Arthroscopic Biceps Tenodesis Using Interference Screw Fixation in the Bicipital Groove

Thomas Amouyel, M.D., Yves-Pierre Le Moulec, M.D., Nicolas Tarissi, M.D., Mo Saffarini, M.Eng., and Olivier Courage, M.D.

Abstract: Arthroscopic repair of the long head of the biceps (LHB) is performed to treat various biceps pathologies yet the choice between tenotomy or tenodesis remains controversial. Although tenotomy is simpler and quicker, tenodesis results in fewer complications, and there are several techniques available using various fixation devices and sites. This Technical Note describes an all-arthroscopic, suprapectoral tenodesis technique using a bioresorbable interference screw, without motorized devices to create the humeral tunnel in the bicipital groove. The LHB tendon is detached from its glenoid insertion using an arthroscopic cutting instrument or electrocautery. Two portals are created 50 mm distal to the acromioclavicular joint and at 15 mm on either side of the bicipital groove. The arthroscope is introduced through the distal lateral portal till it makes contact with the humerus. The LHB is fastened within its groove using a grasper, reinforced, and then fixed in the humeral tunnel using an interference screw. The present technique is safe, simple, and reproducible. It requires 2 portals in addition to the standard posterior portal and the intra-articular working portal. It minimizes iatrogenic intra-articular damage and thereby limits possible complications. It also limits the intra-articular operative time compared with SLAP repairs.

Arthroscopic repair of the long head of the biceps (LHB) is performed to treat various biceps pathologies including partial tears, SLAP lesions, hourglass biceps, tenosynovitis, tendinosis, and proximal tendon dislocations with or without rotator cuff tears.

The choice between tenotomy or tenodesis of the LHB remains controversial.[1] In a recent meta-analysis of 16 studies, Slenker et al.[2] compared the outcomes of 433 tenodesis to 699 tenotomies, and found that the only difference was the incidence of a "Popeye sign" cosmetic deformity, which is significantly more frequent after tenotomy (42%) than for tenodesis (8%). These conclusions were confirmed in a large prospective study that found more Popeye deformities in the tenotomy group.[3] By contrast, Wittstein et al.[4] reported that compared with the contralateral shoulder, tenotomy decreases supination torque significantly more than does tenodesis.

Therefore, although tenotomy is a simpler and quicker procedure, tenodesis is increasingly preferred for treatment of biceps pathology.[1] Several techniques for tenodesis were described, using various fixation devices at different sites (intra-articular, suprapectoral, or subpectoral). Hwang et al.[5] reported greater improvement in elbow flexion strength and fewer failures with tenodesis using bony interference screws compared with soft-tissue fixation. Although no clinical studies compared the other fixation devices in vivo, Ramos and Coelho[6] showed in a biomechanical study that biceps tenodesis fixation is strongest with intraosseous bioabsorbable screws, followed by "anchor techniques" and then "soft tissue techniques." These findings were confirmed by Chiang et al.,[7] who reported smaller displacements and higher failure loads for interference screw fixation.

This Technical Note describes an all-arthroscopic, suprapectoral tenodesis technique using a bioresorbable interference screw, without motorized

From the Department of Orthopaedic Surgery (T.A., Y-P.L.M., N.T., O.C.), Hopital Privé de l'Estuaire (HASS), Le Havre; and Alliance Scientifique (M.S.), Lyon, France.

The authors report the following potential conflicts of interest or sources of funding: T.A. received (personal and institutional) travel/accommodations/meeting expenses unrelated to activities listed from Arthrex. M.S. received fees for assistance with manuscript preparation from Arthrex. O.C. receives royalties and consultancy fees from Arthrex, including payment for lectures, patents, and travel expenses. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received February 22, 2017; accepted July 12, 2017.

Address correspondence to Thomas Amouyel, M.D., Department of Orthopaedic Surgery, Hopital Privé de l'Estuaire (HASS), 505 rue Irène Juliot-Curie, Le Havre 76620, France. E-mail: thomas.amouyel@gmail.com

2212-6287/17229

http://dx.doi.org/10.1016/j.eats.2017.07.025

Table 1. Advantages/Disadvantages

Advantages
• Extra-articular, avoiding intra-articular chondral damages
• Excision of the inflammatory distal portion of the long head of the biceps
• Cleaning of the bicipital groove soft tissues
• No need of motorized device to perform the humeral tunnel
• Strong fixation device
Disadvantages
• Increase of the operative time
• Weaker fixation in case of osteoporotic bone
• Possible overtensioning of the tenodesis

devices to create the humeral tunnel in the bicipital groove. It is a safe and simple method that minimizes iatrogenic intra-articular damage, allows the treatment of all proximal biceps pathology, respects the anatomic positioning of the biceps, and thereby limits possible complications (Table 1).

Indications

Anterior shoulder pain and tenderness on palpation of the bicipital groove are often indicators of biceps pathology. Several clinical tests can be used to confirm the diagnosis, all showing great sensibility but poor specificity. In our practice, we perform the "Speed test" and the "O'brien test" and complete them with a shoulder MRI to inspect for SLAP lesions, synovial thickening, tendinitis, tendinosis, or subluxation of the LHB, subscapularis tear (Table 2).

Surgical Technique

Preoperative Setup

The patient is positioned in the beach-chair position and the arm is fixed on the Trimano Arm Holder (Arthrex, Naples, FL) (Table 3). Landmarks are drawn on the shoulder to identify the acromion, clavicle, coracoid process, and bicipital groove (Fig 1).

Tenotomy Portal Placement

A 30° arthroscope is introduced through the posterior portal and intra-articular pathology is identified. If a cuff tear is found, a lateral portal 20-30 mm below the acromion is established to perform the LHB tenotomy, and subsequently repair the torn tendons. If the cuff tendons are intact, an anteromedial portal is used through the rotator interval to perform the LHB tenotomy. Prior to tenotomy, it is important to transfix the proximal segment of the LHB within the intra-articular space using a spinal needle at its entrance into the bicipital groove, to prevent possible retraction and enable its localization later during subacromial bursoscopy.

Table 2. Indications/Contraindications

Indications	Contraindications
Refractory biceps tendinosis and tenosynovitis	Age >70 years (relative)
LHB tendon tear >25%	Glenohumeral joint osteoarthritis
Hourglass biceps	Rotator cuff arthropathy
Subluxation or dislocation of LHB	Biceps chronic rupture with retraction
Failed repairs of SLAP lesions	Osteoporosis (relative)
SLAP type II lesions	
Subscapularis tears	

LHB, long head of the biceps.

Table 3. Key Surgical Steps and Tips

1. Explore the glenohumeral joint, evaluation of the LHB tendon
2. Transfix the LHB tendon at the entrance of the BG with a spinal needle
3. Biceps tenotomy at its junction with the superior labrum
4. Remove the instruments
5. Place shoulder at 40° of flexion, 30° of abduction, and neutral rotation
6. Create the 2 portals, 50 mm distal to the AC joint and 15 mm either side of the BG
7. Introduce the scope through the lateral portal till contact with the humerus is achieved
8. Release soft tissues in front of the BG
9. Open the transverse ligament
10. Withdraw the LHB tendon after removing the spinal needle through the medial portal
11. Secure the LHB tendon with a clamp
12. Excise the intra-articular portion of the LHB tendon (20-30 mm)
13. Reinforce the tendon with a no. 2 FiberLoop over 30 mm and calibrate
14. Clean the BG
15. Create the humeral tunnel at the lower part of the BG using a manual reamer 0.5 mm wider than the LHB tendon
16. Clean the humeral tunnel with a shaver
17. Insert the LHB tendon in the tunnel after feeding the FiberLoop through the closed eyelet of a SwiveLock tenodesis screw
18. Test tension and remove sutures

AC, acromioclavicular; BG, bicipital groove; LHB, long head of the biceps.

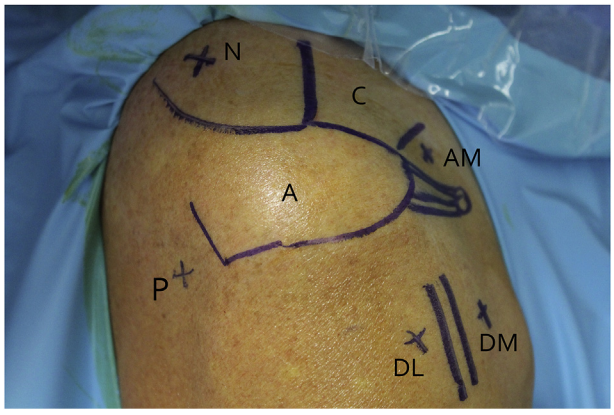

Fig 1. Landmarks drawn on a right shoulder. (A, acromion; C, clavicule; P, posterior portal; N, Neviaser portal; AM, antero-medial portal; DL, distal lateral portal; DM, distal medial portal.)

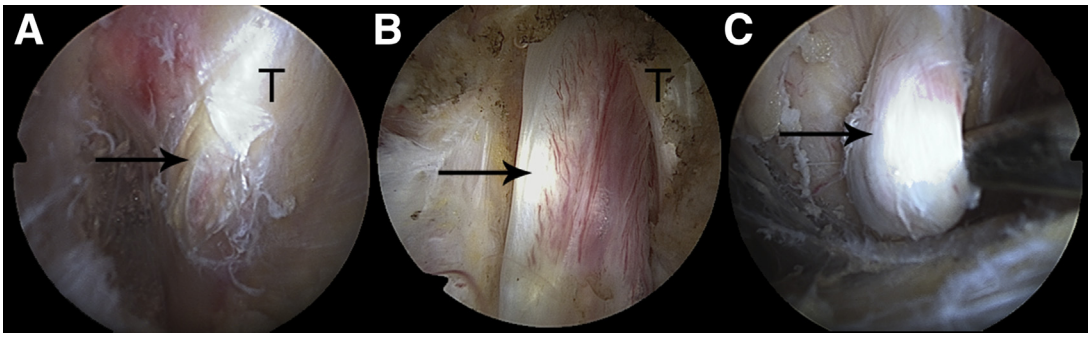

Fig 2. Arthroscopic view of a right shoulder through the distal lateral portal. (A) The long head of the biceps tendon (arrow) under the transverse humeral ligament (T). (B) Inflammatory tendon after the opening of the transverse humeral ligament. (C) The biceps is pulled out of the bicipital groove with a grasper after removing the articular needle.

Tenotomy of the LHB

The LHB tendon is detached from its glenoid insertion using an arthroscopic cutting instrument or electrocautery through the working portal. The scope and instruments are then removed.

Tenodesis Portal Placement

Preparing for tenodesis, the shoulder is placed in approximately 40° of flexion, 30° of abduction, and neutral rotation (Video 1), allowing the anterosuperior subacromial bursa to adequately fill with water and to thereby maximize visibility of the bicipital groove and permit optimal tensioning of the biceps. Two portals are created 50 mm distal to the acromioclavicular joint and 15 mm either side of the bicipital groove.

Biceps Preparation

The arthroscope is introduced through the distal lateral portal till it makes contact with the humerus, while the instruments are introduced through the distal medial portal. The soft tissues in front of the bicipital groove are released using a shaver and the LHB is palpated before opening the transverse ligament using electrocautery (Fig 2). The LHB is fastened within its groove using a grasper and the spinal needle is removed from the joint. The LHB is then exteriorized through the distal medial portal and secured at its distal extremity using a clamp (Kocher forceps). The intra-articular portion is excised to restore natural tension after tenodesis. Cutting more than 30 mm may result in overtensioning of the LHB while cutting less than 20 mm may result in excessive laxity of the LHB. The tendon is reinforced over 30 mm with a no. 2 FiberLoop straight-needle suture (Arthrex) and then calibrated (Fig 3).

Humeral Preparation

The clamp is opened and the bicipital groove is cleaned of all soft tissues (Video 1). A 25-mm-deep humeral tunnel is created at the lower end of the bicipital groove using a manual reamer 0.5 to 1 mm wider than the intended screw diameter (Fig 4). A shaver is introduced in the humeral tunnel to remove any bone debris and tissues that may obstruct the tendon introduction.

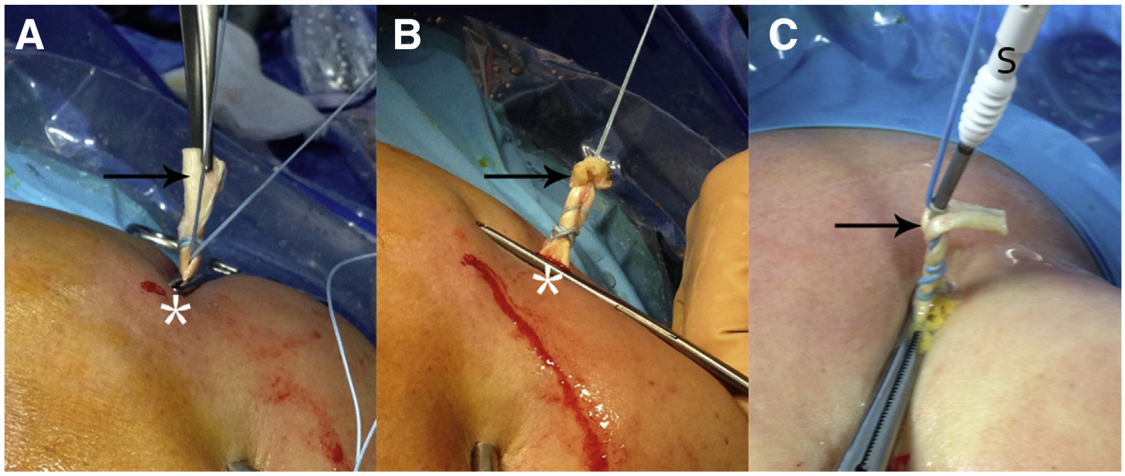

Fig 3. Outside view of a right shoulder. (A and B) The tendon (arrow) is clamped and reinforced using straight-needle suture over 30 mm through the distal medial portal (*). (C) Its end is fed through the closed eyelet of the biocomposite screw (S) until the proximal end of the tendon reaches the eyelet.

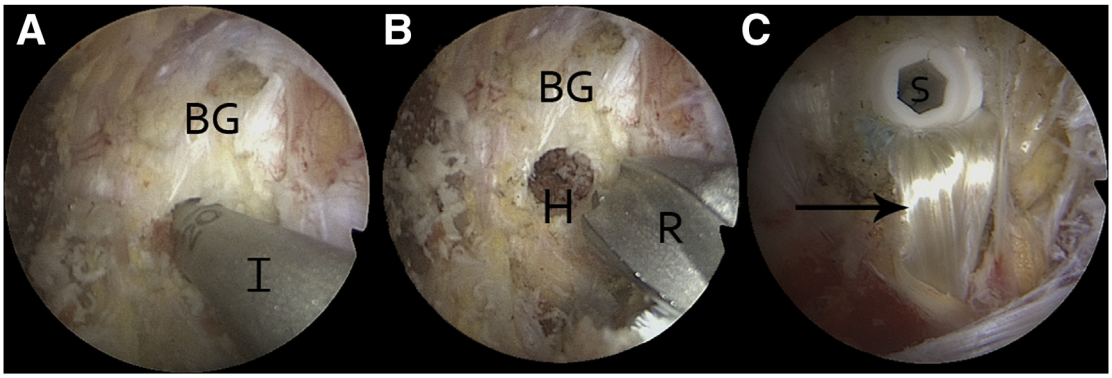

Fig 4. Arthroscopic view of a right shoulder through the distal lateral portal; instruments are introduced through the distal medial portal. (A) A 25-mm-deep humeral tunnel (H) is created at the lower end of the bicipital groove (BG) using a small impactor (I) and (B) a manual reamer (R) 0.5-1 mm wider than the intended screw diameter. (C) Final position of the interference screw (S) and the biceps tendon (arrow) after removal of the sutures and material.

Biceps Fixation

The FiberLoop end is fed through the closed eyelet of a biocomposite SwiveLock Tenodesis Screw (Arthrex) until the proximal end of the tendon reaches the eyelet. The tendon is inserted in the humeral tunnel and the interference screw is fixed until it reaches the cortical bone. After screw placement, fixation is checked by probing the biceps tendon to evaluate the tension, then the material is removed and the sutures are cut.

For postoperative rehabilitation, the shoulder is immobilized for 3 weeks to avoid tendon weakening and risks of screw detachment. Passive flexion of the arm and pendulum exercises are allowed after 3 weeks, active assisted motion is started at 6 weeks, pulley exercises are started at 8 weeks, strengthening at 10 to 12 weeks, and unrestricted activities can be resumed at 4 months.

Discussion

When a surgeon decides to perform LHB tenodesis, many options are available with different benefits and drawbacks, though there are no randomized controlled trials to date that compare the outcomes of these techniques. Biomechanical studies[6-8] have revealed that biceps tenodesis fixation is strongest with intra-osseous bioabsorbable screws. It may reduce the incidence of mechanical failure and therefore prevent Popeye deformities. Our technique does not require use of a drill, as we do not pass a transhumeral pin,[9] avoiding accidental axillary nerve lesions. A few failures of the interference screw have been reported, outlining technical mistakes such as screw oversizing, insufficient tendon preparation, or aggressive rehabilitation.[10]

Fixation of the LHB at the distal bicipital groove allows removal of the pathologic intra-articular portion of the tendon. This is particularly needed in cases of "hourglass biceps" as outlined by Boileau et al.[11] to prevent intra-articular entrapment of the LHB. In cases of tenosynovitis or tendonitis, resection of the intra-articular portion of the LHB is important for pain relief. Alpantaki et al.[12] studied that portion of the LHB and found an extensive network of neurons with substantial sympathetic sensory innervation at the tendon origin. Another advantage of this fixation site is that unlike proximal biceps tenodesis techniques, it permits evacuation of all inflammatory synovium from the bicipital groove, which would reduce the incidence of failure and revisions.[13]

The present technique is safe, simple, and reproducible, and thus can be performed by surgeons beginning shoulder arthroscopy (Table 4). It requires 2 portals in addition to the standard posterior portal and the intra-articular working portal, and therefore limits the intra-articular operative time compared with SLAP repairs. The technique allows treatment of all proximal biceps pathologies and respects the anatomic positioning of the biceps. It also minimizes iatrogenic intra-articular damage and uses the strongest fixation device, thereby limiting possible complications.

Table 4. Pearls/Pitfalls

Pearls
• Always start by the tenodesis in case additional procedures are required (cuff tear, acromioplasty, etc.)
• During articular exploration, pin the LHB as distally as possible in the bicipital groove to locate it more quickly and easily
• Always secure the LHB with a clamp when withdrawing it before opening the grasper to avoid a "bungee effect"
• Always clean the humeral tunnel before inserting the LHB
Pitfalls
• Always check adequate insertion of the LHB within the humeral tunnel as it may stay outside it and lead to tenodesis failure
• The top of the tenodesis screw must fit flush with the cortical bone. Inserting it too deep could weaken fixation strength
• Never cut the sutures before verifying the tension within the tenodised LHB tendon. Overtensioning may result in anterior biceps pain and cramp

LHB, long head of the biceps.

References

1. Hsu AR, Ghodadra NS, Provencher CMT, Lewis PB, Bach BR. Biceps tenotomy versus tenodesis: A review of clinical outcomes and biomechanical results. *J Shoulder Elbow Surg* 2011;20:326-332.
2. Slenker NR, Lawson K, Ciccotti MG, Dodson CC, Cohen SB. Biceps tenotomy versus tenodesis: Clinical outcomes. *Arthroscopy* 2012;28:576-582.
3. Lee HJ, Jeong JY, Kim CK, Kim YS. Surgical treatment of lesions of the long head of the biceps brachii tendon with rotator cuff tear: A prospective randomized clinical trial comparing the clinical results of tenotomy and tenodesis. *J Shoulder Elbow Surg* 2016;25:1107-1114.
4. Wittstein JR, Queen R, Abbey A, Toth A, Moorman CT. Isokinetic strength, endurance, and subjective outcomes after biceps tenotomy versus tenodesis: A postoperative study. *Am J Sports Med* 2011;39:857-865.
5. Hwang JT, Yang CJ, Noh KC, et al. Which is better for arthroscopic tenodesis of the long head of the biceps: Soft tissue or bony interference fixation? *Arthroscopy* 2016;32:560-567.
6. Ramos CH, Coelho JCU. Biomechanical evaluation of the long head of the biceps brachii tendon fixed by three techniques: A sheep model. *Rev Bras Ortop* 2017;52:52-60.
7. Chiang FL, Hong CK, Chang CH, Lin CL, Jou IM, Su WR. Biomechanical comparison of all-suture anchor fixation and interference screw technique for subpectoral biceps tenodesis. *Arthroscopy* 2016;32:1247-1252.
8. Ozalay M, Akpinar S, Karaeminogullari O, et al. Mechanical strength of four different biceps tenodesis techniques. *Arthroscopy* 2005;21:992-998.
9. Boileau P, Krishnan SG, Coste J-S, Walch G. Arthroscopic biceps tenodesis: A new technique using bioabsorbable interference screw fixation. *Arthroscopy* 2002;18:1002-1012.
10. Koch BS, Burks RT. Failure of biceps tenodesis with interference screw fixation. *Arthroscopy* 2012;28:735-740.
11. Boileau P, Ahrens PM, Hatzidakis AM. Entrapment of the long head of the biceps tendon: The hourglass biceps—A cause of pain and locking of the shoulder. *J Shoulder Elbow Surg* 2004;13:249-257.
12. Alpantaki K, McLaughlin D, Karagogeos D, Hadjipavlou A, Kontakis G. Sympathetic and sensory neural elements in the tendon of the long head of the biceps. *J Bone Joint Surg Am* 2005;87:1580-1583.
13. Sanders B, Lavery KP, Pennington S, Warner JJP. Clinical success of biceps tenodesis with and without release of the transverse humeral ligament. *J Shoulder Elbow Surg* 2012;21:66-71.