



OUTCOME OF FLEXIBLE INTRAMEDULLARY NAILING OF DISPLACED DIAPHYSEAL RADIUS AND ULNA FRACTURE IN CHILDREN

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ABSTRACT **INTRODUCTION:** Diaphyseal radius and ulna fracture is one of the most commonly encountered fracture in children that can be treated by closed reduction and cast application indicating operative intervention in open fractures, irreducible fractures and unstable fractures. This study aims to evaluate intramedullary flexible nailing for treatment in paediatrics diaphyseal radius and ulna fractures along with associated complications in such treatment.

METHODS: This was a prospective observational study including 30 children aged 5 - 14 years with diaphyseal fracture of radius and ulna, with open physis and fracture considered unstable or re-displaced, failed closed reduction and open fracture Gustilo and Anderson class I and II. The patients were treated with closed flexible intramedullary nailing and followed up at 2 weekly for 6 weeks and 3 weekly till the radiological union was achieved.

RESULT: Of the total 30 patients included in analysis, the mean age of the patient was 11.40 years (+/-2.49 SD). Closed technique failed in 3 (10%) cases. Radiological union occurred in 5-9 weeks with mean of 6.7 weeks (+/- 1.15 SD). Seven patients had angular deformity maximum 7° resulting in restriction of forearm rotation- supination and pronation in 3 cases. Three patients had superficial infection. Twenty-seven patients had excellent and 3 patients had good results.

CONCLUSION: Treatment of diaphyseal radius and ulna fracture in children by flexible intramedullary nailing is an acceptable option for displaced, unstable fracture and those fractures that failed closed method of treatment.

KEYWORDS : Flexible intramedullary nail, open fracture, Paediatric forearm fracture,

INTRODUCTION

Radial and ulnar shaft fractures are among the most common injuries treated in children, comprising 6% to 10% of all paediatric fractures. Most of the fractures can be successfully treated by closed manipulation and casting with excellent results. Open reduction – internal fixation (ORIF) is the accepted method of treatment for adult fracture and in adolescents who are near skeletal maturity but its role is controversial in pre teenage cases. ORIF is preferred in adults and older adolescent to obtain adequate reduction, maintain adequate forearm rotation and to prevent malunion and non-union. Such problems rarely occur in children as bony remodelling in children after union can improve forearm rotation overtime¹⁻³.

There is general agreement on closed management of fracture in young children but controversy exists for treatment of older child (>8-10 years old) with diaphyseal forearm fracture. Closed manipulation and casting in this age group has a recognized failure rate as much as 11%-. ORIF can provide accurate and stable fixation but soft tissue exposure may lead to complications such as infection, neurovascular injuries, scarring and delayed or non-union.

Intramedullary fixation of diaphyseal radius and ulna fracture is minimally invasive, technically simple, maintains bony alignment and promotes rapid bony healing-, along with decreased surgical morbidity and simpler implant removal as compared with open reduction and plating. ORIF is indicated in failure of closed reduction, open fractures and unstable fracture not amenable to closed reduction. The aim of this study is to evaluate the outcome of flexible intramedullary nailing in management of paediatric diaphyseal radius and ulna fracture. This study also takes into account operative time, surgical complications, time required for radiological union and complications developed during healing.

METHODOLOGY:

This was a Prospective observational study conducted from 1st July 2012 to 30th June 2013 in the orthopedics department of National Medical College & Teaching Hospital, Birgunj, Nepal. All the patients aged 5 - 14 year with x-ray documentation of fracture at least 3 cm away from the physis with open radius and ulna physis were included in the study. Unstable, re-displaced, failure of closed reduction and open fracture Gustilo and Anderson class I and II fractures were also included. Pathological fracture of radius and ulna, open fracture GA type III, associated humerus fracture in the same limb and associated

disruption of proximal and distal radioulnar joints were not included. Patients were admitted in Orthopaedic and Trauma ward after examination and initial management with above elbow posterior slab application. Management of the pain was done with proper dose of paracetamol. Guardians were explained about the operative management with use of flexible nail for fracture along with possible complications and cost of treatment. Informed consent was taken from guardians. Preoperative blood investigations were done. Preoperative antibiotics Injection Cefazoline given in every cases half an hour prior to operation in the anaesthetic room. Under general anaesthesia in supine position proper, tourniquet was applied in the arm with proper padding. Image intensifier was adjusted to obtain appropriate anteroposterior and lateral views of forearm. Fracture reduction was done by adequate traction. Proper size flexible nail as decided preoperatively by measuring the medullary canal in X-ray was used. The diameter of bone in anteroposterior added with diameter in lateral radiograph divided by 2 approximately gave the size of nail to be used. We used nail of 0.5 mm smaller than the calculated size.

FOR RADIUS: One cm longitudinal incision on the lateral side of distal metaphysis was used. Hole was made in the bone first perpendicularly and obliquely towards the elbow by an awl. Flexible nail with proximal 5 mm bent to 30 degree at the tip was introduced and pushed retrograde with hammer if needed, to the fracture site. Fracture was reduced by external manipulation under fluoroscopy and nail fixed to proximal metaphysis under visualization.

FOR ULNA: One cm longitudinal incision on the lateral side of proximal metaphysis was given. Hole was made with an awl in the bone first perpendicularly and obliquely towards the wrist. Flexible nail with proximal 5 mm bent to 30 degree was introduced and pushed antero grade. Fracture reduced by external manipulation under fluoroscopy and nail was fixed to distal metaphysis under vision. Proximal end was bent and cut 5-10 mm from the bone.

Skin closed with one stitch and slab was applied for 2 weeks. Check x-ray was done on next day. Patient was discharged on 2nd day on oral antibiotics. Follow up was done after 1st week discharge and evaluated for any complications along with suture removal. Other follow ups were done in 2nd and 6th weeks later for evaluation and to allow normal activities. After that 4th follow up was done on 12th weeks and final follow up (5th) was done in 24th weeks. Evaluation was done by x-ray and clinical examination including measurement of pronation and

supination movement at final follow up. Radiographic union was said to be present when plain radiographs showed bone trabeculae or cortical bone crossing the fracture site both in anteroposterior and lateral views.

Functional outcome was measured and graded according to price et al 1990.

Excellent: no complaints with sternous physical activity and/or loss of <10° of forearm rotation.

Good: mild complaints with sternous physical activity and/or loss of 11-30° of forearm rotation.

Fair: mild subjective complaints during daily activities and/or loss of 31-90° loss of forearm rotation.

Poor: all other results.



Fig 1: Pre operative Radiography

Fig 2: Entry of radial pin

Fig 3: Radial pin inserted after made by awl closed reduction



Fig 4: Entry port for ulna being made

Fig 5: Ulna pin being inserted



Fig 6: Immediate post op radiography

Fig 7: Final Radiograph after 24 weeks

RESULTS

Out of total 33 patients ,only 30 were included in final analysis as 3 patients lost to follow up. Most of the patients 11(36.7%) were in the age group 13-14 years followed by 10(33.3%) in the age group 11-12 years. Mean age was 11.40+/- 2.49 years (6-14years). considering gender 24(80%) were male and 6(20%) were female. Sixteen (53.3%) patients had fracture on the right side and 14(46.7%) had on the left side. Majority of patient 28(93.3%) had closed fracture and 2(6.7%) had open fracture Gustilo and Anderson type 1. Considering fracture morphology, 23(76.7%) had transverse fracture (Table 1). Majority of the patients 17(56.7%) had fall from tree and height as mechanism of injury followed by Road traffic accident 12 (40%).

The surgical time take for surgery varied from 45 to 85 minutes with mean time 67 +/- 13.62 minutes. Time taken for surgery was 1-2 hours in majority of cases 26(86.7%). Duration of hospital stay in days as shown in figure 1.

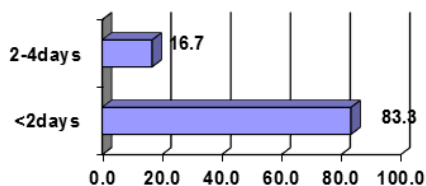


Figure 1: Hospital stay in days.

Only 3(10%) of patient had failed closed reduction which were managed by minimal opening at the fracture site. Besides that there were no other complications during surgery. There were no complications during treatment in 20(66.7%) patient. While 7(23.3%) patients developed angular deformity and 3(10%) patient developed infection. The superficial infection was managed by antibiotics.

Radiological union occurred in all cases with minimum of 5 weeks to maximum of 9 weeks with mean of 6.7 +/- 1.15 weeks. Similarly, 7° maximum angular deformity that was noted. At the final follow up after surgery there was restriction of pronation of 15° and supination of 10° in 1 patient while pronation only was restricted in 2 patients. All of the spiral and comminuted fracture united within 6 weeks while 82.6% transverse and 66.7% of oblique fracture united within 6 weeks (Table 1). Twenty-seven patients had excellent and 3 patients had good results (Table 2).

Table 1: Duration of radiological union of different types of fractures

Type of fracture	Radiological union <6 weeks (N / % of fracture)	Radiological union 6-12 weeks (N / % of fracture)	Total
Transverse	19 (82.6%)	4 (17.4%)	23 (100%)
Spiral	3 (100%)	0 (0%)	3 (100%)
comminuted	1 (100%)	0 (0%)	1 (100%)
oblique	2 (66.7%)	1 (33.3%)	3 (100%)
Total	25 (83.3%)	5 (16.7%)	30 (100%)

(- number of cases, %-percentage)

Table 2: Functional outcome as per Price Criteria with intramedullary nail

Functional outcome	Number of patients (Percentage)
Excellent	27 (90%)
Good	3(10%)
Fair	0
Poor	0
Total number of patients	30 (100%)

DISCUSSION

Diaphyseal fracture of the radius and ulna is one of the commonly treated fractures in children second to supracondylar fracture of humerus. Treatment option varies from conservative treatment to minimally invasive treatment (rush nail and K wire fixation) and ORIF. Amount of displacement, fracture morphology, type of fracture, age of the child and associated injuries decide the treatment modality along with parent's decision and available facilities like fluoroscopy. Low cost, simplicity and possible less complications of surgery as well as anesthesia leads the surgeon to prefer the conservative treatment in most of the cases.

In this study we used the closed reduction and fixation of fracture using flexible intramedullary nailing. The age of the patient varied from 6-14 years with the mean age group of 11.40 years. The mean age was comparable to other studies, mean age ranging from 9 to 11.8 years. Most of the children below 10 years can be managed by conservative methods and the patient who are adolescent are near skeletal maturity and have more chances of failure of closed technique and need operative management.

Out of 30 patients treated with flexible nailing our patient were predominately 24(80%) males and 6(20%) females. Similar study conducted in past have comparable gender distribution i.e. males more than females.

Out of total 30 cases 2 cases were open fracture while 28 cases were closed fracture. The fracture type of this study was comparable to other studies suggesting that open fracture is not so common in case of forearm.

The average period for radiological union in this study was 5-9 weeks, mean 6.7 +/- 1.15 weeks. Radiological union was defined as the absence of fracture line and presence of bony trabeculae in AP and lateral view of x ray. In other study also the mean period of radiological union was 7- 8 weeks. In another comparative study for intramedullary nailing versus plating conducted by ApurvaS. et al, there was no difference in mean time to union between the IM nailing (8.5 weeks) and ORIF (8.9 weeks) groups, but it was not statistically significant. The duration of union was slightly longer in other studies

but older children were also included in those studies^{16,17}.

In this study the mechanism of injury was mainly due to the fall from tree and height followed by RTA. But the similar studies from the western countries report RTA being the major cause of injury besides the fall from tree. This may be due to the geographic and socio economical condition of our country.

In this study only 3(10%) patients had failed closed reduction which ultimately required the minimal opening at the fracture site. Soft tissue interposition at the fracture site had been considered as the major cause of failed closed reduction. In similar studies the rate of failure of closed reduction and need for open surgery was similar to our study^{8,20,24,26}.

Time taken for surgery in this study was 45- 85 minutes with mean of 67 minutes which was longer as compared to other studies.

The period of hospital stay was less than 2 days in 25 cases. We usually discharged the patient on second day of surgery. Houshian S, Bajaj SK also had the median hospital stay period of 2 days (range 1-3 days) which is consistent with this study. This can significantly decrease the financial burden to the family and decrease the time of school absence for the child¹.

There were few complications which included superficial pin site infection in 3(10%) patients. Though they caused significant concern to the parents of the child they were controlled in due course of time with dressing and adequate oral antibiotics. Similar studies have reported major complications like forearm compartment syndrome leading to the fasciotomies in some cases and significant morbidity during the course of treatment¹⁷. However, there were no such complications during our treatment. Superficial skin infection was the common problem in this study similar to that by Parajuli NP et al, except backing out of ulnar pin due to rush nail¹. Rush nail does not engage in the metaphysis as does the flexible nail so there was no backing out of pin. We didn't encounter the radial nerve involvement like in the study by Mohamed A Khalid et al with intramedullary k wire⁸. This can be due to the operative technique where we used direct visualization for the entry portal in distal radius. Rupture of EPL did not occur in our study unlike in study conducted by Cumming D, et al²⁰.

There was angular deformity in 7(23.3%) patients. The maximum angular deformity was up to 7°. They led to the restriction of pronation of 15° and supination of 10° in one patient and pronation restriction of 15° in 2 patients. The outcome was graded according to the criteria given by Price et al 1990. According to it 27 patients had excellent and 3 patient had good results. In a study with closed intramedullary nailing by V Kapoor et al pronation was restricted by an average of 20 degrees in 9 patients⁵. In study conducted by Parajuli NP et al with intramedullary rush nail for fixation of fracture, all fractures maintained good alignment post operatively (price score)³. In all patient's good radiological union was seen in 3 month's time. We also used Price criteria for analyzing the results and our results were similar to their results. Similarly Ponet M, et al obtained 38 good results with flexible medullary nailing (83.3%) and 6 complications (14.7%) which were related to growth disturbance, leading to limitation of pronation; in one case they had rupture of extensor pollicis longus³⁰.

Apurva S. et al, performed similar comparative study where 83% of patients in both groups regained full forearm rotation. Although radial bow magnitude was comparably restored in both groups, the mean location of maximal radial bow was translated distally in the IM nailing group (67.2%) compared with the ORIF group (60.1%, P, 0.001) and a previously reported normal value (60.4%, P, 0.001). The incidence of complications in their intramedullary nailing group are consistent with this study however there were five major complications with the ORIF⁷.

In another comparative study of Fernandez FF et al plate fixation versus intramedullary nailing, the functional outcome and overall complications did not differ significantly. Plating resulted in significantly worse results for surgical approach, operating time, duration of hospitalisation and cosmetic outcome. This is because the ORIF uses plates need wide dissection and periosteal stripping for the procedure⁹.

CONCLUSION:

The flexible intramedullary nailing is a good option for the diaphyseal fracture in children between the age group 5 to 14 years. It is technically simpler, has got less complications and the overall functional outcome is excellent.

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