Intraoperative Finding of Flexor Carpi Radialis Avulsion During Closed Distal Radius Fracture: A Case Report

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ABSTRACT
Distal radius fractures are a common reason for orthopaedic consultations in emergency departments and outpatient orthopaedic clinics. Ruptures of the extensor pollicis longus tendon have been regularly described in conjunction with distal radius fractures, whereas only five cases of flexor tendon injuries have been reported. We describe a patient with acute rupture of the flexor tendon identified during operative fixation of the distal radius fracture. The tendon avulsion was repaired at the same time as fracture fixation; unfortunately, the patient was lost to follow-up. This case highlights the importance of a careful physical examination in treating high-energy traumatic injuries and the need to be aware of potential tendon injuries in the operating room.

Keywords Radius Fracture, Wrist Injury, Tendon Injury

INTRODUCTION
Distal radius fractures are common traumatic injuries treated by orthopaedic surgeons. The fractures can be associated with injuries of the carpal bones, including scaphoid fractures (prevalence, 0.5-6%), wrist ligament injuries, and tendon ruptures. Ruptures of the extensor pollicis longus (EPL) tendon are also common, with a reported incidence of 0.4% with closed treatment of distal radius fractures. Flexor tendon irritation, or rupture, has been extensively described in association with fixation techniques using volar locking plates. Five studies have reported ruptures of the flexor tendons with closed treatment of distal radius fractures. However, no study has reported avulsion of flexor tendons associated with closed treatment of distal radius fractures.

In the past decade, open fixation using volar locking plates has gained popularity for treating distal radius fractures. In 2007, surgeons reported using open surgical approaches to stabilize distal radius fractures in 81% of cases. Owing to the increased use of volar locking plates, perhaps more surgeons will identify injury of the flexor carpi radialis (FCR) tendon. We describe an uncommon finding of an FCR tendon avulsion associated with closed treatment of a distal radius fracture caused by high-energy trauma.

CASE REPORT
A 52-year-old man (right-hand dominant) was involved in a motor vehicle crash. He was an unrestrained driver and sustained high-energy, traumatic injuries. These included aortic injury, pelvic fractures, and rib fractures. The findings of his left wrist radiograph revealed no fracture. Initial radiographic findings were suggestive of carpal instability, but further imaging did not support this diagnosis. In the medical history description, no arthritic or inflammatory conditions were noted except for asthma.

Thirteen days after his initial injury, the patient underwent treatment of his distal radius fracture using a volar locking plate. The delay in operative fixation was due to his respiratory status. The extended FCR approach was used to expose the distal radius. The FCR tendon was noted to be redundant during the exposure. After further exploration, the tendon appeared to be avulsed from its insertion, which was an unexpected finding. Under appropriate tension, the FCR tendon was sutured to the deep FCR sheath. The patient was then placed in a long arm cast.
splint with 20° of flexion at the wrist and a dorsal blocking component to protect the tendon.

In the immediate postoperative period, the patient was advised to perform range of motion of all fingers within the constraint of his dorsal blocking splint. Gentle wrist range of motion was permitted 4 weeks postoperatively.

**DISCUSSION**

Distal radius fractures are common and caused by different degrees of force. Studies have described rupture of flexor tendons with distal radius fractures caused by high-energy trauma. However, in most cases, FCR tendon ruptures may have resulted from the sharp bony edge produced by displacement of the apex volar fracture. In comparison to the EPL tendon, the FCR tendon rupture remains an uncommon finding because of volar protection provided by the pronator quadratus muscle, less constraint in the flexor canal, and a higher tensile strength compared to the EPL tendon. In the current case, however, an acute FCR tendon rupture was found intraoperatively during surgical treatment of a distal radius fracture.

In distal radius fractures, flexor tendon ruptures may occur under strain by a hyperextension force. In this setting, the tendon will rupture at its insertion, musculotendinous junction, or within the muscle substance; however, rupture of the tendon substance almost never occurs. According to Boyes et al, before rupture occurs, half of the tendon substance must be divided, even under extreme stress. The findings of this study support the theory that a combination of a sharp edge at the fracture site and hyperextension force will eventually lead to a FCR tendon rupture. The FCR tendon has three known distal insertion sites: the trapezium, the base of the second metacarpal, and the third metacarpal. Regarding our patient, one could hypothesize that the high-energy

**Figure 1.** Right wrist radiograph on the day of injury, showing an intraarticular comminuted and displaced distal radius fracture and ulnar styloid fracture. A) Anteroposterior view. B) Lateral view. Note the most distal fracture fragment with volar displacement on the lateral view.

**Figure 2.** Intraoperative finding of avulsion of the flexor carpi radialis (FCR) tendon. A) Forceps holding the distal aspect of the avulsed FCR tendon; note the redundant aspect of the tendon. B) Forceps holding the avulsed FCR tendon under tension to recreate normal appearance of the tendon as naturally encountered during surgical approach.
trauma led to the avulsion of the tendon at one of its insertions. Another hypothesis is that there was no weakening of the tendon substance due to bony prominence; therefore, the point of failure was at the insertion of the tendon instead of at its substance.

Techniques used to repair FCR tendon avulsions have been infrequently described. Therefore, an intraoperative decision was made to repair the FCR tendon by suturing it to the deep FCR sheath. It can be argued that the tendon could have been positioned in its anatomical location with the use of a suture anchor. However, at its most distal location, the deep FCR sheath is a non-mobile structure and thus can be used as a proxy to the trapezium. Furthermore, a suture anchor placed on one of the metacarpal bases would have required further dissection distally compared to the exposure obtained using the FCR extended approach.

In treating distal radius fractures using volar plating, the senior author (DM) uses custom-made volar resting splints with the wrist in neutral to slight extension (10°-20°). Patients are encouraged to start with a range of motion of the fingers on postoperative day 1 to prevent stiffness. With the help of a hand therapist, patients will start a gentle range of motion at the wrist starting at 4 weeks postoperatively. In the current case, the flexor tendon repair required the application of a splint with slight wrist flexion to protect the tendon. The standard rehabilitation protocol was also delayed, with range of motion at the wrist starting at 4 weeks postoperatively. Furthermore, the FCR tendon was tensioned tightly when repaired. These factors could place the patient at risk of stiffness, especially decreased wrist extension. However, rehabilitation protocol varies widely and some surgeons prefer to defer range of motion at the wrist at 4 to 6 weeks postoperatively when treating severely comminuted fracture patterns.

In all five case reports and in the current case, FCR tendon rupture was an incidental intraoperative finding. Thus, physicians should be suspicious of tendon ruptures when treating patients with injuries due to high-energy trauma and considerably displaced distal radius fractures. Owing to the limited reports, flexor tendon injuries due to closed distal radius fractures could be further studied to elucidate incidence, improve diagnosis, and enhance treatment.

REFERENCES