

Symptomatic chronic long head of biceps rupture: Surgical results

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ABSTRACT

Purpose: Chronic rupture of the long head of biceps (LHB) tendon is usually asymptomatic. However, some active patients suffer with long-term cramping pain associated with repetitive biceps use. The aim of this study is to review the outcomes of biceps tenodesis performed for chronic LHB ruptures.

Materials and Methods: We performed a retrospective review of 11 consecutive patients who underwent biceps tenodesis for symptomatic chronic LHB ruptures over a 4-year period.

Results: There were 10 men and one woman with an average age at surgery of 41 years (range 23-65). The mean follow-up was 29 months (range 6-60). In five cases a tendon was still identifiable and suitable for repair with an 'in-bone' interference screw. However, in six cases the tendon was not possible to tenodesise with an interference screw. In these cases we used an 'on-bone' technique with suture anchors. All, except one, patients reported improvement in their arm pain (78%), strength (74%) and appearance. All, except one, were glad to have had the surgery.

Conclusions: Symptomatic chronic LHB ruptures improve with a biceps tenodesis procedure. Due to the chronicity of the injury and possible degeneration of the tendon, a suitable tendon for 'in-bone' tenodesis may not be possible. In these cases an 'on-bone' footprint repair with suture anchors achieves good results.

Level of Evidence: IV (retrospective case series).

Key words: Biceps tenodesis, chronic rupture, interference screw, long head of biceps, suture anchor

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INTRODUCTION

Rupture of the long head of biceps (LHB) tendon most frequently occurs secondary to degenerative changes within the tendon and is associated with underlying rotator cuff tendinopathy.^[1-3] A cadaveric study has shown concentration of degenerative changes within the tendon at the distal bicipital groove, which could explain the predilection for tendon rupture at that site.^[4]

Less commonly, acute traumatic LHB ruptures may occur without the presence of rotator cuff disease and several cases have been reported in young athletes.^[5-7] The vast majority of isolated LHB ruptures are asymptomatic, and thus are amenable to conservative management.^[8] However, several clinical studies have demonstrated that elbow flexion strength could

diminish by 8% to 16%, supination strength could decrease by 11% to 21% and muscle endurance could reduce by up to 25%, as a consequence of the ruptures.^[9-11] These observations may explain the small group of patients who subsequently develop long-term cramping pain and discomfort associated with repetitive biceps activities. In these cases, biceps tenodesis may be considered to relieve the symptoms.

In this article, we report the outcomes of patients who have undergone biceps tenodesis for symptomatic chronic LHB ruptures.

MATERIALS AND METHODS

A retrospective review was performed of 11 consecutive patients (11 shoulders) who underwent biceps tenodesis for

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symptomatic chronic LHB ruptures by the senior author between September 2006 and April 2011. The criteria used for inclusion in this study were any patients who had sustained isolated chronic ruptures of their LHB tendons and subsequently undergone biceps tenodesis at least 3 months after injury. Cases of biceps tenodesis performed for biceps tendonitis, instability or as part of other shoulder procedures were excluded from this study.

The diagnosis of LHB rupture was made clinically. Patients often recalled a traumatic incident involving eccentric contraction of the biceps. Clinical examination revealed the characteristic Popeye sign. In addition, the patients were assessed thoroughly for any concomitant shoulder pathology. Imaging such as ultrasound or MRI was employed to exclude any underlying rotator cuff disease. All patients had been seen by an orthopaedic surgeon within 3 months of LHB rupture. All had failed to improve after a period of conservative treatment with analgesia and physiotherapy. The primary complaint of the patients was cramping pain and discomfort associated with repetitive biceps use. The interval period between sustaining the injury to undergoing surgery was at least 6 months.

Patient data were obtained from a prospectively managed database and telephone conversations with all the patients at the latest follow-up. Patient demographics included the following: Age, gender, time to surgery after the injury, and length of follow-up. Findings at the time of surgery and tenodesis technique employed were also noted. At final follow-up, patient progress was evaluated with the following questions:

1. Compared with before surgery, what is the percentage of improvement in the pain of your arm now? (0-100%)
2. Compared with before surgery, what is the percentage of improvement in the strength of your arm now? (0-100%)
3. Compared with your opposite (normal) arm, what is the strength of your operated arm now? (0-100%)
4. How long did it take for the operated arm to regain its maximal strength? (months)
5. How would you grade the appearance of your biceps now? (0- no difference to before surgery;
1- slightly better than before surgery;
2- moderately better than before surgery;
3- the same as before injury)
6. Are you glad to have had the surgery? (Yes or No)

All subjects gave informed consent to participate in the study. Approval by the local institutional review board was not required as it was considered a clinical audit.

Operative technique

All surgeries were performed or directly supervised by the senior author. Surgery was performed under general anaesthesia with additional local anaesthesia. An interscalene block had not been necessary for this procedure. The patient was placed in the beach chair position with his/her arm on light traction holding the elbow in 30 degrees flexion and neutral forearm

rotation. A 3 cm longitudinal incision was made through the skin and subcutaneous tissue at the level of the proximal musculotendinous junction, where the defect in the upper arm was palpable. The inferior edge of the pectoralis major was then identified and retracted superiorly to expose the humerus. If a good quality tendon was found, then this was mobilised and extricated. The tendon could then be reattached more proximally using an interference screw tenodesis technique.

However, in some cases a decent tendon was not found due to the chronicity of the injury, degeneration of the tendon or site of injury being at the musculotendinous junction. In these cases a scarred musculotendinous junction was found with no proximal attachment. The retracted musculotendinous unit was mobilised as much as possible and an attachment point to the humerus was determined where it could be attached without undue tension with the elbow in 30 degrees flexion. The insertion point on the humerus (usually just distal to the inferior edge of the pectoralis major) was prepared by decorticating a 2 × 2 cm area of the anterior humeral shaft, to allow endosteal bleeding. Three Superquick (Depuy Mitek) anchors with double-loaded Orthocord were then inserted in a triangular configuration. This allowed for a broad footprint attachment for good healing. The sutures were passed from deep to superficial through the torn end of the tendon, using a combination of mattress and modified Kessler suture techniques. Sequential tightening allowed a broad and secure apposition of the tendon to the bone.

The elbow and shoulder were then moved through full range to assess the tension of the repair. The wound was closed in layers with absorbable sutures.

Post-operative rehabilitation

Following the operation, a sling was worn for comfort only. For the first 3 weeks, the patient could actively mobilise the shoulder and elbow as tolerated. However resisted elbow flexion and forced passive extension was avoided for 6 weeks after surgery. After that, concentric and eccentric biceps exercises were begun. Heavy lifting was avoided during the first 3 months.

Statistical analysis

The data were not normally distributed and hence, non-parametric test (Mann-Whitney *U* test) has been used to compare continuous variables between the study subgroups. A Pearson's correlation coefficient was computed to assess the relationship between age at surgery and the interval between injury and surgery. The level of significance was set at $P < 0.05$.

RESULTS

Patient demographics

There were ten men and one woman with an average age at surgery of 41 years (range 23-65). The mean follow-up was

29 months (range 6-60). The mean interval between injury and surgery was 25 months (range 6-96). The age at surgery and the interval between injury and surgery were correlated with $r = 0.682$, $P = 0.021$.

Surgical findings

In five of these cases, a decent quality tendon was found and tenodesis was performed using the 'in-bone' interference screw technique. However, in six cases, the tendon was not discernable or possible to tenodesis with an 'in-bone' interference screw. Furthermore, the biceps muscle was too retracted and irretrievable for a standard proximal biceps tenodesis. In these cases we used a footprint 'on-bone' tenodesis technique with suture anchors.

The mean interval from injury to surgery of the suture anchor group ($30.0 \pm$ standard error of mean 13.9 months) was longer than that of the interference screw group (18.0 ± 3.6 months) but the difference did not reach statistical significance (Mann-Whitney U test, $P = 0.927$).

Pain

Using a subjective pain scale, all except one patient reported improvement in their arm pain with a mean percentage of 78% (± 9). This refers to the percentage of relative improvement rather than an absolute reduction.

Strength

Using a subjective strength scale, all except one patient reported improvement in the strength of their arms with a mean percentage of 74% (± 9). Compared with their opposite arms, the mean strength of the operated arms was 72% (± 8). On average, patients took 11 months (range 6-18) to reach the maximal recoverable strength of their arms.

Cosmesis

All, except one, patients noted improvement in the appearance of their biceps contours. Three felt the appearance improved slightly after surgery; four reported moderate degree of improvement; and three felt that their biceps muscles now appeared the same as they were before the injury. The last group of patients all underwent tenodesis with an interference screw.

Failure

All, except one, patients were glad to have had the surgery. Overall there was only one failure in this series who consistently reported no improvement in pain, strength and cosmesis. He was the oldest patient (65 years) in the series and had the longest interval between injury and surgery (96 months).

Complications

There were no cases of infection, neurovascular injury, adhesive capsulitis or humeral fracture in the study population.

DISCUSSION

Chronic rupture of the LHB tendon is usually asymptomatic, but some active patients suffer with long-term cramping pain and discomfort associated with repetitive biceps use. We postulate that these are the patients that fail to auto-tenodesis to the brachialis muscle, short head of biceps or humeral shaft. A muscle requires two fixed points at both ends in order to contract and generate kinetic energy. Where the proximal fixation point is lost, contraction of the muscle leads to cramping and discomfort. In a specialist shoulder practice over a 4-year period, only 11 patients with the condition requested for surgery because of persistent troublesome symptoms. Within the group, younger patients appeared to tolerate discomfort less and tended to seek surgical intervention earlier. In addition the patients were almost exclusively male, which may simply reflect higher physical demands of the patients.

There are many surgical techniques of proximal biceps tenodesis, including bone bridges, keyhole fixation, suture anchors, interference screw, or endobutton.^[12-17] The choice of a specific technique is dependent on the quality and mobility of the torn tendon end as well as skills and preference of the surgeon. Arthroscopic technique would not be suitable for this group of patients due to chronic retraction of the muscles. When a good quality tendon that could be reattached more proximally in the humeral metaphysis was found, tenodesis using an interference screw was our preferred technique. Cadaveric studies have shown favourable biomechanical properties and load-to-failure of interference screw fixation.^[13,18,19] However in over half of the cases, the tendon quality was poor and degenerate. In some it was completely absent precluding the use of an interference screw. In these cases, an in-situ tenodesis utilising three suture anchors at the humeral diaphysis was performed. Millett *et al.*,^[17] suggested that residual pain at the location of tenodesis could be an issue when suture anchors were used in the subpectoral location but this had not been our experience. The use of interference screw at the humeral diaphysis is also not recommended due to the creation of stress riser at the drill hole and cases of delayed humeral fractures have been reported.^[20]

There is a paucity of literature specifically evaluating the outcomes of tenodesis for chronic LHB rupture. Tucker and Dutta described a two-incision technique where the torn tendon was sutured using Krakow technique which was then fixed to the bone with an interference screw.^[21] They discussed briefly their clinical experience with three patients who were improved in terms of pain and appearance of their arms. However no details on the patient demographics or outcome scores were reported.

Preoperatively, the patients were counselled specifically that the operation may not necessarily improve the appearance of their biceps contours. Rather the primary aim of the operation was to relieve the cramping pain associated with

repetitive biceps activities. Nonetheless, all of the patients, except one, in this study noted some degree of improvement in the cosmesis of their biceps. In particular, three of the five patients who still retained a good quality tendon hence permitting reattachment of the tendon at a more proximal site reported that their biceps now appeared the same as before the injury.

The limitation of our study is that we had a relatively small sample size but this simply reflects the fact that most patients with isolated LHB ruptures respond well to conservative treatment.

CONCLUSIONS

Symptomatic chronic LHB ruptures improve with a biceps tenodesis procedure. Due to the chronicity of the injury and possible degeneration of the tendon, a suitable tendon for 'in-bone' tenodesis using an interference screw may not always be found. In these cases an 'on-bone' footprint repair with suture anchors achieves good results.

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