Subpectoral biceps tenodesis using a novel anterior cortical button technique

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Abstract

Background: Various surgical treatments are described in the literature for biceps pathology.

Method: The techniques currently described for subpectoral tenodesis involve the use of suture anchors, interference screws, bicortical suture buttons or unicortical suture buttons.

Results: A review of 31 patients with a subpectoral biceps tenodesis using the anterior cortical button technique is presented.

Conclusions: We describe a novel technique, which provides an opportunity to obtain a robust cortical and intramedullary tenodesis, performed under direct vision without the risk of drilling the far cortex and therefore avoiding any potential for neurological injury. There is no cortical implant, which may lead to a diaphyseal stress riser and subsequent fracture risk.

Keywords

Biceps, endobutton, subpectoral, technique, tenodesis

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Introduction

The role of the long head of the biceps tendon in shoulder function remains in question. As a result, the most appropriate treatment of the diseased tendon has been the subject of controversy.¹ Various surgical treatments are described in the literature for biceps pathology, which can be broadly classified into biceps tenotomy or biceps tenodesis. Tenodesis can be described based upon the location of tenodesis fixation; intra-articular, within the bicipital groove or below the bicipital groove.² Fixation of the tenodesis can be achieved by using suture material, interference screw, suture anchors, suture cortical buttons or a combination of these materials.

A recent cadaveric study has shown that many lesions of the long head of the biceps develop proximal to the bicipital groove. Therefore, suprapectoral (intra-articular or within the bicipital groove) techniques may fail to address much of the pathology and could lead to persistent pain and failure.³ Tenodesis in the subpectoral region is the only technique that can reliably address all potential lesions with the highest ultimate failure strength and a low incidence of revision surgery.^{4,5}

The techniques currently described for subpectoral tenodesis involve the use of suture anchors, interference

screws, bicortical suture buttons or unicortical suture buttons. Interference screws or the use of bicortical suture buttons placed into the subpectoral diaphyseal region of the humerus bears the risk of fractures and neurological injury.^{6–8}

We describe a novel technique, which provides an opportunity to obtain a robust cortical and intramedullary tenodesis, performed under direct vision without the risk of drilling the far cortex and therefore avoiding any potential for neurological injury. Moreover, there is no cortical implant, which may lead to a diaphyseal stress riser and subsequent fracture risk. It also facilitates tenodesis in a poor quality tendon as is commonly seen with patients with chronic biceps tendon problems.⁹ For the purposes of this paper a demonstration of our technique was performed on a cadaveric specimen with generous dissection to highlight key steps. The cadaveric specimen was used in accordance with the Human Tissue Act 2004.

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Surgical technique

Surgery is performed under general anaesthetic with an interscalene block. The patient is positioned in the beach chair position, prepped and draped, leaving the shoulder and ipsilateral upper limb exposed. The arm is placed in a mobile arm positioner (Trimano, Arthrex). Standard posterolateral and anterior portals are made and a diagnostic arthroscopy is performed to assess the glenohumeral joint, subacromial space and the long head of biceps (LHB). After confirming the pathology of the LHB a transfixing spinal needle is inserted into the tendon and an arthroscopic biceps tenotomy is performed. The arm is abducted and externally rotated and held in this position using the arm positioner. A 3–4 cm longitudinal incision is made over the anteromedial aspect of the upper arm in line with the LHB and over the inferior aspect of the pectoralis major. The fascial layer overlying the pectoralis major and the biceps is identified and incised. The underlying LHB tendon is identified. Care is taken to avoid vigorous medial retraction due to risk to the neurovascular bundle.

The musculotendinous junction of the LHB is identified and marked with a marker. The corresponding point on the humerus is then marked to provide a reference point for later tensioning of the biceps tenodesis. This assures that the correct tension within the tenodesis is achieved without over-tightening or

under-tightening of the tendon which could affect the outcome. The transfixing needle is then removed and the LHB tendon delivered through the incision. The bed for the tenodesis is prepared using a rasp or periosteal elevator. The LHB tendon is then divided approximately 2.5 cm from the musculotendinous junction and a modified krackow stitch is placed using a no. 2 high strength suture leaving two trailing sutures at the stump end (Figure 1). If the LHB has a chronic rupture, the retracted tendon can be marked approximately 2.5 cm proximal to the musculotendinous junction and tenodesis performed with reasonable tension.

The anterior humeral cortex is prepared with a 6–8 mm pilot-headed reamer depending upon the size of the biceps stump. A second 2.5 mm unicortical drill hole is made approximately 2 cm proximal to the first hole. A curved suture passer is placed in the proximal hole and the suture lasso from this passer retrieved from the distal hole (Figure 2). The two trailing sutures from the biceps tendon stump are then shuttled through the distal hole to exit the proximal hole and fed through a cortical button. This allows the tendon to be docked into the distal hole and lie in the intramedullary canal. The trailing sutures are tied over the button after adequate tension is achieved (Figure 3). Careful haemostasis is undertaken and the deep and superficial layers

Figure 1. Modified krackow stitch (or equivalent) placed using no. 2 high strength suture.

Figure 2. Suture lasso passed from proximal to distal to retrieve trailing sutures. Drill holes also shown.

Figure 3. Final tenodesis shown with biceps adequately tensioned.

closed including the skin. The arm is immobilised in internal rotation with a sling.

Patients are allowed full range of motion exercises as comfort allows but strengthening is avoided for three months post-surgery. Further rehabilitation is guided by the nature of the index procedure, such as a rotator cuff repair, under the supervision of a physiotherapist.

Clinical outcomes

Between January 2015 and July 2017 the senior author performed 31 subpectoral biceps tenodesis using the anterior cortical button technique. All 31 patients were male with a mean age of 48 years (age 28–63 years). The surgery was performed for the dominant arm in 22 patients. A biceps tenodesis only procedure was performed in one patient, with 14 patients having an associated arthroscopic rotator cuff repair and 16 patients an arthroscopic subacromial decompression. There were no infections, fractures or revisions. Three patients had ongoing subacromial discomfort which settled following a bursal injection and physiotherapy. There was one clinical failure in a patient who started over-early strength training and reported a popeye deformity and cramping, which eventually settled with

therapy. One patient developed anterior arm pain which was thought to be nerve related and following a referral to a peripheral nerve surgeon was discharged with no discernible surgical cause for his symptoms; he eventually improved with therapy. All patients were satisfied with the eventual post-operative results and discharged with a full return to work and/or previous activity levels.

Discussion

Biceps tenotomy and tenodesis are the two commonly performed procedures for biceps tendinitis with tenotomy being a technically simpler procedure.¹⁰ De Carli et al. assessed clinical, functional and radiological results between patients with a rotator cuff tear and LHB degeneration treated with tenotomy or tenodesis. They found a statistical difference in power loss between the operated and non-operated side, but they were unable to demonstrate any significant difference between the biceps tenodesis and tenotomy groups.¹¹ Further studies comparing tenotomy and tenodesis have also failed to show statistically significant differences between the groups in older patients.¹² The incidence of the popeye sign is significantly higher for biceps tenotomy with both Hsu et al.¹³ and Slenker et al.¹⁴ showing a higher incidence of the popeye sign for biceps tenotomy compared to tenodesis with 41% versus 25% and 43% versus 8%, respectively.

There is very little scientific evidence for the best treatment for LHB pathology in the younger patient. Duff and Campbell¹⁵ included manual workers and found that tenotomy was well tolerated. However, several studies have shown that patients treated with tenotomy can have muscle cramps, decreased supination strength, and fatigue.^{16,17} Biomechanical studies in cadavers have shown that there is 40% incidence of failure in patients with biceps tenotomy with the weighted-mean average load to tendon failure being 81.6 N for tenotomy compared with 233.5 N for tenodesis.¹³

Biceps tenodesis, therefore, is usually the preferred surgical technique in the younger patient and has been shown to provide restoration of strength in the biceps muscle.¹² The highest ultimate failure strength of biceps tenodesis was seen in the open subpectoral biceps tenodesis cohort with a low incidence of revision.^{4,5} However, the risk of fractures following interference screws and neurological injury with bicortical buttons remains a challenge. A cadaveric study by Ahmad et al.¹⁸ looked at ultimate failure strength and slippage under cyclic loading of different fixation devices and found the endobutton to have superior fixation biomechanics when compared with an interference screw. Furthermore, the fixation with an interference screw

could potentially weaken the already degenerative tendon further, placing it at risk of rupture at the cortical margin. Our technique addresses these issues as the posterior cortex is not breached and a strong intraosseous tenodesis with an anterior button is achieved avoiding any further damage to the diseased tendon or risk to the axillary nerve.

Conclusion

Open subpectoral tenodesis has the strongest pull-out strength of all fixation methods and the lowest revision rate. Our technique retains all the benefits of a bicortical endobutton tenodesis with protection of the axillary nerve and preservation of tendon quality. We recommend this technique be considered for patients undergoing a biceps tenodesis.

Declaration of Conflicting Interests

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Ethical Review and Patient Consent

All patients in this study signed consent forms for their anonymised data to be used for scientific and research purposes. Data was analyzed retrospectively and there was no change in the patients' standard of care or decision-making.

References

1. Ball C, Galatz LM and Yamaguchi K. Tenodesis or tenotomy of the biceps tendon: why and when to do it. *Tech Shoulder Elbow Surg* 2001; 2: 140–152.
2. Cash D and Jones M. Role of tenodesis in upper limb surgery. *J Bone Joint Surg Br* 2011; 93: 285–292.
3. Moon SC, Cho NS and Rhee YG. Analysis of “hidden lesions” of the extra-articular biceps after subpectoral biceps tenodesis: the subpectoral portion as the optimal tenodesis site. *Am J Sports Med* 2015; 43: 63–68.
4. Sanders B, Lavery KP, Pennington S, et al. Clinical success of biceps tenodesis with and without release of the transverse humeral ligament. *J Shoulder Elbow Surg* 2012; 21: 66–71.
5. Lutton D, Gruson K, Harrison A, et al. Where to tenodesis the biceps: proximal or distal? *Clin Orthop Rel Res* 2011; 469: 1050–1055.
6. Dein EJ, Huri G, Gordon JC, et al. A humerus fracture in a baseball pitcher after biceps tenodesis. *Am J Sports Med* 2014; 42: 877–879.
7. Lancaster S, Smith G, Ogunleye O, et al. Proximity of the axillary nerve during bicortical drilling for biceps tenodesis. *Knee Surg Sports Traumatol Arthrosc* 2016; 24: 1925–1930.
8. Sethi PM, Vadasdi K, Greene RT, et al. Safety of open suprapectoral and subpectoral biceps tenodesis: an anatomic assessment of risk for neurologic injury. *Shoulder Elbow Surg* 2015; 24: 138–142.
9. Ng CY and Funk L. Symptomatic chronic long head of biceps rupture: surgical results. *Int J Shoulder Surg* 2012; 6: 108–111.
10. Frost A, Zafar MS and Maffulli N. Tenotomy versus tenodesis in the management of pathologic lesions of the tendon of the long head of the biceps brachii. *Am J Sports Med* 2009; 37: 828–833.
11. De Carli A, Vadala A, Zanzotto G, et al. Repairable rotator cuff tears with concomitant long-head biceps lesion: tenotomy or tenotomy/tenodesis? *Knee Surg Sports Traumatol Arthrosc* 2012; 20: 2553–2558.
12. Gartsman GM and Hammerman SM. Arthroscopic biceps tenodesis: operative technique. *Arthroscopy* 2000; 16: 550–552.
13. Hsu AR, Ghodadra NS, Provencher MT, et al. Biceps tenotomy versus tenodesis: a review of clinical outcomes and biomechanical results. *J Shoulder Elbow Surg* 2011; 20: 326–332.
14. Slenker NR, Lawson K, Ciccotti MG, et al. Biceps tenotomy versus tenodesis: clinical outcomes. *Arthroscopy* 2012; 28: 576–582.
15. Duff SJ and Campbell PT. Patient acceptance of long head of biceps brachii tenotomy. *J Shoulder Elbow Surg* 2012; 21: 61–65.
16. Lam F and Mok D. Treatment of the painful biceps tendon-tenotomy or tenodesis? *Curr Orthoped* 2006; 20: 370–375.
17. Kelly AM, Drakos MC, Fealy S, et al. Arthroscopic release of the long head of the biceps tendon: functional outcome and clinical results. *Am J Sports Med* 2005; 33: 208–213.
18. Ahmad CS, Gardner TR, Groh M, et al. Mechanical properties of soft tissue femoral fixation devices for anterior cruciate ligament reconstruction. *Am J Sports Med* 2004; 32: 635–640.