A Complex Injury of the Distal Ulnar Physis: A Case Report and Brief Review of the Literature

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Abstract

Physeal fractures of the distal forearm are common injuries in children and adolescents. However, Salter-Harris type III and type IV fractures of the distal ulnar epiphysis are often high-energy injuries that require open reduction for restoration of anatomical alignment. These injuries are uncommon and there are few descriptions of them in the contemporary literature.

Here we report the case of a 13-year-old boy with a type IV distal ulna fracture not diagnosed with standard radiography. After closed manipulation, an incompletely reduced physis was suspected on the basis of fluoroscopic imaging and comparison radiographs of the contralateral wrist. Computed tomography showed a large, displaced physeal fragment. The patient underwent open reduction and internal fixation.

Thorough radiographic assessment should be conducted when there is a high suspicion for these fracture patterns. Appropriate diagnosis can lead to expedient reduction and expectant management of sequelae associated with these injuries.

Physeal fractures of the distal forearm are common injuries in children and adolescents. Most of these fractures result from low-energy trauma and involve both radial and ulnar epiphyses. Isolated distal ulnar epiphysis fractures are generally Salter-Harris type I or II injuries and are amenable to closed reduction and casting. Type III and type IV fractures, however, result from higher energy trauma and may require open reduction and pinning for restoration of anatomical alignment. These injuries are uncommon and there are few descriptions of them in the contemporary literature.

In this article, we report the case of a 13-year-old boy with a type IV distal ulnar physeal fracture with an ipsilateral type II distal radius injury that required open reduction and pinning. The patient's guardian provided written informed consent for print and electronic publication of this case report.

Case Report

A 13-year-old, right-hand–dominant boy presented to the emergency department reporting of right wrist pain. He had fallen while running and landed on his outstretched right hand. Physical examination revealed significant tenderness and swelling of the right distal forearm. Wrist and forearm range of motion (ROM) was limited by pain. The patient was otherwise distally neurovascularly intact.

Plain radiographs showed a physeal fracture of the distal radial and ulnar epiphyses with 100% dorsal displacement (Figures 1A, 1B). After closed manipulation, the distal radius was anatomically reduced, but the ulnar epiphysis appeared abnormal. Fluoroscopic images (Figure 2) and comparison views of the contralateral wrist suggested that only a portion of the epiphysis had been reduced. Computed tomography (CT) showed a type IV fracture of the distal ulna with

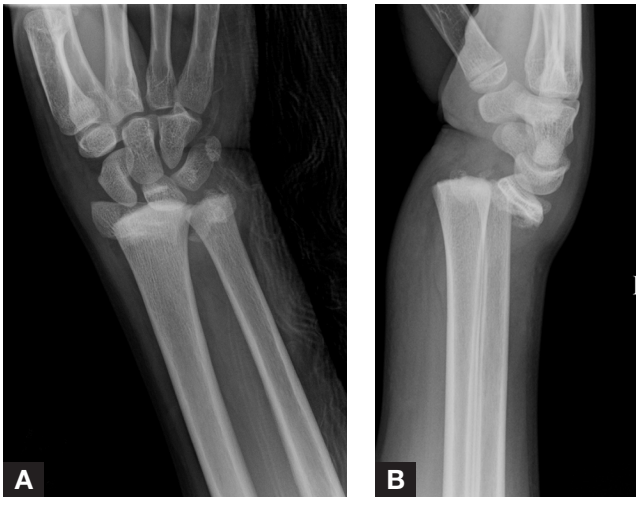

Figure 1. Injury anteroposterior (A) and lateral (B) radiographs of wrist show fractures of distal radius and ulna with 100% dorsal displacement of physes.

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Figure 2. After closed manipulation in emergency room, anteroposterior fluoroscopic radiograph of wrist was suspicious for incompletely reduced distal ulna with possible split of epiphysis.

volar displacement of the lateral half of the epiphysis (Figures 3A, 3B). The patient was taken to the operating room the next day for open reduction and pinning (Figures 4A, 4B). Soft tissue and periosteum were interposed at the fracture site and attached to the displaced epiphyseal fragment. After removal of this debris, the remaining ulnar epiphysis was reduced. The unstable fracture was subsequently fixed with 2 Kirschner wires and the distal radius was also pinned to confer added stability. The patient was placed into a long arm cast and discharged home the next day.

Three weeks after surgery, the reduction was maintained, and there was evidence of interval fracture healing. At 8 weeks, the fracture was further healed and the pins and cast were removed. At 6 months, the fracture was fully healed and the patient demonstrated full ROM and no limitation of activities, though distal ulna growth arrest with ulnar negative variance was noted on follow-up imaging.

Discussion

The incidence of high-energy distal ulnar epiphyseal fractures is difficult to determine, as few numbers have been reported. In 1934, Eliason and Ferguson[1] found that only 9 of 141 physeal injuries of the long bones in the forearm involved the ulnar epiphysis. In 1937, Lipschultz[2] found that only 5 of 106 patients with distal forearm physeal injuries had disruption of the ulnar epiphysis. In addition, in 1972, Peterson and Peterson[3] attempted to classify these injuries and found that, among all distal forearm physeal injuries, the ulna was involved in only 3.6% of cases.

The anatomy of the distal radioulnar joint may explain the low incidence of ulnar physeal fractures.[4] Kasis and colleagues[5] theorized that the meniscus between the ulna and the proximal carpal row provides a protective cushion for the epiphysis and thereby reduces fracture rates. They also believed that the triangular fibrocartilage complex helps dissipate traumatic forces across the ulnar styloid.[5]

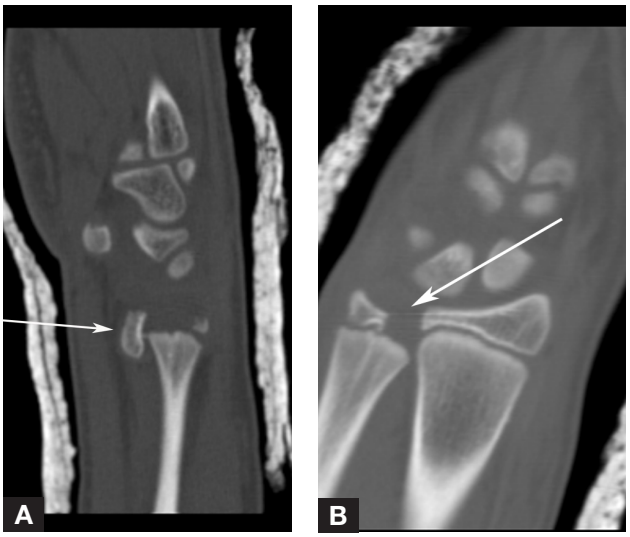

Figure 3. Sagittal (A) and coronal (B) computed tomography of wrist confirmed fragment with persistent volar displacement consistent with lateral ulnar epiphysis. Arrows indicate displaced bony fragment (A) and empty space created by its absence (B).

Most distal ulnar physeal fractures are uncomplicated type I and type II injuries. These fractures are generally managed with closed reduction and immobilization. In the vast majority of cases, the ulnar epiphysis reduces easily with reduction of the distal radius. It is important to obtain plain radiographs, with the patient out of plaster, to adequately visualize the extent of the fracture. In this case, cast material obscured the detail of the ulnar epiphysis, and the extent of the injury might have been missed had the preimmobilization fluoroscopic images not been examined closely. Radiographs of the contralateral extremity may also be useful for comparison purposes. CT can identify small fragments or intra-articular extension. In this particular case, CT was used because the entire ulnar epiphysis could not be visualized, and an adequate closed reduction could not be obtained. Soft tissue, periosteum, tendon, or joint capsule interposition may complicate these injuries. Open reduction would then be required to ensure anatomical alignment.[6-8]

Type III and type IV fractures are more complex and may require open reduction with or without internal fixation. These injuries are rare, and there are few descriptions of them in the literature. Kasis and colleagues[5] described the case of a 12-year-old boy with a type IV fracture of the distal ulna and an intact distal radius. The patient underwent open reduction and internal fixation and was stabilized with cast immobilization. At 1-year follow-up, he had full ROM, but radiographs showed premature closure of the ulnar epiphysis, and an abnormal ulnar styloid and ulnocarpal joint. Engber and Keene[6] reported the case of a 15-year-old girl with an isolated, displaced type III fracture of the distal ulnar epiphysis after motorcycle trauma. When closed reduction was unsuccessful, open reduction with cast immo-

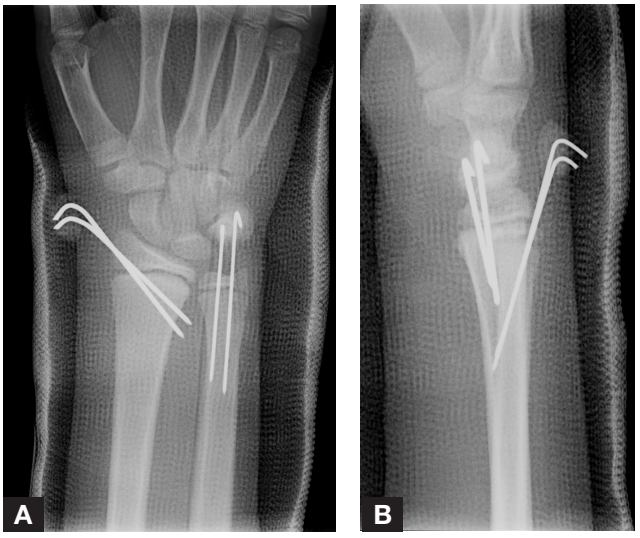

Figure 4. Postoperative anteroposterior (A) and lateral (B) radiographs of wrist. After open reduction, fractures were stabilized with Kirschner wires.

bilization was performed. At final follow-up, a portion of the distal ulnar epiphysis was prematurely closed, and partial wrist and forearm ROM was lost. Faraj and colleagues[9] described the case of a 14-year-old boy with a displaced, rotated type IV fracture of the distal ulna and a nondisplaced distal radius metaphyseal fracture. During surgery, they noted a rotated fragment that had migrated dorsally and proximally with interposed soft tissue at the physis. Reduction was maintained with 3 Kirschner wires and a long arm cast. At 6-month follow-up, the patient had full ROM but premature fusion of the central ulnar epiphysis was documented.

Despite reported satisfactory results after closed or open reduction and pinning of these injuries, complications related to weakness, decreased ROM, and premature ulnar physeal closure are prevalent. Golz and colleagues[8] reviewed the cases of 18 patients with injuries involving the distal ulnar physis. Type III fractures were the most common, with premature physeal closure and ulnar shortening occurring in 55% of patients. However, most of the patients were clinically asymptomatic and had only cosmetic reports. Nevertheless, more serious complications, such as radial bowing, ulnar angulation of the distal radius, and ulnar subluxation of the carpus resulting in pain, decreased grip strength, and decreased wrist ROM, have all been reported.[8,10-12] In these cases, management is individualized on the basis of age, degree of deformity, amount of pain, and loss of function. Surgical indications include progressive ulnar angulation of the distal radial articular surface, loss of motion, and poor cosmesis. The main goal in surgical management is to restore the relationship between radius length and ulna length. Surgical options include complete or partial epiphysiodesis of the distal radius, corrective radial closing wedge osteotomy, ulnar lengthening, and a combination of these procedures.[8,11-13]

Conclusion

Although injuries of the distal forearm are common in children and adolescents, complex physeal fractures of the distal ulna are exceedingly rare. Some of these injuries can be managed with a closed procedure. However, the majority require open reduction and pinning for restoration of anatomical alignment. Thorough radiographic assessment should be performed so that the fracture pattern can be adequately characterized. CT and contralateral radiographs should be obtained in equivocal cases. Outcomes after closed and open management of these injuries are usually satisfactory. Parents and patients should be informed that complications such as decreased ROM, diminished grip strength, and premature physeal closure, though not uncommon, seldom result in significant functional limitations. Serial radiographs and regular follow-up are important in identifying and managing any associated complications.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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This paper will be judged for the Resident Writer's Award.