Median nerve entrapment in a callus fracture following a pediatric both-bone forearm fracture: A case report and literature review

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INTRODUCTION

Forearm fractures are common injuries in childhood. Median nerve entrapment is a rare complication of forearm fractures, but several cases have been reported in the literature. This case report discusses the diagnosis and management of median nerve entrapment in a 13-year-old male who presented acutely with a both-bone forearm fracture and numbness in the median nerve distribution. Following the delayed diagnosis, surgical exploration revealed complete nerve entrapment and a nerve graft was performed.

CASE

A 13-year-old right-hand-dominant boy fell off a bicycle. He was seen at a local emergency room in December 2013. A physical examination revealed a deformed and painful left forearm without neurological or circulatory impairment. Radiographs showed a greenstick both-bone distal fracture (Fig. 1). The patient underwent a closed reduction with satisfactory post-manipulation radiographs. Weekly examinations showed no fracture displacement and normal bone healing, but the patient complained of numbness in his thumb, index finger, and middle finger. The sensory loss was thought to be caused by neurapraxia, and the patient was advised that the numbness would resolve spontaneously.

Two months later, the plaster was removed, radiographs showed union of both fractured bones with callus bridging (Fig. 2), and the patient noted improved sensibility in the thumb.

Six months after the initial injury, the patient presented to the emergency room after burning his middle finger pulp. On examination, there was no 2-point discrimination in the median nerve distribution of the left hand.

Finally, the patient was referred to us for evaluation. Examination revealed a thenar eminence atrophy, decreased power of the abductor pollicis brevis, and the Tinel sign was positive over the fracture site and the wrist. The flexor digitorum profundus extending into the index finger and the flexor pollicis longus muscles were normal in muscle testing. A neurophysiological study revealed abnormal median nerve conduction distally, and nee-
dle electromyography detected denervation of the abductor pollicis brevis. Radiographs showed that the fracture had healed with only a slight irregularity.

Eight months after the injury, surgical exploration of the median nerve was carried out. An anterior incision was performed on the left forearm, centered on the area of the positive Tinel sign. The flexor muscles were split and the median nerve was identified. The nerve was trapped in the radius callus fracture (Fig. 3). Neurolysis was attempted, but was impossible (Fig. 4). After resection of the injured nerve and the neuroma, we found a loss of substance (Fig. 5). The possibility of a nerve suture without tension was tested with a nylon 9/0 suture, but it was not possible, even with flexion of the wrist. A nerve graft was performed using the left sural nerve (Fig. 6).

Two years after surgery, follow-up revealed recovery of the abductor pollicis brevis, and 2-point discrimination was 6 mm on the thumbs and 10 mm on the index and the middle finger.
DISCUSSION

Median nerve entrapment in forearm fractures in children is uncommon. Eleven cases have reported in the literature from 1974 to 2016 (Table 1). The mean age of the affected patients was 11 years (range, 6–13 years). Except for the cases described by Nunley and Urbaniak [10] and Yeo et al. [3], in which the nerve entrapment was at an ulnar fracture site, the nine other cases were due to a radial fracture. The radial fractures were proximal in one case [7], at the mid-shaft in eight cases, and in the distal third in the two remaining cases and our case. Closed reduction was performed in eight cases [1,3-8,11], an open reduction in one case [2], and no reduction was needed in two cases [9,10].

In addition to the median nerve, the interosseous nerve was involved in one case [8]. Except for the case described by Hurst and Aldridge [2], in which surgical exploration was immediately indicated, both the diagnosis and the surgical exploration were delayed. In the reported cases, the median nerve entrapment was released after 39 days to 24 months [7,11]. The reasons for the delayed diagnosis include the absence of clinician continuity in serial follow-up examinations, the unclear nature of complaints from affected children, and the assumption that such numbness will prove to be temporary.

The presence of a slight bony irregularity, a bony canal [10], or a bony spike at the site of the fracture may suggest median nerve entrapment [7]. However, those radiological irregularities are usually only appreciated postoperatively [7]. In our case, a bony canal was present on the anteroposterior view of the healed radial fracture (Fig. 7). Magnetic resonance imaging (MRI) was only performed in one case [3], although it is useful for tracing the median nerve course in the forearm. Yanagibayashi et al. [12] advocate the use of MRI earlier if entrapment is suspected. It enables immediate visualization of the entrapment, and surgical exploration can be promptly performed to release the entrapment.

Neurolysis and neurorrhaphy were the most common management procedures, and a median nerve graft was performed.
Table 1. Literature review of nerve entrapment in the osseous callus in pediatric forearm fractures

| Author                | Year | Age (yr) | Fracture                          | Nerve                  | Entrapment location | Fracture treatment                    | Surgical exploration delay | Surgical management | Follow-up | Outcome                                      |
|-----------------------|------|----------|-----------------------------------|------------------------|---------------------|----------------------------------------|----------------------------|---------------------|-----------|---------------------------------------------|
| Wolfe et al. [11]     | 1974 | 7        | Radius and ulna, middle and distal third junction | Median nerve | Radius | Closed reduction | 39 day | Neuorrhaphy | 2 yr | Complete recovery |
| Nunley and Urbaniak [10] | 1980 | 6        | Proximal third of the ulna         | Median nerve | Ulna | Long-arm cast (no reduction needed) | 9 mon | Neuorrhaphy | 7 mon | Nearly complete recovery |
| Genelin et al. [9]    | 1988 | 13       | Radius and ulna, middle third      | Median nerve | Radius | No reduction needed | 3 mon | Nerve graft | 8 mon | Nearly complete recovery, with persistent derervation signs in electromyography |
| Gainor et al. [8]     | 1990 | 12       | Radius and ulna, mid-shaft        | Median and anterior interosseous nerves | Radius | Closed reduction and casting | 5 mon and 15 day | Neurolysis for both and median nerve neurolysis | 6 mon | Complete sensory recovery, incomplete muscle strength recovery |
| al-Qattan et al. [7]  | 1994 | 10       | Radius and ulna, middle third      | Median nerve | Radius | Closed reduction | 24 mon | Neurolysis | 9 mon | Complete recovery |
| Huang et al. [6]      | 1998 | 13       | Junction of the proximal and middle thirds of the radius and ulna | Median nerve | Radius | Closed reduction and long-arm cast | 4 mon and 14 day | Neuorrhaphy | 11 mon | Good sensory recovery, no motion regained |
| Proubasta et al. [5]  | 1999 | 12       | Closed both-bone forearm fracture, distal third | Median nerve | Radius | Closed reduction and long-arm cast | 6 wk | Neurolysis | 6 mon | Full sensory and motion recovery |
| Benske et al. [4]     | 2005 | 12       | Closed middle-third both-bone forearm fracture | Median nerve | Radius | Closed reduction and long-arm cast | 15 mon | Neurolysis | 1 yr | Full sensory and motion recovery |
| Hurst and Aldridge [2] | 2006 | 13       | Closed midshaft both-bone forearm fracture | Median nerve | Radius | Open reduction and internal plate fixation | 0 day | Neurolysis | 14 wk | Complete recovery |
| Ardolino et al. [1]   | 2009 | 12       | Closed both-bone distal-third fracture | Median nerve | Fracture site | Closed reduction then discharge | 4 mon and 7 day | Neuorrhaphy | 1 yr | Complete motion recovery, with persistent paresthesia |
| Yeo et al. [3]        | 2011 | 11       | Radius and ulna, middle third      | Median nerve | Ulna | Closed reduction and immobilization | 6 mon | Neurolysis, then neurolysis | 1 yr | Complete recovery |
| Current study         | 2016 | 13       | Closed both-bone distal-third fracture | Median nerve | Radius | Closed reduction and long-arm cast | 8 mon | Nerve graft | 2 yr | Complete motion recovery, good sensory recovery |
in one other case [9], as well as in our case. Fortunately, the literature has demonstrated that median nerve function shows excellent recovery in childhood, even with delayed surgery. This case emphasizes the importance of a meticulous clinical examination before and after closed reduction to detect a nerve injury. We highlight the value of clinician continuity in serial follow-up examinations. Early exploration of persistent neurological deficits is advocated, and MRI may be useful.

NOTES

Conflict of interest
No potential conflict of interest relevant to this article was reported.

Ethical approval
The study was approved by the Habib Bourguiba University Hospital Ethics Committee (IRB No. 7-17) and performed in accordance with the principles of the Declaration of Helsinki. Written informed consents were obtained.

Patient consent
The patient provided written informed consent for the publication and the use of his images.

Author contribution
Clinical study, drafting, and approval of the manuscript: Fourati A. Literature review: Karra A. Critical revision: Ghorbel I. Electromyography study: Elleuch MH. Study supervision: Ennouri K.

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