Flexor Tendon Avulsion Injury Associated with Distal and Proximal Phalanx Fracture: A Case Report

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We present an extremely rare case of avulsion injury of the flexor digitorum profundus and the flexor digitorum superficialis tendons associated with fracture of the distal phalanx and bone bruise of the proximal phalangeal base of the small finger. Because of the nondisplaced transverse fracture of the distal phalanx, the early diagnosis of the injury was missed. The patient was treated with two-stage flexor tendon graft and the outcome was acceptable.

Key words: flexor tendon injury, avulsion injury, phalangeal frcature, two-stage tendon graft

INTRODUCTION

Flexor digitorum profundus (FDP) tendon avulsion of the distal phalanx of the ring finger is not a common injury, yet it is well known as "rugger jersey finger". Here, we present an extremely rare case of avulsion injury of the FDP and the flexor digitorum superficialis (FDS) tendons associated with nondisplaced transverse fracture of the distal phalanx and bone bruise of the proximal phalangeal base of the small finger. Because of swelling from the associated fracture, the finger was immobilized diagnosed as sprain, and early diagnosis of the tendon injury was missed. It was eventually treated with two-stage flexor tendon graft.

CASE REPORT

A 45-year-old right-handed man struck his left small finger while attempting to grip a strap to avoid stumbling while taking a train. He visited a local primary physician due to pain, swelling, and subcutaneous hemorrhage of the small finger. Because there was no radiographic evidence of fracture, the injury was diagnosed as a sprain and the finger was immobilized in a splint. Three weeks after the injury, the man was referred to our hospital due to inability to perform active flexion of the small finger.

On initial examination, although there was no swelling or tenderness in the small finger, active flexion of the distal interphalangeal (DIP) and proximal interphalangeal (PIP) joints was not possible (Fig. 1).

Plain radiographs and computed tomography revealed a nondisplaced transverse fracture in the distal phalanx (Fig. 2). Magnetic resonance imaging (MRI) showed a bone bruise at the proximal phalangeal base with high signal intensity on T2-weighted sagittal images. The FDP tendon was detached and retracted at the proximal level of the PIP joint, whereas the FDS tendon was detached and retracted inward to the palm (Fig. 3).

Based on these findings, avulsion of the flexor tendons associated with fractures of the distal and proximal phalanx was considered. Reconstruction surgery was performed four weeks after the injury.

The flexor tendon sheath was exposed using a mid-palmar and zigzag skin incision. The proximal end of the FDP tendon was found at the A2 pulley (Fig. 4a) and could be pulled to the DIP joint level (Fig. 4b). Because the FDS tendon was not found, and the tendon sheath was empty with adhesion distal to the A3 pulley, an artificial silicone tendon spacer (Hunter Tendon Implant, Memphis, TN, USA) was placed for the two-stage tendon reconstruction. Three months after the index surgery, tendon graft was performed using the palmaris longus tendon. The distal site was sutured to the distal phalanx using a suture anchor (Jugger Knot® Soft Anchor 1.0 mm, Zimmer Biomet, Warsaw, Indiana, USA), and the proximal juncture to the FDP tendon was in the lumbrical muscle level (Fig. 5). Protected passive and active motion was started two weeks after surgery. At final follow-up, 21 months after the tendon graft, via two times of tenolysis procedures at 7 months and 15 months (Fig. 6), full grip was possible (Fig. 7). although a slight flexion contracture of the PIP joint remained. Grip strength was 76% and %TAM was 80.7% relative to the unaffected side. Quick DASH scores were 9.09 for disability/ symptom score and 25 for work score. The overall results were good according to Strickland's scoring scale. and the patient was satisfied.

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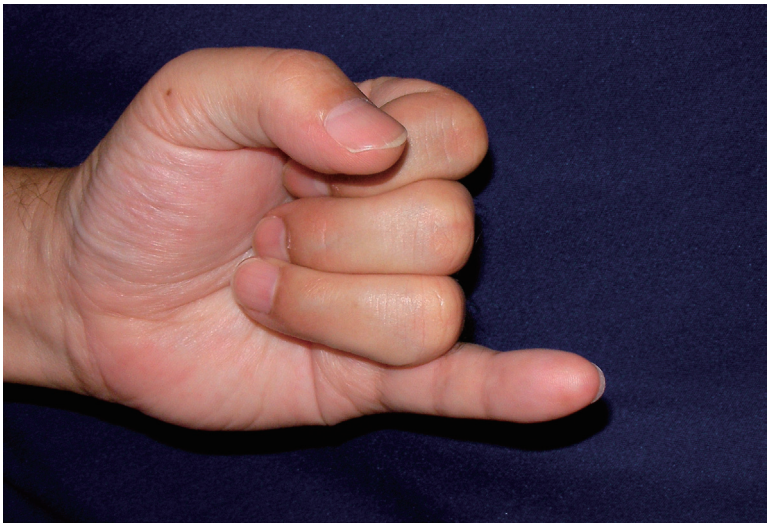

Fig. 1 Active finger flexion on initial examination. Active flexion of the distal interphalangeal (DIP) and proximal interphalangeal (PIP) joints was not possible on full grip.

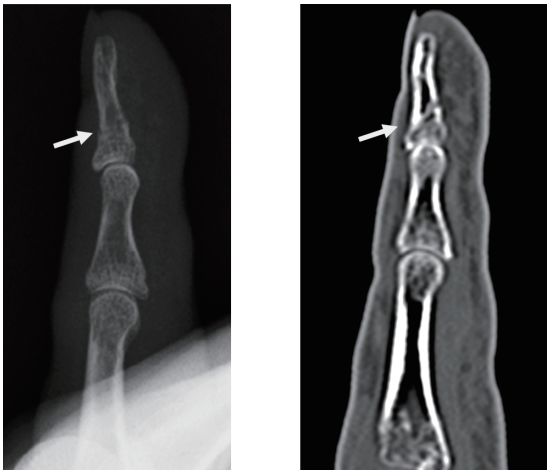

Fig. 2 (a) Plain radiograph and (b) Computed tomography.
A nondisplaced transverse fracture in the distal phalanx (white arrows).

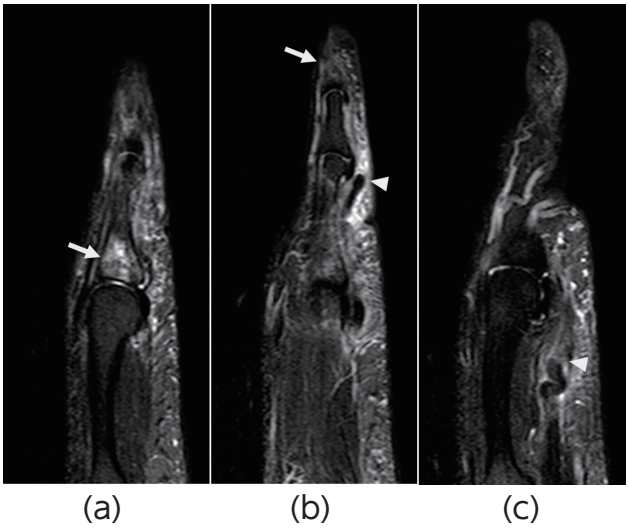

Fig. 3 T2-weighted sagittal MRIs.
(a) Bone bruise was present at the proximal phalangeal base with high signal intensity (white arrow).
(b) A transverse fracture was observed at the distal phalanx (white arrow), and the FDP tendon was detached and retracted at the proximal level of the PIP joint (white arrowhead).
(c) The FDS tendon was detached and retracted into the palm (white arrowhead).

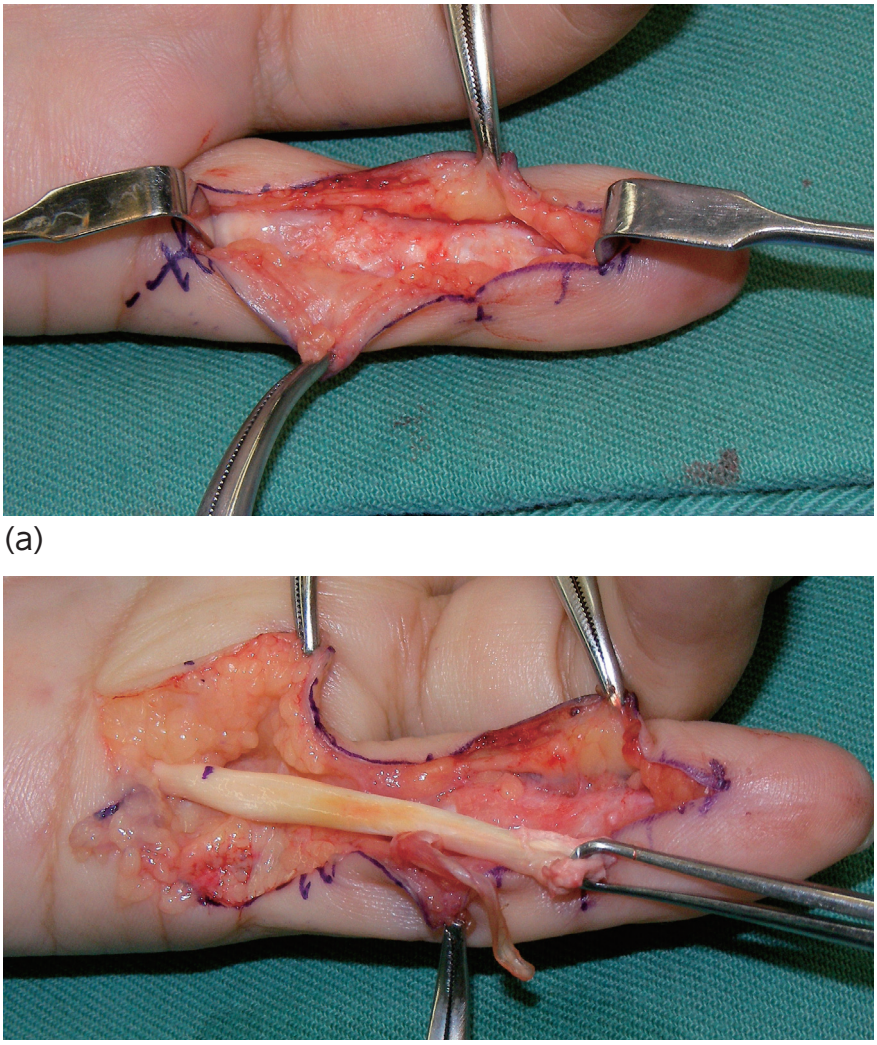

Fig. 4 (a) The proximal end of the FDP tendon was found at the A2 pulley level (arrowhead) and the tendon sheath was empty and adhered (*).
(b) The FDP tendon (arrow) could be pulled to the DIP joint level. The FDS tendon was not found.

Fig. 5 Tendon graft was performed using the palmaris longus tendon. The proximal juncture to the FDP tendon was in the lumbrical muscle level (arrow). The distal site was sutured to the distal phalanx using a suture anchor.

Fig. 6 Second session of tenolysis 15 months after tendon graft. Full flexion of the small finger could be achieved when the FDP (arrow) was pulled in the distal forearm.

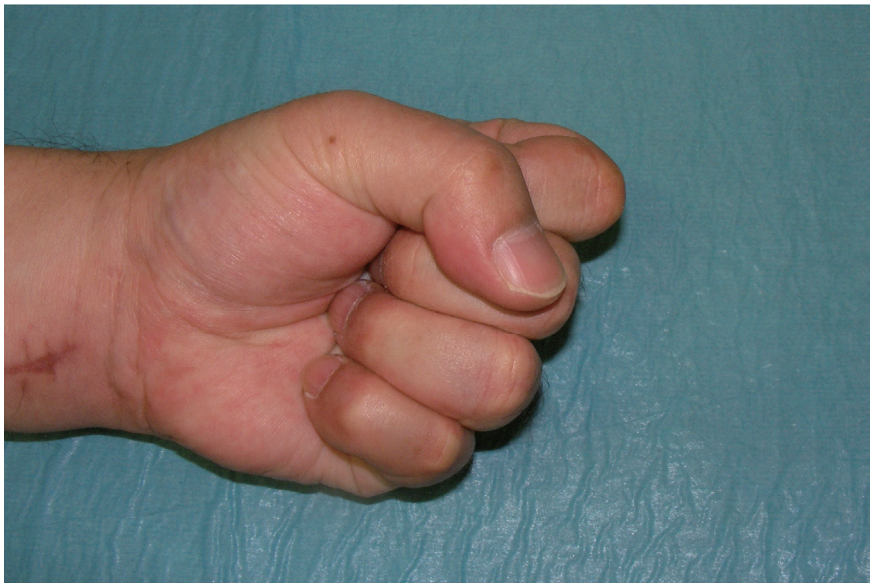

Fig. 7 At final follow-up, 21 months after the tendon graft, full grip was possible.

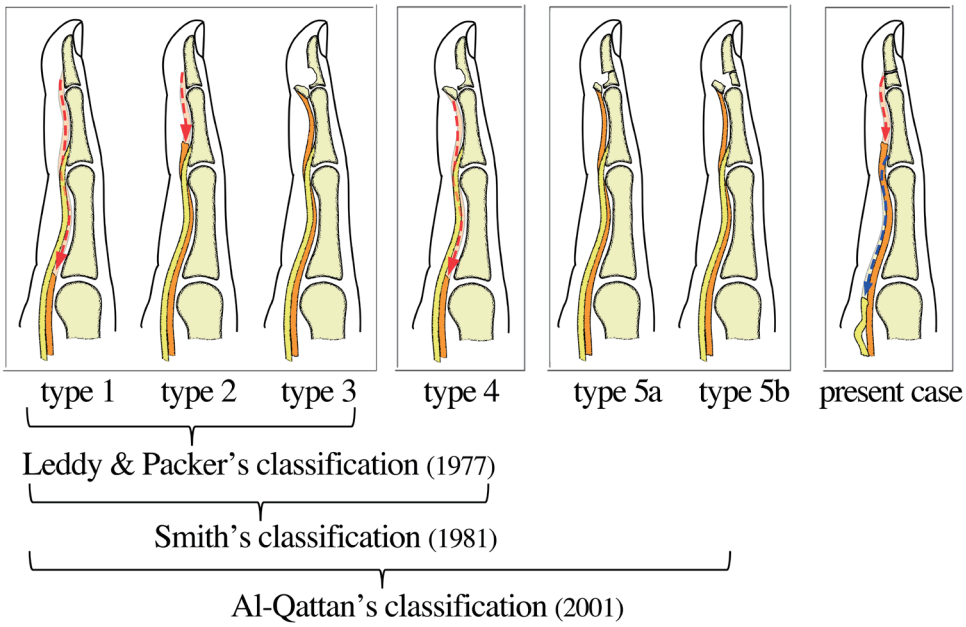

Fig. 8 Classification of the FDP tendon avulsion injury. The patient had FDP and FDS tendons avulsion injury with a transverse fracture of the distal phalanx.

DISCUSSION

There have been several reports on closed traumatic avulsion of the FDP tendon, indicating that it is not such a rare injury. Avulsion of the flexor tendon occurs most frequently at the bony insertion on the distal phalanx, and the ring finger is involved in more than 75% of cases, followed by middle and small fingers [1, 2].

There are several biomechanical factors related to the susceptibility of the ring finger. When only the ring finger is extended during forced grip, the FDP of the ring finger is tethered in the palm by a bipennate lumbrical muscle [2]. Single extension of the metacarpophalangeal (MP) joint in the ring finger is restricted when the MP joints of the middle and small fingers are flexed at 90°, and the extensor of the ring finger is distally tethered by the intertendinous junction [1]. The insertion of the FDP tendon is weaker in the ring finger than in the other fingers [2]. The patient in the present case had flexor tendon avulsion of the small finger, which is a rare injury. Thus, it is thought that only the small finger opposed the strong hyperextension force when the patient attempted to grasp the strap.

The most frequent mechanism of such an injury is indirect force resulting from sudden forcible hyperextension or forced flexion against resistance [2]. Other mechanisms are closed direct blunt trauma or pathological etiologies due to underlying disease, such as rheumatoid arthritis [2]. Because the patient in the present case had a fracture of the distal phalanx and

bone bruise of the proximal phalangeal base with tendon avulsions, the mechanisms of the injury were suspected to be sudden hyperextension as well as axial load.

Leddy and Packer [1] classified FDP tendon avulsion injury into three types according to the retracted tendon status. Smith [3] added a fourth type, namely avulsed bone fragment and retracted avulsed tendon. Al-Qattan [4] added a fifth type that has tendon and bony avulsion with transverse fracture of the distal phalanx. The patient in the present case had a transverse fracture of the distal phalanx without avulsion bony fragment, and thus does not belong to any of the existing types. As a result, the condition could not be identified radiographically.

Thus, FDP tendon avulsion injury associated with FDS tendon avulsion injury is an extremely rare condition. To the best of our knowledge, only six cases of avulsion injury involving both tendons have been reported in the last 30 years, of which four were of the ring finger, one was of the small finger, and one was of the ring and small fingers [5–10]. Although the mechanism was unclear during confused rough fight, the finger was suddenly hyperextended by forcible grasp.

The treatment of avulsion injury of the FDP and FDS tendons depends on the delay from injury to treatment, level of retraction of the tendon, and injured condition of injury of the tendon and its tendon sheath. For an acute injury, the primary treatment is repair by reinsertion of the FDP tendon to the distal phalanx, while the FDS tendon is not repaired in most cases [2]. Transosseous suture repair is preferred using a standard pull-out wire and bottune technique or suture anchors. In cases where surgery is delayed several weeks after the injury, primary tendon graft or two-stage tendon graft are optional treatment [2]. Primary tendon grafting is only considered when the wound is healed, the joints are free of contracture, and there is not excessive scarring. When the primary tendon grafting is relatively contraindication because of delayed case with excessive scar, joint contracture, or tendon sheath damage, then a two-stage tendon graft should be considered: the initial stage, to address the scar, contracture and tendon sheath damage; an interval of soft tissue healing for about three months; a second stage, which is a tendon graft; and then consideration of the following tenolysis.

In the present case, two-stage tendon graft was performed because there was a delayed of four weeks from injury to surgery and fracture of the distal phalanx, and the adhesion and elapse of the tendon sheath around the A3 pulley was severe. Nevertheless, the patient regained full finger flexion after two time of tenolysis procedures, although slight flexion contracture of the PIP joint remained.

This patient was initially diagnosed to have sprain, and then the inability of the active flexion of the finger was noted three weeks after the injury.

Thus, early diagnosis of avulsion injuries of the FDP and FDS tendons without avulsion fragments may be missed, when there is swelling, subcutaneous hemorrhage, and associated atypical fracture of the distal phalanx. Hence, for early diagnosis of avulsion injury of the flexor tendon, especially atypical such as the present case, proper imaging and physical examination are required based on the injury mechanism; there may be various associated injuries depending on the injury force. Additionally, treatment should be optioned according to the time from injury to treatment as well as condition of injury.

CONFLICTS OF INTEREST

There were no conflicts of interest.

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