Paediatrics long bone fracture management by TENs - a prospective study

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ABSTRACT

Introduction-

Intramedullary nailing became the standard treatment in management of diaphyseal fractures in adults. However the management of paediatric diaphyseal fractures remains controversial. Conservative management with plasters is difficult in children because of non-compliance. Rigid Intramedullary nailing in children is associated with growth arrests. To overcome this Titanium Elastic Nailing System (TENS) was developed. The aim of our study was to evaluate the results of operative treatment of paediatric diaphyseal fractures in the age group between 5 to 15 years using titanium elastic nails (TENs).

Material and Methods-

This is a prospective study done among 30 patients with paediatric diaphyseal long bone fractures admitted in our hospital in the period from December 2016- December 2017.

Result-

In the age group 5 years to 10 years were 7 (23.3%) and in 11years to 15 years were 23 (76.6%) patients. . 22 (73.3 %) patients had transverse fracture and rest 8 (26.7%) had short oblique type. Forearm fracture was observed in 18(60%) children tibia and femur had 5(16.7%) children in each type rest 2(6.7%) children had humerus fracture. The average time for union ranging from 14-18weeks.NO patients had any deformities. No patients had malunion or delayed union.

Keywords: Diaphyseal fractures, children, TENS

Introduction

Domestic fall, sports injury, road traffic accident and child abuse are some of the etiological factors causing long bone fracture among paediatrics age groups. In developing countries patient often seek delayed medical treatment due to first aid given by traditional healers, this cause challenge in the treatment of paediatric diaphyseal fracture. When the reach hospital care, in cases of stable fractures caused by low-energy trauma - conservative management include traction therapy or closed reduction followed by spica casting, which are economical are recommended (1)

But the main disadvantage is these techniques is that they require longer periods of hospital stay and immobilization, and patients take a long time to walk independently and to return to school(2) Some of the Complications encountered during these techniques are malalignment, limb length discrepancy (LLD).

Hence surgical options are preferred by the orthopaedicians to overcome all the problems. Broadly, surgical options for fracture fixation can be classified into three categories: i) closed reduction with external fixation (CREF), ii) closed reduction with internal fixation (CRIF), and iii) open reduction with internal fixation (ORIF). (3)

When we use rigid intramedullary nailing in children it might cause growth arrest. To overcome this problem flexible elastic nails were invented. The mechanism of flexible Titanium Elastic Nailing System (TENS) is like "splint "theory- The elastic deformation of bent elastic nails within the medullary canal creates laterally directed force which held the fractures and alignment (4) Thus two TEN causes stress generated in the intra medullary canal achieves the purpose of maintaining the longitudinal axis of fractures.

The aim of our study was to evaluate the results of operative treatment of paediatric diaphyseal fractures in the age group between 5 to 15 years using titanium elastic nails (TENs).

Material and methods

This prospective observational study was done in a south Indian tertiary care hospital from December 2016- December 2017. During this one year period 30 patients who have satisfied our inclusion and exclusion criteria were included in our study after getting the children's assent and their parent's informed consent.

Inclusion criteria

- Patients with Diaphyseal Fractures in Long Bones of 5 years - 15 years of age.
- Simple, Transverse or Short oblique fractures in long bones of lower limb.
- Diaphyseal fractures of upper limb.
- Fractures that cannot be conservatively managed

Exclusion criteria

- Complex, comminuted or Segmental fractures or undisplaced incomplete fractures.
- Length unstable fractures or spiral fractures.
- Fractures of the proximal and distal end of bones.

Management plan

Once the patient got admitted detailed history and investigations were done. X ray was taken to rule out fracture type. Pre-operative anaesthetic evaluation was done. Under anaesthesia, closed reduction and internal fixation with flexible nails under C-arm guidance procedure was performed by experienced orthopaedic surgeons in standard way. Post operatively antibiotics, analgesics, antacids and blood transfusion if needed were administered. Post operative immobilization was achieved by administering Plaster of Paris (POP) cast till 4 weeks. It was extended by 2-4 weeks based on the need. The period of immobilization was followed by active and passive physiotherapy. Full weight bearing and weight lifting started by 8 – 12 weeks depending on the fracture pattern and callus formation.

All the patients were followed up at 4, 8, 12 and 24 weeks. At each follow up, patients were assessed clinically, radiologically and the complication if any was noted.

For all variables proportions are calculated in terms of frequencies and percentages. Simple statistics like mean, median, standard deviation, minimum and maximum values are calculated wherever applicable. To analyse the data SPSS (IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY: IBM Corp. Released 2013) is used.

Results

The mean age in our study was 11.7 ± 2.46. In the age group 5 years to 10 years were 7 (23.3%) and in 11years to 15 years were 23 (76.6%) patients. The results of our study are summarized in the table 1.

Table 1: Patient demographic and pre-operative evaluation data

Patients demographic characteristics	Number	Percentage
Age in years (Mean ± SD)	11.7 ± 2.46	
Gender		
Boys	28	93.3%
Girls	2	6.7%
Limb side affected		
LEFT	16	53.3%
RIGHT	14	46.7%
Cause of fracture		
RTA	15	50.0%
Slip & Fall	15	50.0%
Injury type		
Closed	24	80.0%
Open	6	20.0%
Type of fracture		
Short oblique	8	26.7%
Transverse	22	73.3%

Out of 30 children there were 28 male (93.3%) and 2 (6.7%) females. Left side was involved in 16 (53.3%) cases and right side was involved in 14 (46.7 %) cases. Both road traffic accident (RTA) and slip & fall equally contributed to fracture. Around 24 (80%) had closed fracture. Rest 6 (20%) had open fracture. 22 (73.3 %) patients had transverse fracture and rest 8 (26.7%) had short oblique type. Forearm fracture was observed in 18(60%) children tibia and femur had 5(16.7%) children in each type rest 2(6.7%) children had humerus fracture.

In our study closed reduction with internal fixation (CRIF) was performed for 27(90%) children and open reduction with internal fixation (ORIF) was performed in 3(10%) children both the group Titanium Elastic Nailing System (TENS) was inserted. Intra operative blood loss was less than 25 ml in 24 (80%) patients. The 2mm nail was used in 20 (66.7%), 2.5 mm was used in 9 (30%) and 3mm was used in 1(3.3%) patient.

Table 2. Surgical data

Approximate Blood Loss	Number	Percentage
<50 ml	6	20.0%
<25 ml	24	80.0%
Nail diameter		
2 mm	20	66.7%
2.5 mm	9	30.0%
3 mm	1	3.3%
Surgical procedure		
CRIF With TENS	27	90.0%
ORIF With TENS	3	10.0%

Post operative mean hospital stay was 6.7 ±2.08. Average weeks for union were 14.53± 1.38. More than 80% had no complication. The only complication encountered was terminally restricted in 6(20%) patients. Almost most of the patients had full range of movements and 6 patients had mild restriction which was later improved by physiotherapy.

6 patients had developed irritation at nail entry point, all of them resolved by the end of 18weeks. According to TEN scoring criteria excellent result was observed among 24(80%) patients and 6 (20%) had satisfactory score.

Table3. Post operative patient outcome data

Outcome	Mean ± SD
Duration of Hospital Stay (days)	6.7 ±2.08
Duration of union (weeks)	14.53± 1.38
Complication	
Terminally Restricted	6 (20 %)
TEN Scoring Criteria per Flynn et al	
Excellent	24 (80%)
Satisfactory	6 (20%)
Poor	0

Figure 1: a case of 14 years female, slip and fall, Displaced Femur fracture right side

2a- pre-operative

2b- Immediate Post-Operative

2c- Follow up in 8 weeks

2d- Follow up in 14 weeks

Discussion

Paediatric long bone fractures are treated by a variety method including traction, immediate Spica cast, traction followed by Spica cast, internal fixation with plate and screws, external fixation and intramedullary fixation. The decision of the treatment depends upon on the age of the child, the level and pattern of the fracture by regional, institutional or surgeon's choices.

In our study, total of 30 patients (male 28 and female 2) with diaphyseal long bone fractures in the age group of 5 to 15 underwent definitive management with TENS nail fixation. Out of these, 18 patients had fractures involving forearm, 2 humerus fractures, 5 femur fractures and remaining 5 patients had tibia fractures. Similar findings was seen in study done by Narayanan et al(5), Saikia KC et al (6) and Navdeep S et al (7). Mode of the injury was equally distributed among slip & fall (50%) and road traffic accidents (50%). But in a study by Kumar N and chaudhary(8) RTA was major cause of injury. The difference was might be due to a rise in motor vehicles on the road and improper regulation of traffic rules. Because of poor socio economic status in this region, working parents are not able to keep an eye on their children, which lead to high road traffic accidents. Majority(90%) underwent closed reduction and the remaining (10%) underwent open reduction. Similar finding was seen in Jones et al(9) and Furlan et al (10) studies .This proves that closed reduction along with pins is accepted standard technique for stable fractures

Blood loss was <50ml in all our cases with majority of cases having <25ml (80%). 2mm TENS nail was used in 20 patients (66.7%), 2.5mm TENS nail was used in 9 patients (30%) and the remaining one patient was operated with 3mm TENS nail. Average time for union was 12 weeks. There were no non-union or delayed union in our study, similarly in Todd o Brien et al(11) study Complications like malunion, growth arrest and re-fracture were not happen but the Closed fractures united at a period of 8weeks and open fractures by 15weeks. The only complication encountered in our study was terminally restricted range of movement, which was encountered in 6 patients (20.1%). According to Narayanan et al (5) majority of complication is entry site nail irritation, because of bent or prominent nail ends. This study states that to avoid irritation at entry site, surgeons should place nail ends against the supracondylar flare of femur and to use same diameter. Overall the outcome was excellent in 24 cases (80%) and satisfactory in 6 cases (20%). None of our cases had poor outcomes. Similar finding was found in Abhijit Bandyopadhyay(12). This states that there is a better treatment option due to advancement in the surgical procedure.

Hence this prospective study indicates that Titanium Elastic Nailing System is a minimally invasive procedure which gives excellent functional, radiological and cosmetic results in the treatment of diaphyseal long bone fractures in children.
Limitations which we encountered was number of patients in each group was uneven.

Conclusion

This study gives add on evidence for supporting the use of TENs for long diaphyseal fracture. The titanium elastic nailing provides elastic and stable fixation allowing micro-motion at fracture site without compromising endosteal blood supply and without interfering fracture haematoma. Titanium elastic nailing relatively simple,rapid,reliable and effective method for treating diaphyseal fractures of long bones in children with fewer complications and an excellent functional outcome, allowing early mobilization, hereby decreasing the patient's morbidity and duration of hospital stay.

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