Arthroscopic keyhole proximal biceps tenodesis: a technical note

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ABSTRACT

We describe an arthroscopic keyhole technique for proximal biceps tenodesis. The technique is safe, easy to reproduce, cost-effective, and less time consuming. It does not need any special instrumentation and is suitable especially for use in the developing countries. It enables examination of the biceps sheath and distal biceps tendon for unidentified tears, synovitis, and fibrosis.

Key words: arthroscopy; tenodesis

INTRODUCTION

Pathology affecting the long head of biceps tendon (LHBT) can be due to trauma, micro-instability, excessive use, and underlying inflammatory disease. The LHBT is close to the rotator cuff and may become degenerative or hypertrophic secondary to mechanical impingement. The LHBT comprises an extensive sympathetic and sensory neural network and is considered the pain generator in the shoulder.

The surgical treatment for biceps pathology is tenotomy or tenodesis, but the most appropriate technique remains controversial. A simple tenotomy is associated with the risks of distal migration of the LHBT, ‘popeye’ deformity, recurrent muscle spasm, fatigue, and discomfort after active elbow flexion and supination. Tenodesis involves fixation of the tendon through a bone tunnel or by a suture anchor, staple or interference screw, or by suturing to the rotator cuff, transverse humeral ligament or conjoint tendon. It entails longer surgical time, longer rehabilitation, anterior shoulder pain, recurrent muscle spasm, and symptomatic fixation or hardware. We describe an arthroscopic keyhole technique for proximal biceps tenodesis.

SURGICAL TECHNIQUE

The patient is positioned in the lateral decubitus position with traction (about 10 pounds) on the affected limb. A hypotensive anaesthesia with a
mean systolic pressure of 100 mm Hg is preferred. The posterior, lateral, and anterolateral portals are used for diagnosis and treatment of the rotator cuff pathology and impingement. If a subscapularis tear is encountered, it is repaired first before the repair of other rotator cuff tendons to enable better visualisation. Biceps pathology is addressed at the end of the procedure. The biceps tendon is cut at the level of the supraglenoid tubercle using a radiofrequency device, and the tendon is allowed to retract into the groove.

Separate portals (R, S, and A) are made for the proximal biceps tenodesis. Portals R and S are proximal and distal portals along the course of the biceps tendon, and portal A is located about 3-to-4-finger breadth distal to the anterolateral edge of the acromion (Fig. 1a). A blunt trocar is introduced through the portal S to clear the soft tissue around the bicipital groove. While viewing through the portal A, a shaver and a radiofrequency device is used alternatively via the portal S to clear soft tissues and identify the transverse humeral ligament, the synovial sheath of the biceps, and the superior edge of the pectoralis major (Fig. 1b). A sharp incision is made on the sheath of the biceps tendon, with the tip of a 13 gauge spinal needle introduced percutaneously. In most cases the tendon pops out by itself. In the rare occasion, with an intra-articular hourglass deformity of the biceps tendon, the transverse ligament may have to be incised to deliver the tendon out. With a grasper introduced through the portal S, the tendon is exteriorised (Fig. 1c). The traction on the limb is released to get an adequate length of the biceps tendon after its intra-articular portion is excised.

Regular surgical instruments are used (Fig. 2). At a distance of 2 to 2.5 cm from the musculotendinous junction, the biceps tendon is looped over itself and sutured using No. 2 vicryl creating a plug. A No. 2 polysorb is introduced into the loop before suturing and the 2 limbs of the suture are used as traction sutures (Fig. 1d). The traction suture should slide freely in the loop. The tendon and the plug size is measured using graft sizers generally used in knee ligament reconstructions (Fig. 1e). The tendon is allowed to retract into the portal S. A beath pin with a drill sleeve is introduced through the portal R and is drilled at an angle of 45° into the bicipital groove, at a point in between the superior part of the pectoralis major and the inferior border of the transverse ligament. Care should be taken to select a point in the centre of the groove to avoid skydiving off the edge of the humeral shaft. As soon as the pin penetrates the posterior cortex, it should be tapped to advance until the pin penetrates the skin. This precaution will avoid any possible neurovascular damage. An acorn reamer of the same size as that of the tendon plug (usually 6 or 7 mm) is introduced over the pin and drilled to a depth of 25 to 30 mm to create a pilot hole (Fig. 1f). This unicortical drilling helps to prevent fractures. The beath pin is left in place.

An offset guide of 5 mm (Fig. 1g) is introduced through the portal S to drill a second beath pin distal to the pilot hole (Fig. 1h). Attention is paid to prevent entangling of the tendon and the leading suture. A 4.5-mm cannulated drill bit is introduced over the second beath pin to drill the near cortex only. The bony bridge in between the 2 holes is removed with a Kerrison Rongeur (Fig. 1i) and a keyhole is created (Fig. 1j). A doubled monofilament No. 2 forming a loop at one end is then pulled through the pilot hole via portal R with the help of the first beath pin (left in situ) in such a way that the looped end remains at the portal R and the 2 limbs exits posteriorily. Viewing from the portal A, both the limbs of the traction suture and the loop of the monofilament in the pilot hole are retrieved out via portal S using a suture manipulator. The 2 limbs of the traction suture are then threaded through the loop of the monofilament and are shuttled via the pilot hole to the posterior aspect of the proximal arm (Fig. 1k). Traction is reapplied to the limb. A suture manipulator is introduced through portal A, both the limbs of the traction suture and the loop of the monofilament in the pilot hole are retrieved out via portal S using a suture manipulator. The 2 limbs of the traction suture are then threaded through the loop of the monofilament and are shuttled via the pilot hole to the posterior aspect of the proximal arm (Fig. 1k). Traction is reapplied to the limb. A suture manipulator is introduced through portal S to mobilise the tendon plug toward the proximal portion of the keyhole, while the assistant pulls on the 2 limbs of the traction suture exiting posteriorly. A sudden ‘snap’ is felt as the tendon plug gets locked into the lower portion of the keyhole (Fig. 1l). Once the tendon plug is locked, the traction suture is pulled out (Fig. 1m). The portals are cleaned, sutured, and dressed. The mean time for the procedure is around 15 to 20 minutes.

DISCUSSION

Pathologies of the LHBT are categorised into degeneration (tendonitis), disorder (superior labrum anterior to posterior tear), and instability.10 The indications for surgery are chronic tendinitis, tear of the LHBT involving 25 to 50% of its width, and instability of the LHBT in the bicipital groove.11 Tenotomy of the LHBT is a simple technique for pain relief, but is associated with the risks of a ‘popeye’ deformity secondary to distal migration of the tendon (40 to 70% of time), fatigue and discomfort (30% of time), and loss of strength and glenohumeral stability.5,12 Hence this technique is advocated mainly for women and older individuals with a sedentary lifestyle. Tenodesis of the LHBT can maintain muscle
Figure 1 (a) Portals R, S, and A for arthroscopic keyhole proximal biceps tenodesis. (b) The transverse humeral ligament, long head biceps tendon (LHBT), and pectoralis major tendon are identified. (c) The LHBT is grasped and exteriorised. (d) The biceps tendon plug is created. (e) The sizes of the biceps plug and tendon are measured. (f) An acorn reamer is used to drill a pilot hole. (g) An offset guide is used to drill another beath pin. (h) The pilot hole and secondary hole are created. (i) The bony bridge between the 2 holes is removed by a Kerrison Rongeur, and (j) a keyhole is created. (k) Shuttle relay and traction suture into the pilot hole. (l) A saw bone model simulating the keyhole proximal biceps tenodesis. (m) Final seating of the LHBT into the keyhole.
length and tension and avoid complications (muscle atrophy, pain and discomfort, and the ‘popeye’ deformity). It is usually recommended for young, active individuals concerned with cosmesis and strength. Most studies have reported satisfactory pain relief, but some have reported failure rates of 6 to 40%.

In a study comparing wedge tenodesis with traditional keyhole tenodesis and tenotomy, the bicipital groove remained tender postoperatively in 23% of the wedge tenodesis cases and 6% of the keyhole tenodesis cases. Both procedures achieved similar outcomes. Good pain relief was achieved after transfer of the LHBT to the conjoint tendon. There was no side-to-side difference in the strength, but 12.5% of patients had discomfort and 3 had tendon rupture.

In a cadaveric study comparing the 4 fixation techniques (keyhole tenodesis, subpectoral tenodesis, subpectoral interferential screw fixation, and anchor fixation), the pre-cyclic ultimate failure strength of the interferential screw fixation was comparatively better. Distal open subpectoral tenodesis was superior to proximal biceps tenodesis, as the latter is associated with technical difficulty, hardware problems, pain, and tenosynovitis. The failure strength of interferential screw tenodesis and keyhole tenodesis was similar. Failure occurred at the bone-screw interface owing to splitting or slippage of the tendon in the interferential screw technique, and by pullout in the keyhole technique. Nonetheless, cyclic loading was not used before ultimate failure strength testing, which resembles the stress in vivo at the reconstruction site.

The tendon can fail at the bone-tendon interface or because of the pullout of the interferential screw or anchors, or suture breakage at the eyelet. The limitation of arthroscopic proximal biceps tenodesis is that it is performed before a cuff repair, and if there is an intact cuff it is difficult to perform tenodesis. At the site of tenodesis (the greater tuberosity), a weak bone can be a problem with interferential screw fixation. In addition, the need for special instrumentation, use of hardware, costs, and inherent technical difficulties are a matter of concern.

In a porcine study comparing 5 different proximal biceps tenodesis techniques (using suture anchor, bone tunnel, keyhole, interferential screw, and ligament washer), the interferential screw fixation was superior in terms of ultimate load to failure and gap formation after 200 cycles. Nonetheless, another study reported increased gap formation after interferential screw fixation.

The open keyhole technique enables better visualisation of the entire biceps tendon and its sheath, provides inherent stability with early range of movement of the shoulder and elbow, and requires no hardware. However, its use is limited because of low primary stability, the need for a deltopectoral incision, postoperative pain, and cosmesis.

The strength of the biceps tendon in supination and flexion of the elbow is similar after tenodesis versus tenotomy, as is the range of movement of the involved versus uninvolved sides or the dominant versus non-dominant sides.

An ideal fixation should provide early full range of active movement and return to activity. The arthroscopic keyhole technique is safe, easy to reproduce, cost-effective, and less time consuming. It does not need any special instrumentation and is especially suitable for developing countries. It enables examination of the biceps sheath and distal biceps tendon for unidentified tears, synovitis, and fibrosis.

REFERENCES