All-Arthroscopic Suprapectoral Long Head of Biceps Tendon Tenodesis With Interference Screw–Like Tendon Fixation After Modified Lasso-Loop Stitch Tendon Securing

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Abstract: Arthroscopic suprapectoral techniques for tenodesis of the long head of the biceps tendon (LHB) are appropriate for the treatment of proximal biceps lesions. Several types of techniques and fixation devices have been described and evaluated in biomechanical studies regarding primary stability. In this technical note, we describe an all-arthroscopic suprapectoral technique using the 6.25-mm Bio-SwiveLock device (Arthrex, Naples, FL) for an interference screw–like bony fixation after having armed the tendon with a lasso-loop stitch. Both the interference screw fixation and securing of the lasso-loop tendon have been well described and approved in biomechanical tests concerning the primary stability. One advantage of this technique performed from the glenohumeral space, in addition to the strong and secure fixation with ingrowth of the tendon in a bony canal, is the avoidance of touching the soft tissue above the bicipital groove, which results in a smooth fitting of the tendon into its natural canal and therefore avoids mechanical irritation of the stump at the rotator interval. In conclusion, the all-arthroscopic suprapectoral LHB tenodesis performed from the glenohumeral space with the modified lasso-loop stitch for securing of the tendon and the 6.25-mm Bio-SwiveLock suture anchor for interference screw–like bony tendon fixation is an appropriate technique for the treatment of LHB-associated lesions.

Tenodesis of the long head of the biceps tendon (LHB) has been shown to be an appropriate therapy for LHB partial tears, massive rotator cuff tears with biceps damage, and biceps pulley lesions, as well as SLAP lesions. Several studies have described and evaluated different techniques for LHB tenodesis.1-7 Two options regarding the position of the tenodesis have been described: the suprapectoral position,1-3,8 at the entrance of the bicipital groove, and the subpectoral position,4 caudal to the insertion of the tendon of the pectoralis major muscle. In a preliminary study we have biomechanically compared 4 arthroscopically performable techniques for suprapectoral LHB tenodesis on human cadavers: 2 techniques with interference screws and 2 with widely used knotless suture anchors. We measured the highest ultimate failure load (UFL) for the 8-mm BioTenodesis Screw (BTS) (Arthrex, Naples, FL) as a gold-standard fixation device.4,7 The modified lasso-loop stitch2 technique for securing the tendon achieved 86% of the BTS UFL, whereas the fixation with the 5.5-mm Bio-SwiveLock device (Arthrex) achieved a significantly lower UFL of 51% compared with the BTS UFL. The 5.5-mm Bio-SwiveLock suture anchor was developed for the lateral-row rotator cuff fixation and only approximates the LHB to the bone and fixes the suture to the bone rather than to the tendon itself. Thus the failure mode was suture cutting out of the bone-anchor interface. However, the use of the 5.5-mm Bio-SwiveLock suture anchor, similar to an interference screw, to fix a single

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bundle of the biceps tendon in the bone tunnel does not seem to be effective because of the relatively small diameter of the suture anchor compared with the tendon.

With respect to our biomechanical findings, a 6.25-mm Bio-SwiveLock device was recently developed for similar use as an interference screw that is able to solve this problem by fixation of an LHB tendon limb inside the bone tunnel for a better primary fixation and to achieve a real tendon-to-bone ingrowth with long-term stability.

To use this device for an arthroscopically performed suprapectoral LHB tenodesis, we combine it with the modified lasso-loop stitch technique to arm and secure the tendon inside the joint into a bony canal at the entrance to the bicipital groove.

**TECHNIQUE**

Shoulder arthroscopy is performed with standard beach-chair positioning of the patient with elbow flexion of 90° and neutral glenohumeral rotation.

Arthroscopy starts with a standard posterior camera portal. An anterosuperior working portal above the subscapularis tendon is created, followed by another anterior working portal (Fig 1A) in the rotator interval just above and perpendicular to the bicipital groove, without damaging the supraspinatus tendon. Using only the anterior working portal just in front of the entrance of the bicipital groove is normally effectual enough for perforating the LHB as well as for inserting the anchor (Video 1). The additional anterosuperior portal helps gain more space for insertion of the anchor by pulling aside the armed LHB. The LHB is perforated 20 mm proximal to the entrance of the bicipital groove (Fig 1B) through the anterior portal with the Penetrator Suture Retriever (Arthrex), which is loaded with a No. 2 Orthocord (DePuy Mitek, Raynham, MA) suture loop (Fig 1B). After perforation of the LHB, the Penetrator Suture Retriever is pulled back out of the tendon, leaving the suture loop inside the tendon (Fig 1B), but is left inside the joint; it then catches the suture loop and shuttles the suture outside the anterior portal. Then, 1 suture limb is inserted inside the loop, the loop is tied, and subsequently, a lasso-loop stitch is created (Fig 2A). The lasso-loop limb serves as the post and is secured with the free limb with 4 knocking knots. In very thick tendons, the free limb of the suture can be placed medially around the tendon before it is pulled out of the joint and before tying of the knots to arm the entire distal part of the LHB (Video 1). Afterward, the LHB is cut proximally to the suture. The 2 suture limbs are then grasped and pulled out of the anterosuperior portal. Slightly pulling on the armed tendon after having shuttled the sutures out of the anterosuperior portal provides the necessary space to view the bicipital groove for creation of the bony canal (Fig 2A). The 6.5-mm drill is inserted by hand through the anterior portal, and a 20-mm-deep hole is created in a 135° angulation to the humeral shaft at the entrance of the bicipital groove (Fig 2A). We use the 6.5-mm drill most commonly. The drills are available in diameters of 6.0, 6.5, and 7.0 mm. The estimation of about 20
mm of tendon length necessary for fixation while the insertion is still intact allows for proper adjustment of biceps tendon tension without overtightening.

Only the suture is delivered outside the shoulder, and it is now inserted into the tip of the Bio-SwiveLock device. The anchor is positioned close to the created bone tunnel at the entrance of the bicipital groove, and the suture is pulled tight; the tip of the tendon is thus guided by the suture and placed into the bone tunnel, and correct placement of 20 mm of the tendon in the bone tunnel is confirmed. The biceps tendon is then pulled into the bony canal up to the laser mark (20 mm) and secured by screwing in the anchor (Fig 2B). As a result, the biceps tendon is secured into the bony canal through an interference screw technique under original tension and then the sutures are cut (Fig 3A). The tendon is cut as estimated earlier, and the remnant is cut close to the anatomic insertion site at the superior glenoid and labrum. The tendon stump is treated with an electrothermal device (VAPR; DePuy Mitek) to avoid

**FIGURE 2.** Arthroscopic view in beach-chair position in a right shoulder viewed from posterior portal. (A) Slightly pulling on the armed tendon with the lasso-loop stitch (LL) after having shuttled the sutures out of the anterosuperior portal provides the necessary space to view the bicipital groove for creation of the bony canal. The 6.5-mm drill is inserted by hand through the anterior portal (AP), and a 20-mm-deep hole is created in a 135° angulation to the humeral shaft at the entrance of the bicipital groove. (B) The Bio-SwiveLock anchor (SL) is positioned close to the created bone tunnel at the entrance of the bicipital groove, and the suture is pulled tight; the tip of the tendon is thus guided by the suture and placed into the bone tunnel. Correct placement of 20 mm of the tendon in the bone tunnel is confirmed, and the LHB is then pushed into the bony canal and secured by screwing in the anchor.

**FIGURE 3.** (A) Arthroscopic view in beach-chair position in a right shoulder viewed from posterior portal. The biceps tendon is secured into the bony canal with an interference screw technique under original tension, and then the sutures are cut. (AP, anterior portal; SSC, subscapularis tendon; SSP, supraspinatus tendon.) (B) The 6.25-mm Bio-SwiveLock knotless suture anchor and the matching 6.5-mm drill are marked with a laser for a correct depth of 20 mm.
bleeding and mechanical impingement. The created portals are usually left untreated but can be closed arthroscopically with resorbable stitches if necessary.

**DISCUSSION**

For all-arthroscopic suprapectoral LHB tenodesis, the described technique performed from the glenohumeral space uses a modified lasso-loop stitch for securing of the tendon combined with an interference screw–like tendon fixation. The technique is based on our biomechanical tests, which have evaluated a proven method of securing the LHB using the arthroscopic modified lasso-loop stitch for arming the tendon and for pulling the tendon aside to gain space for drilling the bone canal. The 5.5-mm Bio-SwiveLock device with fixation of only the sutures between the bone-anchor interface has not reached an appropriate primary UFL for LHB tenodesis, resulting in slippage out of the sutures. However, for LHB tenodesis, the interference screw technique securing 1 limb of the tendon into a bony canal has been shown to reach the highest UFL in biomechanical tests.1,4,6 We have biomechanically tested the 8.0-mm-diameter Bio-Tenodesis screw with excellent results of UFL agreeing with other studies.4,6 In our biomechanical study, we analyzed a double-limb tendon fixation of the LHB using the Biceptor tenodesis screw (Smith & Nephew, Andover, MA). We found a lower ultimate load to failure compared with the single-limb LHB fixation using the Bio-Tenodesis screw. A V-shaped splitting of the distal limb caused by the fixation device when securing a double limb of the LHB in the bony canal was seen.6 On the basis of these findings, we do not recommend a double-limb LHB fixation in the bony canal. However, in our clinical experience, the 6.25-mm-diameter screw (i.e., Bio-SwiveLock) combined with a 6.5-mm drill provides a good tendon fixation and is large enough for a single-limb LHB fixation as well.

One advantage of this technique performed from the glenohumeral space, in addition to the strong and secure fixation with consecutively postulated bony ingrowth, is the avoidance of touching the soft tissue above the bicipital groove, which usually shows a good blood and nerve supply. The suprapectoral LHB tenodesis performed from the subacromial space1,7 touches and violates the soft tissue (i.e., transverse ligament) even just above the bicipital groove under the deltoid muscle. An advantage of this technique performed from the subacromial space might be that a longer part of the potentially synovitic inflamed proximal LHB (i.e., hourglass biceps) is resected and the tendon is fixed more distally. Nevertheless, our technique results in a smooth fitting of the refixed tendon into its natural canal and therefore avoids mechanical irritation of the stump at the rotator interval, which sometimes can be the cause of prolonged rehabilitation. To date, we have diagnosed neither impingement nor pain due to a remnant synovitic part of the LHB after proximal tenodesis. However, long-term follow-up with further clinical studies is needed to evaluate the patients’ outcome.

In massive and swollen tendons, the technique has limitations with regard to a more difficult placement of the tendon inside the bone tunnel. In such cases we recommend the use of a larger drill (i.e., 7.0 mm) to obtain a wider entrance of the bone tunnel for easier pulling in of the tendon. A further limitation is that the proximal synovitic part of the tendon is not resected in a suprapectoral LHB tenodesis, as mentioned earlier. However, we have not seen any problems in the form of resistant pain at this position. The good results might be explained by the smooth and flat fitting of the tendon coming outside the bone tunnel and avoiding mechanical irritation of the stump at the rotator interval.

In conclusion, the all-arthroscopic suprapectoral LHB tenodesis performed from the glenohumeral space with the modified lasso-loop stitch for securing of the tendon and the 6.25-mm Bio-SwiveLock suture anchor for interference screw–like bony tendon fixation is an appropriate technique for the treatment of LHB-associated lesions.

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