Anatomic Single-Incision Repair of Distal Biceps Tendon Ruptures Using Intramedullary Soft Anchors

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Abstract: Distal biceps tendon ruptures are uncommon injuries responsible for only 3% of all injuries to the biceps tendon. For most of these cases, unless the patient is elderly or infirm, conservative management should be avoided and the injury should be treated with a surgical procedure to reattach the bicep tendon to the radial tuberosity. In this Technical Note and accompanying video, we describe an anatomic single-incision technique using 2 intramedullary soft anchors, which decreases the likelihood of complications associated with bicortical drilling and metal suspensory fixation.

Distal biceps tendon ruptures are relatively uncommon injuries that occur in only 1.2 of 100,000 people annually and represent 3% of all injuries to the biceps tendon.1,2 Most individuals who experience distal biceps ruptures are men between the 4th and 5th decade of their lives.2-4 The injury occurs when the elbow is forcefully extended while the biceps is flexed.2-5 For elderly or infirm patients whose lifestyle is sedentary in nature, a nonsurgical approach may be used.2-4 However, as most individuals with distal biceps tendon ruptures are not in this patient population, the standard of care is a surgical procedure to repair the tendon to an anatomically correct position.3,4,6 There are several surgical options for distal biceps tendon repair distinguished by single-incision versus double-incision exposure and anatomic versus nonanatomic repair and fixation methods. In a single-incision exposure, an anterior approach is performed through the antecubital fossa. In 2-incision repairs, the tendon is retrieved through an incision in the elbow crease, and the reattachment is performed through a second more dorsal exposure to the radial tuberosity. The most common fixation techniques for a distal bicep repair include suture anchors, bone tunnels, intraosseous screw fixation, and a suspensory cortical button.3,4,6 One complication of suspensory cortical button fixation is potential injury to the posterior interosseous nerve while performing bicortical drilling. The purpose of this Technical Note is to describe a single-incision double-suture anchor technique in which two 2.6-mm FiberTak (Arthrex, Naples, FL) soft nonmetal anchors provide intramedullary cortical fixation, eliminating the need for bicortical drilling.

Surgical Technique

Preoperative Evaluation

The diagnosis of distal biceps tendon repair is based on patient history and physical examination. Physical examination can show flattening of the distal contour of the arm owing to proximal retraction of the biceps. Patients can show weakness with supination and flexion. O’Driscoll et al.7 described the hook test where patients look at the palm of their hand while their forearm is supinated, elbow is flexed, and shoulder is elevated. In an uninjured case, the examiner can hook their finger around the intact tendon, whereas if it is torn, the examiner is unable to do so.
Patient Setup
The patient is placed supine on a standard operative table, with an arm table attached to the operative side, and anesthetized using general anesthesia. A tourniquet is placed around the proximal bicep for safety in the case of excessive blood loss and to maximize visualization. The operative arm is prepared with preoperative skin prep solution from the proximal arm to the fingers and is then draped in the usual sterile fashion.

Surgical Approach
A 3- to 5-cm incision is made over the radial tuberosity in a longitudinal manner. Using blunt dissection between the brachioradialis and the pronator teres, the radial tuberosity is exposed, taking care to avoid neurovascular structures such as the lateral antebrachial cutaneous nerve, which will be retracted laterally. Through the same incision, bluntly dissect the pathway to the ruptured distal biceps tendon, retrieve, and tag it using an Allis clamp (Fig 1).

Suture Anchor Placement
A small section of periosteum over the radial tuberosity is removed using electrocautery. A drill guide is placed medially over the radial tuberosity, and the first pilot hole is drilled perpendicular to the radial tuberosity (Fig 2). A 2.6-mm FiberTak (Arthrex) is then malleted down through the same drill guide (Fig 3). A second pilot hole is drilled 5 mm lateral to the first suture in the same fashion to ensure an adequate bone bridge. A second 2.6-mm FiberTak is then malleted down through the drill guide. Fixation of both suture anchors is then tested by pulling tension on the sutures from both anchors simultaneously (Fig 4).

Securing and Tensioning Distal Biceps Tendon
Starting with the medial suture anchor, a free needle is used on 1 limb of the loaded suture to whipstitch the medial side of the distal biceps tendon from distal to proximal to distal (Fig 5). The free needle and suture from the lateral suture anchor are then used to whipstitch the lateral side of the distal biceps tendon in the same fashion. The opposite end of each suture from the medial and lateral suture anchor is then pulled to tension the distal biceps tendon down to the radial tuberosity (Fig 6). The free needle is then used again to place...
one whipstitch in the distal biceps tendon with the tensioning end of the suture from the medial suture anchor. This suture is then tied down to the medial suture anchor. The free needle is then used once more to secure the suture from the lateral suture anchor in the same fashion. The excess suture is then cut. The final construct is seen in Figure 7. These key steps are demonstrated in Video 1.

Final Examination and Postoperative Care

For the first week, the patient should remain in a posterior splint that is not to be removed. Beginning with the second week, the patient should wear a hinged elbow brace locked at 90°. The splint or elbow brace should be removed or unlocked to perform passive range of motion exercises from 30° of extension to 130° of flexion 5 to 6 times per day for 25 repetitions. Ice should be applied following each exercise session.

At the 3-week mark, passive flexion may be increased to full flexion as tolerated while the active extension limit is set to 20°. The patient should supinate and pronate through the pain-free range as well as work on active wrist flexion and extension. Four weeks after the procedure, the patient should change the active extension limit to 10° and continue the previous exercises. At the 5th week, full active extension is permitted, and by the 6th week, the use of the brace may be discontinued. At this point, light strengthening exercises are permitted and ice should be used after each exercise session.

Discussion

There is currently no consensus on which fixation technique for distal biceps tendon repair leads to a superior outcome. A recent systematic review by Kodde et al. found that there is no significant difference in range of motion based on which of the 4 fixation techniques were used. Additionally, various investigators note that both single- and dual-incision approaches, as well as the various fixation techniques, lead to good surgical outcomes. However, it is important to note that suture anchors, which are described in this Technical Note, are most often used as a baseline when comparing between various fixation techniques owing to their optimal clinical and functional outcome. In addition, other studies assert that suture anchor fixation leads to superior yield strength when compared with bone tunnel fixation.

The technique that we present maintains many of the possible advantages provided by a single-incision approach with the suture anchor technique while allowing for a reduction in technical difficulty and increased knot security. One advantage of our intramedullary suture anchor technique is that it provides a maximization of surface area between the tendon and the bone, which helps lead to a more effective recreation of an anatomic distal bicep insertion. Additionally, when compared with bone tunnels and cortical buttons, this technique minimizes the risk of iatrogenic posterior interosseous nerve injury because it does not require bicortical drilling. Finally, when compared with the cortical button technique, suture anchors minimize the amount of radiation exposure because no radiographs are needed to confirm the positioning of a metal button.

![Fig 5. Intraoperative photo of whipstitching the distal bicep tendon of the left arm using a free needle.](image)

![Fig 6. Intraoperative photo of tensioning down the distal bicep tendon to the radial tuberosity in the left arm.](image)

![Fig 7. Intraoperative photo of the final construct of the distal biceps tendon repair using two 2.6-mm FiberTak anchors in the radial tuberosity of the left arm.](image)
Table 1. Advantages and Disadvantages

| Advantages                                                  | Risks                                                                 |
|-------------------------------------------------------------|-----------------------------------------------------------------------|
| Maximization of surface area between tendon and bone        | Increased risk of transient neurapraxias                              |
| Reduced risk of iatrogenic posterior interosseous nerve injury | Decreased chance of bone-to-tendon healing because the tendon rests on the periosteum rather than within the bone |
| Reduced radiation exposure                                   | Possible heterotopic ossification                                      |
| Reduction in technical difficulty owing to single cortex drilling |                                                                       |

One possible disadvantage our technique may pose is that a single-incision approach may lead to slightly more cases of transient neurapraxias (Table 1) owing to increased traction on the lateral antebrachial cutaneous nerve. However, this complication occurred in only 0.3% of the cases reviewed by Kodde et al. and was mostly transient in nature. At the same time, our technique is susceptible to the common complications that arise from any distal bicep tendon repair, including heterotopic ossification, loss of motion or strength, elbow pain, rerupture, and neurapraxias. Further studies are necessary to determine whether a specific approach or technique leads to significant improvement in outcomes while minimizing complications.

References

1. Dobbie RP. Avulsion of the lower biceps brachii tendon. *Am J Surg* 1941;51:662-683.
2. Safran MR, Graham SM. Distal biceps tendon ruptures: incidence, demographics, and the effect of smoking. *Clin Orthop Rel Res* 2002;404:275-283.
3. Kodde IF, Baerveldt RC, Mulder PGH, Eygendaal D, van den Bekerom MPJ. Refixation techniques and approaches for distal biceps tendon ruptures: A systematic review of clinical studies. *J Shoulder Elbow Surg* 2016;25:e29-e37.
4. Sutton KM, Dodd SD, Ahmad CS, Sethi PM. Surgical treatment of distal biceps rupture. *J Am Acad Orthop Surg* 2010;18:139-148.
5. Sarda P, Qaddori A, Nauschutz F, Boulton L, Nanda R, Bayliss N. Distal biceps tendon rupture: Current concepts. *Injury* 2013;44:417-420.
6. Watson JN, Moretti VM, Schwindel L, Hutchinson MR. Repair techniques for acute distal biceps tendon ruptures: A systematic review. *J Bone Joint Surg Am* 2014;96:2086-2090.
7. O’Driscoll SW, Goncalves LBJ, Dietz P. The hook test for distal biceps tendon avulsion. *Am J Sports Med* 2007;35:1865-1869.
8. Maciel RA, Costa PS, Figueiredo EA, Belangero PS, de Castro Pochini A, Egnism B. Acute distal biceps ruptures: Single incision repair by use of suture anchors. *Rev Bras Ortop* 2017;52:148-153.
9. Lemos SE, Ebramzedeh E, Kvitne RS. A new technique. *Am J Sports Med* 2004;32:406-410.