

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

Amine Fourati¹, Iyadh Ghorbel¹, Amir Karra¹, Mohamed Habib Elleuch², Khalil Ennouri¹

Departments of ¹Plastic Surgery and ²Physical Medicine and Rehabilitation, Habib Bourguiba Hospital, Sfax, Tunisia

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-yearold 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.

Keywords Humans / Forearm injuries / Fractures, bone / Median nerve / Transplants

Received: 4 Nov 2017 • Revised: 13 Mar 2018 • Accepted: 14 Apr 2018 pISSN: 2234-6163 • eISSN: 2234-6171 • https://doi.org/10.5999/aps.2017.01606 • Arch Plast Surg 2019;46:171-175 Department of Plastic Surgery, Habib Bourguiba Hospital, Faculty of Medicine of Sfax, Sfax University, Sfax 3000, Tunisia Tel: +216-28020002 Fax: +216-74243427 E-mail: amine_fourati@ medecinesfax.org

Correspondence: Amine Fourati

INTRODUCTION

Forearm fractures are common injuries in childhood. Fractures of the distal third of the radius and ulna account for 75% of all pediatric both-bone forearm fractures [1,2]. Median nerve entrapment is a rare complication of forearm fractures, but several cases have been reported in the literature [1-11].

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-

Copyright © 2019 The Korean Society of Plastic and Reconstructive Surgeons

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/

licenses/by-nc/4.0/) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited. | www.e-aps.org

Fig. 1. The radiographs of the both-bone forearm fracture

The radiographs were obtained in the emergency room, with an anteroposterior view (A) and lateral view of the radial and ulnar fracture with dorsal angulation (B).



Fig. 2. The radiographic follow-up after 2 months

Radiographs showed the union of the fracture without angulation in the coronal plane (A) and 15° of tolerated angulation in the sagittal plane (B).



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

Fig. 3. Intraoperative view of the surgical exploration

The surgical exploration revealed entrapment of the median nerve at the radial fracture site.

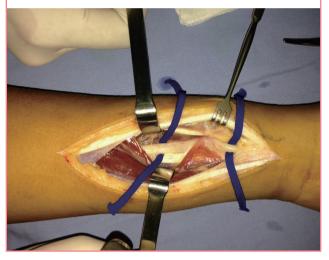
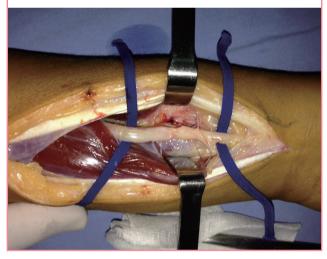


Fig. 4. Intraoperative view after a neurolysis attempt

Neurolysis failed because the nerve was caught in the bony callus. Dissection was impossible. The picture shows a nerve discontinuity caused by attempting release, and a flattening in the distal part.



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.

Fig. 5. Intraoperative view of nerve loss of substance

The dissected part, the neuroma, and the glioma were resected, resulting into a loss of substance measuring 20 mm.

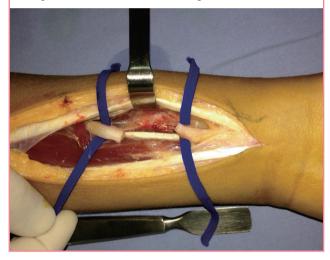


Fig. 6. Intraoperative view of the median nerve graft

After excision of the entrapped part, the median nerve defect was grafted using the sural nerve.

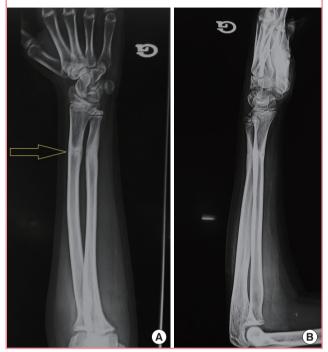


DISCUSSION

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].

Fig. 7. The radiographic follow-up after 8 months

(A, B) The radiograph shows complete bone healing and bone remodeling. Note the bony canal (yellow arrow) at the healed radius fracture site.



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

AtherYesMore (with) (with)FractureEnclore (with) (with)Fracture (with)SurgicalSurgical (with)Surgical											
1747Redia and utalian incluice and disal merveRediaRedia reduction3 dayNeurotraphy2 yr1891010Redia reductionMatan merveMatan merveMatan merve1 montaphy7 montaphy2 yr19913Radia reduction in the intersonance mericanMatan merveMatan merveMatan merve1 montaphy1 montaphy1 montaphy19913Radia reduction in the intersonance mericanMatan merveMatan merican1 montaphy1 montaphy1 montaphy19910Radia reduction in the intersonance mericanMatan mericanMatan merican2 montaphy1 montaphy1 montaphy19910Radia reduction in the intersonance mericanMatan mericanMatan merican2 montaphy1 montaphy1 montaphy19910Radia reduction mericanMatan mericanMatan mericanMatan merican2 montaphy1 montaphy19913Radia reduction mericanMatan mericanMatan merican2 montaphy1 montaphy1 montaphy19913Radia reduction mericanMatan mericanMatan merican2 montaphy1 montaphy1 montaphy19913Radia reduction mericanMatan mericanMatan merican2 montaphy1 montaphy19913Radia reduction mericanMatan mericanMatan merican2 montaphy1 montaphy1913Radia reduction mericanMatan mericanMatan merican2 montaphy1 montaphy	Author	Year	Age (yr)		Nerve	Entrapment location		Surgical exploration delay	Surgical- management	Follow-up	Outcome
1006Powinat Intio of the unaxMedia IneviceUnaxOperationation contropioTime11012Reduce International contropioMedia IneviceMedia IneviceRadian nerveRadianRadian nerveRadian11012Reduce and unaxMedia IneviceRadian nerveRadian nerveRadianRadian nerveRadian11012Reduce and unaxMedian nerveRadian nerveRadian nerveRadianRadian nerveRadian1101313Median nerveRadian nerveRadianRadian nerveRadianRadian nerveRadian1101314Median nerveRadian nerveRadianRadian nerveRadianRadian nerveRadian1111314Median nerveRadian nerveRadianRadian nerveRadianRadianRadianRadian11313Median nerveRadian nerveRadianRadianRadianRadianRadianRadianRadian11313Median nerveRadianRadianRadianRadianRadianRadianRadianRadianRadianRadian11414Median nerveRadianRadianRadianRadianRadianRadianRadianRadian11414Median nerveRadianRadianRadianRadianRadianRadianRadianRadian11514Median nerveRadianRadianRadianRadian <td< td=""><td>Wolfe et al. [11]</td><td>1974</td><td>7</td><td></td><td></td><td>Radius</td><td>Closed reduction</td><td>39 day</td><td>Neurorrhaphy</td><td>2 yr</td><td>Complete recovery</td></td<>	Wolfe et al. [11]	1974	7			Radius	Closed reduction	39 day	Neurorrhaphy	2 yr	Complete recovery
138 13 Botis and una, middle third Madan nerveir Badius Interessona Botis Botis <td>Nunley and Urbaniak [10]</td> <td>1980</td> <td>9</td> <td>Proximal third of the ulna</td> <td>Median nerve</td> <td>Ulna</td> <td>Long-arm cast (no reduction needed)</td> <td>9 mon</td> <td>Neurorrhaphy</td> <td>7 mon</td> <td>Nearly complete recovery</td>	Nunley and Urbaniak [10]	1980	9	Proximal third of the ulna	Median nerve	Ulna	Long-arm cast (no reduction needed)	9 mon	Neurorrhaphy	7 mon	Nearly complete recovery
190 12 Radius and unit-shaft Media nard anterior intercoseous nevels Media nard anterior intercoseous nevels Media narve	Genelin et al. [9]	1988	13	Radius and ulna, middle third	Madian nerve	Radius	No reduction needed	3 mon	Nerve graft	8 mon	Nearly complete recovery, with persistent dernervation signs in electromyography
19410Redus and una, middle thirdMedian neveRadiusCused reduction24 monNeurolysis9 mon194813Unction of the proximal and middle Median neveRadiusCused reduction and long-14 dayNeurorhably11 mon194912Cosed both-bone foreartin factureRadiusCused reduction and long-14 dayNeurohisably11 mon194912Cosed both-bone foreartin factureMedian neveRadiusCused reduction and long-6 whoNeurohisably11 mon204513Cosed middle-third both-boneMedian neveRadiusCused reduction and long-16 won16 won10 won204613Cosed middle-third both-boneMedian neveRadiusCosed reduction and long-15 monNeurohisably11 mon204013Cosed middle-third both-boneMedian neveRadiusCosed reduction and long-15 mon10 won/sist14 who204013Cosed middle-thirdMedian neveRadiusCosed reduction and long-15 mon14 who204114Cosed middle-thirdMedian neveRadiusCosed reduction and long-15 mon14 who204214Cosed middle-thirdMedian nerveMedian neve14 who14 who204314Cosed reduction and long-14 who14 who14 who204414Median nerveMedian neve14 who14 who204414Median nerveMedian nerve14 wh	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 neurorrhaphy	6 mon	Complete sensory recovery, incomplete muscle strength recovery
130813Unction of the proximal and middle Median nerve intid soft the radius and undaRadius am castClosed reduction and long- 14 dayHumon Runorthaphy11 mon130912Closed both-bone forarm fracture.Median nerveRadiusClosed reduction and long- am castMenorthaphyRunorsisClosed200513Closed middle merveRadiusRadiusClosed reduction and long- am castSingNeurohsisClosed200613Closed middle merveRadiusRadiusClosed reduction and internalClosed reduction and internalClosedClosed200613Closed midshaft both-bone forarmMedian nerveRadiusClosed reduction and internalClosedClosedClosed200613Closed midshaft both-bone forarmMedian nerveRadiusClosed reduction and internalClosed reduction and internalClosedClosed200614Closed doub-bone forarmMedian nerveRadiusClosed reduction and internalClosed reduction and internalClosedClosed200710Closed doub-bone forarmMedian nerveFracture siteClosed reduction and internalClosed reduction and internalClosedClosedClosed reduction and internalClosedClosed201011RadiusClosed reduction and internalClosed reduction and internalClosed reduction and internalClosed reduction and internalClosedClosed201111RadiusClosed reduction and internal	al-Qattan et al. [7]	1994	10	Radius and ulna, middle third		Radius	Closed reduction	24 mon	Neurolysis	9 mon	Complete recovery
199912Closed both-bone fracture. Median nerve distal thirdRadiusClosed reduction and long- am castKeurolysisBeurolysis <t< td=""><td>Huang et al. [6]</td><td>1998</td><td>13</td><td>Junction of the proximal and middle thirds of the radius and ulna</td><td></td><td>Radius</td><td>Closed reduction and long- arm cast</td><td>4 mon and 14 day</td><td>Neurorrhaphy</td><td></td><td>Good sensory recovery, no motion regained</td></t<>	Huang et al. [6]	1998	13	Junction of the proximal and middle thirds of the radius and ulna		Radius	Closed reduction and long- arm cast	4 mon and 14 day	Neurorrhaphy		Good sensory recovery, no motion regained
200512Closed middle-third both-boneMedian nerveRadiusClosed reduction and long- am cast15 monNeurolysis1 yr200613Closed midshaft both-bone forearmMedian nerveRadiusOpen reduction and internal0 dayNeurolysis1 yr200613Closed midshaft both-bone forearmMedian nerveRadiusOpen reduction and internal0 dayNeurolysis1 wr200610Closed both-bone distal-thirdMedian nerveFractureClosed reduction then0 dayNeurolysis1 wr201111Radius and ulna, middle thirdMedian nerveUlnaClosed reduction and6 monNeurolysis, then1 yr201111Radius and ulna, middle thirdMedian nerveUlnaClosed reduction and6 monNeurolysis, then1 yr201113Closed both-bone distal-thirdMedian nerveUlnaClosed reduction and6 monNeurolysis, then1 yr201113Closed both-bone distal-thirdMedian nerveUlnaClosed reduction and6 monNeurolysis, then1 yr201113Closed both-bone distal-thirdMedian nerveUlnaClosed reduction and0 wrolysis, then1 yr201113Closed both-bone distal-thirdMedian nerveUlnaClosed reduction and0 wrolysis, then1 yr201113Closed both-bone distal-thirdMedian nerveWedian nerveWedian nerve1 yr201114 <td< td=""><td>Proubasta et al. [5]</td><td>1999</td><td>12</td><td>Closed both-bone forearm fracture, distal third</td><td></td><td>Radius</td><td>Closed reduction and long- arm cast</td><td>6 wk</td><td>Neurolysis</td><td>6 mon</td><td>Full sensory and motion recovery</td></td<>	Proubasta et al. [5]	1999	12	Closed both-bone forearm fracture, distal third		Radius	Closed reduction and long- arm cast	6 wk	Neurolysis	6 mon	Full sensory and motion recovery
2006 13 Closed midshaft both-bone forearm Median nerve Radius Open reduction and internal 0 day Neurolysis 14 wk [1] 2009 12 Closed both-bone distal-third Median nerve Fracture site Closed reduction then 7 day Neurohsis 14 wk [2] 2009 12 Closed both-bone distal-third Median nerve Fracture site Closed reduction then 7 day Neurohsis 1 yr [2] 101 11 Reduction their Neurohsis 7 day Neurohsis 1 yr [2] 101 11 Reduction their Neurohsis 1 day Neurohsis 1 yr [3] 2011 11 Reduction their Neurohsis 1 day 1 yr [3] 2011 11 Reduction their Neurohsis 1 day 1 yr [4] 11 Reduction their Neurohsis 1 day 1 day 1 yr [5] 10 10 Neurohsis 1 day 1 day 1 day 1 day [6] 13 13 Neurohsis 1 day <td>Bendre et al. [4]</td> <td>2005</td> <td>12</td> <td>Closed middle-third both-bone forearm fracture</td> <td></td> <td>Radius</td> <td>Closed reduction and long- arm cast</td> <td>15 mon</td> <td>Neurolysis</td> <td>1 yr</td> <td>Full sensory and motion recovery</td>	Bendre et al. [4]	2005	12	Closed middle-third both-bone forearm fracture		Radius	Closed reduction and long- arm cast	15 mon	Neurolysis	1 yr	Full sensory and motion recovery
[1] 2009 12 Closed both-bone distal-third Median nerver Fracture site Closed reduction then 4 mon and Neurorhaphy 1 yr 2011 11 11 Radius and ulna, middle third Median nerve Ulna Closed reduction and 6 mon Neurorhaphy 1 yr 2011 11 11 Radius and ulna, middle third Median nerve Ulna Closed reduction and 6 mon Neurolysis, then 1 yr 2016 13 Closed both-bone distal-third Median nerve Radius Closed reduction and long- 6 mon Neurolysis, then 1 yr 12 2016 13 Closed both-bone distal-third Median nerve Radius Closed reduction and long- 6 mon Nerve graft 1 yr 12 13 Closed both-bone distal-third Median nerve Radius Closed reduction and long- 8 mon Nerve graft 2 yr 13 Fracture 14 montantiantion 8 mon Nerve graft 2 yr 14 Fracture 14 montantiantion 8 mon Nerve graft 2 yr	Hurst and Aldridge [2]	2006	13	Closed midshaft both-bone forearm fracture		Radius	Open reduction and internal plate fixation	0 day	Neurolysis	14 wk	Complete recovery
2011 11 Padius and ulna, middle third Median nerve Ulna Closed reduction and 6 mon Neurolysis, then 1 yr 2016 13 Closed both-bone distal-third Median nerve Radius Closed reduction and long- 8 mon Nerve graft 2 yr Tracture Radius Closed reduction and long- 8 mon Nerve graft 2 yr	Ardolino et al. [1]	2009	12	Closed both-bone distal-third fracture	Median nerver	Fracture site	Closed reduction then discharge	4 mon and 7 day	Neurorrhaphy	1 yr	Complete motion recovery, with persistent paresthesia
2016 13 Closed both-bone distal-third Median nerve Radius Closed reduction and long- 8 mon Nerve graft 2 yr fracture arm cast	Yeo et al. [3]	2011	#	Radius and ulna, middle third		Ulna	Closed reduction and immobilization	6 mon	Neurolysis, then neurorrhaphy	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.

ORCID

Amine Fourati https://orcid.org/0000-0003-3401-2010 Iyadh Ghorbel https://orcid.org/0000-0001-7395-4196 Amir Karra https://orcid.org/0000-0001-9827-2511

Mohamed Habib Elleuch https://orcid.org/0000-0002-7432-4839

Khalil Ennouri https://orcid.org/0000-0003-1387-1772

REFERENCES

- 1. Ardolino A, Webb D, Richards S. Median nerve entrapment in fracture callus following a paediatric forearm fracture: case report and review of the literature. Injury Extra 2009;40:274-6.
- 2. Hurst JM, Aldridge JM 3rd. Median nerve entrapment in a pediatric both-bone forearm fracture: recognition and management in the acute setting. J Surg Orthop Adv 2006;15: 214-6.
- 3. Yeo G, Prodger S, Latendresse K. Median nerve entrapment in a paediatric fracture of the ulna demonstrated by magnetic resonance imaging. J Hand Surg Eur Vol 2011;36:329-30.
- 4. Bendre A, Adeeb M, Malkan D. Median nerve entrapment in mid-shaft radius fracture callus. Eur J Trauma 2005;31: 407-8.
- 5. Proubasta IR, De Sena L, Caceres EP. Entrapment of the median nerve in a greenstick forearm fracture: a case report and review of the literature. Bull Hosp Jt Dis 1999;58:220-3.
- Huang K, Pun WK, Coleman S. Entrapment and transection of the median nerve associated with greenstick fractures of the forearm: case report and review of the literature. J Trauma 1998;44:1101-2.
- 7. al-Qattan MM, Clarke HM, Zimmer P. Radiological signs of entrapment of the median nerve in forearm shaft fractures. J Hand Surg Br 1994;19:713-9.
- 8. Gainor BJ, Olson S. Combined entrapment of the median and anterior interosseous nerves in a pediatric both-bone forearm fracture. J Orthop Trauma 1990;4:197-9.
- 9. Genelin F, Karlbauer AF, Gasperschitz F. Greenstick fracture of the forearm with median nerve entrapment. J Emerg Med 1988;6:381-5.
- 10. Nunley JA, Urbaniak JR. Partial bony entrapment of the median nerve in a greenstick fracture of the ulna. J Hand Surg Am 1980;5:557-9.
- Wolfe JS, Eyring EJ. Median-nerve entrapment within a greenstick fracture: a case report. J Bone Joint Surg Am 1974; 56:1270-2.
- Yanagibayashi S, Yamamoto N, Yoshida R, et al. Magnetic resonance imaging visualizes median nerve entrapment due to radius fracture and allows immediate surgical release. Case Rep Orthop 2015;2015:703790.