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Case Report

Reconstruction with interference screw of ruptured distal biceps brachii tendon at level of insertion into radial tuberosity: a case report

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ABSTRACT

Distal biceps tendon rupture is a relatively rare injury. The incidence of distal biceps rupture is 1.2 cases per 100,000 patients per year, with the average age is 47 years old and the majority is male patient with dominant extremity. A 43 years old male presented with pain of the left elbow and weakness to flex and supinate the forearm following gymnastic activity. He heard pop sound on his left elbow during lifting dumbbell and followed by a sudden pain on his arm and weakness to flex and supinate the elbow. The USG examination were performed and confirmed there was a rupture on the distal biceps tendon at the level of insertion. Durante operation confirmed a complete rupture of distal biceps tendon. A Henry approach incision is performed to expose radial tuberosity, and the ruptured tendon was reconstructed by anchored into the tuberosity of radius with bioabsorbable screw. After closing the incision, patient is immobilized by cast in 60 to 90o elbow flexion and neutral pronosupination. Distal biceps tendon rupture can be successfully repaired by single anterior approach using anatomical anchor on radial tuberosity, so that can avoid posterior approach and associated proximal radioulnar synostosis risk while conserving interosseous membrane.

Keywords: Biceps, Reconstruction, Rupture, Screw, Tendon

INTRODUCTION

The biceps tendon is composed of two heads. The long head of biceps tendon originated from the supraglenoid tubercle, whereas the short head originates from coracoid process and merges with the long head at the level of deltoid tuberosity. In the distal, the tendon inserts onto bicipital tuberosity on the proximal portion of the radius. Lacertus fibrosus (bicipital aponeurosis) is an associated structure of biceps tendons that originates from distal tendon at the level of musculotendinous junction. It consists of three layers, which envelope the forearm flexor muscles and serve as stabilizer to the distal tendon. It passes anterior to the elbow joint and expands ulnarly, blending with the fascia of the forearm. (Figure 1) shows the anatomy of the biceps tendons.[1-2]

Distal biceps tendon rupture is a relatively rare injury, but it can cause significant functional consequences. The majority of this injury occurs in male patients on their dominant extremity, at between the age of 30 and 60 years old. The incidence of distal biceps rupture is 1.2 cases per 100,000 patients per year, with the average age is 47 years old at the time of injury.

The dominant extremity is involved in 86% cases, and smoker patients have 7.5 times greater risk of injury compared with the nonsmoker patients.[1]

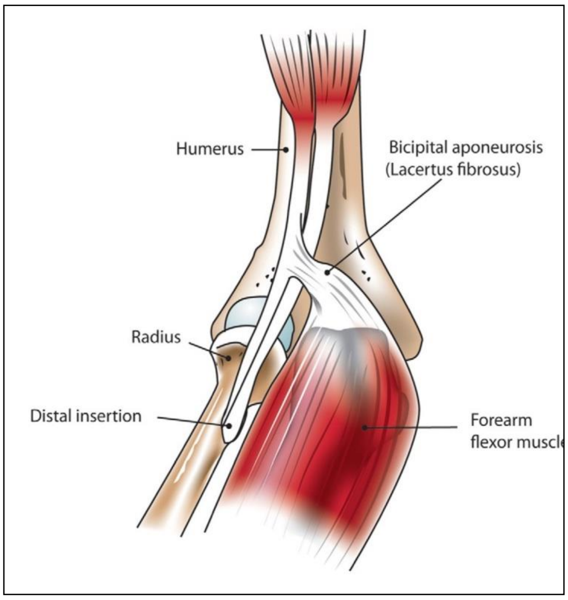

Figure 1: Anatomy of biceps tendons.[1]

There are two mechanisms in the pathogenesis of biceps tendon rupture, they are hypo vascular and mechanical mechanisms. These two mechanisms cause rupture at musculotendinous junction. There are three zones of vascularity in the distal biceps tendon insertion (Figure 2). The zone 2, which is approximately have a diameter of 2.14 cm, is the hypo vascular area of the tendon. This hypo vascularity causes focal degeneration that can be seen on light microscopy, making it predisposed to rupture if there is lack of blood supply to distal biceps tendon. In the mechanical mechanism, mechanical impingement of the tendon causes rupture of the tendon. When the forearm is fully pronated, the distance between lateral border of ulna and the radial tuberosity, which correspond to the space available for tendon, was 48% less than the distance in full supination. In addition, when forearm in pronation position, the biceps tendon occupied an average of 85% of the radioulnar space at the level of tuberosity. This mechanical mechanism explains the decrease in radioulnar space at the level of the radial tuberosity as the forearms goes from full supination to pronation. Furthermore, there is one contributing mechanism in the rupture of distal biceps tendon, it is the contribution of lacertus fibrosus anatomy. When the forearm flexors contract, they tense the lacertus fibrosus and subsequently cause a medial pull on the biceps tendon. This mechanism proposed to contribute to the rupture of distal biceps tendon.[3-4]

Patients with distal biceps tendon rupture commonly have history of unexpected extension force on the flexed elbow, this force is followed by eccentric contraction of the biceps. This eccentric contraction causes symptoms of tearing sensation in the antecubital fossa. When the acute pain relieves, chronic pain persists, and patients may have complaints of weakness when the elbow is in flexion and when the forearm is in supination.

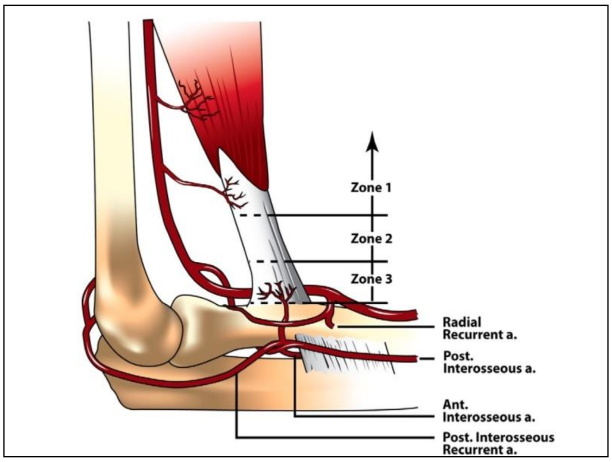

Figure 2: Zones of vascularity at the distal biceps tendon insertion.[1]

In inspection loss of normal biceps contour and obvious deformity can be found. But, when the lacertus fibrosus remains intact, the rupture of distal biceps tendon can be missed clinically. The tests that can be performed to diagnose distal biceps tendon is biceps squeeze test and hook test. Biceps squeeze test is developed by Ruland et al, and is similar to the Thompson test. When the tendon is intact, a squeeze in biceps brachii will elicit forearm supination. Hook test is developed by O'Driscoll et al and is used to diagnose complete biceps tendon avulsion. This the is performed by inserting the finger under the lateral edge of the biceps tendon between brachialis and biceps tendon and hooking the finger under the cord-like structure spanning the antecubital fossa with the patient's elbow flexed 90o. With this hook test (Figure 3), the integrity of biceps tendon can be detected.[5,6]

Figure 3: Hook test to detect the integrity of biceps tendon.[1]

The imaging modality that can be performed to distal biceps tendon diagnosis is radiograph and MRI of the elbow. The occasional finding in radiograph is enlargement and irregular changes about the radial tuberosity or an avulsion of the radial tuberosity itself.

The MRI is performed in FABS (flexed abducted supinated) position, which is 90O elbow flexion, 180o shoulder abduction, and forearm supination, can detect all cases of distal tendon rupture (Figure 4).[1]

Figure 4: MRI finding shows complete distal biceps rupture (arrow).[2]

The treatment of distal tendon rupture can be operative and nonoperative. Non operative treatment is reserved for sedentary patient who do not need elbow flexion and supination strength and endurance, and for patient who are not fit for surgery.[1] Surgical fixation of the distal biceps tendon rupture can be nonanatomic, which is by tenodesis on the brachial muscle tendon, or anatomic onto radial tuberosity. The anatomic fixation gives better result. Radial anchoring on biceps tendon rupture is the method of surgery in which distal biceps tendon is reinserted to the radial tuberosity by suture anchor using a single surgical technique. The main advantage of anchorage lies in avoiding the posterior approach and associated proximal radioulnar synostosis risk, while conserving the interosseous membrane.[2]

In this technique, patient is positioned in dorsal decubitus position with the upper limb lying on an arm table. The pneumatic tourniquet is applied as high as possible on the arm so as to avoid the reinsertion region. The next step is incision using singular anterior (radial tuberosity) approach. The incision starts in the medial bicipital groove and then moving to the lateral into the elbow flexion fold. The distal branch of the incision descended along the medial edge of brachioradialis muscle. Superficial veins are then retracted, and the lateral antebrachial cutaneous nerve is located, then, the biceps tendon is located and released. The course of radial tuberosity is exposed by dissection using blunt dissector, between the medial edge of brachioradialis muscle and the lateral edge of pronator teres muscle.[2]

Figure 5: Anterior (brachial tuberosity) approach incision.[2]

The forearm is then positioned in forced supination, to give access to radial tuberosity (Figure 5). The subsequent step is to position the elbow in 60^{O} flexion, and the radial tuberosity is exposed using Langenbeck retractors. This exposure using Langenbeck retractors has aims to release the motor branch of the radial nerve, reduce reinsertion tension, and increase the contact between tendon and radial tuberosity. The suture anchors are then positioned on the radial tuberosity without performing scraping on the surface. This is done my making four unicortical holes at the site of the footprint followed by creation of a hatch in the first bone cortex between four holes using an osteotome.[4]

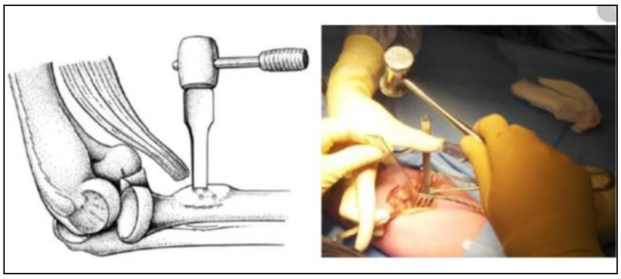

Figure 6: Creation of holes using osteotome.[3]

Mitek drill is the then used to create two holes in the opposite cortex, into which mitek anchors are placed (Figure 6).[4]

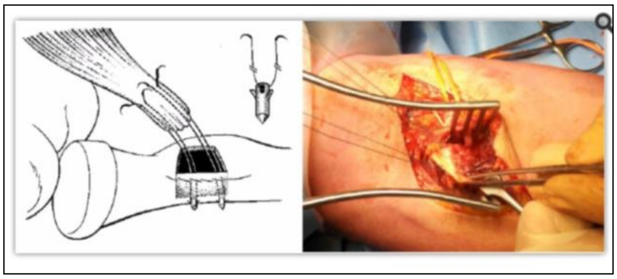

Figure 7: Placement of anchor using Mitek drill in opposite cortex.[4]

Next, the biceps tendon is fixed by tying the Bunell stitches of the Mitek anchors, fixed in the dorsal bone cortex. Mechanically solid reinsertion was thus obtained, with optimal tendon/bone contact (Figure 7).[4] The subsequent step is to perform abundant lavage to remove bone powder left from preparation of the anchor insertion hole and to close the incision using resorbable intradermal suture (Figure 8).[4]

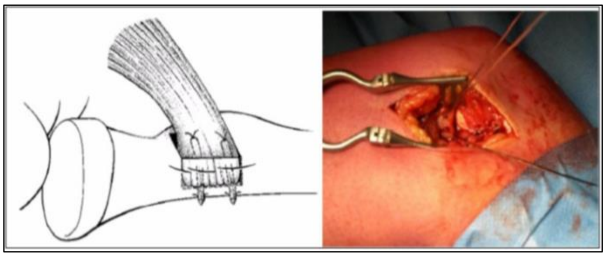

Figure 8: Fixing the biceps tendon using Bunell stitches of Mitek anchors.[5]

The postoperative management is immobilization in Neofrakts removable cast/splint in 60 to 90o elbow flexion and neutral pronosupination. Rehabilitation for the patient is passive, with elbow flexion in the sector is protected by the orthoses. Active work and recovery of elbow extension are started on removal of the cast /splint, which is between postoperative days 30 to 45.[4]

Bioresorbable implants are used widely for fracture fixation in orthopaedic surgery. Its materials slowly dissolve in the human body, such that second operation to remove synthetic material is not needed. The most commonly used resorbable implants for anterior cruciate ligament reconstruction, shoulder surgery, meniscal repair, and fracture care are interference screw, plates, pins, suture anchors, meniscal repair implants, and simple fracture fixation implants. Traditionally, internal implants are made of stainless steel and titanium and its alloys. However, there are intrinsic problems with the use of metallic implants, such as stress-shielding phenomenon, pain, local irritation, and risk of endogenous infection. It also can lead to destruction and osteoporosis in the surrounding bone tissue. For these reasons, there is need for second surgery to remove the metallic fixation after the bone has healed.

Bioabsorbable implants has several advantages over metallic fixation, including no need to remove the implants after osseous healing, radiolucency, no corrosion, no accumulation of metal in the tissue, less pain, and reduced stress shielding since the implants bear less load initially and gradually transfer the load as they degrade. These devices are most often manufactured from polylactides (polylactic acid, PLA), polyglycolides (polyglycolides, PGA), and their co-polymer compositions as they are highly resorbable. The commercially available bioabsorbable implants that can be used in suture anchor of biceps tendon rupture are showed in (Table 1).[7,8]

Table 1: The commercially available bioabsorbable implants that can be used in suture anchor of biceps tendon rupture.[5]

Commercial name	Material	Application
Bio-Phase suture anchor; Reunite Screw, pins, plates; Gentle Threads (Biomet Arthrotek)	PLA/PLG	Fracture fixation, arthrodesis, suture anchor
SD Sorb Anchor, staples, EZ tac (Stryker, Howmedica, Osteonics Surgical Dynamics)	PLG	Suture anchor, meniscus repair
Panaloc RC; BioRoc EZ; Phantom screws (Depuy, Mitek, Ethicon, J&J)	PLA	Rotator cuff repair, suture anchor

Current management in the distal biceps tendon rupture is in the favour of anatomical reinsertion of tendon into radial tuberosity as described in the above technique using single anterior incision with suture anchor, especially in young and active individual. Repair of distal biceps tendon using bioabsorbable interference screw is a new technique which use minimal incision technique. In this technique, the avulsed tendon and bioabsorbable screw are secured in a drill hole on the radial tuberosity using whip stitch and fiber wire suture according to Biotenodesis system guidelines. This new technique requires minimal volar dissection that is associated with reduced number of synostosis and posterior interosseous nerve injuries. Beside its bioabsorbable property just like the suture anchor has, it also has greater pullout strength than suture anchor, which hypothetically will provide early active motion and return to previous activity. The technique for this surgery is with the patient is in general anesthesia, the patient is placed in supine position with the extremity on an arm board. A tourniquet is not applied. In 2 cm distal to the cubital crease overlying the bicipital tuberosity of the radius, a transverse 4 cm incision is made. After the deep fascia is incised, blunt dissection is used to access the radial tuberosity. The arm is grasped, and the tendon is milked distally to deliver it in the wound. The retrieved tendon is debrided and trimmed to a chevron shape. The chevron is sized for a biotenodesis screw. A 5 mm pilot hole in the radial tuberosity is made using biotenodesis drill with the forearm maximally supinated. Only the chevron portion of the distal tendon entered the hole with the screw, due to the large surface area of the bicipital tendon and small area of radial tuberosity. A no. 5 nonabsorbable whip stitch suture and two no. 2 fiber wire suture are inserted through the tendon, one into the chevron portion of the tendon and other into the broader section for overlying. The distal no. 2 fiber wire suture in the chevron tip is passed through the biotenodesis inserter with a presided 5.5-mm screw mounted with elbow flexed and supinated. Screw insertion is done as per biotenodesis system guideline. The no. 2 fiber wire sutures are tied together to oppose tendon to bone. The no. 5 whip suture is then tied to no. 2 fiber wire suture to allow further apposition and support. But this interference screw is a new technique in which its superior clinical effectiveness to suture anchor has not been proved.[9-10]

CASE REPORT

A 43 years old male presented with pain of the left elbow and weakness to flex and supinate the forearm following gymnastic activity. He heard pop sound on his left elbow during lifting dumbbell and followed by a sudden pain on his arm and weakness to flex and supinate the elbow. On examination, there was loss of biceps contour on left elbow. The forearm supination was not elicited during biceps test and the integrity of biceps tendons during hook test was also lost.

Figure 9: Henry Approach was done and found there was a rupture of distal biceps tendon on level of it insertion.[5]

Figure 10: Tendon was stiched with Krackow's technique.[6]

Figure 11: Distal tendon mounted into the tuberosity of radius with bio absorbable screw.7

The USG of the cubiti was performed and confirmed there was a rupture of the distal biceps tendon on it insertion, and the repair surgery was done. A durante operation confirmed a complete rupture of distal biceps tendon on it insertion. A Henry approach incision is performed to expose radial tuberosity (Figure 9), the distal tendon was stitched by Krackow's technique (Figure 10) and the radial tuberosity drilled with 8mm cannulated reamer with forearm in fully supination position. The stitched tendon than mounted in the radial tuberosity with bioabsorbable screw (Figure 11). After closing the incision, the limb than placed into a above elbow back slab with elbow in 900 and in neutral position.

DISCUSSION

Although distal biceps tendon rupture is a relatively rare injury, it can cause significant functional consequences. Patients with distal biceps tendon rupture commonly have history of unexpected extension force on the flexed elbow, this force is followed by eccentric contraction of the biceps. This eccentric contraction causes symptoms of tearing sensation in the antecubital fossa, followed by weakness when the elbow is in flexion and when the forearm is in supination. As can be seen on the patient, the gymnastic activity using dumbbell in training of biceps brachii tendon can cause extension force by the weight of the dumbbell.[1-5]

Radial anchoring on biceps tendon rupture is the method of surgery in which distal biceps tendon is reinserted to the radial tuberosity by suture anchor using a single surgical technique. The main advantage of anchorage lies in avoiding the posterior approach and associated proximal radioulnar synostosis risk, while conserving the interosseous membrane. This technique consists of anterior approach incision to expose radial tuberosity, creation of a holes and anchoring the distal biceps tendon with bioabsorbable screw, closing of incision, and finally postoperative management involving immobilization using a cast in 60 to 90o elbow flexion and neutralpronosupination.[9,10]

CONCLUSION

Distal biceps tendon rupture can be successfully repaired by single anterior approach using anatomical anchor on radial tuberosity, so that can avoid posterior approach and associated proximal radioulnar synostosis risk while conserving interosseous membrane.

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