Irreducible dorsal epiphyseal fracture dislocation of the distal phalanx: a case report

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Introduction

In children, injuries about the distal interphalangeal (DIP) joint most commonly are Salter–Harris I epiphyseal fractures where the joint stays congruent and is not disrupted. Extrusion of the epiphyseal fragment (or epiphyseal dislocation) is a very rare injury, and few cases have been reported in the literature. We report a case of an irreducible dorsal fracture dislocation of the DIP joint, with the epiphysis being almost devoid of soft tissues and angulated 90°. The joint capsule, volar plate, collateral ligaments and extensor tendon all appear to be intact. The extensor tendon inserts slightly more distal on the distal phalanx than usual, allowing for the epiphysis to displace, with the extensor tendon still intact. Our case demonstrates that subtle variations in anatomy can cause alternative fracture patterns about the DIP joint.

Case Presentation

An 8-year-old girl presented 4 weeks after her left index was crushed by a door. On examination, there was a dorsal mass over the DIP joint and an extensor lag of 25°. Passive extension was impossible due to pain.

Radiographs demonstrated a displaced fracture through the physis of the base of the distal phalanx, with the epiphyseal fragment dislocated dorsally at a right angle relative to the metaphysis. Only a thin sleeve of the distal part of the epiphysis remained in situ. The articular cartilage of the distal phalanx was facing upward (Fig. 1).

An attempt at closed reduction was unsuccessful, and the joint remained unstable. Open reduction was performed through a dorsal skin incision centred about the DIP. The intact extensor tendon was released close to its insertion on the base of the distal phalanx. This exposure allowed visualisation of the epiphyseal fragment which was almost completely devoid of soft tissue and dislocated dorsally with the articular cartilage facing upward. There was a thin periosteal attachment to the rest of the phalanx, but no attachment of the tendon (Fig. 2). The epiphysis was easily reduced and remained stable when the joint was mobilised, obviating the need for temporarily K-wire fixation. The extensor tendon was repaired with 4/0 Vicryl and the skin closed with 4/0 nylon. Postoperatively, a dorsal padded aluminium splint was applied for 4 weeks.

At 2 weeks follow-up, there was good alignment and no wound healing difficulties. At 12 weeks of follow-up, she had decreased range of movement, but no mallet deformity. The DIP joint had full active extension and active flexion of 45°. There was no apparent shortening of the distal phalanx, but a slight ulnar deviation was present. She was pain free. Radiographs demonstrated virtually complete resorption of the distal phalangeal epiphysis (Fig. 3).

Discussion

In children, the hand is the most commonly injured body part. Thirty-four per cent of all metacarpal and phalanx fractures involve an epiphysis [3]. Injuries about the DIP joint are the most frequent [10].

The distal interphalangeal joint is a stable joint with strong collateral ligaments on either side. The dorsum is stabilized by the extensor tendon and the palmar surface by the flexor digitorum profundus insertion. The extensor tendon inserts on the prominent dorsal crest at the base of

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Fig. 1 Preoperative radiographs demonstrating a fracture through the distal phalangeal growth plate with dorsal displacement and 90° angulation of the epiphysis

the distal phalanx and is also adherent to the DIP joint capsule. On the palmar surface, the flexor tendon inserts into the whole width of the base of the distal phalanx and is also adherent to the volar plate. The volar plate is very flexible, allowing hyperextension of the DIP joint and pulp-to-pulp pinch.

Forceful flexion or hyperextension may cause fracture or separation through the epiphyseal plate. Typically, these injuries present as open physal fractures. The patient exhibits a mallet finger deformity and a nail plate dislocation superficial to the proximal nail fold (with or without a nail bed laceration) [9, 12]. Closed injuries occur as well and represent a greater diagnostic challenge because of their more benign clinical appearance.

There may be simple angulation at the epiphysis with an intact DIP joint, representing a Salter–Harris I fracture. In that event, the body of the distal phalanx is flexed due to the unopposed action of the flexor digitorum profundus, while the epiphysis is maintained in an extended position by the extensor tendon (Fig. 4a) [2, 7].

More rarely, the epiphysis may be pulled away from the joint attached to the extensor tendon (Fig. 4b) [6]. Alternatively, a segment of the epiphysis may be pulled away,

Fig. 2 Intraoperative clinical picture showing the dislocated epiphysis with the articular cartilage facing upward. In our case, the extensor tendon inserted slightly distal to the epiphysis, which is more distal than usual. This allowed the epiphysis to fracture, completely devoid of soft tissue, with the extensor tendon still intact

Fig. 3 Radiographs at 12 weeks follow-up demonstrating near complete resorption of the epiphysis

representing a Salter–Harris III fracture (Fig. 4c). Rupture of the extensor tendon is uncommon in childhood because the epiphyseal plate is weaker than the tendon [7].

Palmar fracture dislocations of the epiphysis have also been reported (Fig. 4d). One case of irreducible palmar dislocation of the DIP joint was reported in which an entrapment of the extensor tendon in front of the head of the middle phalanx was the cause of irreducibility [4]. Alternatively, a displaced epiphyseal fragment can prevent reduction of the palmar dislocation of the DIP joint [8, 13].

Our case represents an irreducible dorsal fracture dislocation of the DIP joint. The epiphysis was separated from the extensor tendon and angulated 90° so that the articular cartilage of the distal phalanx was facing the undersurface of the extensor tendon. Only a thin sleeve of the distal part of the epiphysis remained in situ. The joint capsule, volar plate, collateral ligaments and extensor tendon all appeared to be intact (Fig. 4e). This pattern has not been documented in literature to date. It demonstrates that subtle variations in anatomy can cause alternative patterns of injury. In our case, the extensor tendon inserted slightly distal to the epiphysis, which is more distal than usual. This allowed the epiphysis to fracture, completely devoid of soft tissue, with the extensor tendon still intact.

Anatomic reduction of the displaced fracture at the time of injury would seem to be the preferred treatment. It aims to restore normal extensor mechanism tension, to minimize the probability of growth disturbance and to reduce the likelihood of arthritic degeneration at the DIP joint. The dorsal fracture dislocation of the DIP joint presented in this report required open reduction because of the marked displacement of the epiphysis and the intact joint capsule, volar plate, collateral ligaments and extensor tendon, which prevented adequate distraction of the joint on attempted closed reduction.

Fig. 4 Fractures about the DIP joint. Refer to the “Discussion” for full description

Ossification of the epiphysis of the distal phalanx starts at between 22 and 36 months [11]. Injury prior to ossification may not be detected because of lack of radiographic evidence. Careful examination is required to diagnose displaced epiphyseal fractures in this age group. A lateral x-ray may show significant dorsal soft tissue swelling and provides an additional clue that the epiphysis is dislocated. This is especially true in closed injuries, which typically are not surgically explored. Exploration might otherwise aid in the diagnosis of a displaced epiphysis [12].

Diagnosis of epiphyseal fractures about the DIP joint is frequently delayed and described up to 8.5 years after the

initial injury. In case of late presentation, anatomic reduction is still theoretically the preferred treatment. Excision of the dislocated fragment and reattachment of the tendon under appropriate tension may, however, be the only technically feasible option. Reduced movement, growth deformity of the distal phalanx and nail plate, and early degenerative arthritis are likely to ensue [12].

A nail bed injury may be missed if the nail plate is intact or elevated above the nail fold. If a dislocated nail plate is seen acutely, the nail should not be removed. Instead, the nail bed and attached nail plate should be relocated back underneath the nail fold, and the epiphyseal fracture should be reduced and splinted in extension. Insertion of a K-wire may become necessary if the fracture is unstable or the injury is seen late. Obvious nail bed injuries should be explored and repaired surgically. Otherwise, the nail should be left in place as a splint [5].

Infection, avascular necrosis, growth disturbance and premature physeal closure are likely complications after fracture and separation of the epiphysis of the distal phalanx. Complete detachment seems to be a poor prognostic sign with regard to avascular necrosis and early closure of the epiphysis. If left untreated, potential extensor mechanism dysfunction, growth deformity and shortening of the distal phalanx, and disruption of the articular surfaces can impair hand function and may have long-term adverse effects [12]. Al-Qattan presented a series of 25 extra-articular transverse fractures of the base of the distal phalanx (18 in children or adolescents, 7 in adults). Closed reduction and splinting was performed in 18 patients, with complications noted in four patients (one infection, three mild residual flexion deformity). Open reduction and K-wire fixation were performed in five patients, with no reported complications. Two patients received no treatment (initially neglected by the patient), leading to malunion [1].

Our case emphasises the importance of careful examination and high index of suspicion. One should have low threshold for radiographic assessment. Early referral is important, especially in children with uncalcified epiphyses. Subtle variations in anatomy can cause alternative patterns of injury.

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Conflict of interest The authors declare that they have no conflicts of interest, commercial associations or intent of financial gain regarding this research.

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