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An unusual injury of pediatric both forearm fractures: Distraction epiphysiolysis: A case report

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ABSTRACT

INTRODUCTION AND IMPORTANCE: Pediatric both forearm fractures are one of the common traumas we encounter in clinical practice. We aimed to show a complication not shown in the literature, its possible cause and management of this complication in the surgery of these fractures.

CASE PRESENTATION: 9 years old girl applied to emergency orthopedics unit after fall. Both forearm fracture was appeared after X-ray. Due to reduction loss in the control X-ray of the first week, closed reduction and intramedullary K wire were planned. The prebent K-wire was tried to be sent as intramedullary. While attempting to advance the K-wire, loss of intramedullary resistance was felt. When controlled with fluoroscopy, type 1 epiphysiolysis was observed in the distal radius. Open anatomical reduction was performed on distal radius epiphysis. Two K wires were placed so that crossed the physis line. In 2-year follow-up, there was no length discrepancy or limitation of movement between the left and right radius.

CLINICAL DISCUSSION: Intramedullary fixation is first choice for surgery in pediatric both forearm fractures. There are 2 opinions for K-wire entering point: proximal and distal of physis. The biggest concern about transphyseal transmission of the K wire is that this conduction may cause physeal damage or arrest. However, physeal damage or arrest could not be shown in the literature. On the other hand, transphyseal application provides convenience in terms of surgical applicability.

CONCLUSION: In our opinion, it will be more appropriate and safe to send the K wire transphyseal over the styloid for pediatric population have both forearm fractures.

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1. Introduction

Forearm fractures are one of the most common fractures seen in childhood. It comprises for 5–10% of all fractures in children [1,2]. The general concept is closed reduction and casting in pediatric population on these fractures. But it has failure rates 7–32% require surgery after closed reduction and casting [3–5]. Anatomic reduction seldom needed on forearm fractures before 8–10 years pediatric population, because of high remodelling potential [6–9]. It has shown rotational limitation is minimal when angulation <10 degrees [10]. Intramedullary (IM) K-wire with open/closed reduction is the most preferable method among surgical procedures. There are several advantages of this technique. IM fixation is easy to implement. Also provide bone alignment and promote bone healing [3,11]. If need to open fracture site, 2–3 cm is enough and this provide minimal invasive approach and minimal cosmetic problems. This procedure decreases morbidity cause of implant removal [12]. But there are some disadvantages too such as delayed union-

nonunion, pin related infection, pin migration, re-fracture or loss of reduction after implant removal, compartment syndrome [13]. We report a complication case encountered during the surgical application of k-wire. There is no case in the literature in which this complication occurred during the operation. We hope that this complication and its' management, will be instructive for future cases. This article has been reported in line with the SCARE criteria, and written informed consent was obtained from the patient's parents for publication of this case report and accompanying images [14].

2. Presentation of case

9 years old girl presented by her parents to our emergency orthopedics unit after fall. The patient had no chronic-genetic disease, no previous surgery or fracture. The patient had pain and deformity on forearm. Neurovascular exam was normal. Both forearm fracture was appeared after X-ray (Fig. 1). Closed reduction and long arm casting were performed in emergency conditions. (Fig. 2). Due to reduction loss in the control X-ray of the first week (20 degree angulation on AP radiographs) (Fig. 3) closed reduction and intramedullary K wire were planned. The operation was per-

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Fig. 1. First admission to emergency service with both forearm fracture.

formed in university hospital next day. The patient lay in the supine position under general anesthesia. The tourniquet sleeve was tied above the elbow. The surgical team consisted of an upper extremity specialist orthopedic doctor and 1 senior and 1 junior orthopedic resident. The entry point of the K wire to the radius was determined as the radial side of the lister tubercle from between the 2nd and 3rd extensor compartments. After the second extensor compartment tendons were removed to radial, the window was opened on the bone with a sharp pointed appliance, proximal to the physis line under fluoroscopy control. The prebent K-wire was tried to be sent as intramedullary. Due to resistance encountered while the wire was being moved with rotation movements slowly by K wire holder. While attempting to advance the K-wire, loss of intramedullary resistance was felt. When controlled with fluoroscopy, type 1 epiphysiolysis was observed in the distal radius (Fig. 4).

Longitudinal incision was performed from the wrist dorsal to the fracture line and epiphysiolysis site. Firstly open anatomical reduction was performed on distal radius epiphysis by extensor tendon exclusion. Fracture was stabilized by moving two K-wires which was placed as intramedullary to the proximal part of the fracture line was moved intramedullary. We did not stabilize ulna (Fig. 5).

Postoperative wound control was pursued on the elbow splint for 2 weeks. Finger movements were started after surgery. In the second week, X-rays were checked, sutures were removed and casting was shortened under the elbow. Elbow movements were started. After X-ray control in the first month, it was decided that reduction and healing was good. Then cast was removed. Wrist exercises were started slowly and in pain limit with K wires. At the 6th postoperative week, all the wires were removed and active-assistive exercises were started. In the 3rd month it reached full



Fig. 2. Xray after reduction and casting at emergency service.

ROM and previous activity level. X-rays and 3 month controls were followed up due to physical arrest could be happen.

In 2-year follow-up, no limitation was observed in the patient's wrist movements compared to the other side (Fig. 6). In 2-year follow-up, there was no length discrepancy between the left and right radius (Fig. 7).

3. Discussion

Both forearm fractures are an important part of the pediatric age group trauma. The general concept is closed reduction and casting. Although it is a common trauma, especially the re-modeling potential at children under the age of 8–10 makes it difficult to determine the surgical treatment indication clearly [15]. The advancement of technology, medico-legal problems and concerns of families also affect the orientation towards surgery.

Although there are different surgical options such as; IM kirschner wire, plate, external fixator, IM fixation is preferred for surgery. The implementation rate of IM fixation technique, which was first defined by Delbet, has been shown to increase from 1.8%–22% in a recent study [16]. Being less invasive, applicable, minimal cosmetic problem are the advantages of IM fixation compared to plate application. However, morbidity due to implant removal is less common in this technique.

In the both forearm fractures, the implementation of the classical K wire technique is not practical. It is technically difficult to find the opposite cortex, which is perpendicular to the fracture by the location of the broken fragment. Therefore, implementation of K wire as IM is a faster and more practical option in these patients [17].

There are basically 2 surgical techniques related to the entrance of the K wire to the radius.

The first is transmitting the wire transphyseal from the radial styloid. The study of Lieber et al. stated that sending K wires transphyseal provides a longer linear support to the fracture line and prevents axial rotation [17]. The other is to open a small window by using drill from the physis proximal and to forward the k-wire from this window to the proximal [11].

In this case, we preferred the second technique. Epiphysiolysis was occurred during the process of sending K wire to proximal.

The biggest concern about transphyseal transmission of the K wire is that this conduction may cause physeal damage or arrest. In a study of Shoemaker et al., 28 patients of 32 were pinned transphyseal and rest 4 were pinned by opening the window from the physis proximal. Although K wires remained inside for an average of 8.5 weeks, 28 patients do not have any physeal damage or arrest [3]. In the study of Yung et al. with 84 patients, any length difference, growth retardation, compared with the other side, was not shown in the follow-up of the patients who underwent the K wire



Fig. 3. Loose of reduction, 1 week after reduction.

as transphyseal to radius [11]. In another study performed by Choi et al. with 157 patients, no findings were found in favor of early closure or physical arrest in growth plates in patients who underwent transphyseal K-wire [18]. In a study conducted by Lieber et al. about unstable forearm double fractures, no physical arrest was detected in patients who received K wire transphyseal [17].

Transphyseal application also provides convenience in terms of surgical applicability. As it is a landmark that can be palpated easily, it also minimizes recurrent traumas related to the entrance [17]. In a study of Yuan et al., complication of compartment syndrome was evaluated in IM wire fixation [19]. They said that the trauma caused by multiple K wire trials in soft tissue increases the risk of compartment syndrome and stated the 3 transition rules. If the wire did not cross the broken line in 3 attempts, they said that the broken line should be opened minimally and the fracture should be reduced. Although contrary to the minimally invasive approach, they stated that it was less traumatic than multiple reduction maneuvers. In the study of Yung et al., if the reduction was not completed in the

second attempt which means a minimal open reduction was made [11].

While the K wire is applied as intramedullary, when it rests on the cortex, the direction of the K wire is turned and directed to the medulla. However, sometimes this orientation is not enough and the applied K-wire may come out of the cortex. But in our case, we encountered distraction epiphyseolysis as a result of the force applied after encountering a difficulty in the transmission of the K wire. Possibly the K-wire got stuck in the cortex and could not come out and repetitive forces caused distraction epiphyseolysis. We preferred the physis proximal as the entry point. Since the strength of the soft tissues in the pediatric population is more than the osseous structures, the repetitive forces we applied caused this complication to occur. If we applied the transepiphyseal technique from radial styloid, this complication would not occur. Physeal arrest, which was feared about transphyseal administration, could not be demonstrated in the studies performed and examined here.

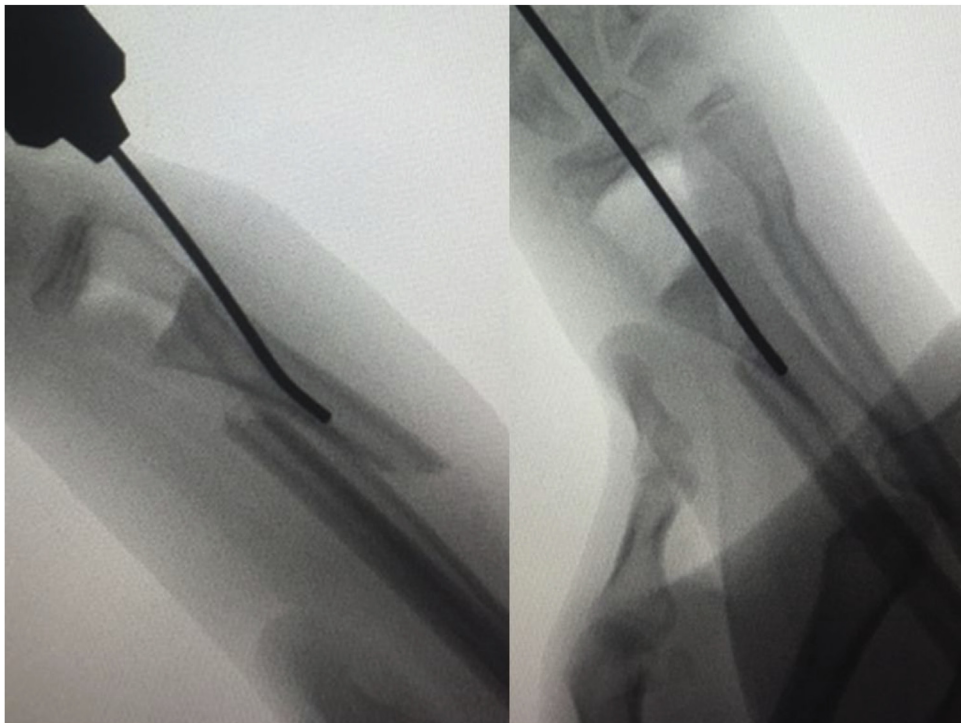


Fig. 4. Peri-operative distraction epiphysyolysis fluoroscopy view.

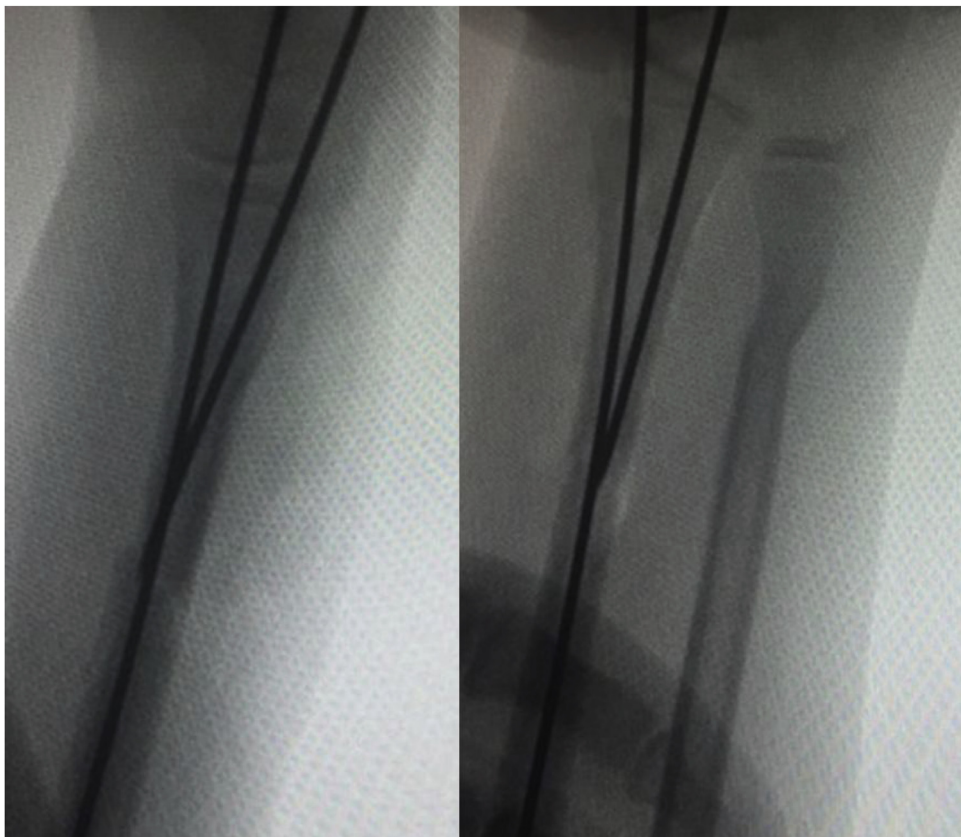


Fig. 5. Peri-operative fluoroscopy view after open reduction and IM K wire.



Fig. 6. Wrist movements, post-operative 2 years.

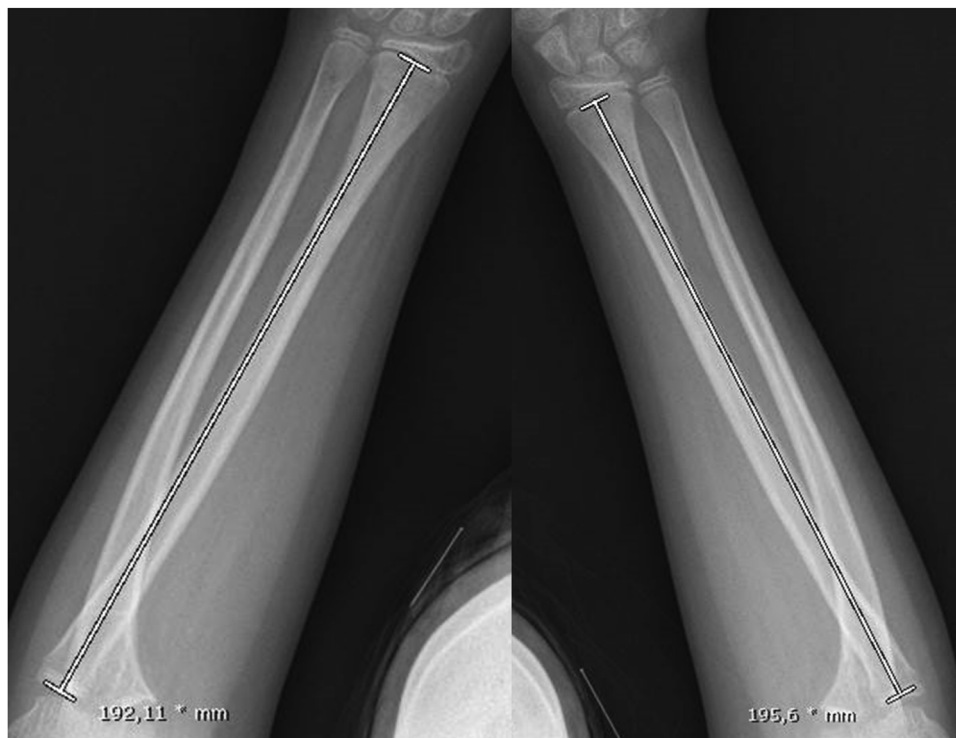


Fig. 7. Bilateral radius lengths – post-operative 2 years.

4. Conclusion

Forearm fractures are one of the most common fractures seen in childhood. Intramedullary (IM) K-wire with open/closed reduction is the most preferable method among surgical Procedures. Consequently, in our opinion, it will be more appropriate and safe to send the K wire transphyseal over the styloid.

Declaration of Competing Interest

All authors declare that there is no conflict of interest regarding this case report.

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Ethical approval

The study is exempt from ethical approval in our institution.

Consent

Written informed consent was obtained from the patient's parents for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author's contribution

Kerem Bilsel MD: Study concept and design.
Mehmet Kapicioglu MD: Data analysis and interpretation, data collection.
Anil Pulatkan MD: Data collection.
Muzaffer Agir MD: Data collection, writing the paper.

Registration of research studies

Not applicable.

Guarantor

Kerem Bilsel, MD.

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