

Closed Rupture of the Flexor Digitorum Profundus Tendon of the Left Little Finger

Richard Simman, MD

Vincent G. Fietti, Jr, MD

Closed ruptures of flexor tendons are rare; however, when they occur, the site of rupture is almost exclusively at the tendon-bone insertion and less frequently at the musculotendinous unit. Midsubstance ruptures are extremely rare and are usually due to an underlying cause such as fracture, cystic degeneration, rheumatoid arthritis, or sequelae following local steroid injection. The most common mechanism of injury for spontaneous rupture of the flexor tendons occurs when the hand is engaged in resisted flexion.

This report describes the case of a patient who experiences closed rupture of the flexor digitorum profundus (FDP) tendon at the A2 pulley level after a blunt trauma to the volar aspect of the left little finger, with no evidence of underlying tendon pathology. Anatomy and etiology are also discussed.

CASE PRESENTATION

Presentation to the Emergency Department

A 33-year-old woman presents to the emergency department after her left hand is struck by the rearview mirror of a car. The patient has sustained a direct blunt trauma to the volar aspect of the left little finger that has caused it to hyperextend.

Physical and Radiographic Examination

Examination of the left hand reveals swelling and tenderness over the proximal phalanx of the left fifth digit. Neurovascular examination reveals intact function. The patient is unable to flex the distal interphalangeal (DIP) joint but has full range of motion of the proximal joint. Radiographic examination shows no fracture or dislocation.

Diagnosis and Treatment

The patient is taken to the operating room for surgical repair of the FDP tendon under an ulnar nerve block. Because the surgeon's initial impression is that the injury is an avulsion at the bony insertion of the dis-

tal phalanx, this area is explored first. However, the tendon's insertion point is found to be intact. A midsubstance rupture is identified at the A2 pulley level (zone II) of the FDP tendon (**Figure 1**). The flexor digitorum superficialis (FDS) tendon is intact. No evidence of tenosynovitis, cystic degeneration, or other abnormalities is identified. A Bruner zigzag incision is extended to find the proximal end of the severed tendon; this area is found at the level of the distal palmar crease. Tendon repair is performed using a modified Kleinert technique with 3-0 nylon and a running epitenodinous 6-0 suture. A dorsal splint is used to immobilize the wrist for 1 week, with wrist flexion at 45 degrees and metacarpophalangeal joints (MPJs) at 90 degrees. A dynamic splint is then applied for active extension/passive flexion for an additional 5 weeks.

Clinical Findings at Follow-up

The patient is not compliant with follow-up visits and is last seen 2 months after surgery, at which time the tendon remained intact. Active range of motion for the MPJ is 0 to 60 degrees; proximal interphalangeal (PIP) joint, 0 to 45 degrees; and DIP, 0 to 15 degrees. Passive range of motion for the MPJ is 0 to 70 degrees; PIP, 0 to 90 degrees; and DIP, 0 to 60 degrees.

DISCUSSION

Closed rupture of a flexor tendon is rare. The profundus tendon insertion on the distal phalanx is the usual site of injury and, as such, is appropriately termed an *avulsion*. A profundus avulsion injury results in the inability to flex the DIP joint. Leddy and Packer^{1,2} have described three types of profundus avulsions. In type I,

Dr. Simman is a Fellow in Plastic and Reconstructive Surgery, Craniofacial Institute, Providence Hospital, Southfield, MI. Dr. Fietti is Associate Professor of Orthopaedic Surgery, College of Physicians and Surgeons, Columbia University, New York, NY, and St. Luke's-Roosevelt Hospital, New York.



Figure 1. Photograph of the tendon rupture in the case patient's finger, which has occurred at zone II directly over the condyle of the proximal phalanx. Note the more proximal incision of the palm, which was necessary to locate the retracted proximal end of the flexor digitorum profundus tendon.

the tendon retracts to the palm with disruption of the entire vincular system. Type II avulsion is characterized by retraction of the tendon to the PIP level that spares the vinculum longum. In type III, the profundus tendon avulsion occurs in addition to a fracture of the distal phalanx base. Rarely, a type III-A injury occurs, in which the tendon avulsion and fracture occur separately.

Anatomy and Etiology

The aforementioned injuries occur in zone I of the flexor tendon system or distal to the FDS insertion (**Figure 2**). Zone II, the "critical zone," where the FDS and FDP tendons run together in the flexor sheet, extends from the first annular pulley (**Figure 3**) to the insertion of the FDS tendon. Closed ruptures in zone II are extremely rare and have been described infrequently in the literature. In the few cases that have been reported, the cause was an underlying pathology such as infection, previous injury, chronic repetitive injury, bony irregularities, or sequelae after a fracture.³⁻⁵ Other causes may be cystic degeneration, rheumatoid arthritis, or sequelae following local steroid injections. Boyes et al⁴ reviewed 78 patients who had closed ruptures and found that 74 patients experienced avulsions at the distal phalanx. They described three patients in whom the rupture occurred at the level of the lumbricals in the midpalm in which both

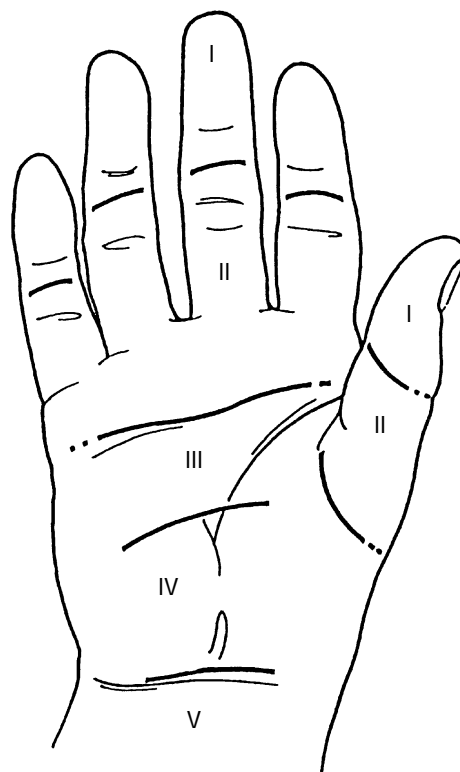


Figure 2. The flexor tendon zones. Recognition of pulley anatomy and tendon vascular supply is necessary for tendon repair. Zone I commences from the insertion of the FDS at the middle phalanx to the insertion of the FDP at the distal phalanx. Zone II is known as the "critical zone" or "no man's land" and is the area where the FDP and FDS run together in the flexor sheath. This zone extends from the A1 pulley in the palm to the insertion of the FDS to the base of the second phalanx. Zone III is the palm or lumbrical muscle area. Zone IV is the carpal tunnel area. Zone V is the area proximal to the carpal tunnel. FDP = flexor digitorum profundus; FDS = flexor digitorum superficialis. Adapted with permission from Marks MW, Marks C: *Fundamentals of Plastic Surgery*. Philadelphia: WB Saunders, 1997:356-357.

the FDP and FDS were disrupted. Two of these patients had no evidence of underlying pathology.

Naam⁶ reported on 13 patients who had spontaneous ruptures of the FDP tendon; the ruptures in all except one of these patients occurred in the lumbrical area (zone III) and were caused by forced extension of the finger while under maximum flexion of the muscle. Imbriglia and Goldstein⁷ described 10 patients who had intratendinous ruptures of the FDP tendon of the small finger. Again, all ruptures occurred at work with the hand engaged in resisted flexion; in two patients

the ruptures were just distal to the A2 pulley level. Yang et al⁸ reported on one patient who had a closed profundus rupture in zone III at the origin of the lumbrical muscle.

Although all of the aforementioned case reports describe a midsubstance rupture of an apparently normal flexor tendon, the mechanism of injury was always forced flexion against resistance. After review of the literature, the case presented here is the only one the authors could identify in which the mechanism of injury was either hyperextension or blunt trauma to the tendon against the underlying phalangeal condyle. The current case presentation also demonstrates that the little finger is more susceptible to such injury. As is true for laceration repairs in zone II, hyperextension or blunt trauma injuries to the FDP tendon of the little finger have a poorer prognosis in zone II as compared with other zones.

SUMMARY

Closed rupture of the FDP tendon is rare. The most common site of rupture is the tendon-bone insertion, called an avulsion; a less frequent site is at the musculotendinous unit. A closed rupture of the FDP is clinically diagnosed by the patient's inability to flex the distal phalanx. Midsubstance ruptures are even more unique and are usually due to underlying pathology such as fracture, cystic degeneration, rheumatoid arthritis, or sequelae following local steroid injection. **HP**

REFERENCES

1. Leddy JP, Packer JW: Avulsion of the profundus tendon insertion in athletes. *J Hand Surg Am* 1977;2:66-69.
2. Leddy JP: Flexor tendon acute injuries. In *Operative Hand Surgery*. Green DP, ed. New York: Churchill Livingstone, 1993:1823-1852.
3. Rae PS, Finlayson D: Closed rupture of flexor pollicis longus tendon associated with treatment of Bennett's fracture. *J Hand Surg Br* 1984;9:129-130.
4. Boyes JH, Wilson JN, Smith JW: Flexor tendon ruptures in the forearm and hand. *J Bone Joint Surg Am* 1960;42:637-646.

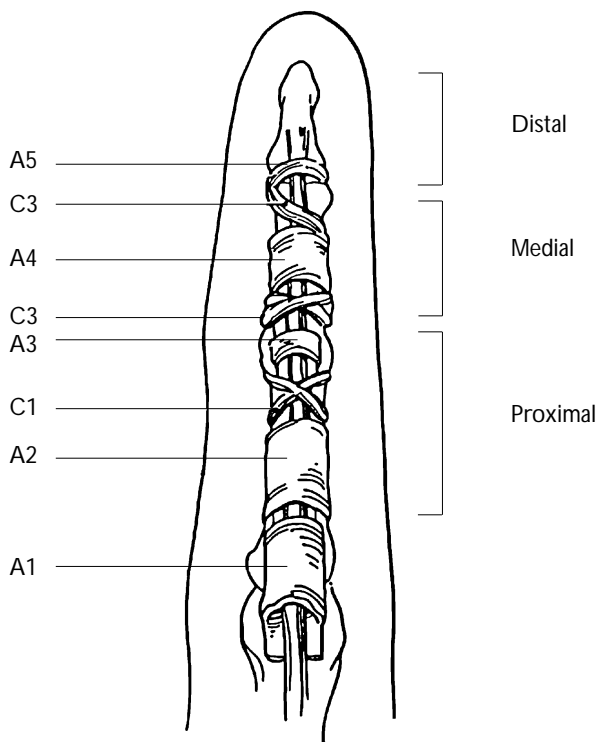


Figure 3. The flexor tendon pulley system consists of five annular pulleys and three cruciate pulleys. A = annular; C = cruciate. Adapted with permission from Marks MW, Marks C: *Fundamentals of Plastic Surgery*. Philadelphia: WB Saunders, 1997:356-357.

5. Folmar RC, Nelson CL, Phalen GS: Ruptures of the flexor tendons in hands of nonrheumatoid patients. *J Bone Joint Surg Am* 1972;54:579-584.
6. Naam NH: Intratendinous rupture of the flexor digitorum profundus tendon in Zones II and III. *J Hand Surg Am* 1995;20:478-483.
7. Imbriglia JE, Goldstein SA: Intratendinous ruptures of the flexor digitorum profundus tendon of the small finger. *J Hand Surg Am* 1987;12:985-991.
8. Yang SS, McCormack RR, Weiland AJ: Closed rupture of the flexor digitorum profundus tendon in the palm of a nonrheumatoid patient. *Orthopedics* 1998;21:205-208.

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