

Modified Arthroscopic Double-Row Technique for Isolated Biceps Tenodesis

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Research article

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Abstract

Background

Due to certain complications with single anchor fixation reported in the literature, we proposed a modified double-row technique for arthroscopic biceps tenodesis.

Methods

From June 2014 to January 2018, 42 patients with isolated lesions of the long head of the biceps tendon were treated with an arthroscopic modified double-row technique. The Constant-Murley shoulder score, University of California Los Angeles shoulder score, and visual analogue scale score were evaluated preoperatively and postoperatively.

Results

All patients were followed up for an average of 28.6 months. The mean Constant-Murley shoulder score, University of California Los Angeles shoulder score, and visual analogue scale score were significantly improved from 52.6, 12.8, and 6.4 preoperatively to 94.3, 33.1, and 0.6 at the last follow-up, respectively ($P < 0.001$ for all). There was no postoperative incidence of persist bicipital groove pain or Popeye sign reported.

Conclusion

Arthroscopic tenodesis with a modified double-row technique could achieve satisfactory efficacy in the treatment of lesions of the long head of the biceps tendon. This method could be an alternative and reliable option for the treatment of the long head of the biceps tendon lesion.

Introduction

Lesions of the long head of the biceps tendon (LHBT) are a common cause of shoulder pain and dysfunction[1]. LHBT lesions can manifest as tendonitis, fraying or tearing, subluxation, and dislocation. LHBT lesions can be treated with conservative or surgical treatments in different circumstances. When conservative treatment is ineffective, biceps tenotomy or tenodesis is often used [2].

LHBT tenotomy has advantages of being simple, fast, and providing rapid convalescence[2, 3], but it also has disadvantages such as Popeye deformity, cramping pain, and occasional weakness[4]; hence, it is mainly used in elderly and low-demand patients[5]. LHBT tenodesis can maintain the length-tension relationship, prevent muscle atrophy, maintain elbow flexion and forearm supination strength, avoid cramping pain, and reduce the occurrence of Popeye deformity[6], and thus, it is especially suitable for young, highly active patients with thin arms[3].

LHBT tenodesis can be performed with an open or arthroscopic technique. With the advancement of arthroscopic instruments and surgical techniques, arthroscopic biceps tenodesis is being pursued by an increasing number of surgeons[7], because it has the advantages of less invasive, fewer complications and addressing concomitant shoulder conditions[8].

Methods for tenodesis can be generally categorized as soft tissue fixation[9, 10] and rigid fixation. The latter category can be further divided into the keyhole technique[11], bone tunnel technique[12], cortical button technique[13], interference screw technique[14], and anchor technique[3, 15], of which, the arthroscopic anchor fixation is the most common technique. Due to residual shoulder pain[16], tendon rerupture[17], and failure of fixation[18] with single anchor fixation presented by some reports[16-18], we proposed a modified double-row technique for arthroscopic LHBT tenodesis.

This study introduces the new technique for treating isolated LHBT lesions and presents an evaluation of the early clinical and functional outcomes following this surgical treatment. We hypothesized that this modified arthroscopic double-row technique could achieve satisfactory results in the treatment of isolated LHBT lesions.

Materials And Methods

From June 2014 to January 2018, a total of 42 patients with an isolated LHBT lesion were treated with our modified double-row technique for arthroscopic biceps tenodesis, and operations were performed by the same group of surgeons. This study was approved by the Ethics Committee at our hospital.

Inclusion/Exclusion Criteria

The inclusion criteria were: ineffectiveness of conservative treatment for >3 months; age ≤ 70 years; high demands for function and appearance; and confirmed presence of isolated LHBT damage (partial-thickness tear or fray of LHBT tendon of >25% to 50%; LHBT subluxation or dislocation; refractory inflammation of the tendon) during the surgery.

The exclusion criteria were: age >70 years; obsolete rupture and retraction of the LHBT; and combination with other shoulder disorders (such as neuropathy, rotator cuff diseases, Bankart lesion, shoulder fractures, etc.).

Surgical Technique

Under general anesthesia, the patient was placed in the side-lying position with the affected upper extremity abducted by 20° to 30° and flexed at 20°; longitudinal traction was provided with a weight of 5 to 10 lb (Star Sleeve Traction System; Arthrex, Naples, FL).

Standard posterior and anterior portals were established for intra-articular examination. After a thorough examination of the glenohumeral joint, the distal part of the tendon was drawn into the joint with a retriever to evaluate any pathologies of the portion within the intertubercular sulcus.

A spinal needle was utilized to pierce the LHBT into the joint cavity, and a radiofrequency device (Smith & Nephew, Andover, MA, USA) was used to sever the tendon at its junction with the glenoid insertion and debride the stump. The spinal needle was used to keep the LHBT in position and later to help find the location of the bicipital groove in the subacromial space.

Initially, the arthroscope was inserted into the subacromial space through the posterior portal. The routine lateral and anterolateral portals were established. The subacromial bursa was debrided, and acromioplasty was performed if necessary. Then the arthroscope was inserted into the lateral portal. Through the anterolateral portal, the spinal needle which was located at the bicipital groove was found, and the biceps sheath was opened. The LHBT was totally released to the level of the musculotendinous junction with the radiofrequency device. After that, the tendon was pulled out of the bicipital groove, and the inflamed tissue and synovium around the tendon and at the groove was debrided with the radiofrequency device. On the proximal part of the bicipital groove, a fresh bleeding bone bed was created. A double-loaded suture anchor (5.5-mm AR-1927BCF-45, corkscrew; Arthrex, Naples, FL) was placed into the groove at about 1 cm distal to its starting point (i.e., close to its entrance) via the anterolateral portal (Fig. 1A), and one suture was pulled out for cerclage of the distal row. A BirdBeak device (Arthrex, Naples, FL) was applied to penetrate the LHBT. One strand of the remaining suture was pulled through the tendon to make a suture loop (Fig. 1B,C), and the other strand of the remaining suture was pulled through the loop (Fig. 1D). The two strands of the suture were pulled to the anterior portal and untied temporarily.

Next, about 1 cm distal to the proximal loop made by the suture anchor, the middle part of the suture previously pulled out was grabbed to pass under the biceps tendon to form a loop (Fig. 2A). Both strands of the suture were pulled through the loop to tie the tendon (Fig. 2B). A PushLock (Arthrex, Naples, FL) was fixed into the groove about 1 cm distal to the first anchor with both strands of the suture threaded through the PushLock and tightened. The suture tails were trimmed short (Fig. 2C).

Then, both strands of the suture of proximal anchor were pulled to the anterolateral portal and tied using standard suture techniques. The tendon stump proximal to the suture anchor was debrided with the radiofrequency device. Finally, the elbow was flexed and extended to check the stability of the construct. The biceps tenodesis was now completed in the groove by the modified double-row technique (Fig. 2D).

Postoperative Rehabilitation

After operation, no shoulder sling was applied. Passive and active range-of-motion exercises were allowed immediately after the surgery, but active biceps flexion was prohibited for 2 weeks. Unrestricted active elbow activity and resistance exercises begun from the fifth week. Full recovery to sport activity was not granted until 3 months after the operation.

Follow-up and Outcome Evaluation

Preoperatively, all the patients were evaluated using the Constant-Murley shoulder (CS) score, the University of California Los Angeles (UCLA) score, and the visual analogue scale (VAS). All patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months after surgery, and the final postoperative follow-up review, and the final follow-up results were recorded. Postoperative complications were recorded.

Statistical Analysis

Statistical analysis was performed using SPSS 22.0 software. Data are expressed as average \pm standard deviation (SD), and the Wilcoxon rank sum test was used to perform statistical analysis. $P < 0.05$ was considered as statistically significant.

Results

The study included 18 males and 24 females with an average age of 52 years (range, 36–68 years). Lesions were on the left side in 12 cases and on the right side in 30 cases, and the lesion was on the dominant side in 37 cases. Among the 42 cases, there were 14 cases of biceps tendonitis, 6 cases of partial tendon rupture, and 22 cases of instability. All 42 patients were followed up for an average of 28.6 months (range, 25–32 months).

From the preoperative evaluation to the last follow-up, the CS score improved from 52.6 ± 2.4 to 94.3 ± 2.6 ; the UCLA shoulder score increased from 12.8 ± 1.7 to 33.1 ± 1.4 ; and the VAS score improved from 6.4 ± 0.9 to 0.6 ± 0.7 (Fig. 3). These improvements were all statistically significant ($P < 0.001$). During the follow-up period, no complications occurred, and all patients were satisfied with the operation. All the patients experienced pain relief, good functional recovery, and return to normal activity level.

Discussion

An isolated LHBT lesion is one of the most common causes of shoulder pain even in the absence of rotator cuff disease[19]. LHBT lesions are often associated with other shoulder diseases, and surgical outcomes would be affected by many confounding factors. There are only a few studies reporting clinical results for isolated LHBT lesions. In this study, patients with isolated LHBT lesions were enrolled and the early treatment effects were evaluated.

Although surgical treatment for LHBT lesions can be classified as LHBT tenotomy and LHBT tenodesis, in young patients with high activity requirements and concern with cosmetic appearance, biceps tenodesis is preferred because it is well-known to keep the length–tension relationship of the biceps tendon, maintain muscle strength, and result in less cramping pain and Popeye sign (cosmetic deformity) compared with tenotomy[6]. In this study, the mean age of the patients was 52 years old. Most patients had a dominant side injury, and all of them had a high requirement for function and appearance. Therefore, biceps tenodesis was chosen.

LHBT tenodesis can be performed with an open subpectoral technique[14] or an arthroscopic suprapectoral technique[20]. Studies have shown satisfactory efficacy of open subpectoral tenodesis[7, 21], but it is associated with greater risks of neurovascular injury[22], humeral fracture[23, 24], infection, scar cosmesis[25], and trauma. With the advancement of arthroscopic instruments and surgical techniques, arthroscopic biceps tenodesis is being adopted by an increasing number of surgeons[7], and it has certain strengths. For example, it is less invasive, capable of addressing additional concomitant shoulder pathologies, and associated with a lower risk of potential complications such as humeral fractures, neurovascular injury, and infection.

A variety of fixation methods exist for the arthroscopic suprapectoral biceps tenodesis, including the keyhole technique, interference screw, anchor fixation, etc. Good effects have been reported in the literature for these methods[7, 21], but also some shortcomings such as residual groove pain[16, 26-28], tendon rerupture[17, 29-31], and fixation failure[18, 27, 32] have been reported. There are several explanation for these complications: the absence of biceps sheath release and extensive debridement of the inflammatory tissue and synovium at bicipital groove and around the tendon during the operation[16, 33]; poor strength of the tenodesis construct; tendon fray; excess tension; and poor bone quality. For example, keyhole fixation may fail due to low primary stability[34], knot pullout[35], and excess tension[36]. The interference screw technique may lead to screw loosening[37] and tendon concis[32] because of proximal cancellous bone and tendon–bone extrusion[32], and the length-tension relationship is difficult to control with this technique[38, 39]. The traditional single anchor fixation technique may not offer adequate stabilization of the tendon, and the construct strength may be poor. Moreover, the biceps sheath is usually unreleased, and the contact area between the tendon and bone is small.

The modified arthroscopic double-row technique that we chose has the following strengths. First, the release of the biceps sheath could reduce the incidence of residual groove pain. Second, a more even distribution of load was provided by the two fixation points, thus decreasing the possibility of fixation failure associated with anchor failure or tendon concis. Third, the two fixation points form a straight line to increase the stability of the LHBT. Fourth, we performed cerclage (distal row) and strapping (proximal row) of the tendon, which reduced the risk of tendon rupture. Finally, because the fixation is reliable, there is no need for postoperative immobilization as long as the patient abstains from active biceps flexion for 2 weeks, allowing early mobilization of both the shoulder and elbow, which could decrease the risk of potential complications[34]. This study is limited by a sample size of only 42 patients with isolated LHBT lesions and a relatively short follow-up period. High quality clinical randomized controlled trials with larger sample sizes and longer follow-up periods are warranted to assess the efficacy of our technique.

Conclusion

we believe that on the premise of extensive release of the biceps sheath, firm fixation, and early passive and active training after surgery, this arthroscopic modified double-row technique can achieve good effects and is a recommendable treatment for LHBT lesions.

Declarations

Acknowledgements

Not applicable.

Authors' contributions

TK conceived the study design. LRL and TK performed the study, collected the data, and contributed to the study design. LRL prepared the manuscript. TK edited the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Not applicable.

Consent for publication

All the authors agreed to publish this study in the "J Orthop Surg Res."

Competing interests

The authors declare that they have no competing interests.

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Figures

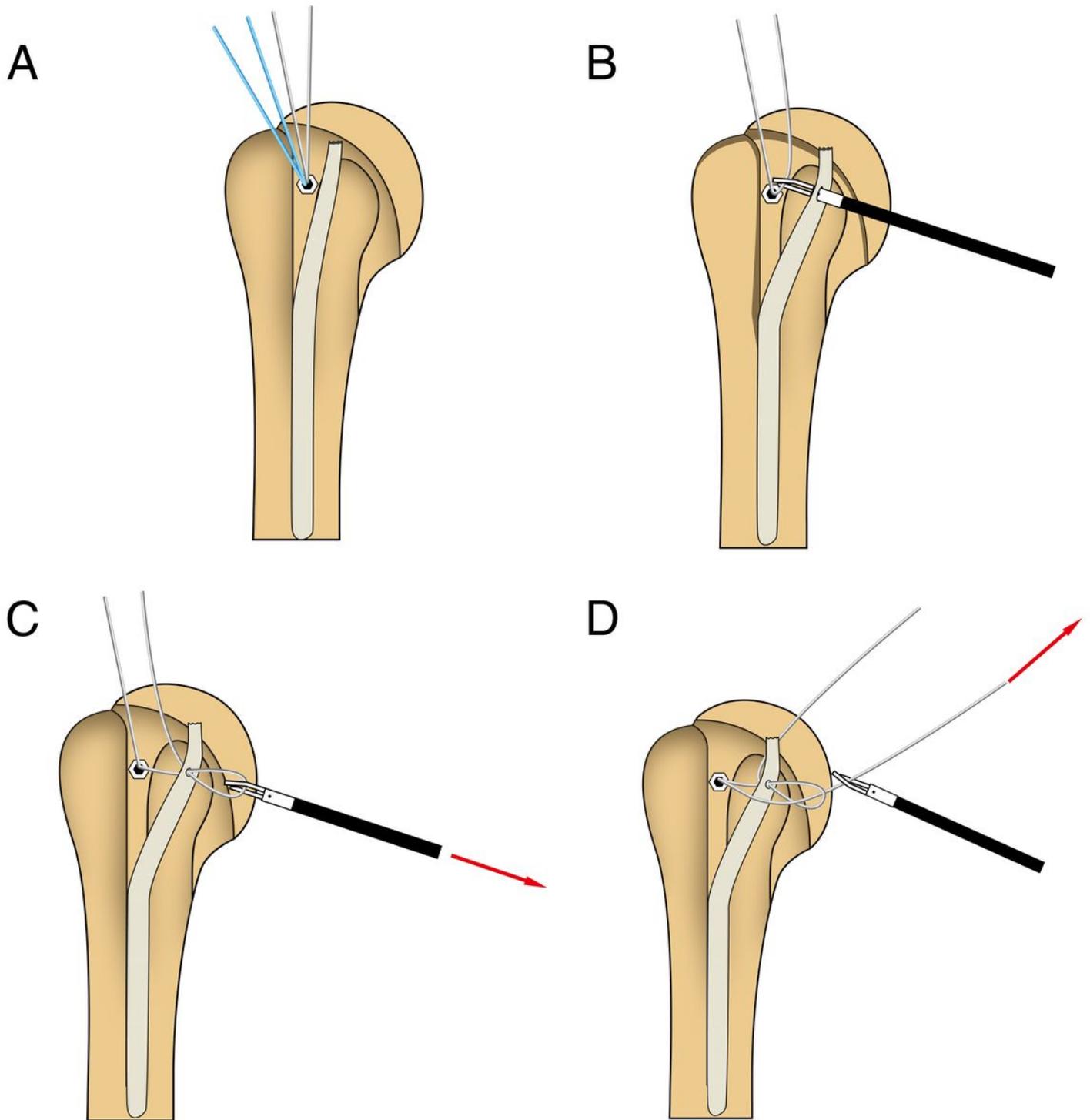
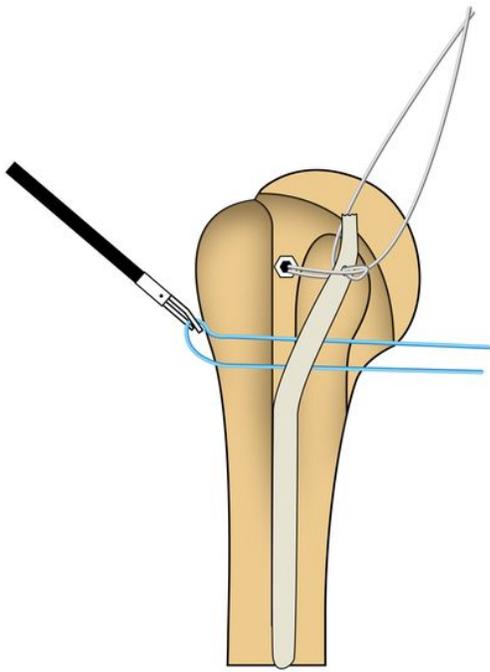
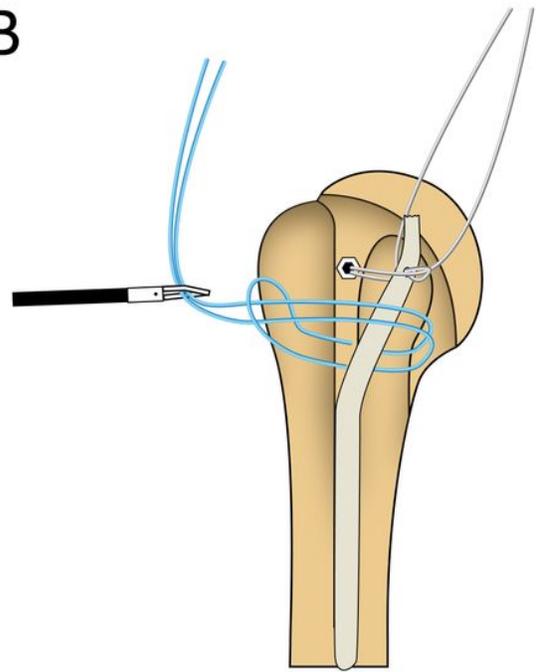
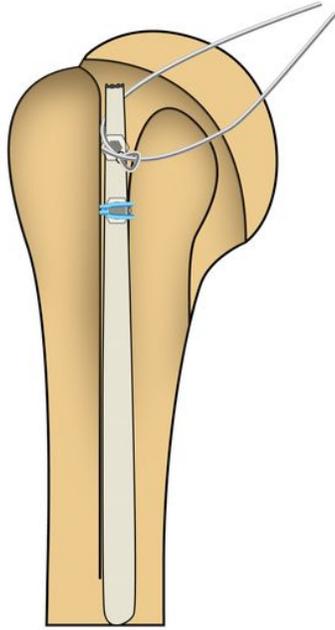
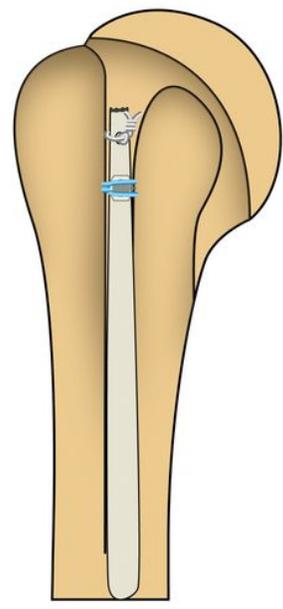


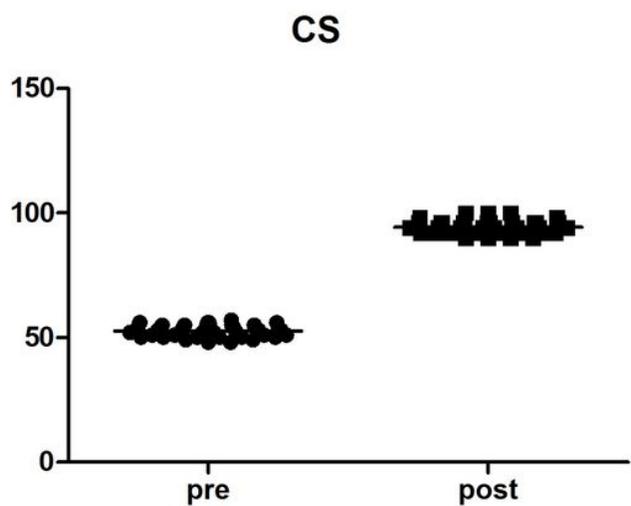
Figure 1

Schematic illustrations of tenodesis of the LHBT. A double-loaded suture anchor was placed in the bone close to the entrance of the bicapital groove (A). One strand of the suture was grasped to passed the tendon, partly to form a loop (B,C). The other strand of the suture was grabbed by the grasper to pass through the loop (D).

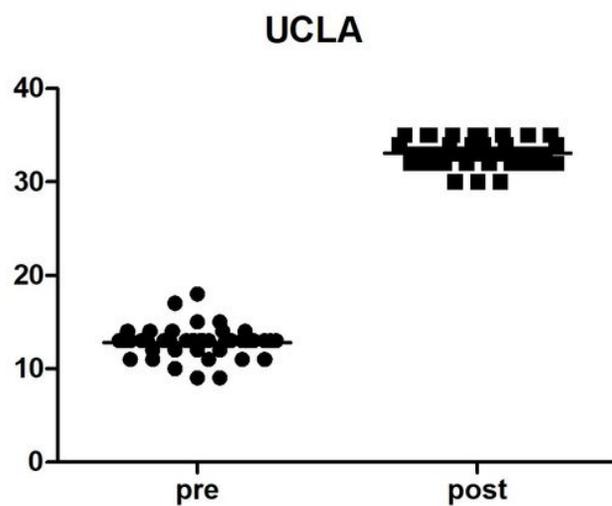
A**B****C****D****Figure 2**

Schematic illustrations of tenodesis of the LHBT. The middle part of the suture was grabbed by the grasper to pass under the biceps tendon to form a loop (A). The free ends of the suture were passed through the loop on the opposing side (B). The PushLock anchor was advanced into the bone (C). Final construct of the biceps tenodesis (D).

A



B



C

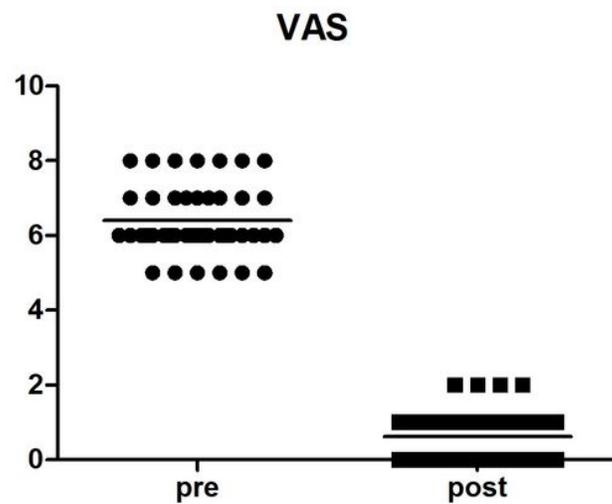


Figure 3

Preoperative and postoperative results for Constant-Murley, UCLA, and VAS scores.