Multiple Nerve Injuries Following Repair of a Distal Biceps Tendon Rupture

Case Report and Review of the Literature

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Abstract

Current repair of a distal biceps tendon rupture has reverted to the single incision technique. Postoperative complications are rare, but the most common are due to neuropraxia. We present the case of patient who sustained multiple nerve injuries following distal biceps repair. This case is presented with a review of the literature.

Rupture of the distal end of the biceps brachialis tendon is a relatively uncommon injury that usually occurs in active, middle-aged men after an eccentric muscle contracture (often during heavy lifting). Patients often present with pain, ecchymosis, and swelling over the antecubital region of the dominant arm. The physical examination and radiographs can be equivocal due to the strength of the uninjured brachialis muscle and the stabilizing power of the lacertus fibrosis. However, ultrasound and MRI imaging can be used to determine whether a suspected tear is present and whether the tear is partial or complete.[1,2]

The treatment is surgical because a nonoperative approach has led to the development of significant loss of forearm flexion and supination strength with suboptimal results.[3] A variety of surgical techniques and approaches have been advocated, although isolated nerve injury is the most common complication associated with the single incision approach.

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We present the case of a patient, with a surgically repaired distal biceps tendon rupture performed through a single incision, with injury to both the posterior interosseus and lateral antebrachial cutaneous nerves.

Case Report

A healthy, right-hand dominant 51-year-old man sustained injury to his right distal biceps while shoveling dirt. He was diagnosed with an acute right distal biceps rupture (confirmed by ultrasound, Fig. 1) and subsequently underwent operative repair within a week of the injury.

The surgery was performed via a single incision. Intraoperatively, it was found that 90% of the distal biceps tendon was avulsed from the radial tuberosity. The remaining fibers were subsequently released. The distal biceps tendon was then secured using a single #2 Orthocord© (Depuy, Warsaw, IN) placed in a whip stitch fashion. A Biomet Zip Loop© (Biomet, Warsaw, IN) cortical button plate was then secured to the distal biceps in a three-bit suture construct. A 7 mm drill hole was placed in the radial tuberosity which was then enlarged with a rongeur to an oval configuration. The opposite cortex was penetrated with a 4.5 mm drill bit. The leading suture was brought percutaneously through the dorsal aspect of the forearm using a Beath pin. The cortical button plate was rotated and secured against the opposite radial cortex. The biceps tendon was then brought into the prepared drill hole on the radial tuberosity by shortening the zip loop. The repair was made without technical difficulty or other complications.

Immediately after the operation, the patient complained of increased paresthesias and numbness along the lateral antebrachial cutaneous nerve (LACN) distribution and an inability to extend his wrist, fingers, and thumb. Initially, these findings were attributed to neurapraxia of both the LACN and posterior interosseus nerve (PIN) caused by intraoperative retraction. The patient was placed in a thermoplastic

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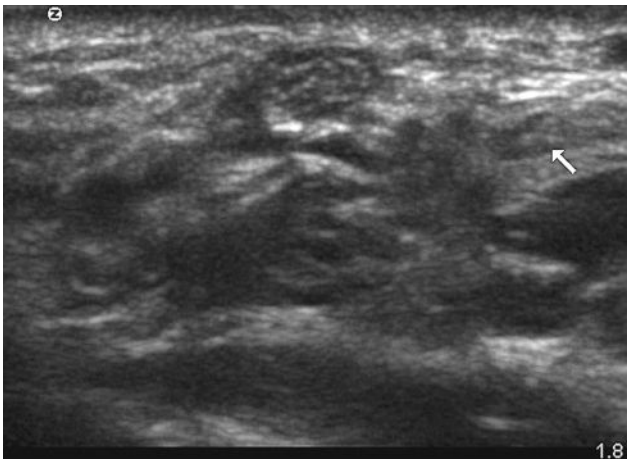

Figure 1 Immediate post-injury ultrasound depicting avulsion and retraction of the distal biceps tendon (arrow).

dynamic digital extension splint and started early active range-of-motion exercises. At 4 weeks postoperatively, the patient continued to have dysesthesias and absence of extensor function in the hand and wrist and was evaluated by us.

On physical examination, the patient was well nourished in no apparent distress. He had strong pulses throughout. A well-healed curvilinear single incision extended 7 cm across the right antecubital fossa to the medial forearm. On neurological examination, the patient displayed normal muscle bulk and tone throughout with reflexes grossly intact. Individual muscle testing of the right upper extremity demonstrated deficits in wrist extension 2/5 and finger extension 1/5. These findings are consistent with injury to the PIN. On sensibility testing, light touch and pinprick were intact with the exception of the right upper extremity where the patient complained of decreased sensibility and numbness along the lateral volar aspect of his forearm representative of injury to the LACN. He had full passive range of motion of his right upper extremity. No contractures were noted.

Electrodiagnostic testing was conducted 4 weeks following surgery. The nerve conduction study demonstrated an absent Compound Muscle Action Potential for the right radial nerve, a 50% decrease Sensory Nerve Action Potential for the right radial nerve, and an absent SNAP for the right LACN. The needle electromyography displayed an intact brachioradialis and extensor carpi radialis longus. However, the right extensor digiti communis and extensor carpi ulnaris showed mild membrane instability with fasciculations. There was no recordable motor unit action potentials with submaximal effort.

An MRI was likewise obtained to augment the findings of the electrical studies. It demonstrated findings suggestive of posterior interosseus nerve injury and compression within the supinator muscle causing early muscle denervation (Figs. 2 and 3). The patient was observed for the next several months. He continued an aggressive physical and occupational therapy regimen and direct muscle stimulation. Within 6 months of injury, he was regaining PIN function. After 9 months, the patient's LACN sensibility did not return. The PIN motor function gradually improved. At 1 year after injury, muscle function throughout the right upper limb returned to 5/5. LACN sensibility remained absent.

Discussion

Nonsurgical treatment of distal biceps tendon ruptures has led to inferior outcomes especially in forearm flexion and supination strength. Therefore, most practitioners would choose to surgically repair an acute distal biceps rupture. Various approaches have evolved. Early repairs utilized a single anterior incision via the Henry approach to anatomically reattach the distal biceps to the radial tuberosity via drill holes.[4] Injury to the radial nerve is a well-known and frequently described complication. Boyd and Anderson developed a two-incision technique in response to the high rate of nerve injury.[5] This was later modified by Failla and colleagues[6] to decrease the risk of heterotopic ossification formation. Of note, no significant differences in recovery

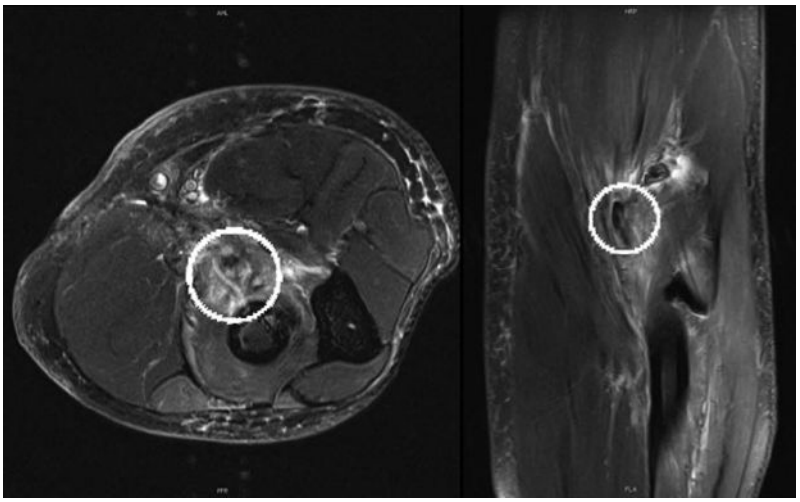

Figure 2 Axial (left) and coronal (right) fat suppressed intermediate MR images depict increased signal in the extensor and supinator muscles compatible with muscle denervation. Post-surgical edema is noted anteriorly. The posterior interosseous nerve and its accompanying vessels are noted in the plane between the two heads of the supinator muscle (circled on left image). The avulsed biceps tendon is presented on the coronal image (circled on right image).

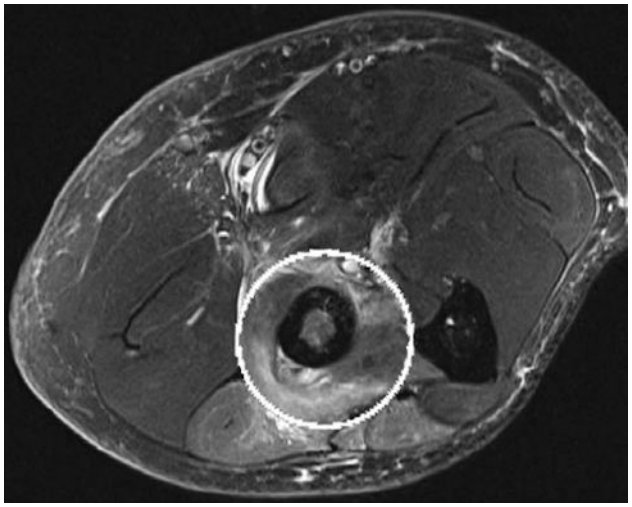

Figure 3 Axial fat suppressed intermediate signal MR image demonstrates increased signal of the supinator and extensor muscles (circled).

of flexion and supination strength exist between the single or double incision technique.[7]

Recent advances in tendon fixation techniques include suture anchors, biointerference screws, and cortical buttons. This has led to a trend back to the single incision approach because of the heavy braided suture and the knot-tying techniques before fixation.[8] Current research have found satisfactory results with all techniques; however, surgical complications are not uncommon. In a meta-analysis of one-incision distal biceps tendon repairs, Chavan and associates[9] reported an overall complication rate of 18% (29 of 165 elbows), with the most common complication being single nerve injury (occurring in 13%).

Knowledge of the local cutaneous and deep neurovascular anatomy is crucial during the surgical exposure. The LACN runs superficially between the biceps and the brachialis muscle, where the LACN becomes a continuation of the musculocutaneous nerve. Iatrogenic injury or excessive retraction of this nerve can lead to a painful neuroma and paresthesias down the anterolateral aspect of the forearm. This complication is reported in up to 5% to 7% of cases.[10]

The radial nerve courses in between the brachialis and brachioradialis muscles (Fig. 4). It bifurcates at the level of the elbow joint into the superficial nerve, which courses dorsally under the extensor carpi radialis brevis, and the PIN, which dives under the superficial head of the supinator muscle and continues along with the posterior interosseous artery to supply all of deeper lying extensor muscles.[11] Injury to the PIN has been reported in up to 5% of cases of distal biceps repairs using a single anterior incision.[5,12] Although much less common, PIN palsy can occur using a 2-incision technique.

If nerve function does not return (due to traumatic injury) by approximately 4 to 6 weeks, electrical (EMG/NCS studies) are recommended at that time. Absence of electrical activity at 3 months is an indication for either nerve exploration or more commonly tendon transfers to restore hand function.

Bain and coworkers were the first to report the clinical results of a single-incision technique with cortical button fixation for the repair of distal biceps tendon.[13] All patients had a return of full strength, and there were no instances of radioulnar synostosis or neurological injuries. A second arm of this study included five cadaver dissections that were performed to measure the distance from the distal biceps tendon insertion site to the neurovascular structures. On the average, the guide wire was 12 mm from the median nerve and 18 mm from the posterior interosseous nerve. However, the investigators cautioned against drilling laterally and dorsally as the distance to the PIN is decreased. The investigators advanced the Steinmann pin at a 0° angle (directly posterior), the average distance to the posterior interosseous nerve was 14 mm; when the Steinmann pin was advanced at a 45° posterolaterally-directed angle, the average distance to the posterior interosseous nerve was only 8 mm.

Greenberg and colleagues[14] also reported encouraging results in 14 patients an average of 20 months after tendon repair with a cortical button. The investigators noted three cases of transient lateral antebrachial cutaneous nerve symptoms, which resolved; no instances of posterior interosseous nerve injury were seen. A second arm of the study likewise included cadaveric dissection that revealed the button was separated from the radial nerve by a layer of supinator muscle superficial to the button and deep to the nerve. The mean distance of the button from the nerve was 9.3 mm. Most recently, Peeters and associates[15] reported on 23 patients who underwent repair with use of the cortical button fixation technique and followed for a mean of 16 months. There were no neurological complications.

DiRaimo and coworkers were the first to investigate the use of the Biomet Zip Loop© for fixation of distal biceps tendon ruptures. The Zip Loop toggle lock system is a suspensory cortical fixation device with a modification that allows the surgeon to attach the implant to the tendon away from the wound and adjust the tension of the suture loops and subsequently the repair.[16] The investigators' state this allows for a technically easier reinsertion while maintaining appropriate elbow flexion and rotation. They report on a series of four patients where one sustained transient superficial sensory radial nerve palsy.

In this case, the etiology of nerve injury can be attributed to the single incision exposure without identification of either the LACN or the PIN. Neither nerve was exposed surgically, and this underlies the inherent risk. Although excessive intraoperative retraction was initially thought to be responsible for both the LACN and PIN injury, direct injury to the LACN is more probable in light of the duration of patient symptoms. The PIN was mostly likely injured at one of the following steps: during the surgical exposure, excessive lateral retraction, the use of the drill during creation of the

bone tunnel, and percutaneous advancement of the Beath guidewire. The injury was neuropraxic only in view of the rapid recovery. Care should be taken to place the forearm in a maximally supinated position and the drill and guidewire directed distal and medial.[17]

Nerve recovery is classically 1 mm per day or 1 inch per month.[18,19]

Conclusion

Distal biceps tendon repairs require vigilant attention to detail. Even in the most experienced hands, nerve complications are not uncommon. Fortunately, the majority of these cases are transient and reversible without surgical intervention.

Disclosure Statement

None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

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