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Management of displaced distal forearm fractures in children

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Highlights

- **A prospective clinical study of displaced distal forearm fractures in children**
- **Evaluates the role of surgical fixation in preventing fracture displacement**
- **Surgical fixation with Kirschner wires is a safe and reliable simple method of treatment**

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ABSTRACT

Distal both bones forearm fractures are quite common injury in children. They are generally treated by closed reduction and casting alone or with added percutaneous pinning with excellent results. The target of this prospective study was to delineate if re-displacement after stable reduction of displaced distal forearm fracture in a child can be prevented by percutaneous fixation with Kirschner wires. A complete of 48 children aged between 2-12 years with displaced distal both bone forearm fracture underwent either conservative treatment by immediate closed reduction and long arm cast in plaster room without anesthesia or surgical procedure by additional fixation with percutaneous Kirschner wires and long arm cast, with 28 had conservative treatment and 20 had surgery. All patients were available for follow-up with average of 6.7 months. Fractures fixed with percutaneous Kirschner wires showed no displacement, compared to three displacements within the fractures maintained by cast alone (chi-squared test, $p < 0.01$). Range of supination and pronation is a smaller amount affected in fractures treated with pinning (6°vs.13°). Fewer complications were seen within the fractures treated by pinning than in fractures treated by cast alone (5% vs 17.8%). We conclude that the utilization of a percutaneous Kirschner wire to reinforce the reduction of the fracture in children who have a completely displaced metaphyseal fracture of the distal radius may be a safe and reliable way of maintaining alignment of the fracture. Lastly, use of percutaneous Kirschner wires to keep the reduction of the displaced distal forearm fracture in children is reliable method to stop re-displacement of the fracture.

1. Introduction

Distal both bones forearm fractures are quite common injuries in children. They involve greenstick fractures, torus or buckle fractures, metaphyseal fractures, epiphyseolysis, physeal fractures, and Galeazzi fractures. The distal radius is that the most typically affected bone in childhood, and almost half of children with a distal radius fracture have an associated ulna fracture while isolated ulna fractures are rare (Canale and Beaty, 2017). Associated injuries may include ipsilateral scaphoid and supracondylar humeral fractures. These fractures are usually caused by a fall onto an outstretched upper limb. Because of its high incidence, the management of this fracture is one of the basics of paediatric orthopaedic care (Canale and Beaty, 2017). These fractures can generally be treated by closed reduction and casting, with excellent results. Closed treatment remains the foremost common method of treatment. Because 90% of the expansion of the forearm occurs distally, there is high remodelling ability for these fractures (Canale and Beaty, 2017). However, complications may develop like several injuries. Attention to details may allow early recognition of those complications and forestall them from becoming disabling long-term problems. Still, there is considerable argument over the treatment of those fractures. Some authors have shown better maintenance of reduction with closed pinning using K-wire fixation and recommend this approach (Herring, 2007). High-risk distal forearm fractures in children should be treated by primary percutaneous pinning with Kirschner-wire fixation augmented by cast immobilization (Mostafa El-Adl and Enan, 2009). The state of the art in surgery is that the K. wire internal fixation after closed reduction (Laurer *et al.*, 2009). Another study showed that selective K-wire fixation in displaced fractures does not seem to reduce displacement and re-manipulation rates (Luscombe *et al.*, 2010).

2. Aim of study

This study has been conducted to find out if re-displacement after stable reduction of displaced distal forearm fracture in a child can be prevented by percutaneous fixation with Kirschner wires compared to closed reduction and casting alone with primary outcome being fracture re-displacement.

3. Material and Methods

A prospective study was conducted at Hawari General Hospital, Benghazi-Libya from Jan.-2012 to Dec.-2013. Consecutive 48 displaced distal both bones forearm fractures in children aged between 2-12 years were allocated to immediate closed reduction and long arm cast in plaster room without anesthesia (conservative group), or surgical treatment by additional fixation with percutaneous K.wires and long arm cast (surgical group) with 28 had conservative and 20 had surgical treatment. Age, male to female ratio, mechanism of injury, and associated injuries, were verified.

We excluded all physeal fractures of distal both bones forearm and pathologic fractures. Patients were followed clinically and radiologically by x-ray at one-week interval for the first three weeks,

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then at two months, six months, and finally at one year. Range of supination and pronation of forearm and flexion-extension of wrist were recorded.

The cohort was allocated into 2 groups:

- Conservative treatment group: included 28 fractures (58.3%) treated by immediate closed reduction without anesthesia and fixed with long arm cast in plaster room, and then admitted to the hospital for 24 hours with closed observation for cast compression. Instructions to elevate the limb were given to both patients and parents. The cast was kept for 6 weeks.
- Surgical treatment group: included 20 fractures (41.7%) treated by closed reduction and percutaneous K-wires fixation under general anesthesia and image intensifier; the wires were inserted in retrograde manner, in 14 fractures (70%) K-wires passed through the distal epiphyseal growth plate of one or two bones (in 4 cases the k-wires were also passed through the growth plate of ulna), and in 6 fractures (30%) K-wires passed outside the distal epiphyseal growth plate. The K.wire was smooth with a diameter of 1.6 mm to 1.8 mm, with 2 crossing or converging K.wires inserted according to fracture configuration. Oral antibiotics were given for 7 days; the K. wires were left outside the skin and removed as outpatient setting after radiological evidence of healing. Long arm cast was applied and kept for 2 weeks after wire removal. Home exercises were advised following cast removal.

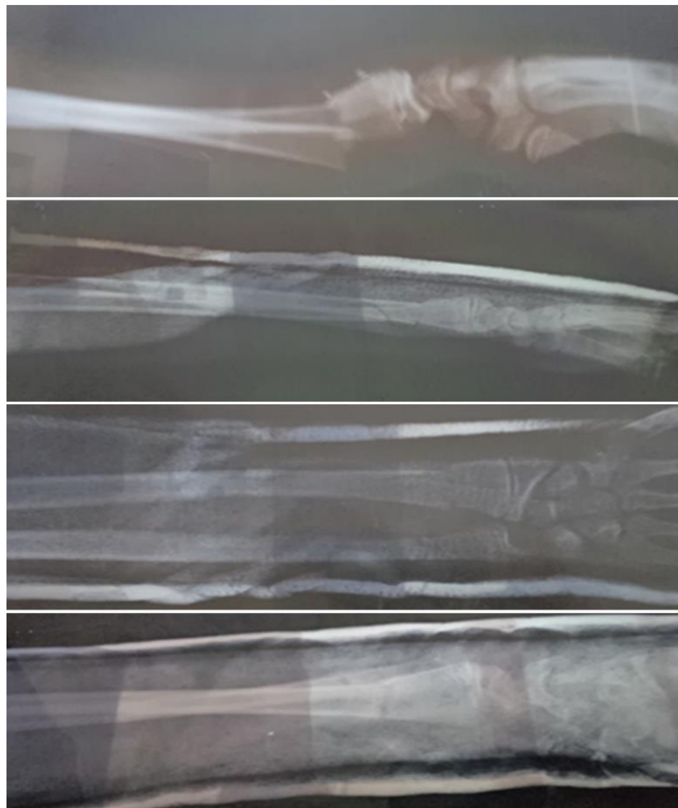

Fig. 1. Pre and postreduction X-Ray of distal BB forearm fracture and follow-up view shows callus with good position.

All fractures were closed, age ranged from 2-12 years (average of 7 years). Male to female ratio was 3:1 with 36 males (75%) and 12 females (25%). Mechanism of injury was falling from body height onto outstretched hand in 36 patients (75%), fall from a swing in 10 patients (20.8%), and a twisting injury of upper limb in 2 patients (4.2%). All fractures were unilateral, the average follow-up period was 6.7 months and all children attended follow-up for the first 12 weeks.

Among the 28 fractures of the conservative treatment group, 25 fractures (89.2%) showed good radiological union (Fig. 1) of the fracture with good functional results. Three fractures (10, 7%) re-displaced in cast and were revised by closed reduction and percutaneous K. wire fixation and ended with good union (Fig 4). Two fractures (7.1 %) had malunion and revised by open reduction and internal fixation by two crossing K-Wires (Table 1). The forearm supination and pronation was good, with average loss of 13° (5°-18°).

The surgical treatment group had 10 fractures fixed by percutaneous two K-wires through the distal radial epiphysis (Fig. 2), 4 fractures treated by two K-wires through distal radial epiphysis, and one K-wire through distal ulnar epiphysis (Fig. 3). The other 6 fractures were fixed by two K-wires of distal radius through distal metaphysis, not through distal epiphysis. One patient developed pin tract infection (5%) which was treated by dressing and oral antibiotics. Neither displacement nor malunion were seen. Ultimately, all fractures treated surgically fully united and demonstrated excellent to good functional results (Figs. 4-6). The forearm supination and pronation was very good, with average loss of 6° (4°-10°).

The complication rate for the conservative treatment group was 17.8% with 3 fractures re-displaced, and 2 fractures malunited mandating surgical revision, compared to surgical treatment group (Table 1) which showed one fracture with pin tract infection with complication rate of 5%, this is statically significant (chi-squared test, $p<0.01$). All complications were managed and fractures healed completely.

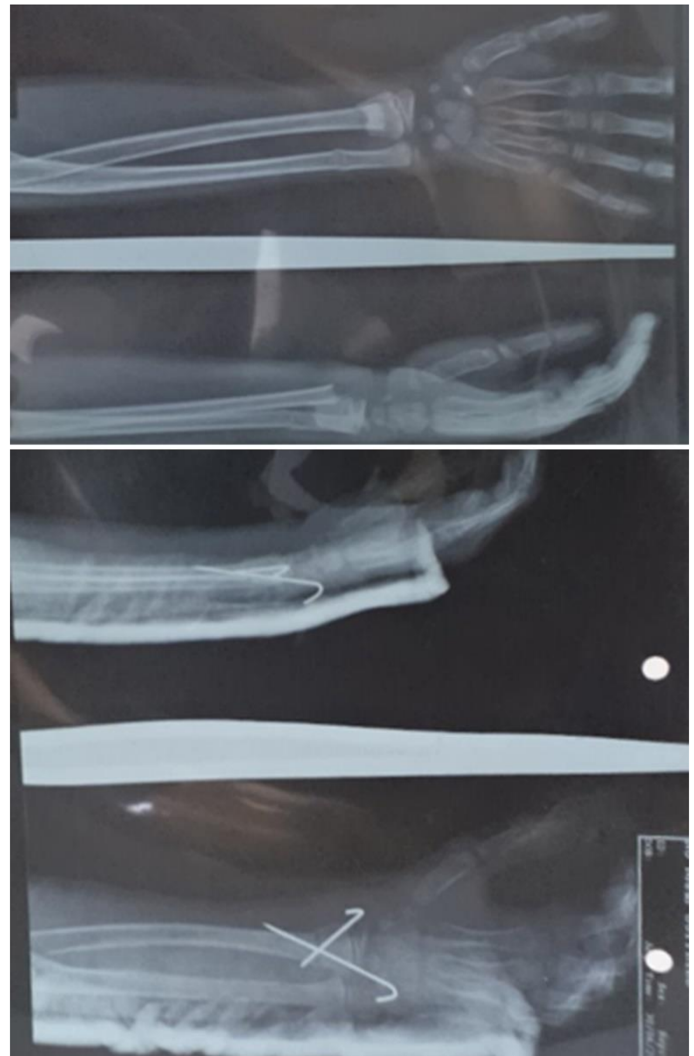

Fig. 2. Distal both bone forearm fracture fixed by closed reduction and two crossing K-wires through the distal radial epiphysis.

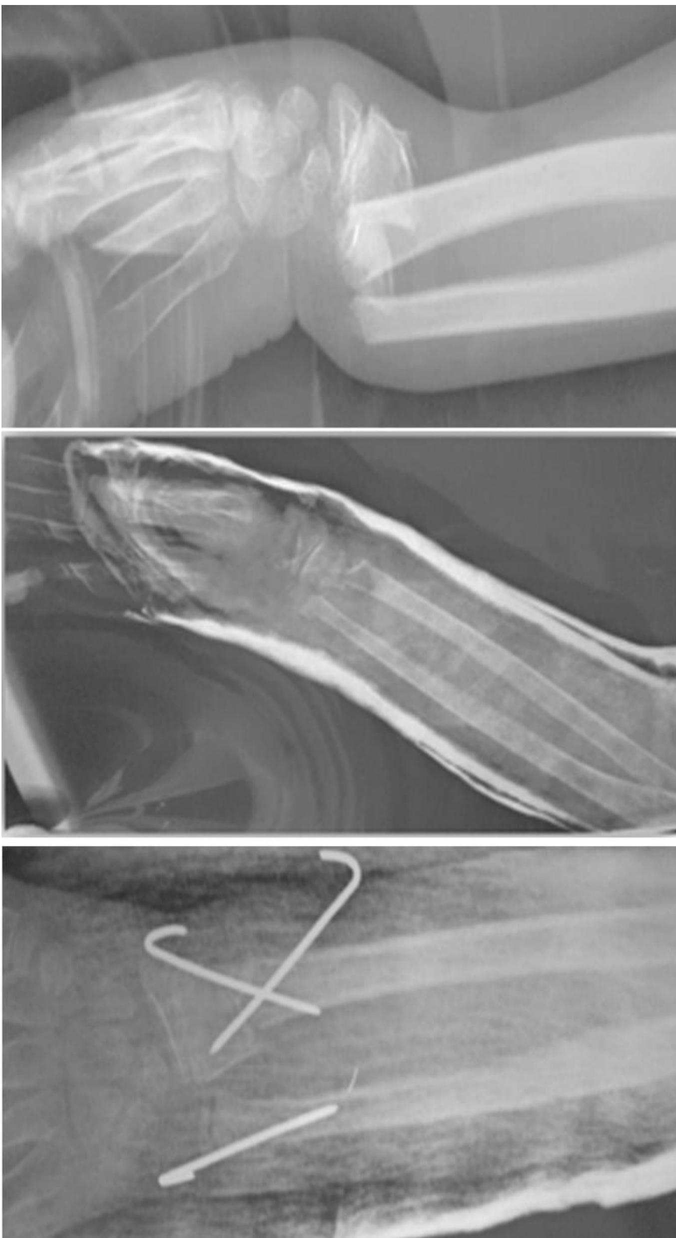

Fig. 3. Distal BB forearm fracture of 9-y.o. boy first treated by closed reduction which displaced in cast then fixed by closed two crossing K-wires through the distal radial epiphysis and one through distal ulna epiphysis.

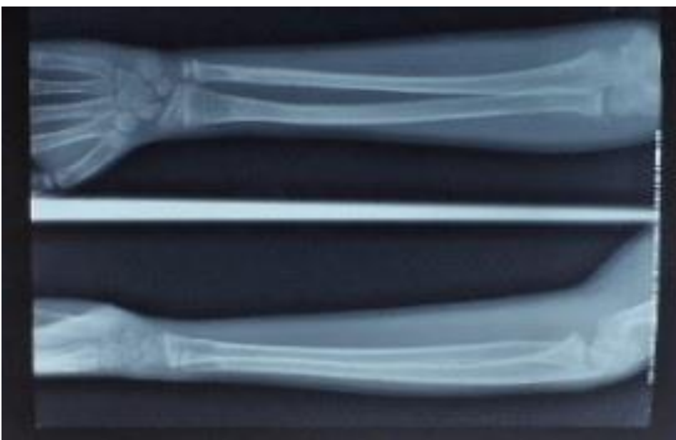

Fig. 4. Radiograph of the same patient in Fig. 3 after one year with complete remodeling of fracture.

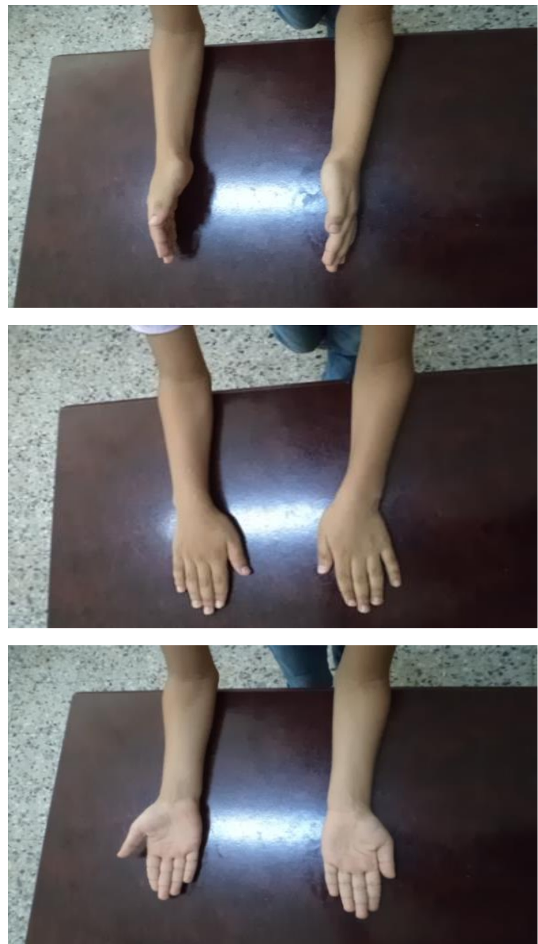

Fig. 5. Photographs of the same patient in Fig. 4 showing full supination and pronation.

Fig. 6. Photographs of the same patient in Fig. 5 with almost full flexion and extension of the affected left wrist.

Table 1

Summary of two methods of treatment with final results.

Group	No. of cases	Rate of union	Displacement	Infection	Malunion	Growth arrest
Conservative	28	%100	3	0	2 cases	0
Surgical	20	%100	0	1	0 cases	0

5. Discussion

The usual treatment of distal both bones forearm fracture in children is reduction, followed by immobilization until healed. Some authors have shown better maintenance of reduction with pinning by K-wire fixation and recommend this approach (MacLauchlan *et al*., 2002). Others recognize the high ability of a skeletally immature child to remodel displacement and angulation (Do *et al*., 2003), they advise for cast immobilization without reduction for fractures in pediatric age group with angulation 15° or less and shortening up to 1 cm. Others show that stable fractures angulated less than 10° need less x-ray check-up. Although several researchers (Miller *et al*., 2005) have reported immediate fixation by pinning for displaced distal forearm fractures, we agree with Do TT, et al in that displaced distal metaphyseal fractures can generally be treated by closed reduction and long arm casting, though in our experience this can be done without anesthesia in emergency room, this is in disagreement with McLauchlan GJ, et al, but patient should be admitted 24 hours for observation especially if there is swelling.

We disagree with Horii *et al*. (1993) who noted that fracture pinning across the physis can cause injury to it, we do not believe that a small-diameter smooth pin crossing the physis could substantially increases the risk for growth abnormality as proved in our study that showed no growth disturbance in all cases that fixed by one or two k-wires passing through the distal physis of both bones.

6. Conclusion

The displaced distal both bone forearm fractures in children can be treated by closed reduction and above elbow casting until healed. Percutaneous pinning with K.wires across the physis could be safe for fixing these fractures and no growth abnormalities have been seen in our study especially if smooth small-diameter pins are used. To reduce the risk of displacement and maintain alignment of the fracture after closed reduction we recommend using percutaneous K-wires. It is safe and reliable way to avoid displacement.

References

Canale, S. and Beaty, H. (2017) *Campbell's Operative Orthopedics*. Philadelphia 13th edn.

Do, T., Strub, W., Foad, S., Mehlman C, and Crawford A. (2003) 'Reduction versus remodeling in pediatric distal forearm fractures', *A preliminary cost analysis. J Pediatr Orthop B,* 12(2), pp. 109-115.

Herring, A. (2007) *Fractures of the Distal Forearm*. Tachdjian's Paediatric Orthopaedics, 4th edn, Elsevier-Health Sciences Division.

Horii, E., Tamura, Y., Nakamura R., and Miura T. (1993) 'Premature closure of the Distal radial physis', *J Hand Surg [Br],* 18(1) , pp. 11-16. doi: 10.1016/0266-7681(93)90186-j.

Laurer, H., Sander, A., Wutzler, S., Walcher F, Marzi I. (2009) 'Therapy principles of distal fractures of the forearm in childhood', *Chirurg*, 80(11), pp.1042-52`.doi:10.1007/s00104-009-1750-8.PMID:1958508.

Luscombe, K., Chaudhry, S., Dwyer, J., Shanmugam, C.,and Maffulli, N. (2010) 'Selective Kirschner wiring for displaced distal radial fractures in children', *ActaOrthopTraumatolTurc*, 44(2), pp.117-23. doi: 10.3944/AOTT.2010.2133.PMID: 20676013.

McLauchlan, G., Cowan, B. and Annan, I. (2002) 'Management of completely displaced metaphyseal fractures of the distal radius in children', *A prospective, randomised controlled trial. J Bone Joint Surg Br*, 84(3), pp. 413-7. doi: 10.1302/0301-620x.84b3.11432.

Miller, B., Taylor, B., Widmann, R. ., Bae D., Snyder B., and Waters P. (2005) 'Cast immobilization Versus percutaneous pin fixation of displaced distal radius fractures in children', *Aprospective, randomized study', JPediatrOrthop*, 25(4), pp. 490-494. DOI: 10.1097/01.bpo.0000158780.52849.39.

Mostafa, M., El-Adl, G., and Enan, A. (2009) 'Percutaneous Kirschner-wire ixation for displaced distal forearm fractures in children', *Acta Orthop Belg*, 75(4), pp. 459-66.