Technical Note

Subpectoral Biceps Tenodesis: All-Suture Anchor Onlay Technique

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Abstract: Surgical management for biceps pathologies has advanced to provide stronger fixation and to be less invasive. The long head of the biceps tendon has been recognized as a common contributor to anterior shoulder pain and is often associated with other glenohumeral pathologies such as SLAP lesions, rotator cuff tears, and subacromial impingement. Both tenotomy and tenodesis have shown to be effective in ameliorating pain associated with the long head of the biceps tendon. However, decreased muscle function and cosmetic concerns are seen at higher rates after tenotomy compared with tenodesis. One option for the treatment of biceps tendon pathology includes mini-open subpectoral biceps tenodesis. Lower reoperation rates are observed after subpectoral biceps tenodesis than after suprapectoral biceps tenodesis, with thoughts that releasing the tendon from its sheath and the bicipital groove relieves the patient of most associated pain. The purpose of this Technical Note is to describe in detail our preferred operative technique for mini-open subpectoral biceps tenodesis using an onlay technique with all-suture anchor fixation.

Pathologies of the long head of the biceps (LHB) tendon are a common contributor to anterior shoulder pain.[1-6] Biceps tendinopathy can arise from various causes, including chronic tendinitis, acute trauma, overuse, and degenerative changes. Patients present with pain during overhead movements and internal rotation, as well as pain-limited range of motion.[6]

Both tenotomy and tenodesis have shown to be effective in ameliorating pain associated with the LHB tendon. However, decreased muscle function and cosmetic defects are observed at higher rates after tenotomy compared with tenodesis.[4,5,7-9] In addition, lower reoperation rates are described after subpectoral fixation than after suprapectoral fixation, with thoughts that releasing the tendon from its sheath and the bicipital groove relieves the patient of most associated pain.[5,10]

There is no clear consensus whether bone tunnel or cortical surface (onlay) healing confers better outcomes. Clinical studies comparing interference screw fixation (intramedullary) and suture anchor fixation (onlay) techniques for subpectoral biceps tenodesis found no significant differences in patient outcomes.[10,11] However, interference screw technique has been associated with various complications including humeral fractures at the drill hole, persistent pain, and bioabsorbable screw reactions.[12-14] Subpectoral biceps tenodesis using an onlay fixation technique is a reasonable alternative to mitigate these risks.

The purpose of this Technical Note is to describe in detail our preferred technique for mini-open subpectoral biceps tenodesis using an all-suture anchor onlay fixation technique. We believe that this technique is a viable option for the treatment of biceps tendinopathy with a potentially decreased risk of humeral fractures and its easy approach and anchor placement at the humeral shaft using curved drilling and insertion guides.

Surgical Technique

Patient Positioning

After induction of general anesthesia, the patient is placed in the beach-chair position. The operative extremity is prepared and draped in standard sterile

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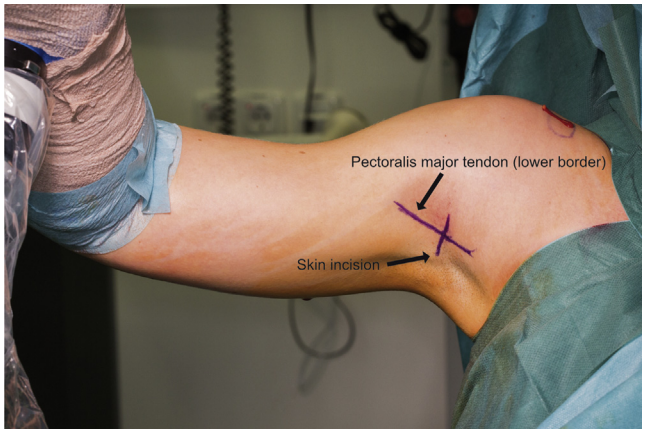

Fig 1. The right arm is positioned in 90° of abduction and 90° of elbow flexion. A 3-cm incision is marked in the axillary crease, extending from 1 cm superior to 2 cm inferior to the lower border of the pectoralis major tendon.

fashion, and the arm is secured in a mechanical arm holder (TRIMANO Support Arm; Arthrex, Naples, FL).

Diagnostic Arthroscopy and LHB Tenotomy

A standard posterior portal is established, and under direct visualization, an anterosuperior portal is created. A diagnostic arthroscopy is performed. The LHB tendon, glenoid labrum, rotator cuff, chondral surfaces, and capsuloligamentous structures are evaluated. By use of a probe, the LHB tendon is pulled into the glenohumeral joint to evaluate the tendon's shape, fraying, and synovitis.

LHB tenotomy is performed with arthroscopic scissors at the superior labral insertion. A radiofrequency ablation device is then used to debride the proximal stump to a stable margin. Any concomitant arthroscopic procedures are carried out at this time.

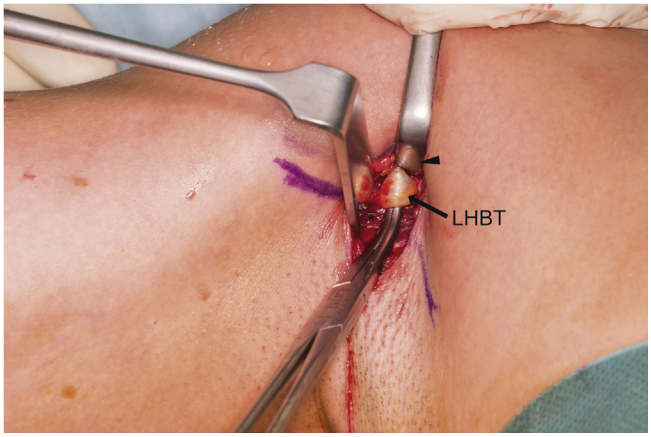

Fig 2. In a right shoulder, with the pectoralis major tendon retracted superiorly (arrowhead), a right-angle clamp is used to loop around the long head of the biceps tendon (LHBT, arrow) and retrieve it from the incision. The asterisk indicates the short head of the biceps.

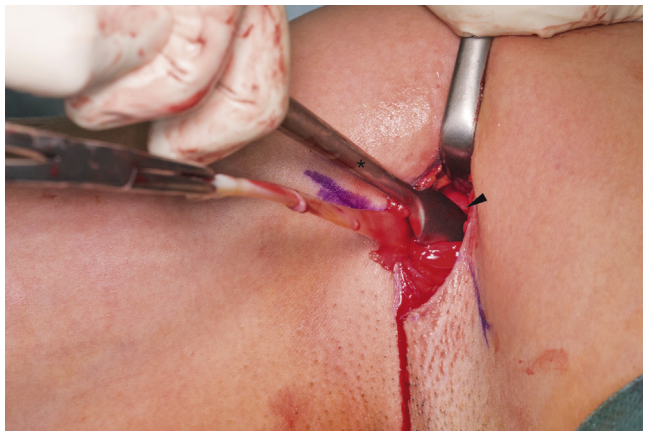

Fig 3. In a right shoulder, the periosteum in the bicipital groove (arrowhead) is stripped off with an elevator (asterisk) to prepare the cortical bed.

Open Subpectoral Biceps Tenodesis With All-Suture Anchor Fixation

The complete surgical technique is shown in Video 1. The arm is positioned in 90° of abduction and 90° of elbow flexion. The lower border of the pectoralis major tendon is palpated. In the axillary crease, an incision is made, extending from 1 cm superior to 2 cm inferior to the inferior border of the pectoralis major tendon (Fig 1). The pectoralis major tendon, coracobrachialis, and short head of the biceps brachii are identified. The fascia overlying the coracobrachialis and short head of the biceps is incised. With the pectoralis major tendon retracted superiorly, the bicipital groove is palpated, leading directly to the LHB tendon. A right-angle clamp is then used to loop around the LHB tendon and retrieve it from the incision (Fig 2).

The periosteum in the bicipital groove is stripped off with an elevator to prepare the cortical bed

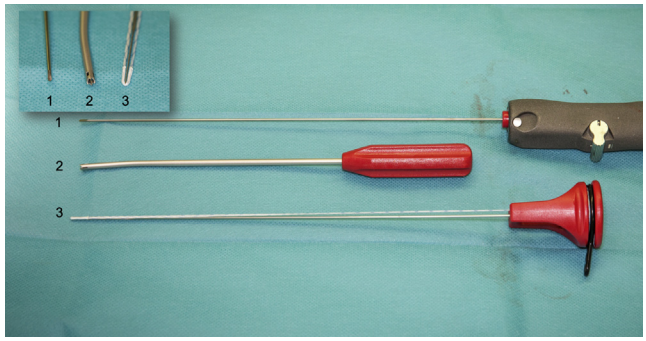

Fig 4. Instruments used for all-suture anchor placement: (1) flexible 1.6-mm drill attached to arthroscopic shaver handpiece, (2) curved drill guide, and (3) all-suture anchor with SutureTape (FiberTak).

Fig 5. A drill guide (arrowhead) is positioned centrally in the bicipital groove (arrow) and approximately 2 cm below the proximal edge of the pectoralis major tendon in a right shoulder. A 1.6-mm drill is used to create a unicortical bone tunnel for a single-loaded all-suture anchor (FiberTak).

(Fig 3). A drill guide is positioned centrally in the bicipital groove and approximately 2 cm below the proximal edge of the pectoralis major tendon. A 1.6-mm drill is used to create a unicortical bone tunnel for a single-loaded all-suture anchor (FiberTak) (Figs 4 and 5).

One suture strand is used to Krackow-type whipstitch the tendon with 4 passes on each side, beginning 1 cm proximal to the musculotendinous junction to a point 2 cm distal (Fig 6A). The remaining proximal portion of the tendon is sharply excised (Fig 6B). The free suture end is passed through the tendon, and applying traction on the suture reduces the tendon down to the anchor. The sutures are then tied down (Fig 7A).

The wound is irrigated and closed in a layered fashion (Fig 7B). Pearls and pitfalls of the technique, as well as advantages and disadvantages, are outlined in Tables 1 and 2.

Postoperative Rehabilitation

For isolated subpectoral tenodesis, sling immobilization for 2 weeks with immediate active and passive range of motion is allowed. Resisted elbow flexion and forearm supination is restricted for 6 weeks after surgery. Overhead strengthening and heavy lifting are delayed for 3 months.

Discussion

Various fixation techniques and implants are described for subpectoral biceps tenodesis.[15-19] Interference screw fixation has traditionally served as the gold standard with superior biomechanical strength.[15] However, because of concerns for a humeral stress riser with larger drill holes, other techniques have evolved to mitigate this risk while taking advantage of the benefits of the subpectoral location.

There is no clear consensus whether bone tunnel or cortical surface (onlay) healing confers better outcomes. In a rabbit model, Tan et al.[20] compared tendon-to-bone healing for both fixation techniques and found no significant difference between groups with respect to failure load, stiffness, and mean volume of newly formed bone. Histologic analysis showed direct tendon-to-bone healing on the outer cortical surface. In the intracortical fixation group, only 5% of the newly formed bone was located intramedullary, whereas 95% was present on the cortical surface. Siebenlist et al.[21] reported good clinical results and a low failure rate

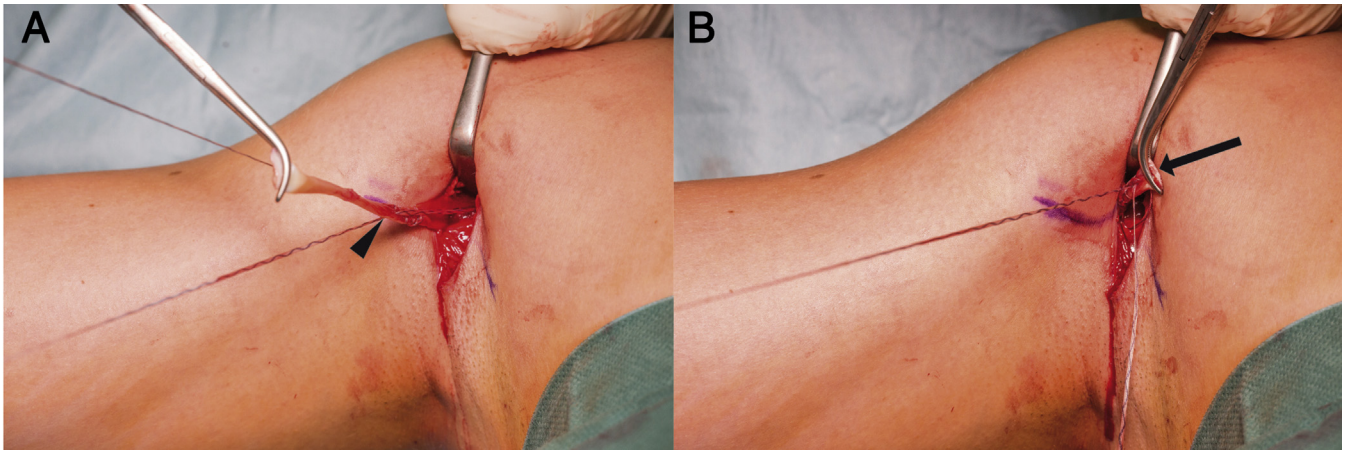

Fig 6. Right shoulder. (A) One suture strand is used to Krackow-type whipstitch the tendon with 4 passes on each side (arrowhead), beginning 1 cm proximal to the musculotendinous junction to a point 2 cm distal. (B) The remaining proximal portion of the tendon is sharply excised (arrow).

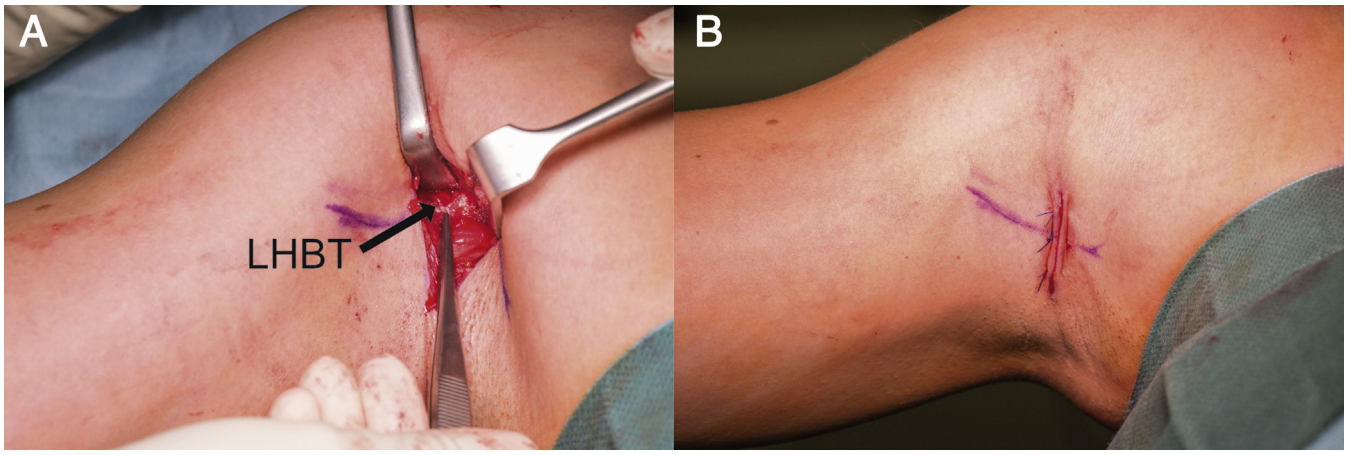

Fig 7. In a right shoulder, the sutures are tied down (A) and the wound is irrigated and closed in a layered fashion (B). (LHBT, long head of biceps tendon.)

with an onlay repair technique for acute distal biceps tendon ruptures.

Several studies have reported on different suprapectoral and subpectoral fixation techniques for biceps tenodesis, showing interference screw fixation to provide the strongest biomechanical stability.[15-19,22] However, complications including implant failure, bioabsorbable screw reactions, and especially humeral fractures have been reported.[12-14] Sears et al.[14] reported a case series of humeral fractures after subpectoral biceps tenodesis. They concluded that the potential stress-riser effect created by the cortical defect, location, and depth of the drill hole may be reduced by limiting the size of the cortical defect. This stress-riser effect and fracture risk may be increased especially in young overhead athletes with repetitive humeral torque.[23] Buchholz et al.[15] introduced a bone-preserving onlay technique using unicortical button fixation for subpectoral biceps tenodesis. Biomechanically, it was shown that the unicortical button withstood similar loads compared with interference screw fixation.[15] In a biomechanical comparison of all-suture anchor versus unicortical button fixation for subpectoral biceps tenodesis, the all-suture anchor using a Krackow-type whipstitch provided similar biomechanical strength to unicortical button fixation using a noncontinuous locking whipstitch.[24] The all-suture anchor fixation technique was shown to be superior in terms of displacement during cyclic loading compared with the unicortical button fixation technique. However, the results of this study helped to show that the fixation method used on the humeral side is less implicative of overall construct strength than stitch location and technique, given that the biceps tendon tissue as well as stitch configuration seems to be the limiting factor in subpectoral onlay tenodesis techniques.

In addition to its bone-preserving approach, the all-suture anchor subpectoral biceps tenodesis is beneficial because of the aforementioned curved drilling and insertion guide, which allows for easy access to the entrance of the bicipital groove below the pectoralis major tendon, resulting in reduced surgery time. This article is a Technical Note and, as such, has a limited scope without comment on the clinical results of the described technique. With promising reported biomechanical results, further studies are needed to evaluate the clinical efficacy of this procedure.

Table 1. Pearls and Pitfalls of Technique

Step	Pitfalls	Pearls
Subpectoral approach	Difficulty identifying interval between pectoralis major tendon and short head of biceps	Palpate the lower border of the pectoralis major tendon.
Suture anchor placement	Incorrect suture anchor position	Position the drill guide centrally in the bicipital groove and 2 cm below the proximal edge of the pectoralis major tendon.
Tendon fixation	Inadequate tendon tensioning	Begin tendon suturing 1 cm proximal to the musculotendinous junction to a point 2 cm distal.

Table 2. Advantages and Disadvantages of Technique

Advantages
Predictable pain reduction with resection of proximal LHB tendon
Facilitation of adequate tendon tensioning
Reduced risk of fracture of proximal humerus
Short duration of surgery
Disadvantages
Open approach with additional scar
Potential risk of iatrogenic injury to neurovascular structures

LHB, long head of biceps.

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