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Medial three-finger drop in high-energy forearm trauma: An unrecognized peripheral nerve injury. A report of two cases

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ABSTRACT

Case: Absent active extension at metacarpophalangeal (MCP) joints of medial three fingers with intact extension of index finger and thumb following high energy forearm trauma due to recurrent branch of posterior interosseous nerve (RBPIN) injury has not been reported yet. The aim is to highlight an unrecognized sequel of a commonly encountered forearm trauma in two patients who sustained fractures around the elbow and forearm.

Conclusion: In the acute traumatic setting, medial three-finger drop due to RBPIN injury can be missed or misdiagnosed. This has medico-legal and prognostic implications.

Introduction

Medial three-finger drop following high energy forearm trauma is consequential to injury to nerve and/or extensor muscle/tendon. At the distal edge of supinator, the posterior interosseous nerve (PIN) divides into the medial recurrent branches (short, superficial) to the superficial extensors (extensor digitorum communis (EDC), extensor carpi ulnaris (ECU), extensor digitorum quinti (EDQ)) and the lateral descending branches (long, deep) to the deep extensors (abductor pollicis longus (APL), extensor pollicis longus (EPL), extensor pollicis brevis (EPB) and extensor indicis proprius (EIP)) [1]. Injury to recurrent branches of PIN (RBPIN) causes absence of active extension of medial three digits (paralyzed EDC, EDQ) along with radial wrist extension (paralyzed ECU).

Medial three-finger drop can also occur following high-energy closed avulsion injuries of EDC and EDQ, with intact EIP. This may involve direct trauma (compressing the tendon between bone and outside force) or indirect trauma (longitudinal traction force against the direction of muscle contraction) [2]. The weakest point is at the muscle-tendon junction (MTJ) (Verdan zone 8) over the distal half of dorsal forearm [2].

Injury to the PIN trunk leads to drop of all five digits, and injury to descending branches of PIN (DBPIN) leads to thumb drop. But traumatic RBPIN palsy has myriad forms manifesting either as finger drop of little and ring fingers [3] or ring and middle fingers (“sign of horns”) [4–6]. They represent a partial injury to RBPIN. However, medial three-finger drop following high-energy forearm trauma, which represents a complete RBPIN injury, has not been reported yet. The aim of this report is to highlight an unrecognized sequel of a commonly encountered forearm trauma. The patients provided informed consent for the purpose of scientific publication.

Case report

At our tertiary care public hospital, two male patients with history of high energy trauma to their forearms presented to the emergency department in late 2019. After triage they were assessed by the emergency physicians who consulted the orthopaedic

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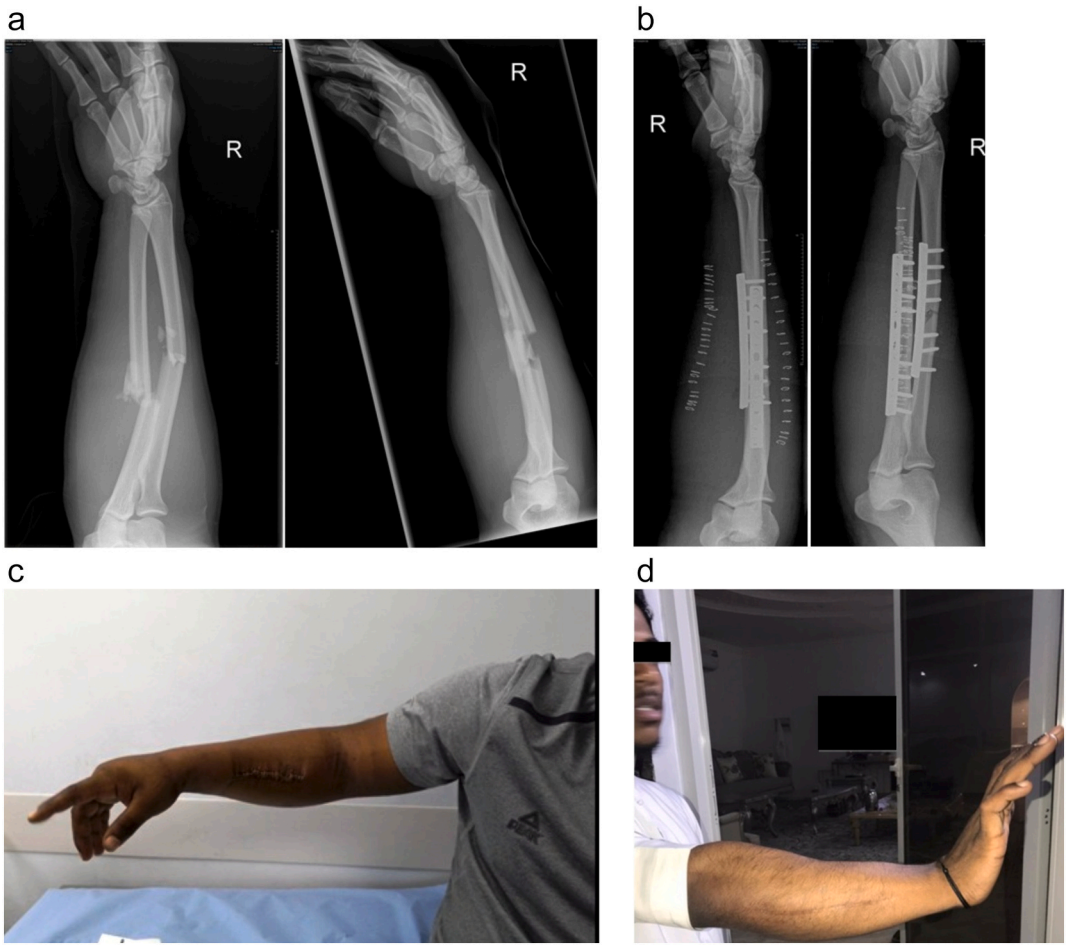

Fig. 1. a- Injury radiographs showing Grade 1 open fractures right radius and ulna
b - Postoperative radiographs
c - Medial three-finger drop seen on day 3 postoperative
d - Recovery of medial three-finger drop at eight months follow-up.

surgeon on-call appropriately.

Case 1

A 22-year-old male involved in motor vehicle accident sustained fracture at midshafts of right radius and ulna (Fig. 1a) with a punctured wound on proximal dorsal mid-forearm. He had limited active flexion and extension at all four fingers. Finger abduction was present indicating normal ulnar nerve function. Thumb motion was normal. There was no sensory deficit. The forearm compartments were not tense. His neurological examination was presumed normal attributing the weak finger motion to fracture-induced pain. On the first day after injury, surgical stabilization of radius was performed via Henry's approach and ulna via direct approach using 3.5 mm system dynamic compression plates (Fig. 1b). Intraoperatively, flexor digitorum superficialis belly was found impaled by the fractured proximal fragment of radius. This could explain the limited flexion of fingers observed preoperatively. On the third post-operative day, we noticed a drop of medial three fingers and radial wrist deviation (Fig. 1c). A partial PIN neuropraxia was diagnosed and managed with splint and mobilization exercises. Extensor muscle/tendon injury could not be ruled out as passive tenodesis test was unreliable. The tests for median and ulnar nerve function were normal. Following wound healing, he was scheduled for nerve conduction studies and electromyogram to detect the level and extent of nerve injury at 3 weeks. He was planned for ultrasound to detect muscle/tendon injury. Owing to the Covid-19 pandemic crisis he was lost to follow-up. At eight months follow-up, the patient was seen at the clinic. He was noticed to have complete active extension of medial three digits at MCP (Fig. 1d) which occurred at seven months post trauma.

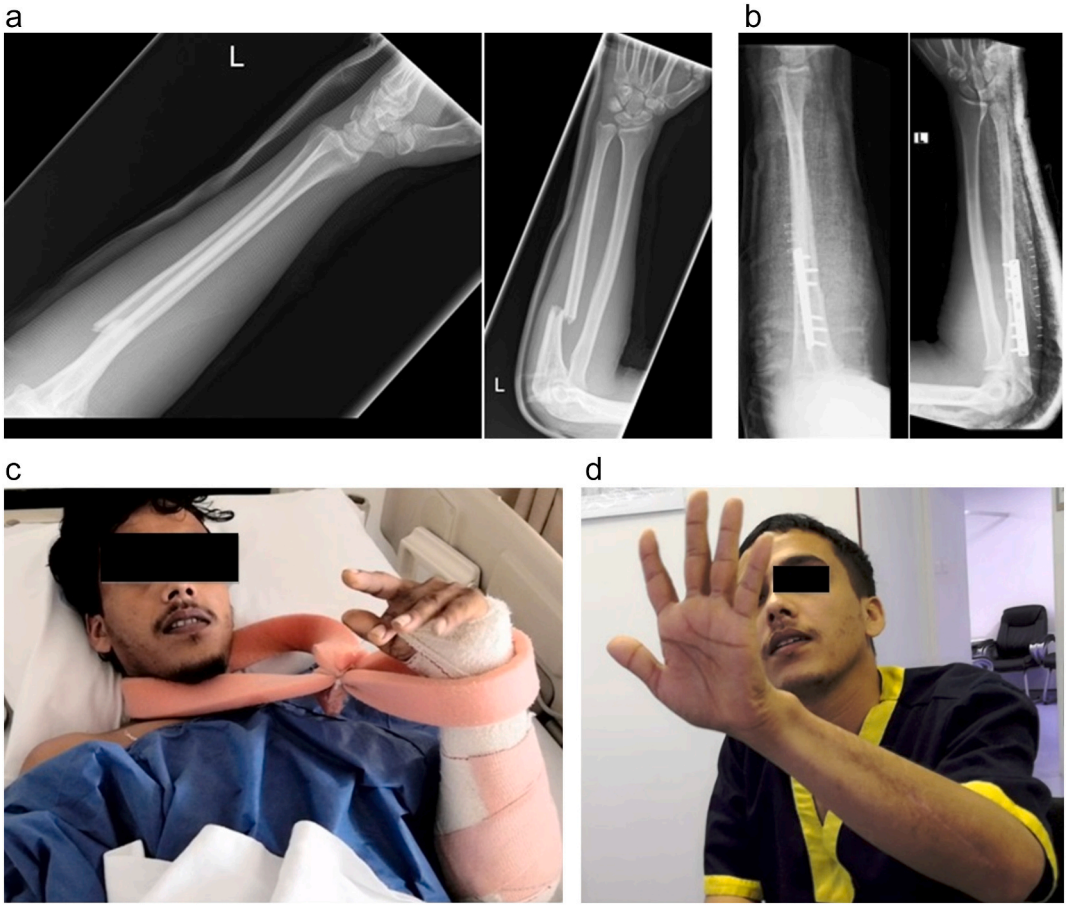

Fig. 2. a – Injury radiographs showing closed left Monteggia fracture-dislocation
b – Postoperative radiographs
c - Medial three-finger drop seen on day 3 postoperative
d - Recovery of medial three-finger drop at four months follow-up.

Case 2

A 23-year-old male involved in motor vehicle accident sustained closed Monteggia fracture-dislocation of left ulna (Fig. 2a). He also had a left-sided Grade 1 open tibia/ fibula shaft fractures and right medial femoral condyle undisplaced fracture. He had left thumb and finger drop with intact medial and ulnar nerve function. There was no sensory abnormality. He was diagnosed to have complete PIN neuropraxia. Ulna was approached directly and fixed with 3.5 mm system dynamic compression plate with spontaneous relocation of radial head (Fig. 2b). The extensor compartment and PIN were not explored. The tibia fracture was fixed with closed interlocking nailing subsequently. On the third postoperative day he was noticed to have medial three-finger drop (Fig. 2c). A partial PIN neuropraxia was diagnosed and managed with splint and mobilization exercises. He was lost to follow-up subsequently after wound healing in 10 days amid the Covid-19 pandemic. Nerve conduction studies and electromyogram were planned for him at 3 weeks. He visited the clinic at 4 months and had already regained complete active extension of fingers (Fig. 2d).

Discussion

A literature search was performed in Pubmed, Science Direct, Google Scholar, Elsevier and Springer journals between 1966 and 2021. There is no report of medial three-finger drop due to PIN branch injury following high-energy trauma to forearm. However, medial three-finger drop following non-traumatic compressive paralysis of PIN branches has been identified in seven publications with a total of only seven cases so far [7–13]. This underscores the significance of this presentation following trauma and behooves us to analyze the reason for its absence from literature.

In the first case, late recovery of medial three-finger drop essentially ruled out extensor muscle contusion (which tends to recover quickly [14]), while its eventual complete recovery ruled out extensor muscle/tendon rupture. Iatrogenic palsy of PIN branches (seen more commonly with Thompson's approach to radius indicating a low-energy trauma) [4] was not a possibility because there was no

Table 1
Differential diagnoses for the patterns of finger drop following high-energy trauma to forearm.

Digital drop	Nerve injury		Contusion or rupture of muscle/tendon
Finger and thumb drop[a]	Complete PIN palsy	and/or	EDC, EDQ, APL, EPL, EPB, EIP
Four fingers drop and normal thumb extension[b]	Not possible[c]		EDC, EDQ, EIP
Medial three-finger drop and normal thumb and index extension	Complete RBPIN palsy	and/or	EDC, EDQ
One or two fingers drop and normal thumb extension	Partial RBPIN palsy	and/or	EDC-1 and EIP (index), EDC-4 and EDQ (little), EDC-2 (middle) EDC-3 (ring)

EDC - Extensor digitorum communis, EDQ - extensor digitorum quinti, APL - abductor pollicis longus, EPB - extensor pollicis brevis, EPL - extensor pollicis longus, and EIP - extensor indicis proprius, PIN - posterior interosseous nerve, Recurrent branch of PIN - RBPIN.

[a] Initial presentation of Case 2 in our series.

[b] Initial presentation of case 1 in our series.

[c] This is only possible when both RBPIN injury and EIP rupture are present.

surgical exploration performed in proximal aspect of dorsal forearm. The RBPIN injury was therefore a diagnosis which was realized retrospectively. It is likely to have been missed at initial presentation because elastic recoil of the four finger flexors could have caused rebound extension. Additionally, further inhibition of extension of the four fingers was presumed to be the result of fracture pain-induced muscle inhibition.

In the second case, the diagnosis of complete PIN palsy was favoured because of the higher probability of PIN palsy in Monteggia fracture-dislocations in clinical practice. Therefore, extensor muscle/tendon injury was not considered. The medial three-finger drop which was apparent postoperatively, disproved our assumption of complete PIN palsy because index and thumb extension could not have recovered earlier than the other fingers. It must be remembered that the motor nerve supply to EDC is proximal than that of APL, EPL, EPB and EIP. Neuronal regeneration from proximal to distal will lead to recovery of the medial three fingers first, followed by thumb and EIP. Iatrogenic injury to the main PIN trunk or muscle/tendon was unlikely because there was “apparent gain” in index finger and thumb motion after the surgery. Furthermore, there was no exploration was performed at proximal dorsal forearm. Thus RBPIN injury was, again, a retrospective diagnosis. It is likely to have been misdiagnosed (rather “overdiagnosed”) as complete PIN palsy because of pain-induced extensor muscle inhibition controlling index finger and thumb. Table 1 shows the various forms of finger and the differential diagnoses to be considered in acute traumatic setting.

This case series has limitations in the form of lack of preoperative diagnostic investigations, intraoperative exploration of RBPIN and regular follow-up examination. Nevertheless, it highlights the importance of diagnosing an unrecognized neurological sequel in forearm trauma. Loss of complete extension of medial three fingers in postoperative period could be a source of potential litigation against the surgeon citing iatrogenic nerve injury (as in the first case). Similarly, a quick recovery of index finger and thumb within few days of diagnosing complete PIN palsy will falsely implicate that the PIN is recovering. When in reality, it is a complete injury to RBPIN which could have been a neurotmesis (instead of neuropraxia as observed in the second case).

In conclusion, medial three-finger drop due to RBPIN neuropraxia following high-energy injury to forearm is an unrecognized sequel. Misdiagnosis can be potentially litigative to the surgeon and/or provide false prognosis to the patient. Investigations such as nerve conduction studies/electromyogram may be of less value in acute trauma. Ultrasound and MRI to detect muscle/tendon injuries can aid in ruling out ruptures. In case of acute medial three-finger drop following high-energy forearm trauma, clinical suspicion followed by operative exploration of the PIN and its branches, and the extensor musculotendinous unit is invaluable in establishing the diagnosis.

Declaration of competing interest

Nil.

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Nil.

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