

Original Research Article

Functional outcome of elastic intramedullary nailing of forearm fractures in children using pin leverage technique

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ABSTRACT

Background: There is a recent trend towards elastic intramedullary nailing in fixation of pediatric forearm bone diaphyseal fractures. But in children we should always attempt closed reduction and immobilisation in a moulded plaster cast. Irreducible, open fractures and those that get redisplaced in moulded plaster cast need operative fixation with intramedullary nailing. Our aim was to know the outcome of tens nailing in such fractures.

Methods: We studied functional and radiological outcome of elastic intramedullary nailing by pin leverage technique in forearm fractures in 34 children. The study was done at a tertiary care centre in Uttarakhand, India from May, 2016 to July, 2018. Inclusion criteria were closed forearm fractures; diaphyseal fractures; age 1 to 19 years. Exclusion criteria were open type 2 and type 3 Gustilo-Anderson fractures; metaphyseal, epiphyseal forearm fractures; age >19 years; pathological fractures.

Results: Closed reduction and percutaneous pin leverage technique for reduction was successful in all but 4 patients where limited open reduction was used for reduction of fracture fragments. All fractures united radiologically between 7 to 13 weeks with mean distribution of 9.2 weeks. For functional outcome we used modified Price and Daruwala's score. 28 patients showed excellent results and 6 patients showed good results. All our patients had radiological union in mean of 9.2 weeks (7-13 weeks).

Conclusions: Fixation with intramedullary TENS nailing is an effective and affordable way of treating patients in paediatric age group.

Keywords: Paediatric, Forearm fractures, TENS, Superficial radial nerve

INTRODUCTION

Historically paediatric forearm both bone diaphyseal fractures are being treated with closed reduction and moulded plaster cast with follow up radiographs to check for re-displacement.

Loss of reduction in follow up can lead to poor radiological and functional results. Operative fixation in

the form of intramedullary nailing or open plating is required in displaced fractures after casting, primarily irreducible fractures and open fractures.^{1,2} External fixation has been used in open Gustilo-Anderson grade 2 and 3 fractures.³

There is a recent trend in increasing use of elastic intramedullary nailing as primary mode of fixation in diaphyseal forearm fractures in children with most

authors reporting good to excellent functional results with none to minimal complications compared to plating.

METHODS

We studied 34 consecutive children prospectively over a period of 2 years at a tertiary care centre govt medical college Haldwani, Uttarakhand, India from May 2016 to July 2018. All patients were operated in the next operation day from 3 to 5 days on average.

28 patients were primarily fixed with closed nailing with TENS using pin leverage technique and 4 patients required minimal open reduction and nailing.⁴ All patients were operated by a single orthopedic resident in elective OT under C-arm. Radial entry portal used was the area between the first and the second extensor compartment of wrist under vision using 3 to 4 cm incision or slightly dorsal approach.^{5,6} For fractures that were difficult to reduce, we used 3.2 mm k-wire percutaneously into the fracture site for leverage of one fragment on to the other until reduction. While the surgeon held the reduction, assistant was asked to advance the nail through the fracture site into the other fragment.^{7,8}

After fixation and closure we immobilized the forearm in a long arm pop slab for 2 weeks for reduction of pain and swelling. After slab removal we encouraged the patients to move the elbow, wrist, supination and pronation through full range of motion. We followed the patients in out-patient department at 2 weekly intervals until union and return to previous activity.

During follow-up we did 2 to 3 weekly radiographs and check for any complication. We followed our patients upto 1 year.^{9,10} Daruwala's score was used for functional assessment as given in Table 1 as under.

Table 1: Price and Daruwalla score.

Results	Elbow, forearm, wrist	ROM restriction
Excellent	/, /, /	<9 degree
Good	/, /, /	10-19 degree
Fair	/, /, /	20-29 degree
Poor	/, /, /	30-39 degree>

RESULTS

Patients age ranged from 7 to 18 years with a mean distribution of 13 years. Table 2 shows age, sex distribution and union in weeks of our patients. All fractures were closed except 4 patients that had open injuries of grade 1 Gustilo-Anderson. We had 20 patients with right sided fractures and 14 patients with left sided involvement.^{11,12} Male to female ratio was 11.6: 2. Table 2 shows sex distribution. 23 patients had fractures in distal 1/3rd, 8 patients had fractures in middle 1/3rd and 3 patients with proximal 1/3rd fractures. Figure 1 shows pre

and post operative radiograph (A and B) and union (C) and range of motion after union of fractures (D and E).

Table 2: Demographic data.

	Serial no.	Age group	Number
Age distribution	1	1-9	6
	2	10-19	28
Sex distribution	1	Male	Female
		30	4
Union in weeks	1	Union in weeks	Number
		5-10	30
	2	11-20	4

Table 3: Results of our treatment according to price and Daruwalla score.

Parameter	Excellent	Good	Fair
# B B forearm	28 (77.7%)	6 (16.6%)	Nil

All fractures united radiologically between 7 to 13 weeks with mean distribution of 9.2 weeks.^{13,14} Table 2 shows union in weeks. For functional outcome we used modified price and Daruwala's score.¹⁵ 28 patients showed excellent results and 6 patients showed good results as shown in Table 3.

Superficial radial nerve was injured in 1 patient in the form of neuropraxia that resolved spontaneously with time. One patient had extensor pollicis brevis partial rupture which we repaired at the time of nailing. 6 patients had implant protrusion at the site of ulnar entryportal with associated pus discharge may be because of superficial infection. Infection and pus discharge subsided after implant removal with excision of the bursa and infected tissue at the implant protrusion site. Implant removal done at 4 to 6 months post operation.

DISCUSSION

Conservative management with closed reduction and moulded casting are usually sufficient for treatment of diaphyseal foreram peadiatric fractures. But, controversy exists as to what amount of rotation, angulation and displacement constitute an acceptable reduction. In a Cadaver study by Rodriguez Mechain et al, they suggested that angular deformity of >10 degrees results in limitation of supination and pronation.¹⁶ Moreover, after 8-10 years of age the remodeling potential of ulna and radius is limited.

Our study demonstrates that good to excellent functional outcomes can be obtained without anatomic restoration of radial bow with intramedullary nailing. In our series fractures with complete displacement, angulation of more than 10 degrees and rotation of >45 degrees were considered as unacceptable and were fixed with tens nail

either closed or open. Daruwala also recommended an angulation of >10 degrees as unacceptable and recommended fixation. In a Cadaver study by Schmittenebecher et al, they suggested a midshaft angulation of > 5 to 10 degrees can lead to pronation difficulty of 5 to 20% of normal.¹⁷

Plating of forearm fractures in children has also been an alternative method of fixation with excellent results. There is a recent trend in increasing use of TENS nailing in paediatric forearm fractures with most of the published studies reporting good to excellent radiological and functional results with minimal complications.¹⁸ Cost is a factor that should be considered before using titanium implant in our setup. Alternative to titanium can be rush nail or a k-wire made of nickel, cobalt, chromium alloy (stainless steel) when cost is an issue.

In our study, results were excellent in 28 (77.7%) patients and good in 6 (16.6%) patients and comparable with other studies like Parajuli et al, they had 45 patients in their study and reported excellent results in 82% and good results in 17.8% of patients. They used price criteria for assessment of functional results. We used Daruwala and modified price criteria for functional assessment of the results.¹⁹

In our study closed nailing was successful in 30 patients and 4 patients required open nailing because of soft tissue interposition. Radiological union was achieved in 7 to 13 weeks (9.2 weeks average) as comparable to studies by Flynn et al with 6-10 weeks in former and 6.9-8.6 weeks in later respectively.¹²

Complications in our study were minimal including 1 superficial radial nerve injury and skin irritation from implant protrusion. No malunion, nonunion, delayed union was reported in our study.

CONCLUSION

Intramedullary tens nailing in paediatric forearm fractures yields good to excellent results as a primary treatment or following loss of reduction in a moulded cast with minimal complications. Tens is easily available and affordable.

Limitation

Short follow-up and less number of patients were the limitations of the study.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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