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# Intramedullary, unicortical repair of distal biceps tendon rupture

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Historically-used bicortical repair of distal biceps tendon rupture are at risk for posterior interosseous nerve palsy. Here we present a technique, and associated case report, utilizing unicortical repair with a suture cortical button device for this injury. The described technique provides robust fixation and avoids the rare, but potentially devastating complication of posterior interosseous nerve palsy.



Distal biceps tendon rupture is a rare injury, occurring at a rate of 2.5 per 100,000 patient-years[11]; however, it can result in functional limitations in forearm supination and elbow flexion.[10] Generally, modern distal biceps tendon reconstruction techniques have achieved satisfactory functional and patient-reported outcomes.[7,8] These surgeries, however, remain not without significant complications.

Posterior interosseous nerve (PIN) palsy is a rare but potentially devastating complication of distal biceps tendon repair, resulting in inability to extend one's fingers. Incidence of this injury is varied in the literature, ranging from 1% to 8%.[4,6,10,15] PIN palsy can last several months or even be permanent.[15] Although several mechanisms have been proposed, direct injury to the PIN is likely due to either direct injury from the drill when making a hole in the posterior cortex or compression from the cortical button when the PIN is caught between the button and posterior radial cortex.

To mitigate the risk to the PIN with bicortical fixation during distal biceps reinsertion, while maintaining the biomechanical advantage of a cortically anchored construct,[3,12,14] we currently present a technique involving intramedullary, unicortical placement of a cortical button made of suture, the FiberTak anchor (Arthrex, Inc., Naples, FL, USA) (Fig. 1). We present a case of a 48-year-old male who presented with chronic rupture of his right distal biceps tendon. The patient was treated with unicortical FiberTak anchor repair.

## Case report

A 48-year-old right-hand-dominant male presented with chronic left biceps tendon rupture sustained approximately 4 months earlier while attempting to lift a 4 × 4 post. Initial evaluation was completed at urgent care and by his primary care physician. MRI demonstrated a full-thickness biceps tendon tear with approximately 5-cm retraction from the radial tuberosity (Fig. 2). Owing to social reasons, orthopedic evaluation was delayed.

On physical examination, a reverse "Popeye" sign was present with negative Hook test. The distal biceps tendon stump was palpable and mildly tender to palpation. He had full elbow range of motion (ROM): 0-130 degrees flexion and 80 degrees of supination and pronation. Flexion strength was slightly diminished.

The patient underwent left biceps tendon tenolysis, reconstruction using a semitendinosus allograft and unicortical, intramedullary FiberTak suture anchor fixation to the radial tuberosity. At one week postoperatively, he had satisfactory surgical healing and was prescribed progressive ROM exercises with occupational therapy. Approximately at two months postoperatively, the patient achieved full, painless elbow ROM and was started on progressive weight-bearing exercises. At four months postoperatively, the patient has satisfactorily returned to previous level of function with a QuickDASH score of 9.1.

## Materials, methods, and technique

The procedure was performed on an outpatient basis under regional block with general anesthesia. The patient was placed supine on the operating table with the operative extremity placed on a hand table. A nonsterile tourniquet was applied. The biceps

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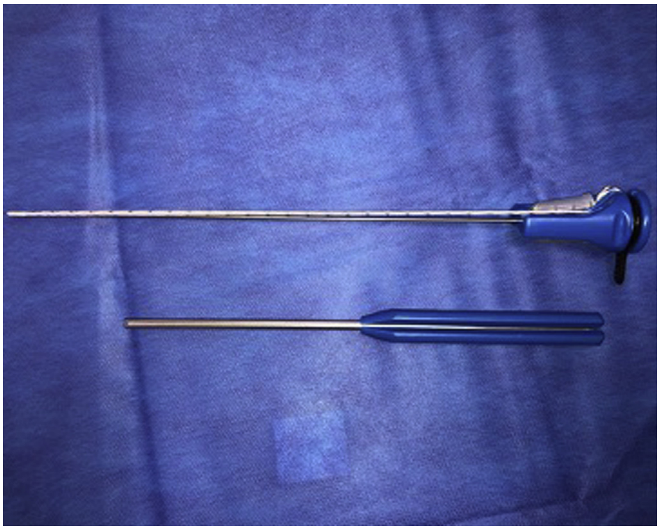

**Figure 1** FiberTak system with slotted drill/anchor guide (*bottom*) and flexible inserter (*top*). The flexible inserter contains the needle casing with two braided sutures at the proximal end and intramedullary anchor at the distal end.

**Figure 2** MRI demonstrating chronic distal biceps tendon rupture with proximal retraction.

tuberosity was palpated with firm pressure applied via the surgeon's fingers as the forearm was rotated through supination and pronation. The tuberosity was felt to cam against the surgeon's fingers negating the need for fluoroscopy. The area of the anticipated incision was infiltrated with 10 mL of 1% lidocaine with epinephrine (1:100,000) to assist with hemostasis.

After exsanguination and tourniquet inflation, a 3-cm longitudinal incision was made along the medial border of the brachioradialis muscle usually about 2 cm distal to the antecubital crease. Superficial dissection was then carried out in the interval between the brachioradialis and pronator teres. During this time, the lateral antebrachial cutaneous nerve was identified and protected. Medially, the radial artery and median nerve were also protected. Meticulous attention to hemostasis was maintained with bipolar electrocautery or ligation with medium vessel clips. The forearm was then placed in maximal supination. Deep dissection was carried down to the biceps tuberosity. The superficial radial nerve was identified and protected at this time. A periosteal elevator was used to elevate the volar aspect of the supinator over the tuberosity. A proximal counter incision was made over the biceps, and the tendon was found encased in psuedotendon, for which tenolysis was performed. Of note, a segment of the lateral antebrachial cutaneous nerve was found to be adherent to the pseudotendon and was gently peeled off. The frayed, degenerative end of the biceps tendon was then debrided back to healthy-appearing tendon. The final tendon length was approximately three centimeters. A semitendinosus allograft was prepared at this time and fixed into the remaining biceps tendon using a four-weave Pulvertaft weave and 2-0 Ethibond suture (Ethicon Inc., Raritan, NJ, USA). The graft was then tunneled subcutaneously down to the distal incision. The graft was trimmed to allow for it to reach the biceps tuberosity with the elbow flexed about 65 degrees.

At this time, the biceps tuberosity was prepared. The forearm was maximally supinated, and a curette used to prep the tuberosity for tendon reinsertion. The implant is an intramedullary device, and the starting point should be in-line with the intramedullary canal at the level of the tuberosity. Using the slotted drill and anchor guide, the biceps tuberosity was drilled unicortically with a 1.9-mm drill. This was performed by scoring the cortex with the drill and then dropping the surgeon's hand about 30 degrees aiming distally to allow for the anchor to deploy (Fig. 3, *A*). We have found that by rotating the drill guide to have the slot down, the surgeon can avoid the problem of the drill binding within the slot on the guide as the hand is dropped 30 degrees. Without moving the drill guide, a 1.9-mm FiberTak anchor was then set within the radial intramedullary canal. The flexible nature of the inserter allows the anchor to follow the intramedullary side of the posterior cortex as the anchor is tapped in with a mallet (Fig. 3, *B*). The anchor was then seated against the intramedullary side of the volar radial cortex by pulling back on the inserter about a centimeter. The needle casing, attached to two braided sutures, was removed from the end of the anchor inserter through the slotted guide. Fixation of the anchor is assessed by lifting the arm off the table with the sutures. As with most double-loaded anchors, the sutures are colored with blue and black stripes (Fig. 4). One limb of the first suture was placed in a locked Krackow fashion along the edge of the distal tendon and then run back toward the end of the tendon. The second limb was brought up through the end of the tendon to allow for the knot to be on the top of the tendon (Fig. 5, *A* and *B*. The second limb functions as the knot post; thus, it is critical that it comes freely though the tendon. Catching the other suture limbs will impede sliding and proper reduction of the tendon to the radius. The second limb was then used to reduce the biceps tendon and tied. When tying, the elbow was generally flexed to about 90 degrees to reduce friction of the sliding sutures against the edge of the hole in the cortex and minimize the work required to reduce the tendon. The second suture was then tied in a similar fashion as backup (Fig. 6).

After fixation, the elbow was brought toward extension and allowed to hang to gravity. This allowed for the evaluation of gapping at the reinsertion site and assess the biceps tightness to gauge the appropriate splinting position. At this time, the wound was irrigated, and the tourniquet released. The wound was closed

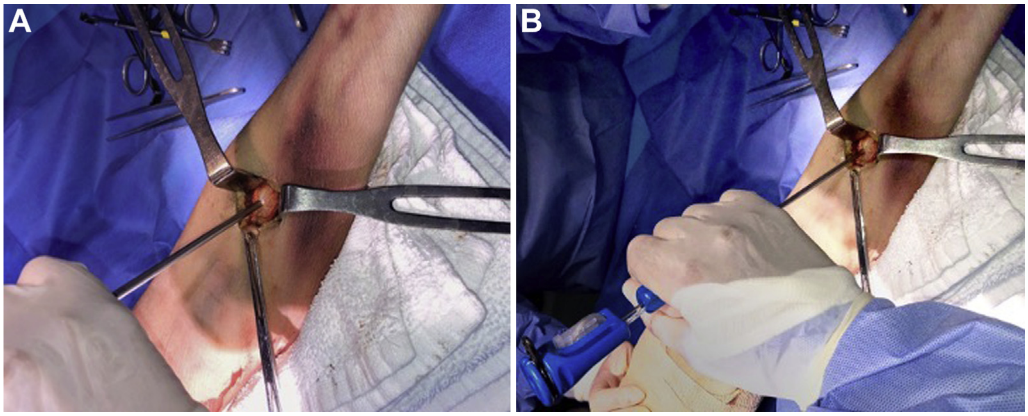


**Figure 3** (**A**) Volar cortex of biceps tuberosity is scored with the drill aimed approximately 30 degrees in the distal direction. During the drilling process, the authors recommend the guide be held with the slotted side down to better maintain collinearity and avoid bending the drill bit. (**B**) Anchor inserter device is placed into the guide at the same angle as drilling. The anchor is malleted into the intramedullary canal. Pulling back on the sutures deploys the anchor.

**Figure 4** Deployed double-loaded anchor arising from the biceps tuberosity with a black-and-blue braided suture.

with absorbable suture, and the arm placed in a posterior elbow splint in flexion.

The postoperative protocol will be surgeon-dependent. We prefer to bring the patient back at approximately one week. Occupational therapy is prescribed, and patients are able to begin active ROM exercises from full flexion to the amount of extension obtained in the operating room. Patients are allowed to progress with extension ROM an additional 10 degrees per week. During this time, the operative extremity is to be non-weight-bearing, and activities carried out without resistance. At rest, the elbow is held in a removable splint at 90 degrees. Progressive weight-bearing usually begins at about 2.5 months postoperatively. The same postoperative protocol is used for both primary repairs and allograft reconstruction.

## Discussion

The use of buttons placed through the bicipital tuberosity and exiting the dorsal radius cortex as an anchor for fixation of an avulsed biceps tendon back to its anatomic footprint is an effective and popular way to repair distal biceps tendon injuries. Biomechanical studies have demonstrated that cortical button repair achieves the greatest fixation strength.[3,12,14] Owing to button size, however, unicortical placement is often not feasible depending on the size of the patient's radial canal. Stronger early term fixation must be examined against the risk of PIN injury with a bicortical approach. To minimize the risk of PIN injury, reports from cadaveric studies have described optimal and suboptimal corridors for placement of drills and guidewires in relation to the PIN. Thumm et al and Lo et al found that an ulnar drill trajectory, specifically at 30 degrees, results in a farther and safer guide wire-to-PIN distance.[13,16] Meanwhile, Bain et al found drilling in a posterior-radial trajectory to be associated with an increased risk of PIN damage.[2] Despite these directional guides, the bicortical nature of standard button repair constructs together with anatomic variations between patients continue to make the risk for iatrogenic PIN injury a significant concern for this surgery.

Owing to design constraints of metal cortical devices in the market, it is difficult to reliably achieve cortical fixation in an intramedullary position, necessitating a bicortical position and placing the PIN at risk. The FiberTak system was designed with a slotted drill guide and flexible inserter, making it ideal for deployment in the intramedullary canal of the radius. Deployment of the FiberTak anchor also does not involve the "flipping" motion associated with cortical buttons upon insertion into the canal. This is particularly convenient in patients with radii of smaller intramedullary caliber. Manufacturer data support that the FiberTak system has a 66-lbf pullout strength.[5] Given that biceps tendon tension during active flexion against gravity has been reported to be approximately 50 N (approximately 12 lbf), this construct is sufficiently robust to allow healing even during the early rehabilitation regimen.[1,9] Anecdotally, the pullout strength is sufficient to lift the arm off the table when inserted as noted in the procedure presented.

Indications for surgical repair of the distal biceps tendon to the radial tuberosity using a unicortical Fibertak anchor are the same as with previously described techniques. Indications include complete or partial tears of the biceps tendon in young, healthy patients who do not want to sacrifice upper extremity supination and flexion. We have used this technique in acute and subacute repairs, as well as in delayed allograft reconstructions. Contraindications include infection, associated fractures surrounding the radial tuberosity insertion site, or loss of the volar cortex of the radial tuberosity from previous instrumentation. In this case report, we demonstrate successful reconstruction of a chronic distal biceps tendon rupture using a Fibertak anchor. Our patient's postoperative course has

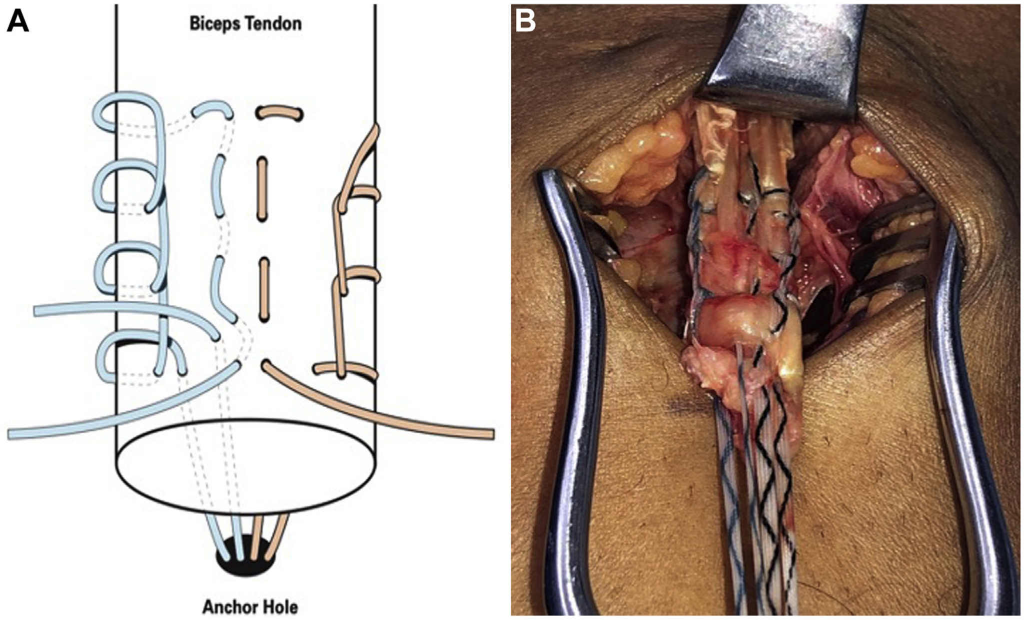


**Figure 5** (**A**) Illustration of Krackow stitch placed in the distal bicep tendon. One limb of the first suture is placed in a locked Krackow fashion along the edge of the distal tendon and then run back toward the end of the tendon. The second limb is brought up through the end of the tendon to allow for the knot to be on *top* of the tendon. The second suture is then tied in a similar fashion as backup. (**B**) Operative construct with both sutures placed in locked Krackow fashion and tendon reduced before knot tying. The distal biceps tendon was firmly reduced down to the biceps tuberosity by pulling the free, or post, limb of both sutures through the tendon.

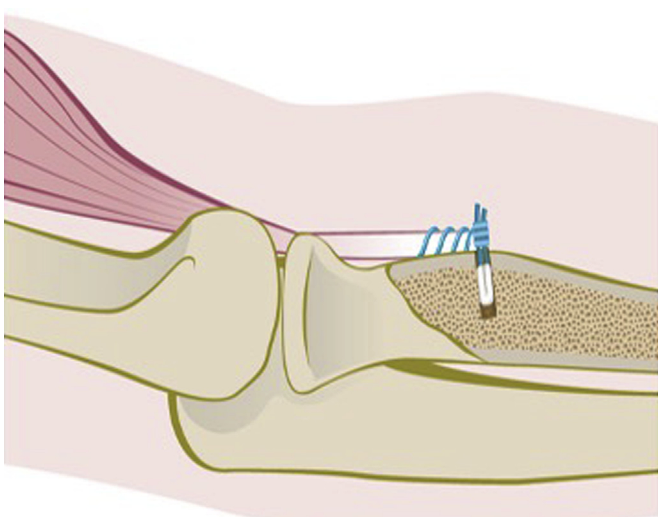

**Figure 6** Illustration of intramedullary suture anchor with the biceps tendon reduced to anatomic footprint over the radial tuberosity.

been uncomplicated, and he has exhibited clinically satisfactory healing and return of elbow function.

## Conclusion

The presented technique describes an intramedullary placement of FiberTak anchors for the fixation of distal biceps tendon ruptures. Historically described fixation techniques, particularly using popular button constructs, have been associated with PIN palsy as a result of bicortical drilling and anchor placement. The unicortical nature of our technique avoids this rare but devastating complication yet provides the robust fixation of a cortical button. Further studies will be required to better understand if clinical outcomes are improved using this technique.

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