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Case Report

Spontaneous Midsubstance Rupture of the Flexor Digitorum Profundus Tendon of the Long Finger

Rehan Zahid, MD, * Uzair Qazi, MD, * Scott Farner, MD *

* Christine M Kleinert Institute of Hand and Microsurgery, Louisville, KY

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Closed flexor tendon injuries can often result from trauma that causes sudden forceful extension of an actively flexed digit. These closed tendon injuries commonly occur as avulsions in flexor zone I. Spontaneous midsubstance flexor tendon ruptures are rare, especially in the absence of an underlying pathology. Diagnosing such injuries accurately is challenging and critical. We present a case of a zone III spontaneous flexor tendon rupture of the long finger after forceful eccentric loading. Surgical exploration was performed, and the level of the rupture was identified during surgery. A side-to-side tendon repair technique was performed using a palmaris longus tendon graft. No underlying pathology to explain the rupture was found in this case. This report emphasizes the importance of considering spontaneous midsubstance ruptures, identifying the level of ruptures, and preoperative planning for such cases. It reviews the possible causes and treatment of spontaneous flexor tendon rupture.

Closed flexor tendon injuries can result from an opposing force to an actively flexed digit. Most closed flexor tendon injuries result in tendon avulsion from its insertion or a rupture at the musculotendinous junction.[1] Midsubstance ruptures are infrequent and usually occur in the presence of an underlying pathology, such as rheumatoid arthritis, fracture, gout, or corticosteroid injections.[1] In 1960, Boyes et al[2] defined spontaneous ruptures as intratendinous ruptures without intrinsic or extrinsic processes. Spontaneous tendon ruptures can easily be misdiagnosed and have been a subject of debate in the past.[3]

Diagnosing midsubstance ruptures clinically is challenging and might be discovered during surgery, when the tendon is found to be intact at zone I. Therefore, a strong clinical suspicion is advised. We present a case of a spontaneous flexor digitorum profundus (FDP) rupture in zone III.

Case Presentation

A 65-year-old right-handed woman presented to the hand clinic with left hand pain and the inability to fully flex her left long finger. Her symptoms started 10 days before the presentation when she fell down the stairs, grabbing the stair-railing with her left hand to regain her balance. The patient sustained multiple bruises to the lower limbs, without any major injury. The patient stated that her hand exhibited power grip when she grabbed the railing, and there was no direct trauma to the palm.

She initially went to another medical facility with the primary complaints of pain in the mid palm of the left hand and the inability to flex the long finger. There was no bruising or swelling of the hand. She was evaluated for her injuries, including hand and wrist radiographs, which showed no fractures or bony injuries. She was discharged with analgesics and referred to our hand care center.

The patient was a nonsmoker, and her past medical history included hypertension and chronic back pain. The patient had no history of repetitive hand motion or other occupational hazards involving manual work. On examination, she had no lacerations or scars on the left hand. There was mild diffuse swelling of the finger, without ecchymosis. Mild tenderness was noted over the flexor sheath and in the mid palm. She had no active flexion at the distal interphalangeal joint of the long finger. Active flexion at the proximal interphalangeal joint was intact. All other fingers had a full range of motion.

A clinical diagnosis of FDP avulsion in flexor tendon zone I was established. Magnetic resonance imaging or sonography was not requested because there was a concern for a retracted tendon in the palm, and imaging would have delayed surgical intervention, potentially compromising the vascularity of the tendon. A plan for

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Corresponding author: Rehan Zahid, MD, Christine M Kleinert Institute of Hand and Microsurgery, 225 Abraham Flexner Way, Suite 750, Louisville, KY 40202.
E-mail address: rehan.zahid1@gmail.com (R. Zahid).

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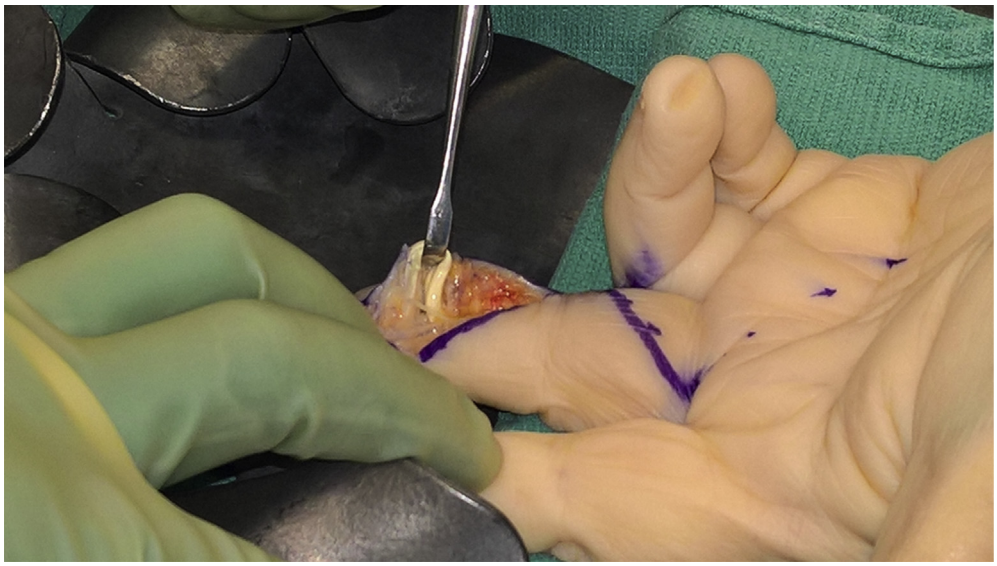

Figure 1. The FDP insertion at the base of the distal phalanx was intact.

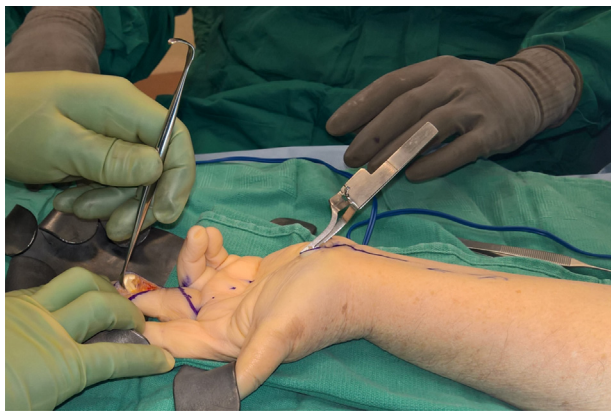

Figure 2. A second incision was made at the wrist and extended proximally to explore the musculotendinous junction.

surgical exploration with reinsertion of the FDP tendon was established and discussed with the patient.

The patient was taken to the operating room 2 weeks after the injury. Left long finger exploration was performed through a Brunner incision centered over the distal interphalangeal joint and middle phalanx. The FDP insertion at the base of the distal phalanx was found to be intact (Fig. 1). At this point, a second incision was made proximal to the wrist to explore the musculotendinous junction (Fig. 2), where the tendon was found to be intact. The Brunner incision over the finger was extended proximally to the base of the long finger. The distal FDP tendon was pulled from the palm at the level of the A3 pulley, and the rupture of the tendon was confirmed at zone III (Fig. 3). Further dissection into the distal carpal tunnel and palm revealed the FDP proximal to the left long finger (Fig. 4). About 1-cm length of each tendon end was resected and sent for a biopsy along with the synovium. Some hemorrhage was noted at the level of the rupture. No osteophytes were found in the carpal tunnel using digital palpation.

The palmaris longus graft was harvested from the same side and used to reconstruct the FDP tendon using a side-to-side repair technique, as described by Brown et al.[4] In contrast to direct repair, tendon graft reconstruction was favored to prevent over-tightening and the quadriga effect after tendon resection. The graft was sutured to the distal FDP using high-strength, partially absorbable 4-0 polyblend polyethylene sutures (Fig. 5). It was sutured to the proximal end after passing it proximally under the A2 and A1 pulleys as well as the carpal vascular arch. The initial tension was set using figure-of-eight sutures at the proximal and distal ends of the proximal repair site. Finger motion and graft tension were checked for determining the effect of tenodesis of the wrist, and the repair procedure was completed with a running interlocking stitch along each side of the repair (Fig. 6). Passive range of motion and repair strength were checked during the surgery. The wounds were closed and dressed, and a dorsal blocking orthosis was applied.

A retrospective review of the patient's history as well as serologic testing did not help identify a plausible reason for the rupture. We excluded rheumatoid arthritis, hand and wrist bone fractures, corticosteroid injections, osteoarthritis, gout, fluoroquinolone use, collagen disease, or metabolic disorders.

After the surgery, the patient had difficulty with pain management and the establishment of early rehabilitation despite being scheduled for formal dynamic hand therapy. The wounds healed uneventfully. A biopsy reported degenerative changes; organized scar tissue of the tendon stumps, consistent with the time of the injury; and normal synovial tissue. At the 6-week postoperative visit, the patient had a poor range of motion, with approximately 60° of total arc of motion of the left long finger and stiffness in the adjacent digits. At 3 months, she had a pulp-to-palm distance of 0.5 cm, with residual stiffness in the operative digit. At this point, the patient had mild pain and did not require analgesics. She stopped the formal hand therapy and did not present for follow-up again at the clinic.

Statement of consent

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

Discussion

Flexor tendon avulsion is commonly described as a jersey finger when it occurs in zone I and is usually caused by forced flexion against resistance.[5] Less frequently, it occurs as a rupture at the

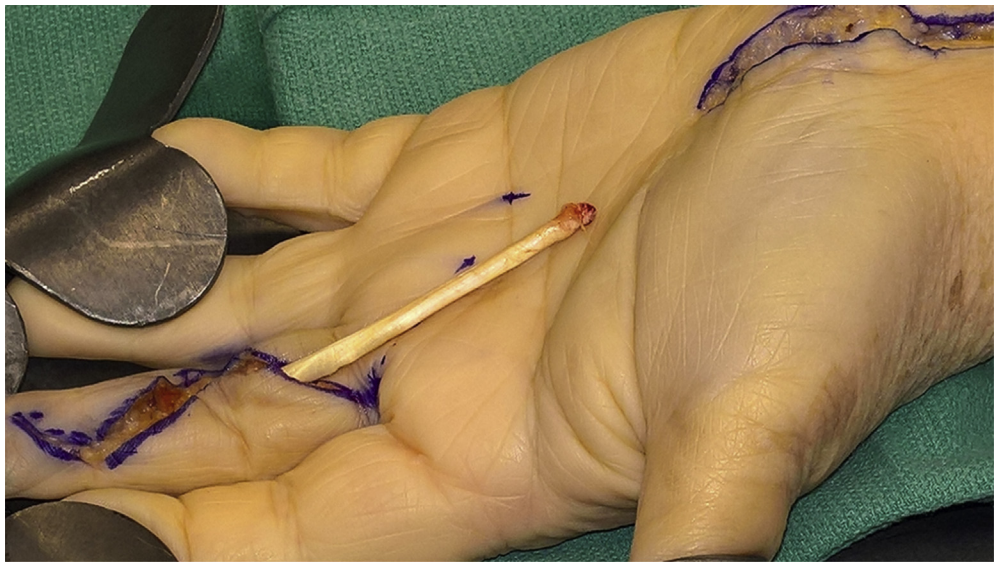

Figure 3. Distal FDP was retrieved at the A3 pulley level, and rupture of the tendon was confirmed at zone III.

Figure 4. A zone III rupture at the lumbrical muscle origin.

musculotendinous junction. Midsubstance flexor tendon ruptures are less common and usually present with an underlying pathology, whereas spontaneous ruptures are exceedingly rare.

Bois et al[1] reviewed the literature over a 50-year period (1966–2006) and found 50 spontaneous ruptures in 43 patients. Only a few spontaneous rupture cases have been reported since then. It is important to note that while defining a tendon rupture, underlying pathologic processes must be excluded.[3] However, whether sudden forceful contraction against resistance, such as in the described case, qualifies as direct trauma to the tendon remains controversial.

Although direct trauma or repetitive stress to the tendon may be a reason for rupture, there could be other contributing factors. Rheumatoid arthritis can cause tendon rupture through erosion from infiltrative tenosynovitis and attrition from osteophytic surfaces and rigid fibro-osseous tunnels.[5,6] Similarly, gout can cause uric acid deposition and tenosynovitis, predisposing the patient to rupture.[6] Various studies have also investigated attritional rupture due to pisotriquetral arthritis, the hook of hamate fracture nonunion, lunate dislocation, and accessory carpal bones. Steroid injections and fluoroquinolone use are also associated with tendon rupture in some cases.[5]

A biopsy of the tendon and synovium in spontaneous ruptures can give valuable information and is recommended. The reported histological findings of the patient included degenerative changes and organized scar tissue of the tendon stumps, consistent with time of the injury, and normal synovial tissue, excluding any pre-existing tendon pathology.

Spontaneous tendon ruptures usually present acutely, although in some cases, they may be painless. In 1 review, 68.4 % of patients described the sensation of a pop, and 28.9% described sharp pain in the region of tendon rupture, most often in the

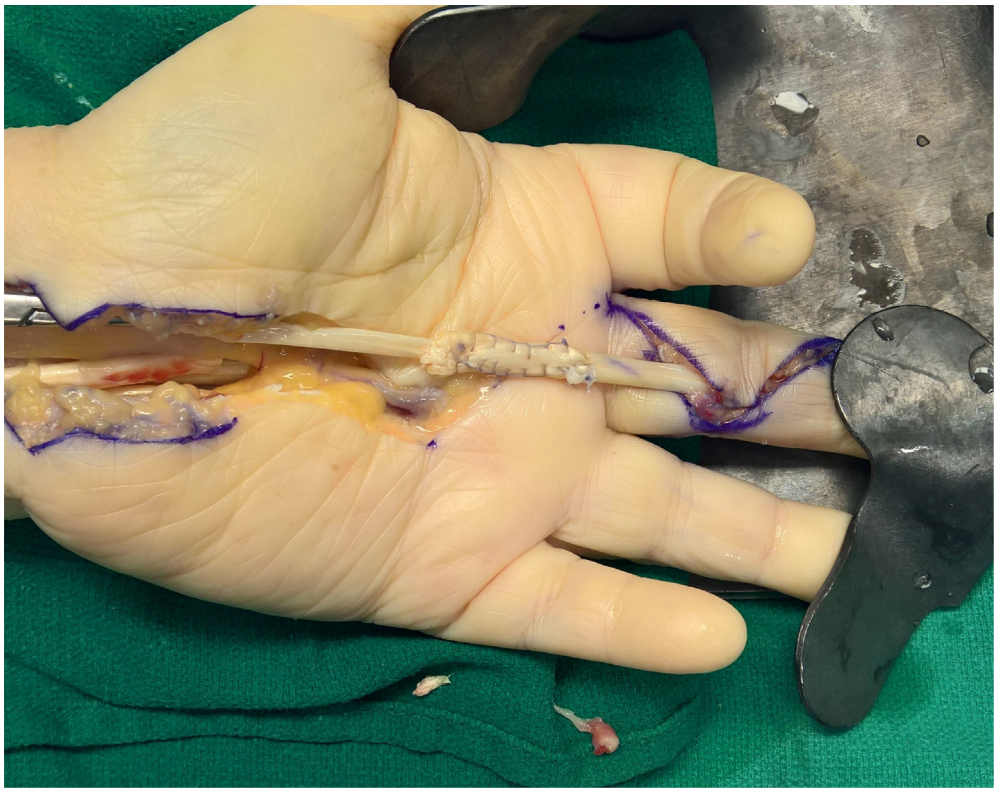

Figure 5. The palmaris longus graft was sutured using a side-to-side repair technique to the distal FDP using high-strength, partially absorbable 4-0 polyblend polyethylene sutures.

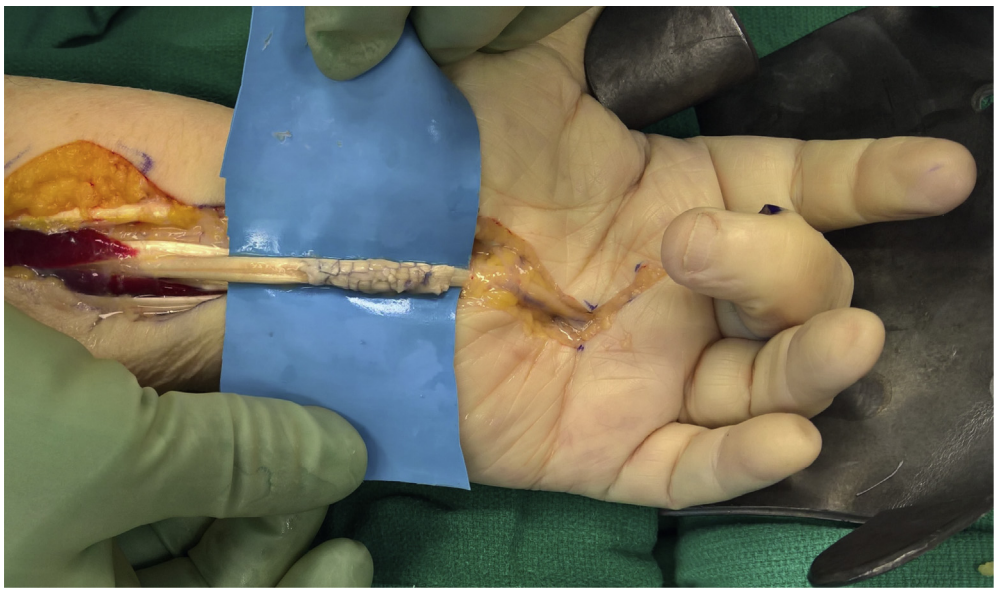

Figure 6. Proximal repair of the tendon graft to the intact FDP tendon.

palm.[1] The small finger is the most affected, followed by the ring and long fingers. This pattern is consistent with their contribution to power grip.

Determining the location of a rupture correctly might be difficult. Although pain in the palm may point toward a zone III rupture, it can also be present because of a retracted tendon due to zone I avulsion. Diagnostic imaging can be a helpful adjunct, especially in equivocal cases. Ultrasound and magnetic resonance imaging have both been proven to accurately determine the location of a rupture.[7,8] These can be effective in preoperative planning and minimizing morbidity.[1] This is evident from the case in review, in which logistic constraints of timely imaging led to avoidable extensive dissection. Although various studies have highlighted the benefit of using diagnostic imaging as an adjunct for spontaneous ruptures, the indications are based on clinical suspicion and vary from case to case.

Spontaneous zone III tendon ruptures often occur at the lumbrical origin, with studies identifying this as a hypovascular region of the tendon.[1,9] The lumbrical muscle receives its blood supply from the superficial palmar arch, common palmar digital artery, deep palmar arch, and dorsal digital artery. In the palm, there are no anastomoses between networks supplying the lumbrical muscles and FDP tendons, suggesting a possible watershed zone between the FDP tendon and the lumbrical muscle origin.[9] This has been hypothesized to contribute to tendon rupture in this region.

Primary tendon repair is usually possible within 3 weeks after a rupture. It is crucial to ensure that the repair is not too tight because it can either result in a digit that is unable to fully extend or an adjacent digit that has flexion lag due to the quadriga effect. The quadriga effect is defined as flexion lag in a finger adjacent to the one with a shortened FDP tendon, owing to the common muscle belly of the FDP tendons.[10] The long, ring, and middle fingers share the FDP muscle belly, and shortening by even 1 cm can lead to the quadriga effect.

In conclusion, spontaneous flexor tendon ruptures should be diagnosed and treated in a timely fashion. Pathological processes that weaken the tendon must be investigated and addressed to avoid future injury. Ultrasound and magnetic resonance imaging are useful adjuncts to accurately determine the location of tendons. Further studies will help develop a standard approach for diagnosing and treating spontaneous flexor tendon ruptures.

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