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A case of radial nerve paralysis associated with supracondylar fracture of the humerus in a child

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Introduction

Supracondylar fractures of the humerus are the most common type of elbow fractures in children. Nerve injuries are a complication associated with supracondylar fractures and reportedly occur in 10% of patients.[5,6,9,13,14] Most neuropraxias recover spontaneously. However, in rare cases, nerve paralysis persists without recovery. Therefore, some authors have reported that it may be necessary to check the nerve during open surgery if nerve paralysis persists. We present a case of radial nerve paralysis complicating a supracondylar fracture of the humerus in a child.

Case report

A 7-year-old girl sustained a supracondylar fracture of her left humerus when she fell while riding a bicycle. There was a 5 mm-wide open wound accompanying the fracture. The injury was Gartland classification type III (Fig. 1, *A*) and Gustilo open fracture classification type I. Emergency surgery was performed, involving percutaneous cross pinning (Fig. 1, *B*) and casting of her left arm. Three weeks after the operation, she was unable to extend her wrist and fingers. Four weeks after the operation, the Kirschner wires were removed after union of the fractured bone. As she was still unable to extend her wrist and fingers 6 weeks after the operation, she was referred to our department for treatment.

Radiography confirmed bone union (Fig. 1, *C*). She had a motor deficit in her left arm; she could not extend her wrist and fingers at all (Fig. 2). The manual muscle testing scores were as shown in Table I. She was diagnosed with radial nerve paralysis associated with supracondylar fracture. We conservatively observed the motor function of her forearm until 3 months after the operation because the bone fracture had already united. However, the motor function of the extensor muscles of her wrist and fingers did not recover, and another open surgery was performed to check the condition of her left radial nerve.

The elbow was exposed through a lateral approach, and the proximal aspect of the radial nerve was exposed. External neurolysis along the radial nerve revealed that the radial nerve was entrapped within the bone fracture site, and the fractured bone had already united. At the site of the radial nerve lesion, two-thirds of the diameter of the radial nerve was within the united bone with bone callus (Fig. 3), whereas one-third remained connected outside the fractured bone but was surrounded by scar tissue and seemed nonfunctional. We did not expect the nerve to recover from this damage; therefore, we cut out the affected area of the radial nerve to remove the scar tissue (Fig. 6) and sutured the radial nerve end-to-end (Figs. 4 and 7).

Three months after surgery on the radial nerve, the manual muscle testing scores of extensor digitorum communis, extensor carpi radialis brevis, and extensor carpi radalis longus had improved. Six months after the surgery, the extensor pollicis longus, extensor indicis proprius, and extensor digitis minimi had returned to normal (Fig. 5). The range of motion of her elbow was 145° in flexion and 5° in extension. She was able to play the piano with no difficulty.

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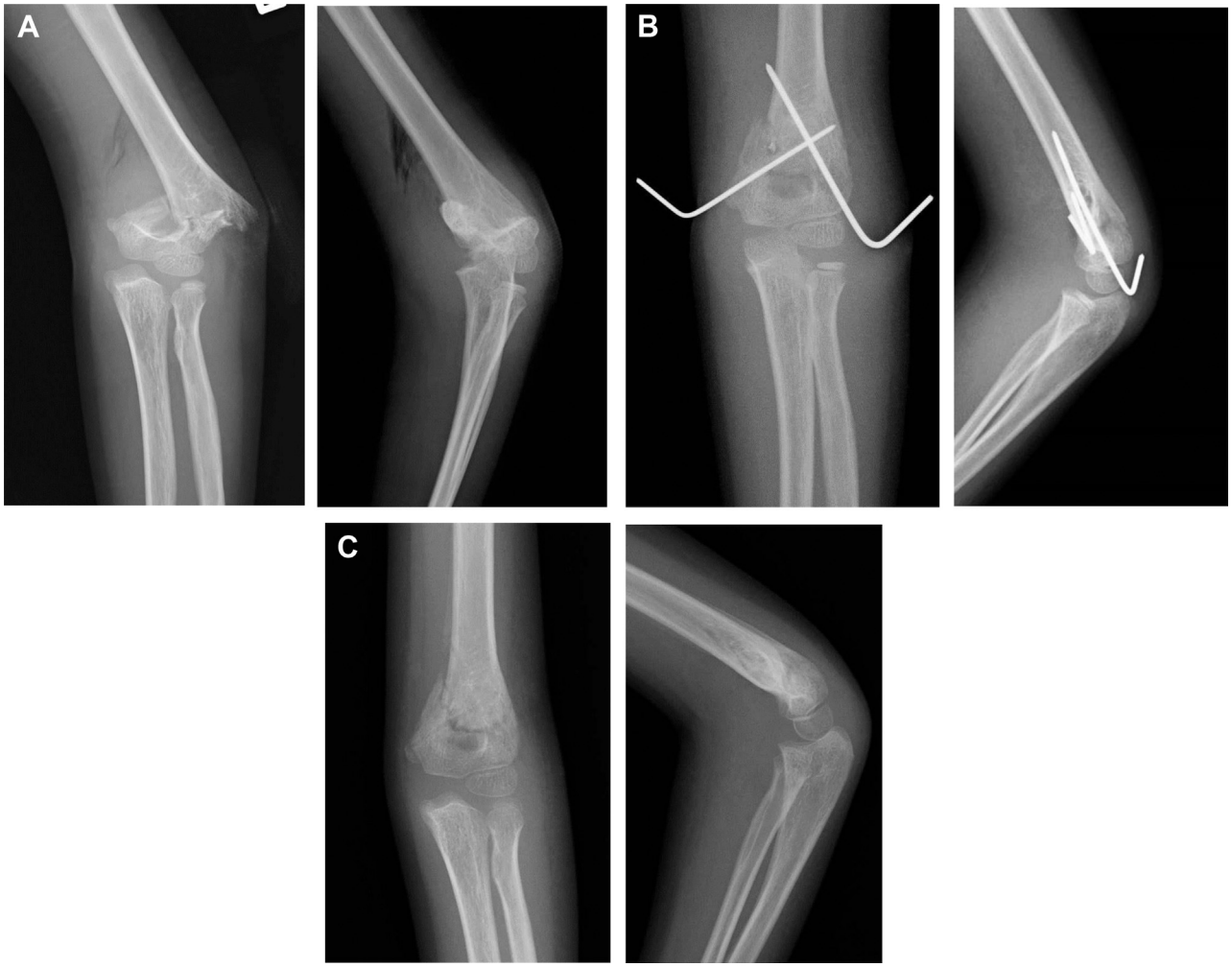

Figure 1 (**A**) Preoperative X-ray. (**B**) Postoperative X-ray. (**C**) 6 weeks after the first operation.

Figure 2 She could not extend her wrist and fingers at all.

Table I
Manual muscle testing (MMT) at the time of referral.

Muscle	MMT score
Extensor pollicis longus (EPL)	0
Extensor digitorum communis (EDC)	0
Extensor indicis proprius (EIP)	0
Extensor digitis minimi (EDM)	0
Extensor carpi radalis longus (ECRL)	0
Extensor carpi radialis brevis (ECRB)	0
Flexor carpi radialis (FCR)	5
Flexor digitorum profundus (FDP)	5
Flexor pollicis longus (FPL)	5

Discussion

Neurologic complications associated with supracondylar fractures of the humerus in children are well recognized. The incidence of neurologic injury in children with supracondylar fractures of the humerus has been reported as approximately 10%, ranging from 6.5%[1] to 17.8%.[1,5]. In Gartland type III supracondylar fractures of the humerus alone, the incidence ranged from 12% to 49%.[3,6] The incidence of neurological injury is associated with more displaced supracondylar fractures of the humerus.

It is assumed that the neurologic assessment is not adequate when children are injured. Mayne[10] reported that only 12 of 137 patients had a complete preoperative neurologic or vascular assessment documented. In our hospital from 2010 to 2015, 30% of the children with supracondylar fractures of the humerus did not have a neurologic assessment documented at all. It is necessary to recognize that neurologic evaluation at the time of presentation for a fracture is very important.

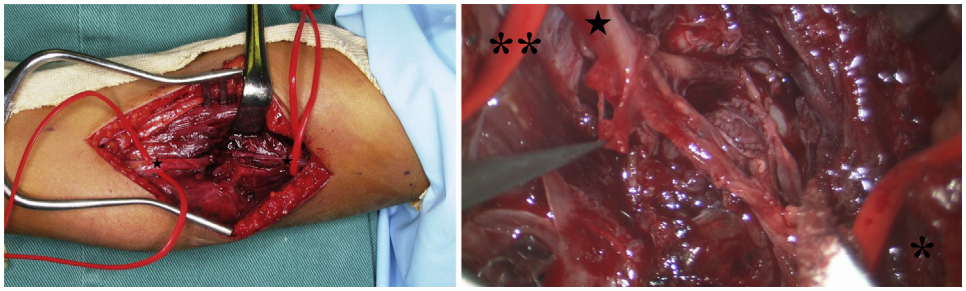

Figure 3 Intraoperative findings. Radial nerve was entrapped in bone fracture site that had already unioned.★, radial nerve. A part of radial nerve was within the united bone with bone callus. *, proximal side; **, distal side; ★, radial nerve.

Figure 4 The radial nerve was sutured end-to-end.

Figure 5 6 months after the second surgery (neurorrhaphy). Her wrist and finger returned to normal.

Regarding skin sensation, the lateral antebrachial cutaneous nerve (dorsal branch of musculocutaneous nerve) sometimes overlaps with the radial nerve at the back of the hand. As a result, the patient might have normal sensations in her or his hand, even with a radial nerve injury.[12] This may sometimes make it difficult to determine whether there is a nerve injury. It is important to check both motion and sensation very carefully at presentation and during follow-up.

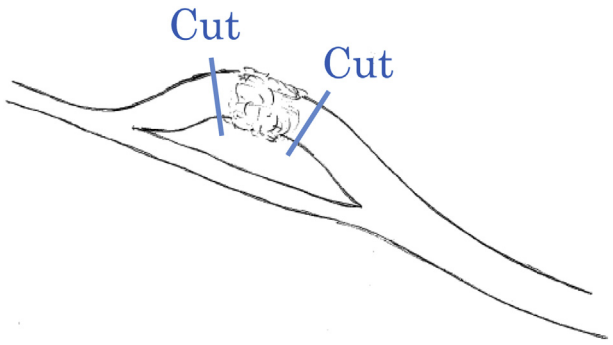

Figure 6 Scheme of radial nerve removed from the bone fracture site. We cut out the affected area of the radial nerve.

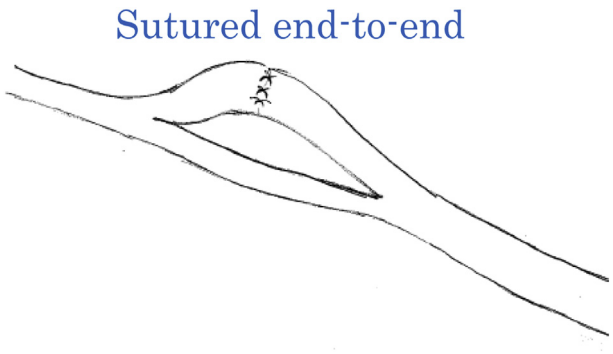

Figure 7 Scheme of the sutured radial nerve.

Some have proposed that most nerve paralysis cases associated with supracondylar fractures of the humerus in children heal spontaneously within a period of 2-6 months;[2] therefore, some reports recommend waiting at least 5-6 months before the patients undergo surgical exploration of their nerve lesions.[1,2,5,7] However, other authors reported that the nerve might be entrapped at the fracture site or trapped within the callus and fibrous scar tissue, or the nerve may be lacerated completely.[4,7,8,11] Therefore, it may be preferable to explore such injuries in the early stage. Ramachandran et al[11] suggested five indications for nerve exploration after trauma, and one of these indications, a complete lesion with sympathetic paralysis, was present in our case. In our case, the radial nerve was trapped in the fracture site, and the fracture site had already united. Therefore, it might have been possible to prevent severe nerve paralysis by removing the radial nerve trapped in the fracture site before the bone united.

Conclusion

This case highlights the fact that some cases could be explored as early as possible before bone fracture union.

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