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Research Article

Clinical Outcomes After Mini-Open Subpectoral Biceps Tenodesis

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Background

Long head of the biceps tendon pathology is a common cause of shoulder pain. Current surgical treatment options for long head of the biceps tendon disorders include tenotomy and tenodesis. Younger and high-demand patients are usually treated with tenodesis since tenotomy is associated with increased biceps pain and cramping, cosmetic deformity and patient dissatisfaction. Previous studies have shown biomechanical advantages of subpectoral open approach over arthroscopic suprapectoral approach, with less biceps over tension and increased ultimate load to failure. Despite this, there is a lack of consensus in the literature regarding the management of biceps-related pathology.

Methods

We retrospectively reviewed all patients who underwent subpectoral biceps tenodesis with unicortical endo-button fixation between January 2015 and December 2019. Only patients who had a minimum of 24 months follow-up were included in the study. We reviewed patient demographics. The American Shoulder and Elbow Surgeons and Visual Analogue score were assessed and complications were recorded.

Results

A total of thirty-two patients were enrolled in this study. 15 were young patients and sports athletes with SLAP (Superior Labrum from Anterior to Posterior) lesions or isolated biceps instability and the remaining 17 were middle-age patients with degenerative biceps disease and concomitant pathology. The mean follow-up time was 36 months. SLAP lesions group average age was 24,3 and degenerative group average age was 53,8. The ASES score and the VAS score and were statically significative better in the isolated subpectoral tenodesis due to SLAP lesions 99,8 and 0,1 respectively in

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comparison with the degenerative group, 85,7 and 1,5 respectively. We recorded two complications. One case of superficial infection and one case of a patient that was concomitant submitted to arthroscopic rotator cuff tear repair with persisting shoulder pain. There was no case of failure of fixation or associated Popeye deformity.

Conclusions

Subpectoral biceps tenodesis with unicortical endo-button fixation is a viable treatment option for patients with symptomatic biceps disease. Anterior shoulder pain and biceps symptoms were resolved with this technique. Patients with coexistent rotator cuff lesion may have less favorable outcomes.

INTRODUCTION

Although controversy exists regarding the function of the long head of the biceps tendon (LHBT), it is clear that disease affecting the LHBT can cause clinically significant shoulder pain (Forsythe, Zuke, Agarwalla, et al., n.d.; Belk et al. 2021).

LHBT pathology includes tendinitis, subluxation, dislocation, partial and complete biceps tendon tears and SLAP lesions, which are known sources of anterior shoulder pain (Chen et al. 2012). LHBT pathology is often caused by tendon degeneration resulting from persistent inflammation, tendon anchor disorders and LHBT instability (Romeo, Mazzocca, and Tauro, n.d.). Though commonly seen in association with other shoulder pathology, especially rotator cuff tears and glenohumeral joint osteoarthritis, injury to the biceps tendon is recognized as a significant, independent source of pain if left untreated (Belk et al. 2021).

LHBT might have a weak active head depressor or stabilizing effect that is clinically insignificant in the normal shoulder. Therefore, if the LHBT is implicated as a possible source of a patient's symptoms, the risk of decreased shoulder function from tenotomy or tenodesis is negligible compared with the risk of continued pain from biceps pathology (Strauss et al. 2014).

Authors differ whether tenodesis or tenotomy is the preferred surgical treatment for LHBT pathology (van Deurzen et al. 2020). Surgeons commonly perform biceps tenotomy in older, less active patients with no concerns about cosmetics and tenodesis in young, active patients, as it provides several theorical advantages such as maintaining forearm supination and elbow flexion strength. Tenodesis also has the advantage of maintaining the length-tension relation of the biceps muscle, which may reduce spasms and avoids "Popeye" deformity (Romeo, Mazzocca, and Tauro, n.d.; van Deurzen et al. 2020; Ergün et al. 2022).

Technical considerations include open versus arthroscopic approach, fixation technique, and tenodesis location, which are generally divided in arthroscopic suprapectoral or open subpectoral tenodesis. However, there is limited clinical evidence to suggest that superior LHBT tenodesis location may result in inferior outcomes as compared to a more distal tenodesis location (Belk et al. 2021; Lutton et al. 2011).

Arthroscopic suprapectoral technique appears to be associated with higher rates of Popeye deformity and persistent bicipital pain, while open subpectoral tenodesis is associated with transient neuropraxia (Ergün et al. 2022), but it also has been shown to reduce bicipital groove pain and stiffness in the early postoperative period (Belk et al. 2021; Y. Yi, Lee, Kwon, et al. 2016; G. Yi, Yang, Zhang, et al., n.d.). However, a recent meta-analysis found a significant, though not clinically relevant, difference in ASES in favor of subpectoral LHB tenodesis when compared with suprapectoral LHB tenodesis. Comparable results were found with regard to outcome scores, pain in the bicipital groove and avoiding a "Popeye" deformity (van Deurzen et al. 2020).

A systematic review showed that arthroscopic and open biceps tenodesis procedures have similar outcomes and complication rates, however, the authors excluded patients

with concomitant rotator cuff repairs (Abraham, Tan, and Kumar, n.d.).

The objective of this study was to evaluate the outcomes and complications of our experience with open subpectoral biceps tenodesis.

MATERIAL AND METHODS

All patients undergoing LHBT tenodesis from January 1, 2015 to December 31, 2019 at two medical institutions were identified.

A total of 32 patients that were submitted to arthroscopic long head of biceps tenotomy and mini-open subpectoral biceps tenodesis with unicortical endo-button fixation were included.

Patient demographics, comorbidities, and surgical variables of interest were recorded. Patient demographic characteristics included age at the time of surgery, sex, sports practice and history of prior ipsilateral shoulder surgery.

Surgical variables of interest included concomitant procedures at the time of LHB tenodesis, including rotator cuff repair, labral repair or subacromial decompression.

Outcome measures of interest were broadly categorized into patient reported outcome measure. General shoulder measures included the American Shoulder and Elbow Surgeons (ASES) score and the Visual Analog Scale (VAS) score. Patients were asked whether they experienced anterior shoulder pain, biceps spasms, or biceps muscle "fatigue." Furthermore, range of motion, strength testing, and neurologic function were assessed.

The Speed, Yergason and O'Brien tests were performed. All patients were observed for presence of a "Popeye" deformity, indicating failure of proximal fixation. Bicipital groove tenderness was assessed by palpation of the bicipital groove.

Sports athletes patient were evaluated according to their return to sports to the previous level.

Evaluated complications included wound infections requiring either antibiotic treatment or return to the operating room.

SURGICAL TECHNIQUE

Patients were placed in lateral decubitus position. After a diagnostic arthroscopy, arthroscopic tenotomy was performed. A 3 cm incision was then made in the axilla centered over the inferior border of the pectoralis major. The biceps tendon was found, and the diseased portion of the tendon was excised. Krakow-like sutures were placed 20 mm proximal to the myotendinous junction. A unicortical bone tunnel was then drilled in the bicipital groove using a guidewire. The tendon was fixed into the proximal humerus with an unicortical endobutton. Finally, the tag ends of the suture are then tied to reinforce the repair and cut to complete the procedure.

STATISTICAL ANALYSIS

Categorical variables are presented as frequencies and percentages, and continuous variables as means and standard deviations, or medians and interquartile ranges for variables with skewed distributions. Normal distribution was checked using Shapiro-Wilk test or skewness and kurtosis. Categorical variables were compared with the use of Fisher's exact test or the chi-square test, as appropriate. For the average comparison, Student's t test was implemented to compare quantitative variables. If test conditions were not met, a nonparametric test was used. All reported P values are two-tailed, with a P value of 0.05 indicating statistical significance.

RESULTS

A total of thirty-two patients were enrolled in this study. Fifteen patients (47%) were young sports athletes with SLAP lesions or isolated LHBT instability and the remaining 17 were middle-aged patients with degenerative biceps disease or concomitant pathology submitted to arthroscopic rotator cuff tear repair and/or subacromial decompression.

The mean follow-up time was 36.6 months (range 58-24 months). The mean age was 39.4 years (range 16-65 years). Twenty-one patients representing 66% were males and the remaining 11 (44%) were females.

The average postoperative VAS score was 0.84 (range 0-84) and average postoperative ASES score was 92.8 (range 100-79). SLAP lesion group had an average follow-up of 32.1 months vs 41.1 months of the degenerative group.

SLAP lesions group average age was 24.3 (range 16-34) and degenerative group average age was 53.8 (range 40-67). The ASES score and the VAS score and were statically significative better in the isolated subpectoral tenodesis due to SLAP lesions 99.8 and 0.1 respectively in comparison with the degenerative group, 85.7 and 1.5 respectively. ($p<0,001$).

All sports athletes, which include swimmers, handball players, volleyball players and a martial arts fighter, return to their previous sports at the same level.

We recorded two complications (6.25%). One case of superficial infection managed with oral antibiotics and one case of a patient that was concomitant submitted to arthroscopic rotator cuff tear repair with persisting shoulder pain. There was no case of failure of fixation or associated "Popeye" deformity.

DISCUSSION

Arthroscopic suprapectoral and open subpectoral biceps tenodesis are two surgical procedures performed to treat a number of pathologies of the LHBT. It has been shown that arthroscopic tenodesis is associated with persistent biceps tendinopathy due to a proximal tenodesis site that leaves a significative portion of the tendon within the bicipital groove (Lutton et al. 2011; Johannsen, Macalena, Carson, et al. 2013). Also, a biomechanical cadaveric study found that the arthroscopic technique tended to over-tension the

biceps tendon and had a significantly decreased load to failure compared with the open technique (Werner, Lyons, Evans, et al. 2015). However, clinical studies show no differences in pain, shoulder strength, function and failure rate between open with arthroscopic biceps tenodesis patients (Duchman, DeMik, Uribe, et al. 2016; Green, Getelman, Snyder, et al., n.d.).

The present study shows that mini open LHBT tenodesis procedure with similar clinical results and a low rate of complications in an 36.6 months average follow-up time.

In a systematic review with 500 patients, only 3 failures of fixation were noted following arthroscopic tenodesis and 2 failures following open tenodesis. Both open and arthroscopic biceps tenodesis provided satisfactory outcomes in most patients. However, the authors excluded patients with concomitant rotator cuff repairs (Abraham, Tan, and Kumar, n.d.). In our study, patients with concomitant pathology had worse outcomes than the isolated SLAP lesions patients. Patients undergoing concomitant rotator cuff repair have lower patient reported outcomes, mainly because these patients were significantly older and cuff repair undoubtedly changes several aspects of postoperative management and shoulder function. LHBT tenodesis is often performed in conjunction with other procedures, it should be noted that the success or unsuccess of the procedure, as measured by patient reported outcomes, should not be solely attributed to the tenodesis itself.

Clinical failures and complications following open LHBT tenodesis are rare. In our series we didn't have any failure of fixation or "Popeye" deformity. One patient sustained shoulder pain after rotator cuff repair but no tenderness or pain in the bicipital groove. We also had one case of superficial infection managed with oral antibiotics.

The postoperative VAS and ASES scores following open tenodesis studies in the present study compare favorably with previous reports, suggesting a good or excellent clinical outcome.

According to recent studies, the results of biceps tenodesis, compared with SLAP repair, were not inferior in the surgical treatment of overhead athletes with SLAP lesions regarding the ASES score, rate of return to sport, rate of return to preinjury level of sport, and complication rate (Shin et al. 2021).

The present study does have several limitations, including those inherent to a retrospective review. There was no control group with other biceps tenodesis techniques. Patients who were undergoing concomitant rotator cuff procedures was enrolled in this study, which may have affected the course of their treatment, rehabilitation, and recovery time. Another limitation of this study relates to the currently available patient-reported outcomes because no outcome measure has been validated for a LHBT procedure.

CONCLUSION

Open LHBT tenodesis consistently provide good to excellent clinical results with few complications in SLAP lesion and concomitant rotator cuff repair. These results are consistent with previously reported outcomes.

Subpectoral biceps tenodesis with unicortical endo-button fixation is a viable treatment option for patients with symptomatic biceps disease. Anterior shoulder pain and biceps symptoms were resolved with this technique. Patients with coexistent rotator cuff lesion may have less favorable outcomes.

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