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Technical note

An arthroscopic technique for full-thickness rotator cuff repair by transposition of the long head of biceps

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ABSTRACT

Arthroscopic rotator cuff (RC) repair is now considered as an effective treatment for patients with symptomatic rotator cuff tears. We reported a new method for repairing a full-thickness RC tear by using the double-row technique with transposition of the long head of biceps (LHB). The novelty of this technique is using the long head of the biceps as an augmentation. The indication of this technique consists of two aspects including LHB lesions and RC tears. Three patients were enrolled. An ideal reconstruction of the anatomic footprint of the tendon and stabilization of glenohumeral joint was achieved after the double-row technique with the transposition of the long head of biceps. At 6-month postoperation, the mean VAS score was 1.23 ± 0.15 and the mean Constant score was 88.00 ± 9.17. Transposition of the long head of biceps is a choice for full-thickness RC tear.
Level of evidence: IV, case series.

1. Introduction

The rotator cuff consists of the tendons of subscapularis, supraspinatus, infraspinatus and musculi teres minor. Its main role is to dynamically stabilize the glenohumeral joint, prevent upward migration of the humeral head, contributing to the initial phase of shoulder abduction and the internal and external rotation [1]. Rotator cuff tears continue to be a common cause of pain and disability of shoulder [2]. So far there is no consensus on the classification of rotator cuff lesions. In one study, Kuhn et al. [3] reported a high interobserver agreement in distinguishing between full-thickness and partial-thickness tears among experienced surgeons.

The advent of arthroscopy and arthroscopic surgical techniques has greatly provided various choices for treatment of rotator cuff tears [4]. Although a complete primary repair is ideal, this may not be achievable due to poor tendon quality or mobility. Thus, we could choose other methods including a decompression and debridement [5,6], partial repair [7,8], tendon transfer [9,10], and tendinous or fascial allograft materials inserted into the rotator cuff deficiency [11,12].

In this report, we described a new surgical technique for arthroscopic full-thickness rotator cuff repair with transposition of the long head of biceps (LHB), which is used as autograft material to fill the defect when a complete primary repair could not be implemented. Three patients accepted this feasible, minimally invasive option for the surgical treatment of full-thickness rotator cuff tears. The technical note is backed up by clinical results.

2. Preoperative set-up

Patients received a combination of general anaesthesia and an interscalene regional block. Patient was placed in the lateral decubitus position using a bean bag-type support placed on the torso and pelvis on a standard operating table. The operative arm was then placed in a foam traction sleeve, and 10 lb of traction was applied with the lateral arm holder. The arm was placed in 40 to 50 of abduction and 15 of forward flexion.

3. Portal placement

We started with a standard posterior portal approximately 2 cm inferior and medial to the posterolateral corner of the acromion.

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The scope was inserted into the glenohumeral joint. An anterior portal can be created using an inside-out or outside-in technique. This portal was approximately 1 to 2 cm inferior and medial to the anterolateral corner of the acromion through the rotator interval. The position of the lateral portal was localized by a spinal needle. We tried to position this portal at the midportion of the exposed footprint and 3 cm lateral to the lateral edge of the acromion. An accessory lateral portal is established just lateral to the lateral border of the acromion. This portal is established after localization with an 18-gauge spinal needle.

4. Surgical stages

4.1. First stage: initial assessment and acromioplasty

We evaluated the subscapularis, supraspinatus, infraspinatus tendon and the LHB tendon. Then we identified the location, size, and depth of the rotator cuff lesion. The arthroscope was then directed into the subacromial space using the lateral portal. The bursa was cleared using an arthroscopic motorized shaver via the posterior portal and the anterior portal. Then the radiofrequency device is used to expose the undersurface of the acromion, followed by standard anterior acromioplasty using a cutting block technique with a 5.5-mm arthroscopic burr. Next, careful inspection of the tear by using a cuff grasper may allow recognition of the tear pattern, which would be able to give us more precise information regarding to the treatments and outcomes. A large reverse L-shaped tear was identified in one patient (Fig. 1). The postoperative rotator cuff tear may still exist if we only adopt suture-bridge technique. Then, we evaluated the condition of the LHB tendon for degeneration, tearing and stability in the groove.

4.2. Second stage: transposition of the long head of biceps

An elevator was used to release any bursal-sided adhesions and mobilize the RC. We resected damaged tissue with the shaver up to a healthy-looking tendon. Then the LHB tendon was sutured to anterior edge of the supraspinatus by a nonabsorbable suture in simple suture (Fig. 2).

4.3. Third stage: fixation of the long head of biceps

The footprint was prepared under direct visualization through the same posterior portal using the shaver. Then a spinal needle was used to localize placement for an anchor portal, which was placed antero-medially closely to the entrance of the intertubercular groove. An awl was used to create sockets for the suture anchors, which were placed at an angle of 45° relative to the plane of the tuberosity. The arm can always be rotated internally or externally to ease insertion of the awl and anchors. The first suture was used to fix the LHB tendon (Fig. 3). After knotting the sutures with a common knot pusher, the remaining sutures of the anchor were performed to fix the LHB tendon again if necessary.

4.4. Fourth stage: transection of the LHB

The LHB tendon was cut with a radiothermal device 5 to 10 mm proximal to the knot of the suture near the bicipital groove (Fig. 4).

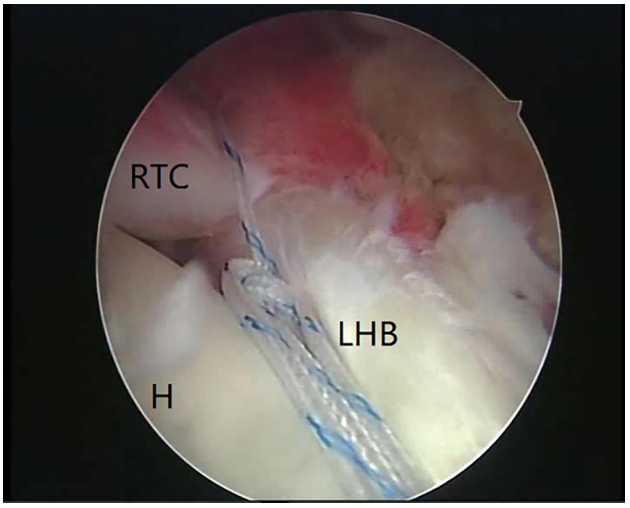

Fig. 2. Right shoulder (lateral decubitus position) viewed from the lateral viewing portal. The LHB tendon is sutured to the supraspinatus by a nonabsorbable suture in simple suture (LHB: long head of the biceps tendon; H: humeral head; RTC: rotator cuff).

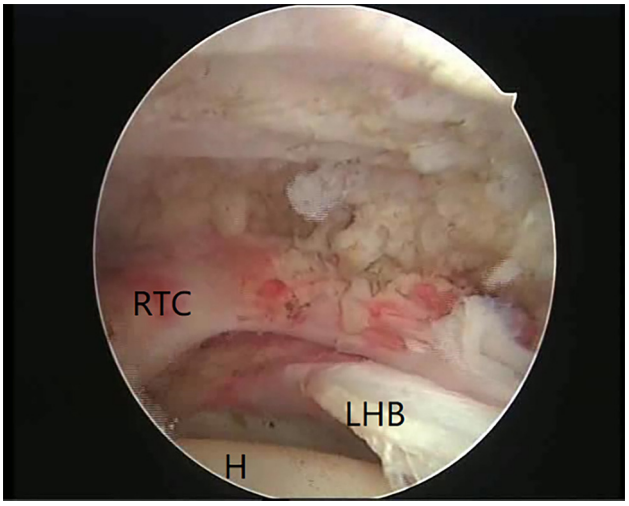

Fig. 1. Right shoulder (lateral decubitus position) viewed from the lateral viewing portal. The large reverse L-shaped tear is clearly visualized (LHB: long head of the biceps tendon; H: humeral head; RTC: rotator cuff).

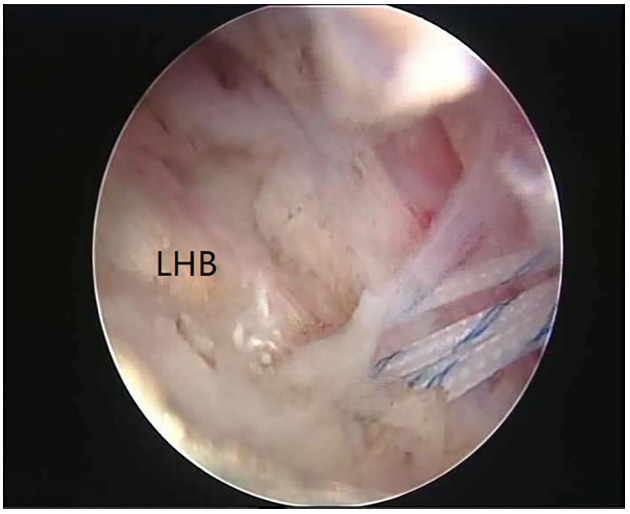

Fig. 3. Right shoulder (lateral decubitus position) viewed from the lateral viewing portal. Fixation of the LHB tendon using the sutures from the previous anchor (LHB: long head of the biceps tendon).

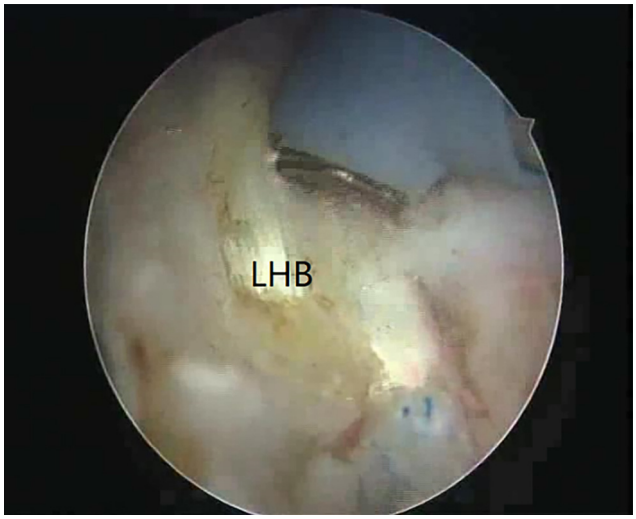

Fig. 4. Right shoulder (lateral decubitus position) viewed from the lateral viewing portal. Using a radiothermal device cut the LHB (LHB: long head of the biceps tendon).

4.5. Fifth stage: stabilization the long head of biceps

Then, we used marginal convergence sutures to make a more anatomic repair by 2 nonabsorbable sutures in simple suture, which is similar with the progress in the second stage. Thus the LHB tendon was more closed to the supraspinatus (Fig. 5).

4.6. Sixth stage: rotator cuff repair

All soft tissues of the greater tuberosity were cleared using the radiofrequency device, and the burr was used to prepare the greater tuberosity to bleeding bone. Then the awl was used to create sockets for the suture anchors at the articular cartilage margin. Double-loaded, 4.5-mm screw-in suture anchors were placed into the previously created sockets via the accessory lateral portal. After each anchor was placed, we tested the pullout by pulling on the sutures.

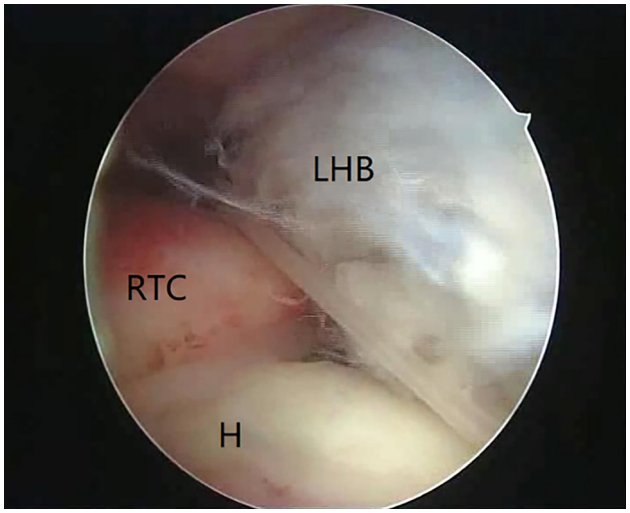

Fig. 5. Right shoulder (lateral decubitus position) viewed from the lateral viewing portal. After reassessment of torn cuff mobilization, two margin convergences (side-to-side suture) were performed to reduce the tear gap and to make the LHB tendon more closed to the supraspinatus (LHB: long head of the biceps tendon; H: humeral head; RTC: rotator cuff).

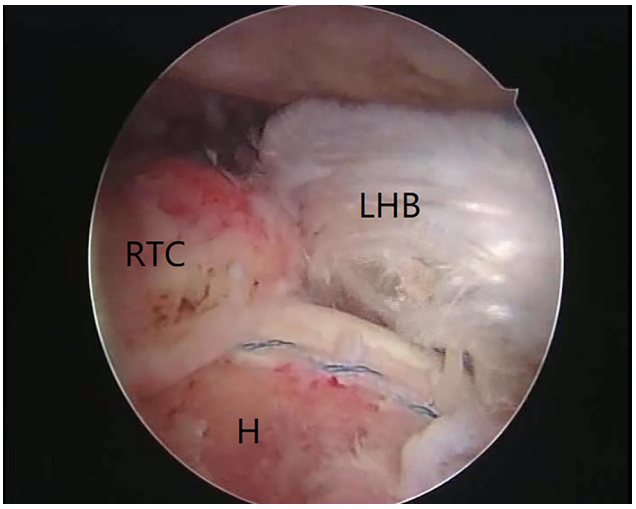

Fig. 6. Right shoulder (lateral decubitus position) viewed from the lateral viewing portal. The sutures limbs from the anchor is passed antegrade through the RTC tendon and pulled out through the lateral portal (LHB: long head of the biceps tendon; H: humeral head; RTC: rotator cuff).

The sutures were passed through the torn rotator cuff tendon in a horizontal mattress fashion with a suture-passing device (Fig. 6). The suture from anchors were passed as far away from the lateral edge of the cuff tissue and closed to the musculotendinous junction where the tissue quality was usually better to minimize suture cut-through. Sutures from the medial row anchors were then retrieved and tied through the accessory lateral portal, leading to re-establishing the rotator cuff footprint (Fig. 7).

Next, the bone was exposed laterally to the greater tuberosity using a radiofrequency ablator in preparation for lateral row anchor placement. The awl was used to create the socket for the anchors, which should be inserted approximately 10 mm distal to the lateral edge of the greater tuberosity. The previous sutures were retrieved through the lateral portal using a loop grasper. And 2 knotless lateral row anchors were then placed to receive the sutures from the medial row by the eyelet of the anchors. The anchor was placed into the socket, but prior to fully seating the anchor, the sutures were tensioned and bridged over the bursal surface of the RC. The anchor was then fully seated, and the sutures were cut flush with

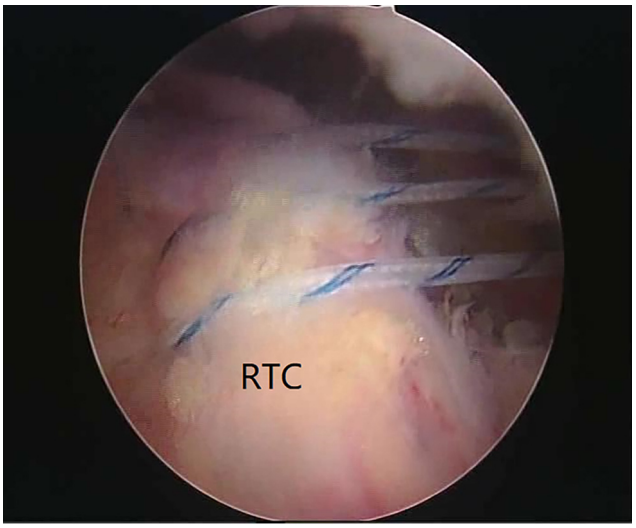

Fig. 7. Right shoulder (lateral decubitus position) viewed from the lateral viewing portal. After each pass, sutures are retrieved and brought out through the anterior portal (RTC: rotator cuff).

the anchor. This process was then repeated with the second lateral row anchor.

4.7. Seventh stage: transection of the LHB

The radiothermal device was used to cut the insertion of LHB tendon in the supraglenoid tubercle (Fig. 8).

5. Schematic diagram

The whole surgical procedure was illustrated in Fig. 9.

6. Results

All patients underwent an entirely arthroscopic procedure, with no conversion to open surgery. No intra-operative complication no infection occurred. At 6-month postoperation, the visual analogue scale (VAS) [13] score was decreased from 6.33 ± 1.85 to 1.23 ± 0.15, and the Constant score [14] was increased from 45.33 ± 16.04 to 88.00 ± 9.17.

7. Discussion

The pathologies of LHB tendon can be divided into inflammation, instability and traumatic lesions [15]. After evaluation of LHB tendon with arthroscope, we must make a decision of how to deal with LHB tendon. A majority of biomechanical studies investigated the contributions of LHB to glenohumeral stability, restraining abnormal translations [16–18], so we should conserve the tendon when no damage of LHB tendon happens. On the other hand, many surgeons prefer to perform biceps tenotomy or tenodesis to repair rotator cuffs when biceps tendon degeneration is confirmed during surgery, because the preserved biceps tendon has a potential risk of shoulder pain even after successfully rotator cuffs repair [19,20].

In this study, we found the lesions of LHB tendon in all three patients, which indicated tenotomy or tenodesis of LHB tendon. Next, we needed to choose the methods of repairing RC. Then, we could find that a complete primary repair of RC could not be achieved. Thus, we thought about making the long head of the biceps as an augmentation to fill the defect. Three patients received this novel technique.

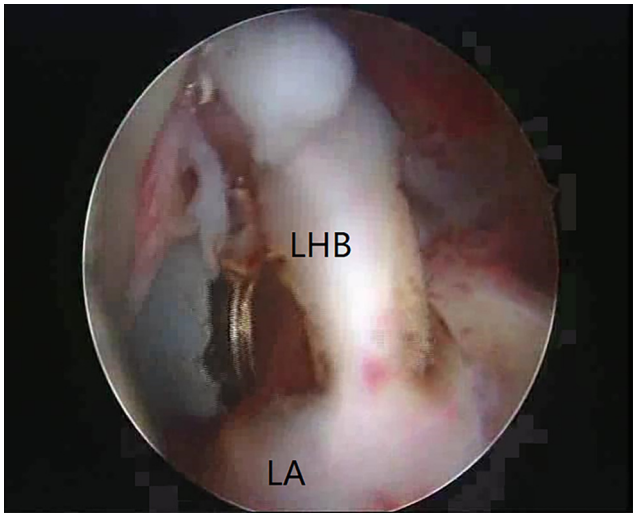

Fig. 8. Right shoulder (lateral decubitus position) viewed from the posterior intra-articular viewing portal. Cut the LHB tendon at its insertion at the supraglenoid tubercle using the radiothermal device (LHB: long head of the biceps tendon; LA: labrum articulare).

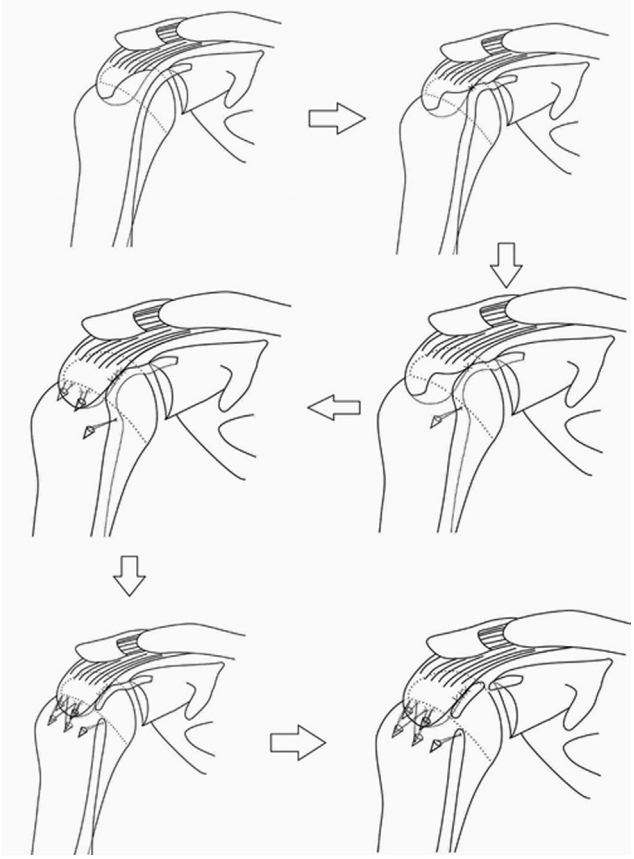

Fig. 9. Sketch map of operation procedure.

Besides, at the seventh stage, we consider cutting the supraglenoid insertion of the LHB for the finding of LHB degeneration at the supraglenoid insertion in these three patients. If not, we would omit the seventh stage, which could act as a biological superior capsular reconstruction [21,22].

The indication of this technique consists of two aspects. One is the degree of LHB lesions. Good tendon or severely damaged tendons are not suitable for this technique. Because, good tendon should be conserved whenever [23], and severely damaged tendons lack of strength to be an autograft. Another aspect is the classification of rotator cuff lesions. When a reducible cuff could be repaired with a complete primary repair, we do not need this technique. Also, massive irreparable rotator cuff tear is not suitable because a large defect may remain even after extensive release and mobilization of the retracted tendon stump [24]. So simple reducible cuff and massive irreparable rotator cuff tears are not suitable for this technique.

Compared to previously described arthroscopic techniques by using graft materials [25,26], as the autologous transplantation of tendon, this technique has the advantages of avoiding immune rejection, convenience of obtaining, and few expenses. Besides, it allows removal of the tendon from the bicipital groove and thereby potentially decreases postoperative pain, which is similar with the tenotomy and tenodesis.

8. Conclusion

There were many different rotator cuff repair techniques described in literatures. Herein, we developed a new surgical technique and should be continually tested before the implementation into clinical practice. However, patients chosen to be operated via this technique must comply with the indications. These three

patients in our study accepted this procedure with good outcome. We can conclude that transposition of the long head of biceps is a choice for full-thickness RC tear. Further, we need more clinical and biomechanical researches to support this novel technique.

Disclosure of interest

The authors declare that they have no competing interest.

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Authors' contribution

Surgery: Xinxian Xu, Xinghe Xue, Yang Yang, Xiaoyun Pan, Jian Lin.

Writing: Jian Lin, Weihui Qi, Kai Chen, Xiaobin Li, Yingzhao Yan.

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