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Case Report

Partial Flexor Tendon Injury Causing Locking: Illustration of the Utility of Dynamic Ultrasound

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Clinical diagnosis of partial flexor tendon lacerations is challenging because tendon function may be preserved. Although some partial flexor tendon tears can be managed conservatively, pain, stiffness, and triggering/locking may result, requiring surgical management. The mechanism by which this occurs has been investigated in animal and cadaver studies but has not been demonstrated in patients with real-time, in vivo imaging. Here, we present a case of partial tendon tear presenting with severe pain and locking that was diagnosed before surgery and characterized with dynamic ultrasound.

Limited and/or painful finger flexion following laceration is a presentation of partial flexor tendon injury.[1,2] Triggering and locking are less common and may occur immediately after the injury or up to weeks later. In vivo animal models and cadaveric studies postulate varied mechanisms, including intratenosynovial bunching of tendon fibers at the laceration site and catching of the torn tendon edges on intact pulley fibers.[1,3] When the injury is oriented obliquely or there is subsequent longitudinal delamination, a flap or tag may be produced, which can be palpable on examination as a small mass or nodule. If the flap is pointed distally, there will be triggering or locking with extension, whereas if it is pointed proximally, mechanical symptoms will occur with flexion.[4]

Ultrasound is highly accurate for the diagnosis of flexor tendon injuries in the hand and is superior to physical examination alone.[5–9] It has previously been reported as useful for the diagnosis of partial flexor tendon tear with flap entrapment; however, the flap was not prospectively recognized and dynamic maneuvers were not used.[10–12]

Case Report

Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

A 34-year-old man presented to our clinic with right ring finger pain and stiffness following volar ring finger laceration from shattered glass 7 weeks before. At the time of initial injury, he had presented to urgent care in which examination excluded complete flexor tendon disruption, radiographs were negative for fracture and radiopaque foreign body, antibiotics were prescribed, and the wound was irrigated and glued. His wound healed uneventfully, but the digital pain and stiffness worsened. At presentation to our clinic, physical examination showed a healed oblique zone 2 laceration with a palpable nodule deep to the scar at the level of the middle phalanx. Flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) were grossly intact, but composite digital flexion was limited to 4 cm from the distal palmar crease. He was distally neurovascularly intact. Given the concern for flexor tendon injury and/or adhesion, the patient was referred for ultrasound.

Diagnostic ultrasound demonstrated a partial injury of the superficial fibers of the FDP tendon and marked tenosynovitis (Fig. 1). The injury delaminated longitudinally in the distal direction, generating a flap or tag that herniated through a defect in the overlying tendon sheath and A2 pulley. With passive and active flexion, the tendon flap caught on the residual intact pulley fibers, blocking further flexion (Fig. 2). Digital neurovascular bundles were intact.

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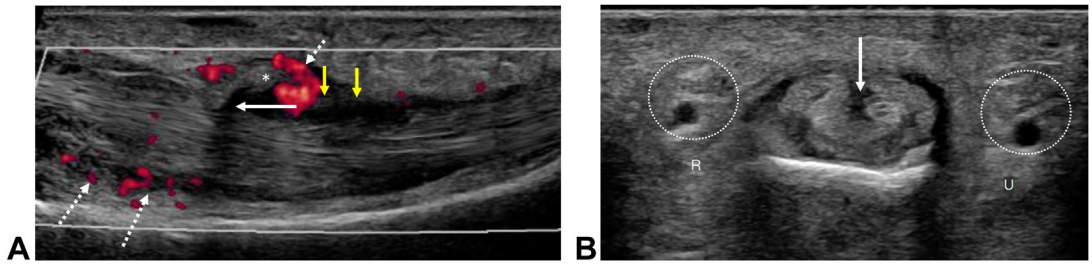

Figure 1. **A** Longitudinal power Doppler and **B** transverse gray-scale ultrasound images of the ring finger volar aspect at the level of the proximal phalanx. There is a 50% partial thickness longitudinal laceration of the FDP (*solid arrows*), yielding a superficially displaced flap of tissue (*). Tenosynovitis is characterized by hyperemic, thickened tenosynovium, and trace fluid is elicited (*dashed arrows*). The A2 pulley is thickened (*yellow arrows*). Radial, R; ulnar, U; digital neurovascular bundles (*dashed circles*).

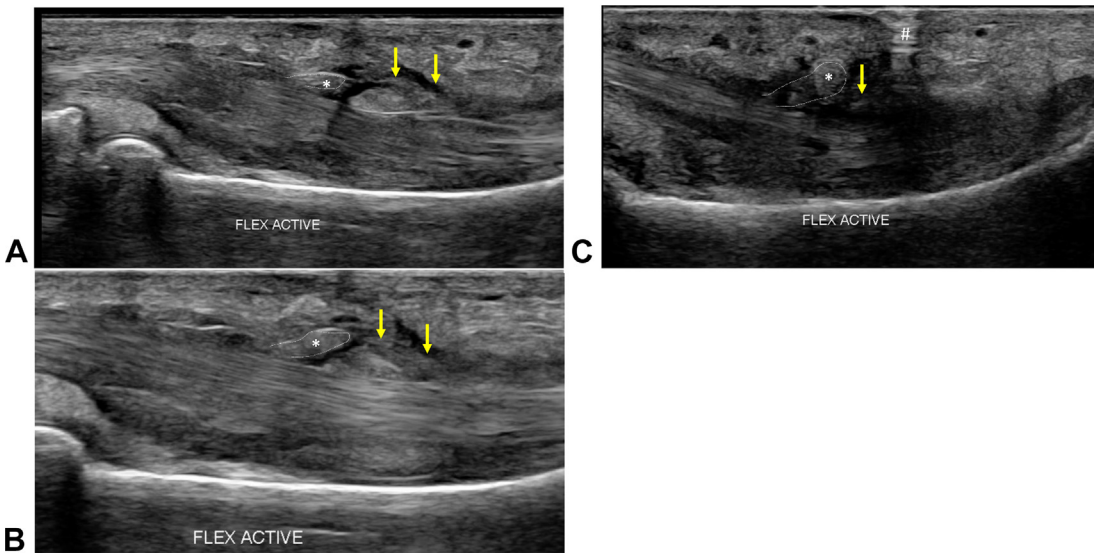

Figure 2. Longitudinal gray-scale ultrasound images of the ring finger volar aspect at the level of the proximal phalanx with the finger **A** fully extended, **B** partially flexed, and **C** flexed to the point of locking. The FDP tendon flap (*, *white outline*) lies flat against the rest of the tendon at rest. With flexion, the flap catches on the intact A2 pulley fibers (*yellow arrows*) and herniates through the laceration defects, becoming thicker and more bulbous in configuration. Air reverberation artifact (#).

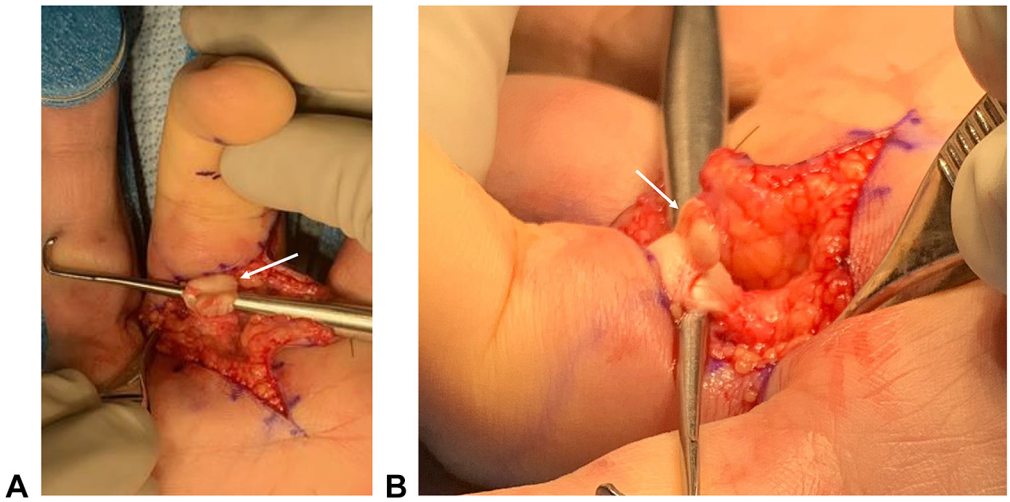

Figure 3. Surgical photographs of the ring finger flexor tendons in **A** longitudinal and **B** transverse orientations to the ring finger confirm the presence of a zone II FDS partial laceration with flap formation (*arrows*).

Given his history and examination and ultrasound findings, surgery was indicated. Surgery was performed under intravenous sedation and digital block. Regional block was not used to allow for intraoperative assessment of range of motion. Healed traumatic scar was incorporated into a Bruner incision. Under a tourniquet, the skin was incised, full-thickness skin flaps were reflected, and the flexor tendon sheath was examined. At the level of the mid-A2 pulley, abundant scar tissue was encountered, which was carefully separated from the flexor tendon sheath and tendons. A 1.25-cm defect in the flexor tendon sheath was present. As demonstrated on the preoperative ultrasound images, the FDP tendon had a 50% laceration with a large flap (1 cm in length) that herniated through the A2 pulley defect on passive digital range of motion; the FDS tendon was intact (Fig. 3). Abundant tenosynovial inflammation was excised. Flexor digitorum profundus tendon debridement was performed with excision of the superficial flap to create a smooth contour. Passive digital range of motion demonstrated persistent catching of the FDP tendon between the FDS slips. Thus, the FDS ulnar slip was excised. Sedation was lightened, and the patient was asked to perform active digital range of motion. Flexion improved to improved to 1 cm from the distal palmar crease, but there was buckling of the FDP tendon through the A2 pulley defect. Thus, an A2 pulley reconstruction was performed with the FDS ulnar slip tendon graft. Sedation was lightened again, and the patient demonstrated full active digital range of motion. The skin was closed, and the hand was placed in a dorsal-blocking splint. Hand therapy was initiated on postoperative day 6 with placement of a thermoplastic splint and an A2 pulley ring. Sutures were removed on postoperative day 13. Splint and pulley ring were discontinued at postoperative week 7. By 2.5 months after surgery, he had recovered full range of motion.

Discussion

We found that an ultrasound evaluation is helpful in identifying and characterizing a partial zone II flexor tendon injury with triggering before surgery that was unlikely to heal with conservative treatment. Ultrasound was able to show both the flap and site of entrapment in vivo, precluding surgical exploration as the means of diagnosis. Furthermore, we were able to confirm one of the proposed mechanisms of tendon entrapment provided by cadaveric and animal studies with real-time, dynamic imaging in a patient. Magnetic resonance imaging has also been able to diagnose this specific entity and may be helpful in equivocal cases or if operators with musculoskeletal ultrasound expertise are not available.[2] However, ultrasound is the preferred modality due to its greater sensitivity for partial injuries, dynamic capabilities, and superior detection of concomitant nerve and vascular injuries or foreign bodies in the hand.[9,13,14]

Surgical treatment options include tendon debridement or tendon repair with or without a pulley/sheath reconstruction, depending on the clinical scenario.[1,3] Tendon strength is not significantly different between lacerations involving up to 75% of the cross-sectional area whether they are treated with trimming, suture repair, or no repair ($P < .05$), although gliding resistance was least in the unrepaired group, followed by tendons treated with trimming, and then repair with running suture.[1,3] Some partial injuries with triggering may heal spontaneously, with a gradual resolution of mechanical symptoms.[15] Regardless of the strategy chosen, postoperative outcomes are excellent once correctly diagnosed.

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