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TECHNICAL NOTE • SHOULDER - ARTHROSCOPY

Arthroscopic extra-articular suprapectoral biceps tenodesis with knotless suture anchor

Pinkawas Kongmalai[1]

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Abstract
Tenodesis of the long head of the biceps tendon is a frequently performed procedure during shoulder arthroscopy. Various open and arthroscopic techniques have been described with comparable outcomes and complication rates. We describe a simple, knotless, arthroscopic extra-articular biceps tenodesis technique using a 4.5-mm knotless anchor. This technique avoids the complications associated with open tenodesis surgery while still removing the diseased biceps tendon from the bicipital groove. The benefits from knotless suture anchor include no requirement of arthroscopic knot tying and no risk of the knot irritation under the coracoid and coracoacromial ligament.

Keywords Biceps tenodesis · Suprapectoral biceps tenodesis · Arthroscopic biceps tenodesis · Tension free biceps tenodesis · Hidden biceps lesion · Knotless suture anchor

Introduction

Biceps tendon pathology is a well-recognized cause of shoulder pain and functional impairment. When nonoperative treatment fails to provide adequate symptom relief, surgical tenotomy or tenodesis is the option for treatment, with good results reported [1, 2]. The biceps tenodesis is typically reserved for younger, more active patients because it may decrease the postoperative rate of cramping and offer a better cosmetic outcome [3].

A variety of techniques have been developed for biceps tenodesis. Although it has historically been performed through an open approach, arthroscopic methods have become more popular nowadays [4]. The biceps tendon may be fixed in the suprapectoral area including in the glenohumeral joint [5] and extra-articular within the bicipital groove [6] or in the subpectoral region [7]. Fixation may be achieved with interference screws [8], suture anchors [5] or soft tissue attachment [9].

We present a simple surgical technique for arthroscopic extra-articular suprapectoral biceps tenodesis with knotless suture anchor (PopLok® Suture Anchor, ConMed). The goal of this technique is to create a secure tension-free biceps tendon fixation which will epiosseously heal in extra-articular location. Advantages of our technique include maintenance of appropriate tendon length and strain, ability to complete removal of all hidden biceps lesions, absence of knot tying and no risk of the knot irritation under the coracoid and coracoacromial ligament.

Technical note

After adequate anesthesia, the patient was placed in the beach chair position. An operative shoulder was prepped and draped. Entire arthroscopic procedure was performed using a 30° arthroscope. The standard posterior and anterior portals were established for diagnostic arthroscopy in the glenohumeral joint (Video 1). To examine the extra-articular portion of the biceps tendon, an arthroscopic probe was placed into the joint to retract the biceps tendon. Once the decision is made to proceed with tenodesis, an eighteen-gauge spinal needle was used to localize the position of an anterosuperolateral portal which is next to the leading edge

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✉ Pinkawas Kongmalai
pinkawass@hotmail.com

[1] Department of Orthopaedics, Faculty of Medicine, Srinakarinwirot University, 62 Moo 7, Rangsit-Nakhon Nayok Road, Ongkharak, Nakhon Nayok 26120, Thailand

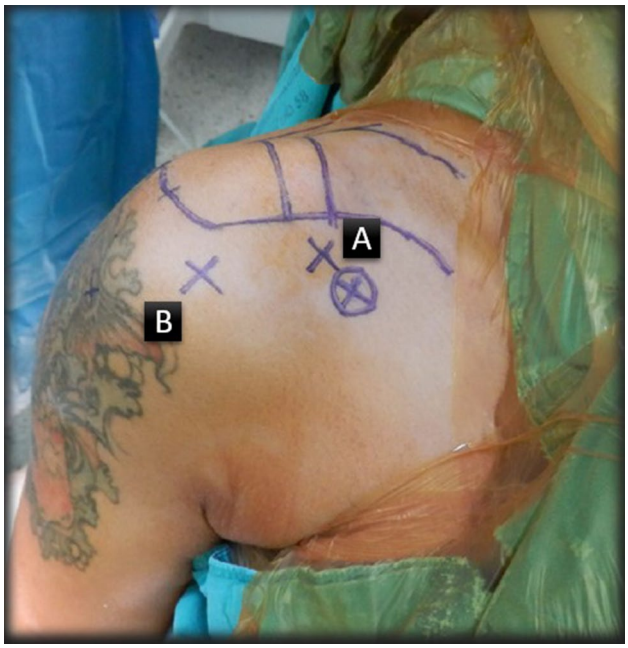

Fig. 1 Anterior (**a**) and the anterosuperolateral (**b**) portals were marked. The patient was in the beach chair position, and the right shoulder was shown

of the supraspinatus tendon (Fig. 1). A no. 1 PDS suture (Ethicon, Johnson & Johnson, Somerville, NJ) was used as a traction suture to the biceps tendon. After the biceps tendon was released from its attachment at the superior labrum, the tendon was pulled extra-articularly by using the PDS suture through the anterosuperolateral portal and stabilized with a clamp. The diseased proximal part was resected as needed, and the tendon was sutured using a Krackow stitch technique with no. 2 braided nonabsorbable suture (Hi-Fi® Suture, ConMed) (Fig. 2). The PDS suture was then removed.

The arthroscope was introduced into the subacromial space using the previously established posterior portal. A subacromial bursectomy was performed through a standard accessory lateral working portal. Subsequently, the arm was placed into a forward flexed position 75°. The arthroscope was transferred from the posterior viewing portal into the lateral portal, and the camera was aimed distal and anterior toward the bicipital groove. By traction of the suture attached to the biceps tendon, the location of biceps tendon in the subacromial space can be easily identified. An electrocautery was used to remove the soft tissue overlying the bicipital sheath. The transverse humeral ligament was then released. Next, the bicipital groove was abraded with 4.50 mm HPS Spherical Bur (ConMed) to prepare the bleeding surface for tenodesis. The pilot hole was punched, and then the suture limbs were loaded into the 4.5 mm knotless suture anchor (PopLok® Suture Anchor, ConMed) (Fig. 3). In a 75° forward flexion of the shoulder and neutral rotation of the elbow, the anchor was inserted and the suture was tensioned to epiosseously tenodesis the biceps tendon in the suprapectoral region. The suture was cut, and the security of the tenodesis site was checked with the probe. The elbow was also moved through a range of motion to make sure that the final construct was tension free (Fig. 4). Other concomitant procedures could be performed after finalization of the tenodesis. An immediate finger, hand, wrist and elbow range of motion exercise can begin immediately postoperative. The stitches were removed during the second week visit (Fig. 5). Rehabilitation protocol can be adjusted according

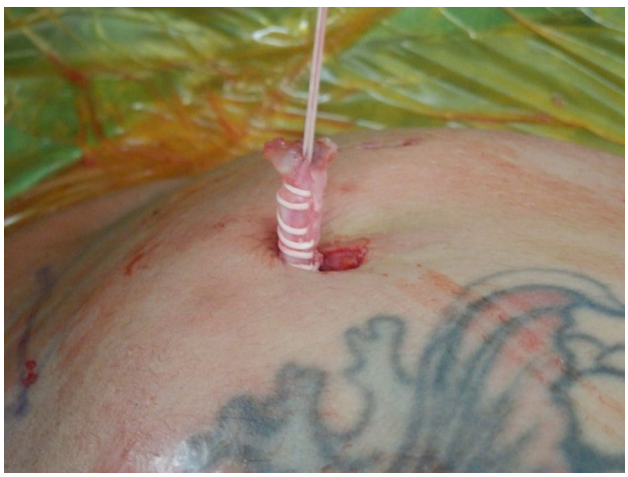

Fig. 2 Biceps tendon was sutured with no. 2 braided nonabsorbable suture (Hi-Fi® Suture, ConMed) using a Krackow suturing technique. The tendon was pulled extra-articularly via the anterolateral portal

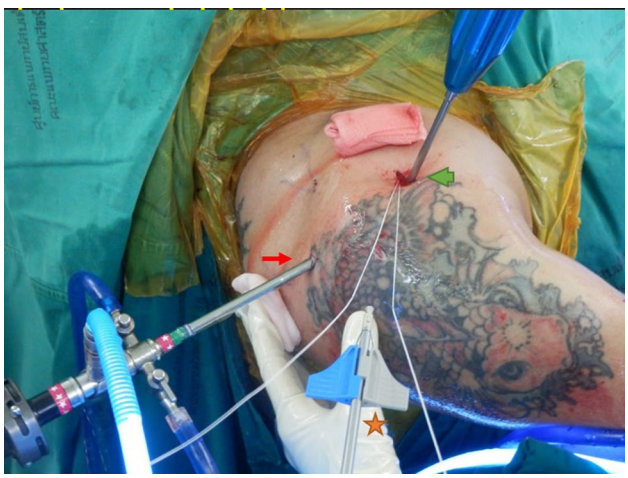

Fig. 3 Two suture limbs were loaded into the 4.5 mm knotless suture anchor (PopLok® Suture Anchor, ConMed) which was going to insert via the anterolateral portal (star). The 4.50 mm PopLok® Punch was also shown (arrowhead). The arthroscope was in the lateral portal (arrow)

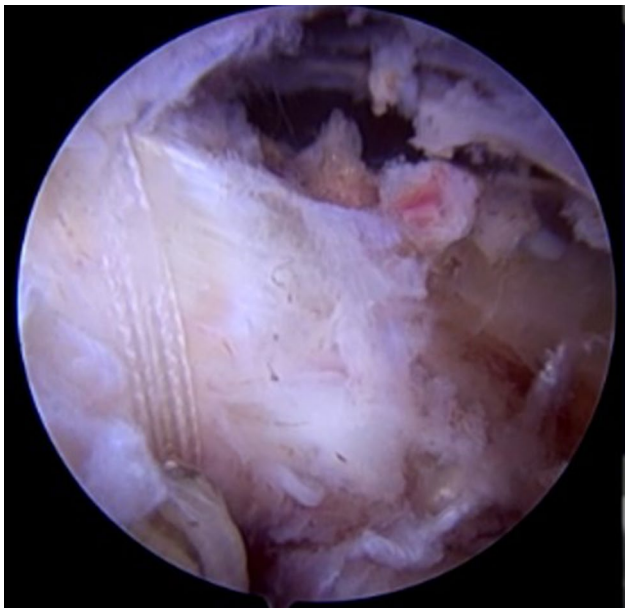

Fig. 4 Demonstrate the final arthroscopic picture after suprapectoral biceps tenodesis with knotless suture anchor

to the combined rotator cuff pathology. Table 1 shows all the key points of our technique.

Discussion

When the biceps tenodesis is indicated for the patient, the controversial points of the surgery are the approach, the location and the fixation technique. We present an arthroscopic technique for tension-free suprapectoral biceps tenodesis with knotless suture anchor. Table 2 shows all the advantages of our technique.

Table 1 Key points

Krackow suture should be used to improve the tendon grip and yield better clinical results
Transverse humeral ligament should be released to complete removal of all hidden biceps lesions
Bicipital groove should be decorticated to increase the contact surface area of fibrous healing
Extra-articular suprapectoral location should be performed to create tension-free tenodesis

Table 2 Advantages

Relatively safe and reproducible
Postoperative elbow range of motion can begin immediately
No requirement of arthroscopic knot tying
No risk of the knot irritation under the coracoid and coracoacromial ligament

Both open and arthroscopic biceps tenodesis cases have increased annually [4]. Although there are many biomechanical analyses of different techniques [10, 11], the clinical data showing the superiority of one technique over another have not yet been established. However, there are many complications associated with open surgery such as a musculocutaneous nerve injury due to the deep dissection [12, 13], a deep wound infection [13], a proximal humeral fracture [14] and a brachial plexus injury [15]. Major advantages of

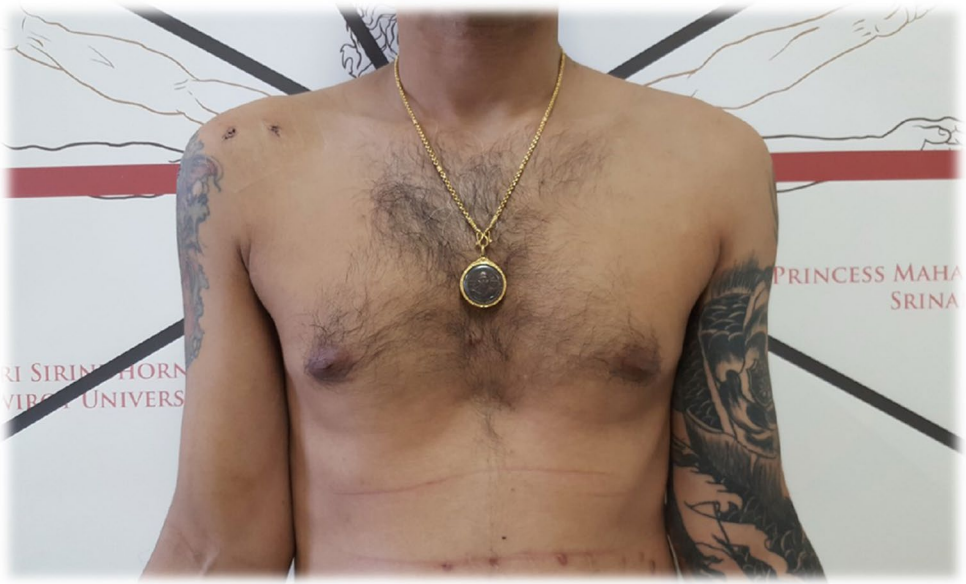

Fig. 5 Clinical picture taken during visit at second week showed no popeye deformity of right arm

the arthroscopic technique are the minimal invasive procedure, better cosmesis and decreased blood loss compared with the procedure. Therefore, an arthroscopic approach may be a better choice.

Moon et al. [16] found a high percentage of hidden lesions of biceps tendon going beyond the bicipital groove and extending to the distal extra-articular portion. Biceps tenodesis techniques within or proximal to the bicipital groove will fail to address the sources of pain within this proximal anatomic location. Sanders also confirmed that the technique which does not release the transverse humeral ligament or removes the tendon from the sheath have increased revision rates, compared to techniques that do [17]. Although subpectoral biceps tenodesis can address this problem, Jarrett et al. [18] proposed that the subpectoral tenodesis may not adequately restore the biceps length–tendon relation. They concluded that proximal biceps tenodesis should possibly be placed closer to the superior border of the pectoralis major tendon to restore the appropriate length–tension relationship. The other problem of the subpectoral tenodesis is a requirement of excessive tendon resection which leads to the difficulty in revision surgery. Therefore, extra-articular suprapectoral location seems to be more reasonable than other locations for biceps tenodesis.

Previous studies reported that there was no biomechanically and clinically statistically significant difference between the interference screw and suture anchors [19]. However, when using the interference screw, there is a chance that the screw threads at the screw–tendon interface cause the postoperative LHB tendon damage because of the tendon being compressed against the cortical bone [20]. Moreover, incorporating the tendon remnant into the tenodesis site with the interference screw may change the length–tension relation, which possibly resulting in persistent pain after the tenodesis. When using a suture anchor, arthroscopic knot tying may be inconvenient in a beginner surgeon. Furthermore, knots those made over the tendon may irritate under the coracoid and coracoacromial ligament and cause problems [21]. In contrast, the knotless anchor technique avoids these problems. Recently, a technical note from Saper used a 1.5-mm Labral Tape lasso loop technique and a knotless anchor to do the biceps tenodesis. However, Kaback et al. [22] found that the mechanical properties of the lasso loop technique were especially poor in comparison with the Krakow technique. We agreed with them and opted to use the Krackow suture which improves the tendon grip and may decrease suture cutout through the tendon, thus further preventing failure and yield better clinical results.

Some authors [23] preferred to protect the fixation of biceps tendon postoperatively by immobilizing the elbow in a flexed 90° and in a neutral rotation position. Our technique creates a tension-free construct when the elbow was brought through a range of motion as shown in video 1 (from 2:27 to 2:38 min). Consequently, there is no need to immobilize the elbow postoperatively.

A disadvantage of our technique is that this involves point contact of the biceps tendon to the bone, as compared with the larger contact created by the interference screw technique. However, we try to decorticate the bone over the fixation site in order to increase the contact area and facilitate tendon to the bone fibrous healing, which may subsequently strengthen the tenodesis construct. Tan et al. [24] also found the similar healing profiles between the tendon fixation in a bone tunnel and on the cortical surface. Moreover, we can avoid the risk of fracture from the creation of large bone tunnels for the interference screw [25].

In conclusion, our arthroscopic suprapectoral biceps tenodesis with knotless suture anchor can be considered a safe, effective and easily reproducible without requirement for extra-incision. We plan to report the clinical outcome in the near future.

Compliance with ethical standards

Conflict of interest Dr. Kongmalai has nothing to disclose.

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