Two-Incision Distal Biceps Repair with Cortical Button: A Technique to Improve Supination Strength

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Abstract: Tears of the distal biceps are common, and nonoperative treatment results in significant loss of supination strength. Surgery is indicated for most patients to restore this supination strength. Both 1- and 2-incision techniques are successful, but each has its own advantages and disadvantages. We believe the 2-incision technique better restores the anatomic attachment site of the tendon, which leads to better supination strength and has a lower rate of neurologic injury. Although it does have a slightly higher risk of synostis, this can be mitigated by routine prophylaxis with NSAIDs. Augmenting the repair with a cortical button has been shown to increase the load-to-failure better than the traditional 2-incision technique that employs transosseous fixation. Here we present our technique of 2-incision distal biceps repair with cortical button, a technique intended to maximize supination strength.

Tears of the distal biceps are common injuries. When treated nonoperatively, not only is there cosmetic deformity and some loss of elbow flexion strength but, most important, there is also significant loss of supination strength. As a result, primary repair is indicated in most patients to restore function, particularly supination strength.

The 1-incision approach is commonly performed. But because the distal biceps footprint on the radial tuberosity is on the ulnar side of the radius, the attachment site through a 1-incision approach, even with maximal supination, is 90° anterior to the native attachment. In addition, because of the more forceful retraction necessary to see all the way down to the radius, there is a higher reported rate of nerve injury.

The 2-incision approach yields direct access to the tuberosity and allows restoration of the anatomic attachment site, which improves supination strength, the most important function of the distal biceps. And because forceful retraction through the anterior wound is reduced, direct retraction of the nerves is reduced, leading to a lower reported rate of nerve injury.

Although the rate of heterotopic ossification (HO) and synostis is slightly higher, the use of indomethacin prophylaxis has been shown to mitigate them.

For many surgeons, the method of fixation is driven by the approach. A 1-incision repair commonly involves deploying a cortical button on the far, nonvisualized cortex of the radius, whereas the 2-incision technique typically involves tying the sutures over a bone bridge under direct visualization. Given that a cortical button has been shown to exhibit a higher load to failure, it can still be used under direct visualization in a 2-incision approach.

Here we present our technique to maximize supination strength after distal biceps tear: the 2-incision distal biceps repair with cortical button (Video 1) (Table 1).

Surgical Technique

Positioning

The patient is supine, with their hand situated on a hand table. The surgeon sits on the lateral side of the arm to allow access to the posterolateral forearm, with the patient’s shoulder internally rotated.

Radius Exposure

We make a 4 cm long incision centered 3 cm distal to the radiocapillary joint (Fig 1A), placed halfway between the radial shaft and the dorsal ulnar crest. The fascia of the common extensor is incised, and the muscle is split.
bluntly. The next fascial layer is the superficial fascia overlying the supinator muscle. Palpating here while rotating the forearm will aid in identifying the radial tuberosity and the ulna, and the fascia is incised toward

| Advantages                                      | Disadvantages                    |
|------------------------------------------------|----------------------------------|
| Allows better restoration of supination strength, the most important function of the distal biceps | Is less familiar to some surgeons |
| May decrease the risk of nerve injury           | May increase the risk of HO and synostosis |
| Improved construct strength occurs with cortical button augmentation | Requires release of the supinator |

HO, heterotopic ossification; LABC, lateral antebrachial cutaneous nerve; PIN, posterior interosseous nerve.

Fig 1. Setup. The patient is supine (left elbow), the surgeon sitting on the lateral side of the arm toward the head (right side of images). (A) Dorsal incision. The dorsal incision is 4 cm long, centered 3 cm distal to the radiocapitellar joint. It should be placed halfway between the radius and the dorsal ulnar crest (dotted line) to allow access to the native footprint. (B) Volar incision. The volar incision (solid line) is 2 cm across, 2 cm distal to the flexion crease.

Fig 2. Bony preparation of the radius. (A) Intramedullary slot. In maximal pronation, an intramedullary slot (dashed outline) is made in the native footprint in the radial tuberosity by using a burr. (B) Suture holes. After supinating 90° from the position of maximal pronation in A, 2 2.0 mm holes are made into the intramedullary slot, leaving an adequate bone bridge from the slot and matching the spacing of the holes of the eventual cortical button. Direct contact or exposure of the ulna should be avoided to minimize the risk of synostosis.

Identifying the muscle fibers of the supinator originating from the ulna in a 60° or 70° angle distally verifies the correct location. While pronating the forearm to bring the posterior interosseus nerve (PIN) more anterior, the muscle is incised with electrocautery to

Table 1. Advantages and Disadvantages of 2-Incision Repair with Cortical Button.

|   | Advantages                                      | Disadvantages                    |
|---|------------------------------------------------|----------------------------------|
|   | Allows better restoration of supination strength, the most important function of the distal biceps | Is less familiar to some surgeons |
|   | May decrease the risk of nerve injury           | May increase the risk of HO and synostosis |
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minimize later bleeding. Unnecessary distal dissection is avoided because the PIN traverses posteriorly more distally.

**Radius Preparation**

Maximal pronation brings the tuberosity into view. We place a short, wide Hohmann retractor posteriorly and an Army-Navy retractor anteriorly. Hohmann retractors anteriorly may trap the PIN against the radius and are avoided.

Any stump of tendon is debrided. We use a 4 mm high-speed burr to create a longitudinal slot in the tuberosity, roughly 10-15 mm long and 4 or 5 mm wide (Fig 2A). The true dimensions are adjusted based on the size of the prepared tendon. After breaching the cortex, the radial tuberosity still has a pedestal of dense bone to remove before reaching the true intramedullary canal. It is important to ensure that the slot is concentric within the radius.

From this position of maximal pronation, we supinate roughly 90° and place 2 drill holes into the superior and inferior aspects of the intramedullary slot using a 2 mm drill bit (Fig 2B). These should be at least 5-10 mm away from the intramedullary slot, and their spacing should match the spacing of the holes of the cortical button.

**Tendon Retrieval and Suturing**

We make a transverse, 2 cm incision roughly 2 cm distal to the elbow flexion crease (Fig 1B). We bluntly dissect the subcutaneous tissue. The lateral antebrachial cutaneous (LABC) nerve is not purposefully identified, but if encountered, dissection should continue ulnar to it. The forearm fascia is opened, followed by the tendon sheath. Serosanguinous fluid is encountered here in acute tears. If the tendon is not visualized, digital palpation and elbow flexion will help.

After retrieving the tendon with a pair of pickups (Fig 3A), we sharply excise the degenerated edge. We secure the tendon with a 1.4 mm XBraid (Stryker, Greenwood Village, CO) in a running, locking Krackow configuration (Fig 3B). The first and last passes need to be as widely spaced as possible to allow recreation of the normal anatomy, with the long head, which is lateral, inserting proximally on the radius. We pass a doubled-over 1.2 mm XBraid (Stryker) through the tendon with a free needle in a single pass, interlocking/overlapping the passes of the Krackow (Fig 3C).

**Tendon Passage and Fixation**

Using the index finger to bluntly follow the path of the tendon sheath distally, we identify the radius while rotating the forearm and slide an extra-long curved Kelly clamp immediately adjacent to the index finger. Avoiding direct visualization of the radius through this wound minimizes retraction and dissection in this area and may lower the risk of nerve injury. We pass the clamp along the ulnar side of the radius, flex the elbow, and pass the clamp through the dorsal incision. Then we retrieve the middle of a free suture into the volar incision and use this loop to retrieve the sutures of the biceps tendon. The tendon is then brought out through the dorsal incision, ensuring free gliding (Fig 4A).

We expose the previously placed drill holes. A Hughston suture passer is traditionally used for retrieval, but we find that using a nitinol suture shuttle
or a free suture such as a 0 Vicryl (Johnson & Johnson, New Brunswick, NJ) is much easier. The Vicryl is passed through the proximal hole, tied around 3 sutures on the lateral/proximal biceps tendon and retrieved. This is repeated through the distal hole for the 3 sutures on the medial/distal tendon.

Each set is passed through the G-Lok button (Stryker), which is then slid down the sutures onto the radius. The doubled-over 1.2 mm XBraid is used initially. Because it has a single pass through the tendon and slides, we employ a racking hitch knot, which has excellent knot- and loop-security that tightens even further in response to load, to reduce the tendon into the intramedullary slot. Because 3 additional half-hitches are placed, it should not loosen and should keep the tendon well seated. Now that the tendon is provisionally fixed, the 1.4 mm XBraid can be tied for more robust and definitive fixation without worrying about loss of reduction while tying the knot (Fig 4B).

Discussion

Distal biceps tears are common injuries and, left untreated, they lead to significant loss of supination strength.1 As a result, the primary objective of distal biceps repair is restoration of supination strength. Both 1- and 2-incision techniques are successful, but each has its own advantages and disadvantages (Table 2).

The 1-incision technique is familiar to many surgeons. Despite the advantage of using a single incision, it does have disadvantages, most notably, not allowing access to the true anatomic attachment site. The radial tuberosity and tendon footprint are on the ulnar side of the radius when the forearm is maximally supinated, so a 1-incision approach places the tendon 90° anterior to the native attachment.2 And because the anterior dissection is greater, and the radius is fairly deep within the forearm, the retraction necessary for visualization has been shown to lead to a higher rate of injury to the LABC and PIN.3

The 2-incision approach allows direct visualization of the tuberosity and reattachment to the anatomic attachment. This more posterior attachment improves the rotational moment arm of the distal biceps to facilitate its most important function, supination.2,4-6 And because forceful retraction through the anterior wound is minimized, direct retraction of the nerves is reduced, leading to a lower reported rates of both LABC and PIN injury.3 The greatest limitation of the 2-incision technique is that it carries a slightly higher rate of HO and synostis.7,8 However, routine use of indomethacin prophylaxis has been shown to mitigate them.7,8

Most commonly, the method of fixation is predicated on the approach and is dictated by access to the radius. The 1-incision approach requires a method of fixation that can be used from the anterior position, which most commonly is a cortical button, suture anchor and/or interference screw. The 2-incision approach most commonly uses a transosseous repair over a bone bridge because of access to the tuberosity and the posterior radius. However, biomechanical studies show that although all repairs are quite strong, a cortical
button has the highest load to failure. As a result, we have incorporated a cortical button into a 2-incision repair. This increases the moment arm by reattaching it anatomically and increases the strength of the repair with a cortical button.

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