Segmental Radius and Ulna Fractures With Scaphocapitate Fractures and Bilateral Multiple Epiphyseal Fractures

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Abstract

Segmental forearm fractures are rare in children, and management is controversial. Epiphyseal injuries further complicate matters. We report the case of a 15-year-old boy who had segmental radius and ulna fractures with a coronal split of a metaphyseal fragment, along with bilateral epiphyseal fractures of the distal radius and ulna as well as ipsilateral scaphocapitate fractures with perilunate dislocation. There was also a contralateral fracture through the radial neck. The patient underwent immediate internal fixation of the forearm fractures and delayed fixation of the scaphocapitate fractures. Results at 12 months showed excellent functional outcome.

Forearm fractures are common in children.[1-4] The usual site of injury is the distal radius.[4] In children, growth plate fractures account for 30% of all long bone injuries.[2] Distal radius fractures in children are more likely to involve the radiocarpal or radioulnar joints than those in the elderly.[3] However, the vast majority of pediatric distal forearm fractures can be treated by closed reduction and immobilization in a plaster cast.[4]

In adults, segmental fractures of the forearm are treated with open reduction and internal fixation (ORIF).[5] In children, these fractures are extremely rare, and correct management is the subject of debate.[6] ORIF with plates and screws, intramedullary elastic nails, and intramedullary and percutaneous Steinmann pins have been used in children, with no increased risk for complications over using pins and plaster cast for unstable pediatric forearm fractures.[7,8] Further controversy exists about how many bones should be fixed in unstable pediatric forearm fractures.[9]

Scaphocapitate fracture syndrome is another rare injury in young patients.[10] Each case can have several injury patterns, including oblique capitate fractures,[11] fractures through the coronal plane,[12] and concurrent dislocations.[13]

We describe the case of a young patient with compound segmental fractures of the ipsilateral radius and ulna with distal epiphyseal fractures of both bones as well as ipsilateral scaphocapitate fractures with perilunate dislocation. The patient also had epiphyseal fractures of both distal ulna and radius with a fracture of the radial neck in the opposite arm. There are case reports of segmental forearm fractures in children,[14] fractures of the radial neck,[15] multiple epiphyseal fractures,[16] and scaphocapitate fracture syndrome.[10] However, to our knowledge, our patient's pattern of injuries was not previously reported in a child or adult. We evaluate our management of such complex fracture patterns and assess the outcome at 12 months.

Case Report

A 15-year-old boy fell from a height of approximately 60 feet in an abseiling (rappelling) accident. The patient sustained multiple injuries, including a fractured frontal bone with a frontal contusion, fractures of the zygoma and petrous apex, and an undisplaced fracture of the left patella. He also sustained complex fractures of both arms. He had an open injury to the

Figure 1. Preoperative anteroposterior and lateral x-rays of left forearm show segmental radial and ulna fractures with epiphyseal injuries as well as fractures of the scaphoid and capitate.

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Am J Orthop. 2008;37(4):214-217.

Figure 2. Preoperative anteroposterior and lateral x-rays of right forearm show distal radius and ulna epiphyseal injuries and an undisplaced fracture of the radial head.

Figure 3. Postoperative anteroposterior and lateral x-rays of left forearm show reduction and various fixations used.

Figure 4. Postoperative anteroposterior and lateral x-rays of right forearm.

Figure 5. Anteroposterior and lateral x-rays of left forearm 12 months after surgery.

Figure 6. Anteroposterior and lateral x-rays of right forearm 12 months after surgery.

Figure 7. X-rays show capitate and scaphoid fixation 12 months after surgery.

left forearm with 2 small compound wounds less than 1 cm on the volar surface over the radial side and 1 small puncture mark, again less than 1 cm over the ulna side. Initial x-rays showed a segmental injury of both the ulna and radius on the left side with multiple epiphyseal injuries. There were Salter-Harris II fractures of both the distal radius and the ulna. There was a transverse midshaft radius fracture as well as a comminuted fracture at the radial metaphysis with the distal fragment angulated around to almost 160° on the lateral view. The ulna had a second fracture with a butterfly fragment at its junction of the distal and middle third. In addition to these injuries, there were fractures of the scaphoid and capitate with a perilunate dislocation (Figure 1). The right forearm had no open injuries. X-rays showed Salter-Harris II epiphyseal injuries to both distal radius and ulna as well as an undisplaced fracture of the radial head (Figure 2).

The patient was taken to the emergency department for immediate attention to both forearm fractures. On the left side, the perilunate dislocation was reduced. The open wounds to the left arm were cleaned and edges excised. Open reduction of the radial fractures was done through an anterior Henry approach. The shaft of the radius was reduced and fixed with an AO (Arbeitsgemeinschaft für Osteosynthesefragen) plate. The distal metaphyseal fragment was split in the coronal plane with a separate volar segment. This deformity was corrected, and the coronal split held with an interfragmentary screw. The radial epiphysis was then reduced onto the shaft and the reduction maintained with 2 smooth Kirschner wires (K-wires). A volar buttress plate was then used to hold the metaphyseal fragment in place. Sutures were passed through the distal periosteum on the epiphysis to tie down to the plate. The ulna was exposed through its subcutaneous border, and the comminuted fracture was reduced. This was fixed with a dynamic compres-

Figure 8. Wrists in neutral at 12 months (right forearm on left).

Figure 9. Wrists in full active palmar-flexion at 12 months (right forearm on left).

Figure 10. Wrists in full active dorsiflexion at 12 months (right forearm on left).

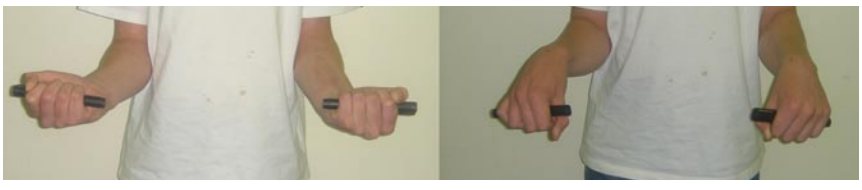

Figure 11. Full supination and pronation at 12 months.

sion plate. The ulnar epiphysis was then reduced and fixed with a single K-wire. The ulnar wound was closed, but the volar incision could not be closed and was left open to act as a prophylactic fasciotomy. After appropriate dressings, the arm was placed into an above-elbow plaster cast, ensuring that the alignment of the carpus was satisfactory (Figure 3). A closed reduction of the radial epiphysis was performed on the right side. This was held in position with 2 smooth K-wires. Closed reduction of the ulna failed, and thus open reduction through a small incision was performed. The ulnar epiphysis was held in place with 2 additional smooth K-wires (Figure 4). The wound was closed and the forearm placed into an above-elbow plaster cast.

Subsequently, the patient remained in intensive care. Further wound inspections were performed, but attempts at closure failed. The scaphoid and capitate fractures were addressed 18 days later, after detailed imaging, by the upper limb team. The carpus was opened through a Berger approach. The capitate and scaphoid fractures were reduced and fixed by mini-Acutrak fixation screws. The patient went on to require split skin grafting to the left forearm. K-wires in both arms were removed after 6 weeks.

The patient was then referred for physiotherapy. Functional outcome was evaluated after 1 year. X-rays obtained at 12 months showed the metal plates to be in situ in the left forearm. The fractures all showed radiologic union in a satisfactory position. However, all the growth plates had fused slightly prematurely (Figures 5–7). There was a slight dorsal tilt of the left distal radius articular surface.

Clinically, the patient had excellent results, no visible deformity, and well-healed scars. Dorsiflexion of the left wrist was slightly reduced to 60°. There was no forearm-length discrepancy. Palmar flexion, pronation, supination, and radial and ulnar deviation were normal and symmetrical on both sides (Figures 8–11). The carpus was stable, demonstrating no subluxation or shift. The distal radioulnar joints also seemed stable on both sides.

The patient worked in a physically demanding job. He did not have any residual pain or restriction in daily activities from his forearm and wrist injuries. At 12 months, there was no appreciable weakness in grip strength.

Discussion

Management of such an array of complex segmental fractures is technically demanding. We opted for internal fixation with dynamic compression plates and a buttress plate for the segmental fractures with percutaneous K-wires to maintain the reduction of the epiphyseal fractures. Other methods (eg, intramedullary K-wires,[17] intramedullary elastic nails,[18] pins and plaster casts[8]) are also available. At time of surgery, however, it was felt that this form of fixation would offer more stability, especially since several fragments required open reduction.

With regard to scaphocapitate fractures, we ensured that the perilunate dislocation was reduced and initially treated in a plaster cast so that the other, more life-threatening injuries could be addressed first. In the meantime, further imaging was performed to determine the exact fracture pattern. Arrangements were made for the upper limb team to perform the fixation electively after the swelling had resolved and the patient's condition stabilized. In other case reports of similar injuries to the wrist, the same good results were not achieved.[10]

We acknowledge that the distal epiphysis fused slightly prematurely, but the patient was not left with any significant limb-length discrepancy or loss of function. Similar results with regard to early growth plate fusion were reported by Osada and colleagues,[16] who used K-wires to fix 3 epiphyseal fractures.

The patient seemed to have excellent function at 12 months and returned to his full-time, manually demanding job soon after undergoing fixation of these fractures. We conclude that ORIF using a combination of plates, screws, and K-wires is a valid method of treatment for such complex segmented forearm fractures and multiple epiphyseal fractures.

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.

Guest Editorial (*Continued from page 187)* A. J. Aboulafia

bone tumors tend to be symptomatic. All too often, asymptomatic soft-tissue masses are thought to be benign solely on the basis of the lack of symptoms. Unfortunately, while it may seem counterintuitive, soft-tissue sarcomas are generally asymptomatic. Since they share this clinical presentation with benign soft-tissue masses, clinical symptoms may not be helpful. Symptomatic soft-tissue masses may suggest a diagnosis of angiolipoma, hemangioma, schwannoma, or abscess. Similarly, soft-tissue sarcomas are generally well defined on magnetic resonance imaging (MRI). Again, this is contrary to the impressions of many orthpedic surgeons and radiologists. Frequently, an MRI scan is read as a benign soft-tissue mass because the lesion is well defined. The orthopedic surgeon relying on the reading of a radiologist in such cases can become an unsuspecting accomplice to delays in treatment or misdiagnosis. If one has a concern about potential malignancy, referral to an orthopedic oncologist may be warranted.The cases that are not easy to diagnose or that foil expectations should remind us of the importance of being thoughtful and humble. The obvious diagnosis is not always the correct one. ■

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