SJ, Sarver JJ, Ebaugh DD, et al. Chronic adaptations of the long head of the biceps tendon and groove in professional baseball pitchers. *J Shoulder Elbow Surg* 2022;31:1047-1054.
6. Oh JH, Kim JY, Nam KP, Kang HD, Yeo JH. Immediate changes and recovery of the supraspinatus, long head biceps tendon, and range of motion after pitching in youth baseball players: How much rest is needed after pitching? Sonoelastography on the supraspinatus muscle-tendon and biceps long head tendon. *Clin Orthop Surg* 2021;13:385-394.
7. Ejnisman B, Monteiro GC, Andreoli CV, de Castro Pochini A. Disorder of the long head of the biceps tendon. *Br J Sports Med* 2010;44:347-354.
8. Nho SJ, Strauss EJ, Lenart BA, et al. Long head of the biceps tendinopathy: Diagnosis and management. *J Am Acad Orthop Surg* 2010;18:645-656.
9. Desai SS, Mata HK. Long head of biceps tendon pathology and results of tenotomy in full-thickness reparable rotator cuff tear. *Arthroscopy* 2017;33:1971-1976.
10. Lee HJ, Kim ES, Kim YS. What happens to the long head of the biceps tendon after arthroscopic rotator cuff repair? *Bone Joint J* 2020;102-B:1194-1199.
11. Vestermark GL, Van Doren BA, Connor PM, Fleischli JE, Piasecki DP, Hamid N. The prevalence of rotator cuff pathology in the setting of acute proximal biceps tendon rupture. *J Shoulder Elbow Surg* 2018;27:1258-1262.
12. Katthagen JC, Wermers J, Paus C, et al. The long head of the biceps has a stabilizing effect on the glenohumeral joint in simulated infraspinatus or subscapularis but not supraspinatus rotator cuff deficiency: A biomechanical study. *Arthroscopy* 2024;40:1059-1065.
13. Boileau P, Krishnan SG, Coste JS, Walch G. Arthroscopic biceps tenodesis: A new technique using bioabsorbable interference screw fixation. *Arthroscopy* 2002;18:1002-1012.
14. Waterman BR, Newgren J, Richardson C, Romeo AA. High rate of return to sporting activity among overhead athletes with subpectoral biceps tenodesis for type II SLAP tear. *Arthroscopy* 2023;39:11-16.
15. Diplock B, Hing W, Marks D. The long head of biceps at the shoulder: A scoping review. *BMC Musculoskelet Disord* 2023;24:232.
16. Vajda M, Szakó L, Hegyi P, et al. Tenodesis yields better functional results than tenotomy in long head of the biceps tendon operations—A systematic review and meta-analysis. *Int Orthop* 2022;46:1037-1051.
17. Guerra JJ, Curran GC, Guerra LM. Subpectoral, suprapectoral, and top-of-groove biceps tenodesis procedures lead to similar good clinical outcomes: Comparison of biceps tenodesis procedures. *Arthrosc Sports Med Rehabil* 2023;5:e663-e670.