Elastic intramedullary nailing in the management of forearm fractures in children: A clinical study

Syed Ifthekar[1], Apser Khan[2,*], Vinod Anand[3]

[1,2]Assistant Professor, Dept. of Orthopaedics, SRMS IMS, Bareilly, Uttar Pradesh, [3]Chief Medical Officer, Dept. of Orthopaedics, Hindu Rao Hospital, Delhi, India

Corresponding Author: Apser Khan
Email: afserkhan@gmail.com

Abstract

Introduction: Forearm fractures are the most prevalent in childhood and adolescence and correspond to between 30% and 50% of all lesions that affect the immature skeleton. Successful treatment of fracture shafts of Radius and Ulna must aim at restoring full function of pronation and supination without which full use of hand is not possible. With conservative treatment, there are increased chances of redisplacement leading to high rates of failure. Intramedullary fixation is an attractive option because of short operative time, excellent cosmesis, minimal soft-tissue dissection, ease of hardware removal and early motion.

Materials and Methods: This was a prospective study of 32 children of forearm fractures treated by elastic intramedullary nailing and their outcome. The study was conducted in the Department of Orthopaedics, Hindu Rao Hospital, Delhi in between March 2015 to April 2016. Forearm fractures of all children admitted through Emergency Department and Out Patient Department were included in the study. Their functional results were analysed using Price et al criteria.

Results: Majority of patients were males accounting to 78.12% (n=25). Male to Female ratio was 3.6:1. Mean age of patients was 9.4 years with standard deviation (S.D) of 1.9. Fall during play accounted to majority of the cases (81.25%, n=26). Majority of the patients in this study had fractures on the left side accounting to 62.5% (n=20). Left: Right ratio was 5:3. Majority of the patients in this study had fracture both bone forearm (22A3) accounting for 53.12% (n=17). In majority of the patients, intra-operative reduction was achieved by closed means (87.5% n=28), while open reduction was required in (12.5% n= 4).

Conclusion: Closed intramedullary fixation is a biological method of fixation with less damage to the muscles and the periosteum, the fracture hematoma is intact, thus leading to early bridging callus formation. The undisturbed surrounding muscles and soft tissues help in spontaneous post operative correction of slight angular deviation. All the cases in this study went on to unite with no incidence of non union. The functional outcome was found to be excellent in majority of the patients.

Keywords: Radius and ulna fracture, Elastic intramedullary nail, Price et al score, AO classification.

Introduction

Injuries to the shafts of Radius and Ulna are the most common reasons for children to receive orthopaedic care.[1] Forearm fractures are the most prevalent in childhood and adolescence and correspond to between 30% and 50% of all lesions that affect the immature skeleton.[2] According to literature, adequate closed reduction maintained with effective plaster cast immobilization prevails as a good therapeutic option, particularly in patients under 10 years of age, due to the notable potential for bone remodelling.[3,4] Although this method is applied to most fractures, a preoccupying rate of complication is reported, including: loss of reduction (7 to 13 %), particularly in the first two weeks after trauma; defective consolidation and consequent functional limitation of the affected limb.[3,5-7] Successful treatment of fracture shafts of Radius and Ulna must aim at restoring full function of pronation and supination without which full use of hand is not possible. With conservative treatment, there are increased chances of redisplacement leading to high rates of failure.[8] Usual operative treatment for both bone forearm fractures include open reduction with plate fixation or intramedullary nailing. Though, compression plate fixation has become a standard treatment for adult diaphyseal fractures of forearm, with union rates of 91-98% and satisfactory results in 72-94%, Several complications related to the use of compression plates have been reported such as extensive soft tissue dissection, increased risk of neuro-vascular damage, increased rates of infection, insufficiency fractures, and a second operation for plate removal. Intramedullary nailing of forearm fractures is an attractive alternative to compression plating as it is less invasive in nature.[9-12] Intramedullary fixation is an attractive option because of short operative time, excellent cosmesis, minimal soft-tissue dissection, ease of hardware removal and early motion.

Materials and Methods

The study was a prospective study of 32 children of forearm fractures treated by elastic intramedullary nailing and their outcome. The study was conducted in the Department of Orthopaedics, Hindu Rao Hospital, Delhi in between March 2015 to April 2016. All children of age 7-14 years with Displaced diaphyseal fracture both bones forearm, Displaced diaphyseal fracture single bone forearm, Re-displaced fractures treated in a cast after initial satisfactory reduction were included in the study. Children with age <7 years or >14 years, old fractures >3 weeks old. Pathological fractures. Open fractures and undisplaced fractures were excluded.

Observations and Results

The observations of this study series are based on 32 patients treated by elastic intramedullary nailing in the department of orthopaedics, Hindu Rao Hospital, Delhi in between March 2015 and April 2016. Majority of patients were males accounting to 78.12% (n=25). Male to Female ratio was 3.6:1. Mean age of patients was 9.4 years with standard deviation (S.D) of 1.9. Minimum age in this series was 7 years and maximum age in this series was 13 years. Majority of the patients were in age group of 7-9 years (43.75%). Three modes of injury were noted in this study, fall during play accounted to majority of the cases (81.25%, n=26), Road traffic accident accounted to 9.4% (n=3), and Fall from height accounting to 9.37% (n=3). Majority of the cases were isolated fractures of both bone forearm. However one case was associated with fracture shaft of femur and one case was associated with fracture shaft of tibia. The mode of injury in fracture Femur patient was fall from height and in fracture Tibia, the mode of injury was Road Traffic Accident. There was no associated nerve and/or vessel injury in any of the patients. 20(62.5%) patients had fractures on the left side 17 (53.12%) patients had fracture both bone forearm (22A3). In case of single bone fractures, the incidence of radius and ulna was approximately same (25% vs 21.87%). Intra-operatively reduction was achieved by closed means (87.5%n=28), while open reduction was required in (12.5%n= 4) patients. Mean duration of union was 9.5 weeks (S.D=1.3) ranging from 8 to 12 weeks. In 53.12% (n=17) patients, union was achieved in between 8-10 weeks. The mean duration of immobilisation was 5.1 weeks (S.D=0.9). 37.5% (n=12) patients required immobilisation for 5 weeks. All the patients in the study achieved reasonable good range of movements with mean supination of 85.2 degrees (S.D. =6.2) and mean pronation 88.6% (S.D= 2.9). In 90.62% (n=29) patients, excellent functional results were achieved and good functional results were achieved in 9.37% (n=3) patients. The frequency distribution of functional results after surgery has been shown below in table and bar chart below. In this study, the whole course of treatment was uneventful. However two complications were noted. Superficial skin infection of stitch site and nail impingement on skin accounted for 6.25% each (n=2).

Discussion

The mean age of the patients in this study was 9.4 years with S.D. of 1.9 years. In a similar study done by Cumming D et al on 19 pediatric patients the mean age was 9 years.[13] Where as in the study done on 27 patients by Wyrsch B et al the mean age of the patient at the time of injury was 11.5 years.[14] In this study the forearm fracture was more common in the male patients in the ratio of 3.6:1 as there were 25 male and 7 female patients. Similarly, in the study of 8682 fracture, Landin LA et al. noted that the forearm fracture was more common among males.[15] In the study done by Cumming D et al. on 19 patients majority of the patients were male with male to female ratio 17:2.73 In the study done by Garg NK et al. on 21 patients of unstable forearm fracture male to female ratio was 14:7.[16] In the study done by Landin LA et al. on 8682 patients in majority of the patients the commonest mode of injury was fall on an outstretched hand.[15] Other mode of injury was road traffic accidents. Similarly, in the study of Tredwell SJ et al the commonest mode of injury was fall followed by Road traffic accident.[17] In this study the commonest mode of injury was fall during play accounting for 81.25% of the patients followed by Road traffic accident and Fall from height with the proportion of 9.37% each. Simple fracture involving both bone fracture were the commonest pattern of fracture seen in this study. According to the Orthopaedic Trauma Classification [OTA] Type 22A3 is designated as the simple fracture of both bone of the forearm. In my study it accounts for 53.12% whereas other type 22A1 were 21.17% and 22A2 were 25%. Similarly, in the study done by Jeffrey E et al. out of 205 forearm fracture majority [185] were having fracture of both bones forearm.[18] In our study closed reduction was achieved in 28 patients (87.5%) and open reduction was required in 4 cases (12.5%). In the study conducted by Cumming D et al. in 2006, out of 19 patients they also required to open the fracture in four cases as they were not able to achieve closed reduction before nail insertion.[13] Whereas in the study of EL Banna EG et al. were able to reduce all the cases by closed means and were able to pass intramedullary nail successfully.[19] In our study, union was achieved in all patients and mean weeks of union was 9.5 weeks ranging from 8 weeks to 12 weeks. We observed union in majority of the cases in between 8 to 10 weeks (53.12%). Similarly, Garg NK et al. observed clinical and radiological union within 13 weeks after the procedure in 19 of 20 patients. Abalo A et al. also observed that the average time to union for closed fractures was 13 weeks.[20] In the study done by Furlan D et al. all patients achieved complete radiographic healing at a mean of 6.4 weeks.[21] Post-operatively, above elbow POP slab was applied in all patients ranging from 4 to 7 weeks depending upon callus formation evident radiographically. The mean duration of immobilization was 5.1 weeks in our case study. Abalo A et al. in their study also observed that casting was required for the mean period of 6 weeks.[20] Whereas, Lascombes P et al. in their study on 85 forearm fractures in children treated using curved elastic nail after closed reduction, advised immediate mobilization after operative procedure.[22] For assessment of final functional outcome we used Price et al criteria and obtained excellent result in majority of the patients (90.62%, n=29) and good results were obtained in 3 (9.37%) patients.[23] In a study done by Shoemaker SD et al. on 32 patients of mean age 8.8

years, excellent results were obtained in 96.8% and good result in 3.2% of the patients. Similarly in the study of Richter D et al. done on 30 patients of forearm fracture treated with Titanium elastic nail, at 2 years of study follow-up, excellent functional outcome was observed in 80%, good in 16.6% and fair in 3.3% of the children.[24] In our study, we noticed a overall complication rate of 12.5%. Out of 32 patients, two patients had superficial skin infection and two patients had nail impingement. The complication rates in our study are similar to a study done by Flynn JM et al, where the overall complication rates were 14.6%.[25] Cumming D et al in a study done on the use of elastic intramedullary nails, reported a complication rate of 16%.[13] The common complications occured in the above series were skin irritation by hard ware, superficial skin infection, delayed union, pin back out, rupture of extensor pollicislongus tendon. However the only complications noted in our study were superficial skin infection and nail impingement over skin.

Table 1: Functional results after surgery

Results	No. of Cases	Percentage
Excellent	29	90.62%
Good	3	9.37%
Fair	0	0%
Poor	0	0%

Case 1

Pre-operative X-ray

Immediate Post-Operative X-ray

4 Weeks follow-up

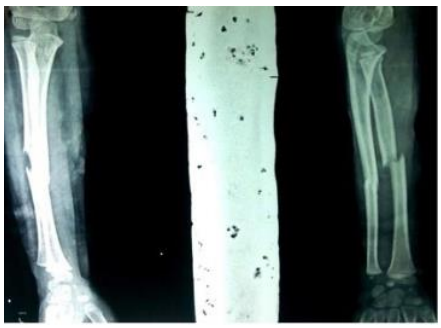
Final X-ray at 6 months

Mid Prone Position

Pronation

Supination

Case 2



Pre-operative X-ray

Immediate Post-Operative X-ray

4 Weeks follow-up

Final X-ray at 6 months

Mid Prone Position

Pronation

Supination

Conclusions

All the cases in this study went on to unite with no incidence of non union. The functional outcome was found to be excellent in majority of the patients. Closed intramedullary fixation is a biological method of fixation with less damage to the muscles and the periosteum, the fracture hematoma is intact, thus leading to early bridging callus formation. The undisturbed surrounding muscles and soft tissues help in spontaneous post operative correction of slight angular deviation. The minimal angulations which could not be corrected intra-operatively by closed methods, remodelled well on subsequent follow ups, especially when the age of the child was less than 10 years. Complications occured in 4 cases, how ever there was no implant failure and the outcomes were either excellent or good inspite of the complications. In our study, we found elastic intramedullary nailing for fractures of both bone forearm to be an easy, safe and effective method. The results of this study are comparable with the other series and the use of elastic intramedullary nails in displaced fractures of forearm in children is a good option for early rehabilitation and better functional outcome.

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