

# Comparative study between close reductions versus close reduction with K-Wire fixation in completely dorsally displaced distal radial metaphyseal fracture, in children and adolescent.

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## Abstract

**Background:** Distal Fracture of the radius in children-sometimes (erroneously) called 'Juvenile colles' is among the commonest sites of childhood fractures. Cases with completely dorsally displaced fracture of distal radial metaphysis were collected, evaluated, and treated with either closed reduction or closed reduction with K-wire fixation.

**Objective:** is to evaluate the advantage of percutaneous K-wire with cast immobilization over cast immobilization alone in management of displaced distal metaphyseal fracture in children and adolescent below 15 years with respect to maintenance of reduction and Joint Motion.

**Methods:** In this study 34 children all sustained completely displaced distal metaphyseal fracture of the radius were divided into two groups:

**Group A** consist of 16 children (10 boys and 6 girls), with a mean age 7.9 years.

**Group B** consist of 18 children (11 boys and 7 girls), with a mean age 8.6 years.

In both groups reduction was achieved by closed method under general anaesthesia and image intensifier and reduction was easily achieved beyond 70% of cortical contact and less than 15° of angulation.

*For group A:* the fracture was immobilized by complete above elbow cast. *For Group B:* the fracture was immobilized by insertion of a percutaneous K-wire across the fracture with complete above elbow pop cast. The patients (in both groups) were discharged from the hospital in the second postoperative day. The patients in

group A reviewed once weekly for the first 3-4 weeks with anteroposterior and lateral radiographs and four children (25%) of this group was complicated by redisplacement of the fracture, three of them required remanipulation under general anaesthesia, while in group B the complications rate were low regarding redisplacement and there was no need for remanipulation. These patients were reviewed every 3 weeks and X-ray exposure was low. The union rate in both groups was the same.

**Results:** Risk of displacement was greater in group A (25%) compared with no displacement in group B. Pin track infection in group B occur only in one case (5-6 %) regarding limitation of pronation supination and dorsiflexion (as compared with uninjured side )in both groups ; for group A wrist flexion 35°(58.3% of normal range )while pronation- supination was 40° (44.4% of normal range ) for group B wrist flexion 40° ( 66.4% of normal range ) and pronation – supination was 55°( 61.1% of normal range )

**Conclusion:** supplementary percutaneous K – wire fixation results in better maintenance of alignment, reduces the need for follow up radiographs and the need for further procedures to correct loss of position.

**Keywords:** completely displaced fracture left radius, cast, K-wire.

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## Introduction

Paediatric forearm and distal radius fractures are common injuries. Resultant deformities are usually a product of indirect trauma involving angular loading combined with

rotational displacement. Successful outcomes are based on restoration of adequate pronation, supination and to a lesser degree acceptable cosmeses. <sup>(1)</sup>

The displaced fracture may be difficult to reduce anatomically due to the interposition of stripped periosteum, muscle, interosseous membrane or tendon. There have been reports of lost reduction after closed procedure resulting in the

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restriction of full extension of the digits, which necessitated open reduction<sup>(2-4)</sup>.

Satisfactory remodeling of angular deformities would occur if displacement were in the plane of joint movement<sup>(5)</sup>. Even complete translocation (bayonet apposition) is tolerated in a child because of remodeling potential of the periosteum. This will not occur for rotational deformities. The movements of pronation and supination will also be adversely affected by interosseous space loss, which could occur during external plaster immobilization, from early resumption of vigorous activity before stable callus is formed.

#### **Patients and methods**

This is a prospective, randomized controlled study conducted at the Department of Orthopedics' surgery, Al-Kadhimya Teaching Hospital in the period between October 2005 and October 2006.

The study included 34 patients (aged between 4-15 years), 21 boys (61.8%) and 13 girls (38.2%) with an overall mean age 8.3 years. The right hand was involved in 19 of the cases (55.88%) and the left hand in 15 of the cases (44.12%), all had completely dorsally displaced fracture of distal radial metaphysis, 12 of the cases (35.3%) had an associated ipsilateral distal ulnar fracture, two of the patients with associated ulnar fracture required K-wire for ulnar fracture in addition to the radial fracture.

The patients excluded from the study were:

- 1- Those with open fracture.
- 2- Those with the physeal fracture.
- 3- Patients with fracture involving distal radial epiphysis.
- 4- Those with irreducible fracture (need open reduction and internal fixation)

5- Patients presented more than 10 days after injury.

6- Patients with associated fractures other than distal ulna like; patient with fracture radial neck, supracondylar fracture, and fracture clavicle.

Standard anteroposterior and lateral X-ray views; including the whole forearm and elbow joint, were obtained for all patients.

All patients were treated initially by applying plaster back slab from above the elbow to the metacarpals necks with an arm sling and elevation for the first 5-7 days to decrease swelling and to have adequate time to prepare the patient for general anaesthesia.

The patients were divided into two groups:-

- *Group A* consist of 16 patients (10 boys and 6 girls), with a mean age 7.9 years. Three cases of those patients had an associated fracture of distal ulna.
- *Group B* consists of 18 patients (11 boys and 7 girls) with a mean age 8.6 years. Nine cases of those patients had an associated fracture of distal ulna.

#### **Follow up**

Patients of group A were assessed weekly for first 4 weeks with anteroposterior and lateral radiographs to evaluate the maintenance of reduction.

Patients of group B reviewed after 3 weeks for radiographic evaluation, removal of K-wire, and changing the cast.

In both groups the cast was removed at 6 weeks, the patients were assessed at the twelfth week both clinically, and radiographically, joints motions were assessed by Goniometer.

Removal of K-wire was easily done during routine outpatient clinic visit.

In both groups the fractures were reduced:

1. under general anaesthesia with screen monitoring,
2. Applying traction through the band in the line of the length of forearm with counter traction by assistant through the proximal forearm for about few seconds for relaxation of the muscle,
3. Applying an extension force with traction for the distal fragment for disimpaction ,
4. The distal fragment was then pushed into place by pressing on its dorsum with the thumb ,
5. Manipulating the wrist into flexion, ulnar deviation, and pronation.
6. Reduction was then checked by fluoroscopy.

Reduction aimed at more than 70% of opposition at fracture site with less than 15° of angulation. No rotation was permitted

*For group A;* a complete plaster cast extending from above the elbow to the metacarpal heads was applied with wrist in 20° flexion and forearm in neutral rotation (midway between pronation and supination) for relaxation of deforming muscles.

*For group B;* after reduction a smooth K-wire was introduced either from

1. Radial styloid process, when the fracture was more distal, after passing

through the fracture the wire directed to the opposite cortex of the radius or;  
2. Lister's tubercle, when the fracture was more proximal, then the wire directed toward the medulla.

For fracture of the ulna; which needed a K-wire fixation, the wire was introduced through the head of the ulna and directed toward the medulla.

After insertions the K- wire, the wire bent and sterile gauze was applied over the entry point and a complete above elbow cast was applied with forearm and wrist in neutral position.

### **Results**

There were 21 boys (61.8%) and 13 girls (38.2%) with male to female ratio 1.6: 1. The right hand involved in 19 of the cases (55.88%), the left hand is involved in 15 of the cases (44.12%).

❖ 19 cases (55.88%) ; 13 boys and 6 girls, where recorded in 5-9 years age group, where as children under 5 years account for 3 cases ( 8.82% ) of these one boy and two girls. The children between 9-15 years account for 12 cases (35.3%) of these 7 boys and 5 girls . the results are summarized in the following tables and figures:

**Table 1: Age and sex distribution**

| Age           | No. of children | Percentage % | Male | Female |
|---------------|-----------------|--------------|------|--------|
| Under 5 years | 3               | 8.82         | 1    | 2      |
| 5-9           | 19              | 55.88        | 13   | 6      |
| 9-15          | 12              | 35.3         | 7    | 5      |
| total         | 34              | 100          | 21   | 13     |

**Table 2: Group classification and mode of treatment**

| Patients group | No. of patient |      |        | Mean age "" | Method of treatment |
|----------------|----------------|------|--------|-------------|---------------------|
|                | total          | male | female |             |                     |
| <b>Group A</b> | 16             | 10   | 6      | 7.9         | MUA+Plaster Cast    |
| <b>Group B</b> | 18             | 11   | 7      | 8.3         | MUA+K- wire+Cast    |

**Table 3: The incidence of redisplacement in Group A**

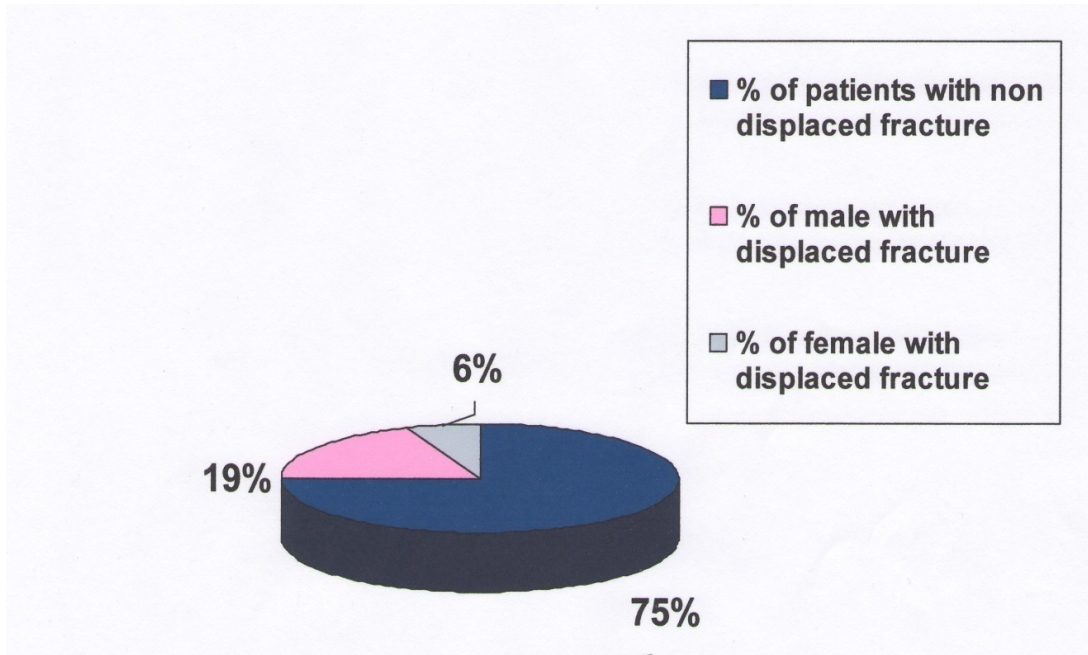
| Sex           | No.of patient | % of patient from Group A | Mean age | Time          |
|---------------|---------------|---------------------------|----------|---------------|
| <b>Male</b>   | 3             | 18.75                     | 8.6      | 2nd -3rd week |
| <b>Female</b> | 1             | 6.25                      | 11.6     | 2nd week      |

**Table 4: Outcome**

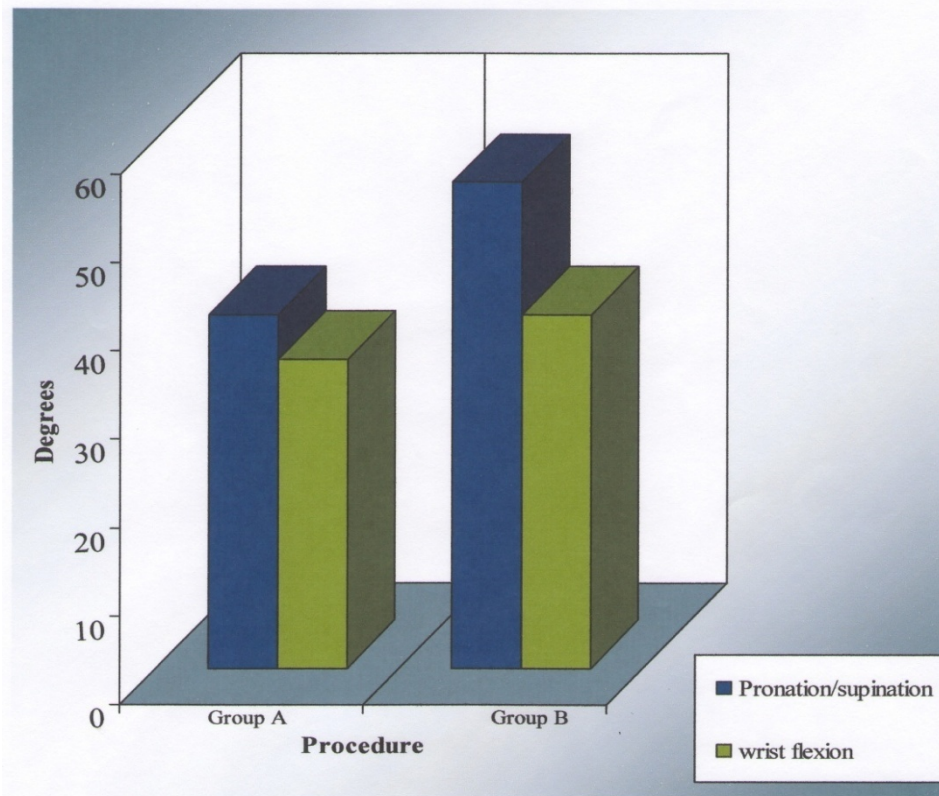
| Parameters                                       | Closed reduction and cast | Closed reduction C with K-wire and cast |
|--|---------------------------|---|
| <b>No. of patients</b>                           | 16                        | 18                                      |
| <b>Mean age</b>                                  | 7.9                       | 8.6                                     |
| <b>Type of plaster</b>                           | Complete p.o.p            | Complete p.o.p                          |
| <b>No. of plaster application within 6 weeks</b> | 3 occasions               | 2 occasions                             |
| <b>No. of x-ray exposure at 12weeks</b>          | 3-4 occasions             | 2 occasions                             |
| <b>Union rate</b>                                | Within 6 weeks            | Within 6 weeks                          |

**Table 5: Complications**

| Parameter                   | Group A                     | Group B                      |
|-----------------------------|-----------------------------|------------------------------|
| <b>Redisplacement</b>       | 4 (25%)                     | Nil                          |
| <b>Pin track infection</b>  | -                           | 1 (5.6%)                     |
| <b>Pronation/supination</b> | 40° (44.4% of normal range) | 55°(61.1°/0 of normal range) |
| <b>Wrist flexion</b>        | 35° (58.3% of normal range) | 40°(66.7% of normal range)   |



**Figure 1: The percentage of displaced fracture among male and female of group A**



**Figure 2: Range of joint motion at 12 weeks**

### **Discussion**

Distal metaphyseal fracture of the radius is among the commonest fractures in children, completely displaced fracture may be difficult to reduce or to maintain reduced after close reduction.

Management by external casting alone may be inadequate because of the difficulty in maintaining alignment.

The need for adequate alignment is important for forearm pronation/supination, fingers flexion and extension and for better cosmesis.

Although a reduction of 50% or more is desirable for adequate remodeling to occur with growth, some of these fractures may unite with rotation and malalignment due to loss of reduction during period of immobilization as trauma edema resolve<sup>(5,9)</sup>.

Closed reduction and percutaneous K-wire fixation decrease the incidence of these complications.

Arguments abound for and against K-wire fixation that cross the distal radial epiphysis and physis<sup>(8,10)</sup>.

The possibility of subsequent growth delay has been highlighted. No such complications among these patients were recorded probably due to short term follow up (12weeks), Smooth K-wire was used to avoid this complication<sup>(6,7)</sup>.

The K-wire fixation is a versatile technique for osseous fixation, though it provides stabilizations rather than rigidity. It avoids the open surgery, frequent displacement in plaster cast fixation and the need for plaster re-application, the removal of the K-wire is easily done during routine out patient clinic visit.

The procedures require the experienced assistant as the reduced fracture should be held in place during pin insertion. The outcome is often a direct function of initial reduction obtained.

**Group A** (mean age 7.9 years) was treated by closed reduction and casting alone, the redisplacement was significant (25 %) during 2<sup>nd</sup>-3<sup>rd</sup> weeks.

**In group B** (mean age 8.6 years) it was found expedient to insert percutaneous K-wires ,because the stability after reduction was unreliable at time of reduction and during plaster immobilization for reasons as resolution of traumatic edema ,muscle action on fracture fragment and greater activity of these children.

The complications rate was low in this study most were recorded in Group A. Redisplacement occur in 25 % of children in this group during the second – third week of plaster immobilization, reduction of pronation and supination was greater in group A, which was 40° (44.4 % of normal range) compared to 55° (61.1 % of normal range ) in group B at 12 weeks .wrist flexion also reduced to about 35° (58.3 % of normal range )in group A compared with 40°(66.7% of normal range ) in group B at 12 weeks. The difference in wrist range of motion between group A and group B may be related to wrist flexion position in which patients in group A were held compared with neutral position in group B. (these readings were measured in comparison with the normal side).

A complete plaster cast was used in both groups to ensure uniformity between the two groups.

The K-wire fixation of completely displaced fractures of distal radius was found to be effective in preventing subsequent loss of position and complications from the use of K-wire are generally minor.

Infrequent visits and fewer radiographs were required in K-wire group during the follow up.

It could be concluded that completely dorsally displaced fracture of the distal radial metaphysis in children have a high propensity for redisplacement, despite satisfactory initial reduction.

Supplementary percutaneous k-wire fixation resulted in a significantly better maintenance of the alignment of the fracture. It was safe and reduces the need for follow up radiographs. It reduces the need for further procedures to correct loss of position. No detrimental effect on the outcome.

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