ORIGINAL RESEARCH PAPER

Orthopaedics

FUNCTIONAL OUTCOME OF DISPLACED AND UNSTABLE DIAPHYSEAL FRACTURES OF BOTH BONES OF FOREARM IN CHILDREN TREATED WITH INTRAMEDULLARY KIRSCHNER WIRE FIXATION.

KEY WORDS: pediatrics , forearm, Both bone fracture, kwire

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ABSTRACT

Introduction Diaphyseal fractures of forearm are very common in children. 90% of the fractures can be managed with closed reduction and cast immobilisation. Surgical intervention is needed in displaced, unstable fractures to prevent angulation and rotation deformity. This work is done to analyse the Functional outcome of displaced and unstable diaphyseal fracture of both bones of forearm in children treated with intramedullary kirschner wire fixation in Department of Orthopaedics, Adichunchanagiri institute of Medical Sciences,B G Nagara, Mandya. **Method** In our series of 30 cases there were 22 males and 8 females, maximum age of 12 years and minimum age of 3 years with mean age of 8.63 years. Fracture reduction and fixation were done with closed reduction and percutaneous nailing or mini open reduction and intramedullary fixation. Our average union time was 8.6 weeks and average kirschner wire removal time was 12.23 weeks. Patients were closely monitored for compartment syndrome and osteomyelitis. **Results** The functional outcome based on Price criteria was excellent in 83.3% (25) of cases, good in 10% (3) of cases and fair in 6.7% (20 of cases. There was no case with poor outcome. 2 patients had refracure other 5 patients had minor complication (pin tract infection(3 cases) , superficial radial nerve injury(1 case) and delayed union(1 case). From this study we consider that intramedullary kirschner wire fixation for unstable and displaced diaphyseal fracture of both bones of forearm in children is an excellent treatment modality. **Conclusion** 1.Treatment of displaced and unstable diaphyseal fractures of the both bone forearm with Kirschner wires is an effective method of maintaining reduction 2.This is simple for fracture fixation with preservation of fracture haematoma. 3.Shorter period of surgery with minimal exposure . 4.Minimum invasive surgery with minimum expertise.

INTRODUCTION

The forearm is a fascinating anatomical structure that redistributes forces from the hand to the upper part of the extremity and allows the hand to rotate. The forearm is not only an axle but also a non-synovial joint[1] .The functions of the hand and the forearm are complex and none of the best robots have yet been able to imitate them[2].The forearm is necessary for the upper extremity to function perfectly.

Its skeleton is peculiarly formed by two separate bones, the radius and ulna. Two bones provide good range of rotation motion (ROM), while remaining light and stable[3].

Being so complex and important in relation to function of the upper extremity, injuries of the forearm can result in potentially hazardous consequences. There is no doubt that forearm shaft fractures are potentially harmful and challenging to manage[4].

They are one of the few paediatric fractures that show a real risk of complications and prolonged morbidity[5]. The most challenging forearm fractures are both-bone fractures in the middle-third of the shaft[6].

The incidence of forearm fractures in children is increasing world-wide[7]. Diaphyseal fractures of forearm comprise 6 – 10% of all pediatric fractures[8,9]. In more than 90% of these fractures, this goal can be achieved by closed reduction and long arm cast immobilization[10,11].

There is a 14.5 fold increase in internal fixation of diaphyseal forearm fractures in children between 2000- 01 to 2008- 09[12]. Indications for surgical treatment are unsuccessful reduction and/ or poor retention of fracture fragments[13] . Diaphyseal angulation of more than 10 degree and malrotation of more than 45 degree are widely accepted criteria for operative intervention[14,15].

When operative intervention is indicated different techniques can be employed such as intra- medullary nailing, osteosynthesis with plate and screw and external fixation[16].While comparing plating with intramedullary nailing it is observed that Plating resulted in significantly worse results for surgical approach, extensive soft tissue release, operating times, frequency and duration of hospitalization and cosmetic outcome. In conclusion, intramedullary fixation of an unstable and displaced forearm fracture in skeletally immature patients is a child- friendly, minimally invasive technique that allows early functional treatment with an excellent functional outcome.

MATERIAL AND METHODS

All patients were briefed about the technique and its possible complications, and an informed consent was obtained to participate in the study A total number of 30 cases of BOTH BONE FOREARM fracture were treated by multiple intermedullary k wire and all cases were given below elbow pop slab after for 3 weeks. Patients fracture fixation and healing was checked radiologically at day2 , 11/2 month and 3 months and 6 month postoperatively. Anatomical and functional outcomes were then evaluated in all the patients treated by multiple k wire. Appropiate test of singnificance applied for data analysis.

Inclusion Criteria:

1) Patients with age > 3 years and <12 years
2) Patients with displaced fractures (angulation of more than 10 degree, rotational malallignment, translation of more than half of the diameter of the bone)
3) Patients with Unstable fractures

4) Patients with segmental fractures
5) Patients with open (Gustilo and Anderson type 1 &2) fractures.

Exclusion Criteria:

1) Patients with stable fractures.
2) Patients with un-displaced fractures, greenstick fracture.
3) Patients with age < 3 years and > 12 years.
4) Patients with open type 3 fractures, where there is tissue loss.
5) Patients who are unfit for surgery.
6) Patients with local tissue conditions making surgery inadvisable like infection, or other neuro-muscular disorders.
7) Patients with Galeazzi and Monteggia fracture dislocation, fracture of single bone.
8) Patients with fracture of other bones in the ipsilateral limb.

Surgical Prcedure

With the patient supine and under general anesthesia, the injured limb was positioned on a radiolucent arm table. A tourniquet was applied to the upper arm. Standard preparation and draping were used. Closed reduction was attempted by increasing the deformity and correction of the rotation, angulation, and translation under image intensifier control. If two attempts at closed reduction failed, a mini-open reduction was done through a 2-cm incision over the fracture site, exposing the bone end, and the fracture was then reduced.

In closed reduction technique, K wires were percutaneously passed through Lister's tubercle or the radial styloid for fractures of the radius and through the tip of the olecranon for fractures of the ulna. Manual reduction was done, and checked in image intensifier In mini-open technique first the radius was exposed through small dorsal incision over fracture site. A K wire of appropriate thickness was driven distally with wrist flexed and in ulnar deviation so that the wire exited on the dorsolateral side of distal end of the radius.

The wire was flushed to the proximal end of the distal segment. After the insertion of k-wire in distal segment fracture was reduced in anatomical alignment and the radial wire was driven up to radial head. Similarly 2nd mini incision was given over the ulna. Fracture was exposed with the help of spikes and bone holders and K-wire of appropriate size was inserted through fracture end into the ulna proximally keeping the elbow in flexion so the wire should exit through the tip of olecranon.

The wire was flushed with the distal end of the proximal segment, fracture was reduced anatomically under direct vision and ulnar wire was driven distally down to the styloid process. After checking the stability both wires were bent with wire bender and cut. Tourniquet was removed, haemostasis secured and both wounds were closed. Pin site dressing was done for both the wires and both surgical wound site dressing was done. Above elbow splint was applied and limb elevation was done.

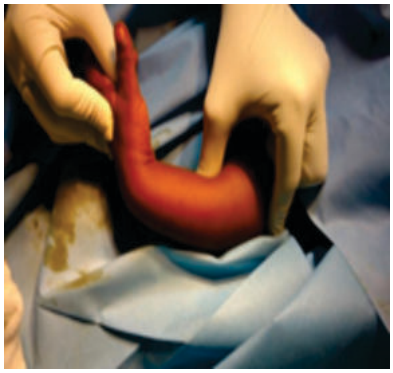

Fig 1 both bone forearm fracture

fig 2 pre op-xray

fig 3 exposure of fracture

fig 4 post fixation

fig 5 post implant removal.

Price Criteria

outcome	Symptoms	Loss of forearm rotation
Excellent	No complaint with strenuous activity	< 15 degree
Good	Mild complaints with strenuous exercise	15- 30 degree
Fair	Mild complaint with daily activity	30-90 degree
Poor	All other results	>90 degree

RESULTS

Diaphyseal fractures of forearm are very common in children. 90% of the fractures can be managed with closed reduction and cast immobilisation. Surgical intervention is needed in displaced, unstable fractures to prevent angulation and rotation deformity.

This work is done to analyse the Functional outcome of displaced and unstable diaphyseal fracture of both bones of forearm in children treated with intramedullary kirschner wire fixation in Department of Orthopaedics, Adichunchanagiri institute of Medical Sciences, B G Nagara, Mandya.

In our series of 30 cases there were 22 males and 8 females, maximum age of 12 years and minimum age of 3 years with mean age of 8.63 years. Fracture reduction and fixation were done with closed reduction and percutaneous nailing or mini open reduction and intramedullary fixation. Our average union time was 8.6 weeks and average kirschner wire removal time was 12.23 weeks. Patients were closely monitored for compartment syndrome and osteomyelitis.

The functional outcome based on Price criteria was excellent in 83.3% (25) of cases, good in 10% (3) of cases and fair in 6.7% (20 of cases. There was no case with poor outcome. 2 patients had refracure other 5 patients had minor complication (pin tract infection(3 cases) , superficial radial nerve injury(1 case) and delayed union(1 case).

From this study we consider that intramedullary kirschner wire fixation for unstable and displaced diaphyseal fracture of both bones of forearm in children is an excellent treatment modality. This procedure is minimally invasive with less soft tissue dissection, easy with less hospital stay duration. Implant cost is far less than titanium and stainless elastic nails with similar functional outcome. The procedure is relatively free from complications if proper wire entry and precautions are maintained. Also, there is no need of a second surgery for implant removal. The terms of successful outcome include a good understanding of fracture biomechanics, good preoperative planning, accurate and proper technique of manipulation, good image intensifier for closed reduction and proper post-operative care including pin tract dressing, wound care and early range of motion exercise.

DISCUSSION

Achieving a good functional result following fractures of both diaphyseal paediatric forearm bones is the objective for both operative and non-operative management of these injuries. The majority of forearm fractures in pediatric patients can be treated conservatively by closed reduction and adequate immobilization[12] .Those that occur in the middle third of the diaphysis and the proximal ones do not remodel in a predictable manner and, therefore, require more anatomical reductions .

Because of a high rate of re-displacement noted after conservative treatment, not surprising a move towards an increased internal fixation surgery has been advocated7. Indications for surgical treatment are unsuccessful reduction and/ or poor retention of fracture fragments1[3]. . Diaphyseal angulation of more than 10 degree and malrotation of more than 45 degree are widely accepted criteria for operative intervention.[14,15]

Sinikumpu et al. recommend surgical intervention for diaphyseal fractures of the forearm with angulations greater than 10 ° because the potential remodeling is limited in this area of the bone and its residual deformities affect forearm movement[7] . Mathews et al. showed in corpses that angular deformities in the forearm of 10 ° did not result in a significant loss of pronosupination, but that an amount of 20 ° would restrict forearm rotation by approximately 30%[17] . Another study in corpses showed that an angle of only 5 °, located in the middle of the forearm axis, can lead to a pronation deficit of up to 27%[18] .

Surgical intervention for displaced and unstable diaphyseal fractures of forearm includes open reduction and internal fixation with plate osteosynthesis, closed or mini open reduction and internal fixation with intramedullary nails.

Plate osteosynthesis is associated with extensive soft tissue dissection, blood loss, wound infection, ugly scar and implant related complication. Also, there is need for second surgery for implant removal. Intramedullary fixation is associated with minimal dissection, less blood loss, less chance of wound infection, less hospital stay. Removal of implant after union is also very easy. Implant may be TENS, Rush pin or K wire.

Our study was aimed to evaluate the efficacy, safety and functional outcome of K-wire fixation as intramedullary implant in displaced and unstable diaphyseal fracture of the both bones of forearm in age group of 3 to 12 years after an extensive review of published data.

Our study consists of 30 patients of unstable and displaced diaphyseal fracture of both bones of forearm treated in Department of Orthopaedics, IGGGH & PGI Puducherry, during the period of May 2016 to June 2018 with 6 months of follow up. The obtained have been compared with results obtained by the other authers using same technique.

	Study period (Years)	Total atient s (n)	Sex	Mean Age of fixation (years)	Type of Implant Used	Average time to Radiological union	Functional outcome of assessment criteria	Functional outcome	Complication
Yalcinkayam et.al	8 yrs	45	M=35 F=10	10	Rush pins, Kirschner wire	6-10 weeks	Price Criteria	Excellent=82.2% Good=17.8%	Major=2(4.44%) Minor=15(33.3%)
Flynn JM et.al	11 yrs	103	Not Mentio ned	10.6	Titanium Nails, Kirschner wire	6.9-8.6 weeks	Children Hospital of Pheladelphia forearm fracture fixation outcome classification	Excellent=77.7% Fair=14.6% Good=17.8%	Major=4(3.8%) Minor=11(10.6%)
Richter Det. al	2 yrs	30	M=18 F=12	Not mentioned	Titanium Nails	13 weeks	Tschern e score	Excellent=80% Good=16.6% Fair=3.3%	Minor=4(13.3%)
Shoemaker SD et.al	8 yrs	32	M=22 F=10	8.8	Kirschner wire	12 weeks	Price Criteria	Excellent=96.8% Good=3.2%	Major=2(6.2%) Minor=7(21.8%)
Our Study	2 yrs	30	M=22 F=8	8.63	Kirschner wire	8.6 weeks	Price Criteria	Excellent=83.3% Good=10% Fair=6.7%	Major=2(6.6%) Minor=5(16.6%)

CONCLUSION

- Intramedullary nail fixation is a very effective and successful method of treatment in displaced and unstable diaphyseal fracture of both bones of forearm in children.
- Kirschner wire fixation has excellent result in majoriy of cases(excellent to good in 93.3% in our study)
- K wire fixation is technically easy, it can be applied with closed reduction or if closed reduction is difficult by mini open reduction method.
- It is a minimally invasive surgery so there is less soft tissue dissection, less blood loss, less intra operative and post operative complications and hospital stay duration.
- There is no need of a second surgery for implant removal.
- K wire is an economical substitute to TENS with results are as excellent as tens fixation, hence it is a gold standard option for economically deprived population.

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