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Case Report

Proximal phalanx shaft fracture with entrapment in the transverse retinacular ligament: a case report

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ABSTRACT

We report the interesting case of a 33 years old male who underwent operative intervention for a left oblique proximal phalanx shaft fracture of the third finger which penetrated the transverse retinacular ligament (TRL). This patient required operative intervention due to entrapment of the bony fragment in the TRL which acted as a noose with traction on the fractured segment. The fracture was irreducible through a closed maneuver. The use of a dorsal approach allowed visualization of the fracture site and implementation of screws for fixation was deemed adequate secondary to the patient's bone quality. He was placed in a volar splint at the conclusion of the case to allow for immobilization and protection of the repair. At follow-up, the patient's radiographic images appeared appropriate and was progressing as expected. We report lessons learned from this case and describe a previously unreported fracture pattern and a possible method of reduction and fixation through a surgical approach in this report.

Keywords: Irreducible oblique phalangeal shaft fracture, Transverse retinacular ligament, Entrapment, Hand

INTRODUCTION

Fractures of the phalanges and metacarpals are common injuries, with an annual incidence of 12.5 and 8.4 per 10,000 persons, respectively.[1] Fractures involving the shaft of the proximal phalanx can either be treated through closed or open reduction. Generally, irreducible fractures of the proximal phalanx are a consequence of soft tissue entrapment or fracture pattern. Penetration and subsequent entrapment of a fractured segment of the phalanx in the transverse retinacular ligament (TRL) has not been previously described, and it was an unexpected finding during the surgery. The transverse retinacular ligament prevents dorsal subluxation of the lateral band. The elastic balance of the triangular ligament and transverse retinacular ligament is important for normal functioning of the lateral bands.[2] No published literature has previously described the transverse retinacular ligament preventing closed reduction in a proximal phalanx fracture due to the fractured segment piercing through the TRL. We present an unusual case where the distal fractured segment of the proximal phalanx pierced through the radial aspect of the TRL and closed reduction was subsequently unsuccessful due to the TRL acting as a noose on the fractured segment.

CASE REPORT

A 33 years old right-hand dominant male presented to the emergency department after being the victim of a carjacking. He was found to have a displaced, long-oblique fracture of the proximal phalanx shaft of his left middle finger (Figure 1 and 2). He was also found to have bleeding from the radial aspect of that digit through a volar wound. In the emergency department, he underwent attempted reduction, irrigation, wound closure, splinting of the digit, and he was discharged with oral antibiotics and was instructed to follow up in clinic. He finally presented to

clinic 2 weeks after the injury, and he was scheduled to proceed with surgery the following day.

Figure 1: Anteroposterior (AP) radiograph of left hand demonstrating oblique fracture of the proximal phalanx with distal segment displaced radially of the middle digit.

Figure 2: Oblique radiograph of left hand demonstrating displaced oblique fracture of proximal phalanx of the middle digit.

During surgery, attempts to close reduce his proximal phalanx were first made under fluoroscopy. Unfortunately, despite a significant amount of traction, the fracture was not able to be reduced. The length of the bone could not be improved with traction for unclear reasons. The decision was made to proceed with open reduction, and a small longitudinal incision was made on the dorsal aspect of his left middle finger overlying the proximal phalanx. The extensor mechanism was elevated off the bone dorsally with a Free elevator, but at least in the mid-portion of the fracture, there was no interposed tissue blocking reduction. Still, the fracture could not be reduced. The approach was extended proximally and distally, and the extensor mechanism was noted to be damaged on the radial aspect of the proximal phalanx head at the site of the open fracture. The distal end of the shaft of the oblique fracture, as it came to a point, had penetrated through the transverse retinaculum on the radial side. The transverse retinacular ligament became tightly wrapped around the tip of the fracture like a noose, and became tighter with increased traction (Figure 3). The transverse retinacular ligament was divided longitudinally in order to mobilize the extensor mechanism and free up the shaft. The ends of the fracture were visualized. The distal end of the bone that was originally trapped in the TRL fractured off accidentally during debridement. The wound bed and bone ends were debrided for this presumed open fracture.

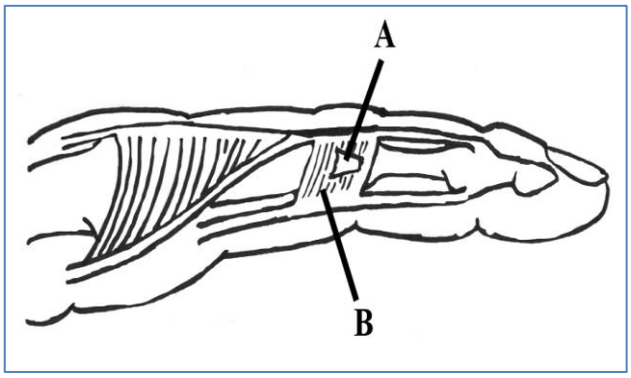

Figure 3: Drawing demonstrating the (A) distal segment of the displaced, oblique fracture of the proximal phalanx piercing through and (B) the transverse retinacular ligament.

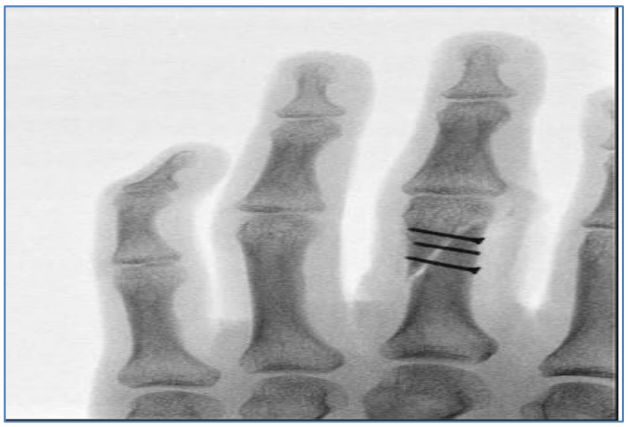

Figure 4: Intra-operative AP fluoroscopic image demonstrating adequate reduction of middle digit.

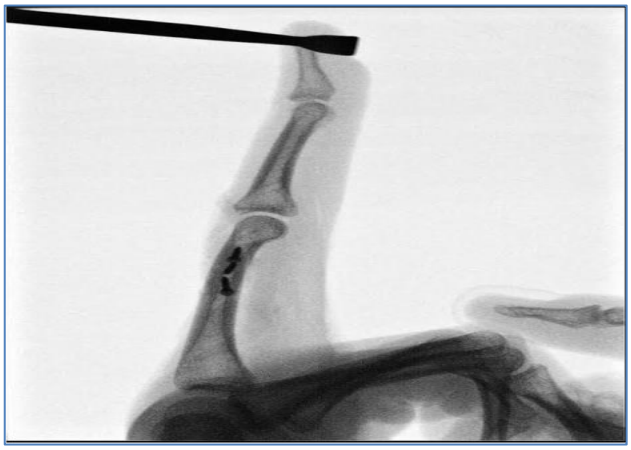

Figure 5: Intra-operative lateral fluoroscopic image demonstrating adequate alignment of middle digit.

The extensor mechanism was then mobilized and another attempt of reduction was made. Unfortunately, even using reduction clamps and traction, it was still difficult to achieve an anatomic reduction. An extensor tendon splitting approach was performed to better visualize the fracture itself and stabilize it. As much of the periosteum as possible was preserved. Once the fracture could be clearly visualized, it was reduced and clamped with a reduction forceps. The finger was imaged with biplanar fluoroscopy and noted to be in acceptable alignment. Clinically, the finger appeared to be appropriately aligned as well. A Kirschner wire was driven across the fracture site to assist with stabilizing the reduction. The fracture was then fixed with three 1.5 mm screws. The head of the initial screw broke off during insertion as the bone was very dense and of excellent quality (Figure 4 and 5). Fluoroscopy was used to confirm final reduction and fixation. The extensor mechanism and transverse retinacular ligament were both repaired. He was placed into a volar splint to protect the fracture.

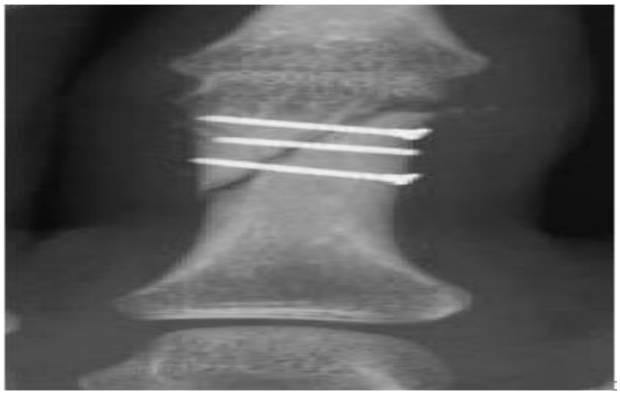

Figure 6: 2 weeks post-operative AP radiograph demonstrating maintained reduction.

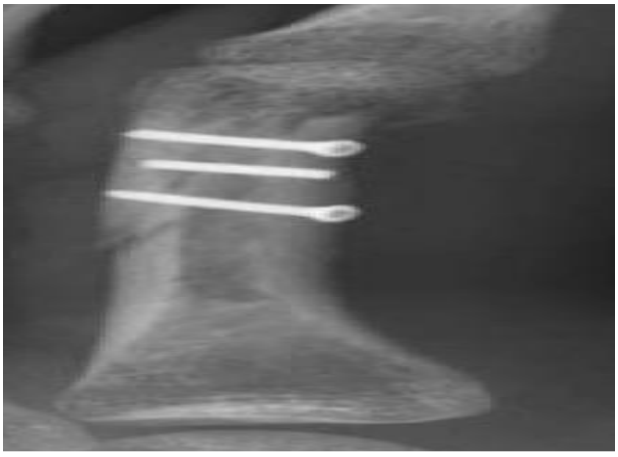

Figure 7: 2 weeks post-operative oblique radiograph demonstrating maintained alignment and mild callus formation.

At his 2 weeks post-operative appointment, the patient was doing adequately and his X-rays appeared appropriate (Figure 6-8). Range of motion activities and edema control were to be initiated with occupational therapy as he had excellent bone quality and stable fixation. He was placed in a finger splint with plans for further follow-up.

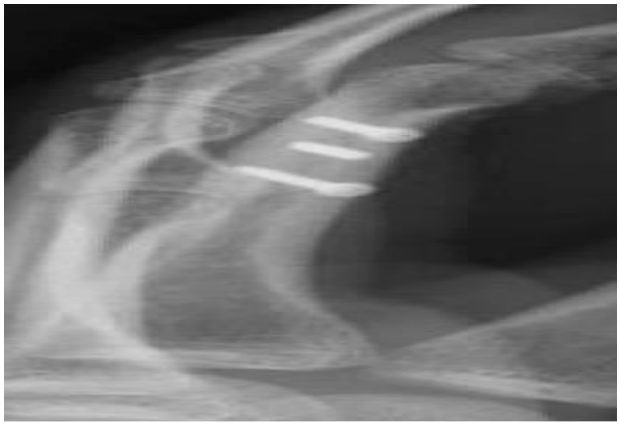

Figure 8: 2 weeks post-operative lateral radiograph demonstrating maintained alignment.

DISCUSSION

Proximal phalanx fractures are a common injury and are commonly fixed through a combination of closed reduction and splinting. Open reduction and internal fixation may be required due to closed methods that fail to achieve reduction, unstable fracture patterns, open fractures, restore articular congruity of small articular fractures, and in instances when fractures are irreducible because of secondary soft tissue interposition.[3] Open reduction and internal fixation provide a strong, stable construct that permits immediate movement of the finger, thus minimizing stiffness and adhesions resulting from associated soft tissue injury and surgical dissection.[4] Range of motion may be initiated early if fixation is felt to be adequate.[3]

Cowen and Kranik reported on a case of a juxta-epiphyseal fracture of a pediatric patient at the base of the proximal phalanx of the fifth digit.[5] The fracture was irreducible by closed methods because of trapping of the distal fragment in a button-hole rent in the periosteum of the fractured phalanx and the dorsal hood. Yamane described another case in a pediatric patient of an irreducible juxta-epiphyseal fracture of the little finger due to entrapment of the extensor hood under the proximal end of the distal end of the distal fracture fragment and open reduction through a dorsal approach yielded a good result.[6]

We believe that this is the first published case in a pediatric or adult patient of an irreducible proximal phalanx fracture caused by entrapment of a bony fragment specifically through the transverse retinacular ligament. Lack of appropriate length was directly caused by the entrapment of the bone through the distal transverse retinacular ligament, which acted like a noose or finger-trap to tighten around the bone with traction. In this case, a somewhat extensile approach was needed to inspect the entire

extensor apparatus to find the cause of the problem. Repair through a dorsal approach allowed visualization of the fracture site, which is difficult to perform from a lateral approach. Because of the long-oblique fracture pattern and the need to get him moving early after an open reduction, internal fixation with screws was used and felt to be adequate because of his bone quality.[7] This approach is one of many that can be utilized to treat this fracture pattern.[8] In this patient's finger, the bone being trapped in the TRL would not have been discovered without opening the injury and was necessary, though we usually try to treat phalangeal injuries closed. Failure to properly extricate the fracture from the TRL would have caused malunion of the bone, improperly tensioned the extensor tendon, and limited excursion of the entire extensor apparatus and must not be accepted during fixation.

CONCLUSION

Phalangeal fractures are a common injury of the hand and reduction methods vary depending on the injury pattern. Closed versus open reduction methods depend on the local soft tissue environment and any involvement of soft tissue in the fracture site may render a phalangeal fracture irreducible. A fracture pattern involving the phalangeal shaft piercing through the TRL disabling reduction via closed reduction methods has not been previously described. Our surgical method of a dorsal approach to allow for visualization of the fracture site and implementation of screws demonstrates a possible surgical method for reduction of this unique fracture pattern with TRL involvement. Though in general, surgeons would prefer a closed reduction and percutaneous pinning of phalangeal fractures, this case highlights another instance when open reduction is preferable or required to achieve appropriate reduction of the fracture.

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