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A Study of Functional Outcome of Ender's Nailing in Long Bone Fractures of Lower Limb in Children

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ABSTRACT
A study of functional outcome of ender's nailing in long bone fractures of lower limb in children. A prospective study was conducted over a period of around 18 months. 30 children within 4-17 years with long bone fractures of lower limb fulfilling the selection criteria admitted in Department of Orthopaedics at tertiary health care hospital, Surat were operated using Ender's Nailing. Out of 30 cases, 21 were male and 9 were female. Most common means of injury seen was . Road traffic accidents (RTA). Femur was the most common bone involved, with transverse fracture being the most common type. Mean duration of union for age ≤10 years(n=17) was 7.35 weeks and for age >10 years(n=13) was 9.38. There was no significant difference in time of union as well as Flynn score based on number of ender's nail inserted and level of fracture. Femur was the most common bone involved, with transverse fracture being the most common type. There were higher chances of restriction in range of motion in patients having longer union time Majority of cases were operated within 2 days of the injury. Only 2 cases had minor complications of which one superficial infection and other was delayed union. No major complications were noted in any patients. Based on our experience and results, we concluded that Ender's nailing as a minimal invasive procedure appears to be safe and reliable method that has good long-term results in the treatment of pediatric diaphyseal fractures of long bones of lower limb in children aged 4-17 years.

INTRODUCTION

Paediatric trauma has become one of the major global health issues. Among them fractures account for approximately 10-25%. The incidence of paediatric trauma is highest among developing nations. Long bone fractures in children have a bimodal distribution with respect to age peaking at around 6 and 16 years[1]. These fractures are more commonly seen in males with male to female ratio of 2:1. Road traffic accidents are leading cause of lower limb fracture in children, the second most common cause being abuse[1,2]. Treating pediatric trauma presents special challenges to orthopaedic surgeon. Depending upon the child age, severity, pattern of fracture and surgeon's preference, various treatment modalities are available namely intramedullary nailing, external fixators, intramedullary nailing and flexible intramedullary nailing. While majority of lower limb fractures in children can be managed conservatively by plaster immobilization and traction, the difficulties encountered like shortening, angulation, malunion, joint stiffness and delay in function recovery, calls for an alternative approach. Patient discomfort, working parents and nuclear families, longer hospital stays, academic leaves associated with conservative management poses pyschosocial and economic burden to patient and family. Due to this, there is an increasing trend nowadays towards surgical intervention by orthopaedicians. Plating is an extensive procedure giving aesthetically unsatisfactory scar. Intramedullary nailing can cause physeal injury. Due to this flexible intramedullary nail is becoming the choice of treatment by orthopaedic surgeons in such cases. Flexible intramedullary nails namely ender's nail and TENS nail are among widely used implant in fractures of lower limb in children. While TENS being the choice of implant in European countries, ender's nail still remains most popular worldwide. The technique is straight forward, safe, quick, cost effective, causes minimal soft tissue damage and has benefits of early union due to repeated micromotion at fracture site and early return to function with minimal complications[1,3]. These implants provide stability on the principle of 3 point fixation.

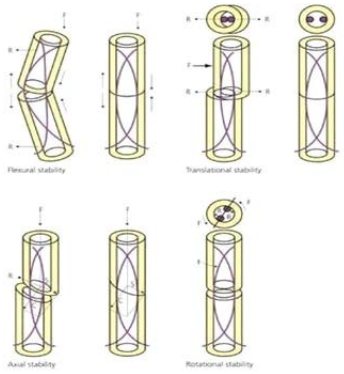

Fig. 1: 3 Point Fixation by Flexible Intramedullary Nails

MATERIALS AND METHODS

A prospective observational study was conducted over a period of 1.5 years from January 2023 to July 2024 in the Department of Orthopaedics at Tertiary Care Hospital, Surat[4,5]. Children between 4-17 years of age with fractures of long bones of lower limb admitted in Department of Orthopaedics at Tertiary Care Hospital, Surat, Gujarat, during the above mentioned study period and fulfilling the selection criteria mentioned below were recruited. 30 patients between 4-17 years of age with fractures of long bones of lower limb, 21 male and 9 female patients were recruited for the study to evaluate the outcome of intramedullary Ender's nail fixation for fractures of long bones of lower limb in children

Inclusion Criteria: (All of the following):

- Diaphyseal fractures.
- Patient's age >=4 years and <=17 years.
- Unilateral fractures.
- Patient's guardian giving consent.
- Patient compliant and willing to have their surgery.

Exclusion Criteria: (All / Any of the following):

- Patient's age 17 years.
- Metaphyseal fractures.
- Epiphyseal fractures.
- Open type 3C fractures.
- Pathological fractures associated with bone tumor, cerebral palsy, neuromuscular disorders.
- Patient's guardian/patient not willing to give consent.
- Patient is unfit for anaesthesia.
- Patients lost to follow up.

Surgical Procedure: After being suitably anaesthetized, the patient is positioned on a radiolucent operating table / fracture table, in supine position. The fracture is reduced by gentle manipulation under IITV guidance and suitable size of implant is selected[6,7]. Following describes surgical method used for insertion and fixation in case of lower third shaft tibia transverse fracture. The starting point for ender's nail insertion is selected about 1.5-2.0 cm distal to the proximal tibial physis, sufficiently posterior in the sagittal plane (middle of the bone in sagittal plane) to avoid injury to the tibial tuberosity. A longitudinal 1-2 cm incision is made on both the lateral and medial side of the tibia metaphysis just proximal to the desired bony entry point, but remaining distal to the proximal tibial physis[8-10]. Both nails are then inserted through the entry holes, turn by turn and advanced up to the level of the fracture site. Under IITV guidance, the fracture is reduced in both the coronal and sagittal planes and the first nail is advanced distal to the fracture site.

Under IITV guidance, the position of the nail inside the medullary canal in the distal segment is confirmed by anteroposterior and lateral views. Both nails are then advanced until the tips lie just proximal to the distal tibial physis.

Fig. 2: Implants

Fig. 3: Patient Position and Skin Incision

Fig 4: Insertion of Ender's Nail

Fig 5: IITV Images

Post-Op Care and Follow Up: After a short hospital stay for pain management and antibiotic coverage, patients were discharged from hospital and called for follow up regularly at 1 week interval till stitch removal and thereafter every 2 weeks for evaluation and radiographic examination, as required[11-15]. External immobilization splint/Supportive slabs were removed upon signs of clinical and radiological union and physiotherapy was started. Patients were evaluated based on functional outcome using the Flynn Scoring System at about 6 months Post op.

Flynn Scoring System

Results	Excellent	Satisfactory	Poor
Parameter at 24 weeks			
Limb length Discrepancy	<1cm	<2cm	>2cm
Inequality			
Malaligment	<5°	5-10°	>10°
Pain	None	None	Present
Complication	None	Minor and resolved	Major and /or lasting Morbidity

RESULTS AND DISCUSSIONS

Time of Union with Age: There are 17 numbers of patient with age ≤10 years having mean duration of union 7.35 weeks. There are 13 numbers of patient with age >10 years having mean duration of union 9.38 weeks.

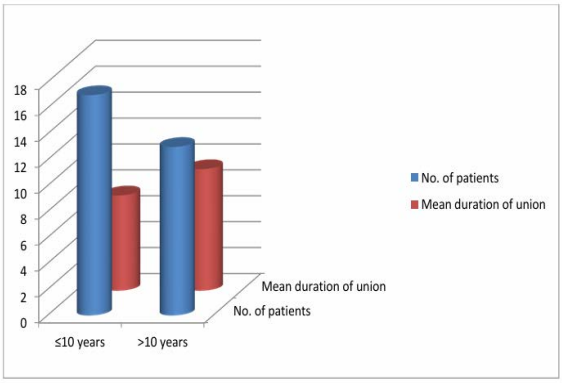

Fig. 6: Time of Union with Age

We found that in younger child the time required for union was slightly less as compared to older child.

Range of Motion with Duration of Union: We found significant difference in range of motion relative to mean duration of union, as out of 11 patients with >8 weeks union time, range of motion (ROM) was mildly restricted in 1 patient[16]. While out of 19 patients with ≤8 weeks union time, range of motion (ROM) was mildly restricted in 1 patient. Therefore there were higher chances of restriction in range of motion in patients having longer union time. This may be due to prolonged immobilization in higher union time which leads to stiffness of joints.

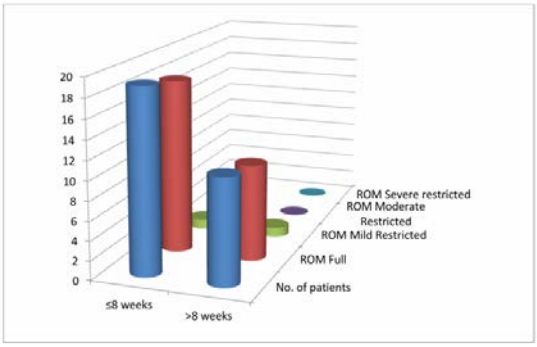

Fig. 7: Range of Motion with Duration of Union

Time of Union with Level of Fracture: We found significant difference in level of fracture and their union as lower 3rd shaft fractures of femur and tibia had more mean duration of union as compared with other two varieties[17-20].

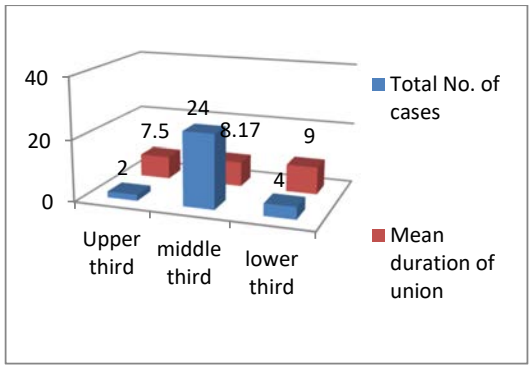

Fig. 8: Time of Union with Level of Fracture

Time of Union with Number of Ender's Nail Inserted: There was no significant difference in time of union required in cases based on number of ender's nail inserted.

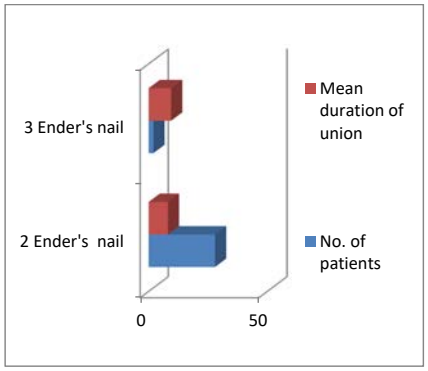

Fig. 9: Time of Union with Number of Ender's Nail Inserted

Flynn's Score with Radiological Type of Fracture: We concluded that there was no significant difference in Flynn's score in patients having various radiological type of fracture.

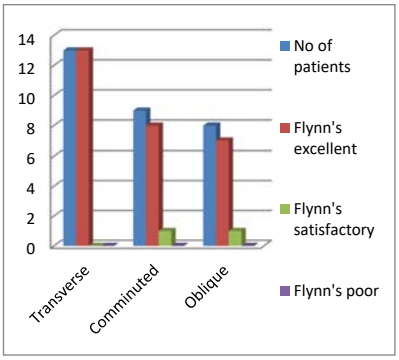

Fig. 10: Flynn's Score with Radiological Type of Fracture

Flynn's Score with Number of Ender's Nail Inserted: We found no significant difference in Flynn's score in various cases based on number of ender's nail inserted. While 2 cases having satisfactory Flynn's score, both were having 2 enders nail inserted. Rest majority of cases (92.9%) where two ender's nails were inserted, gave excellent outcome.

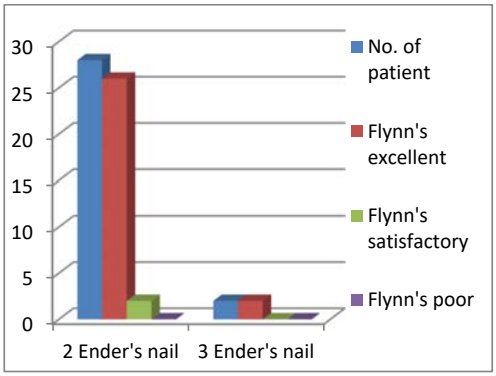

Fig. 11: Flynn's Score with Number of Ender's Nail Inserted

Various treatment methods are available ranging from the conservative traction, plaster casts and splint/ orthosis to surgical modalities like external fixation, intramedullary nailing and open reduction internal fixation using plates and screws. The preferred treatment for minimally displaced diaphyseal fractures in pediatric age group is conservative approach by plaster immobilization and traction but there is a shift towards surgical management recently preferably flexible intramedullary nails in pediatric trauma by orthopaedic surgeons, attributed to various factors like imposition by modern world, major technical development in field of implants and patient's need of early return to functional capacity. This method of fixation is proving to be advantageous in many forms along with having minimal complications. The mean age of patients included in the study was 10.4 years having 21 male and 9 female patients with male: female ratio of 2.33:1, with 17 (56.67%) cases having

left sided limb being affected and 13 (43.33%) cases having right sided. Most common mechanism of injury was road traffic accident (RTA) compromising of 46.67% of total, followed by domestic fall (33.33%), sports related injury (13.33%) and injury by fall from height (least common mechanism) 6.67% of total. Majority of our cases-26 (86.67%) were having closed fractures, while 3 cases (10%) were having open type-1 fracture and 1 case (3.33%) was having open type-2 fracture, having transverse fracture as most common type of fracture pattern in our study, compromising of 43.33% of total. Followed by oblique fracture pattern (30%) and comminuted fracture pattern (26.67%), most common bone involved in our study was femur (60%) with fractures of middle third of shaft being most common (53.33%),. most of them (53.33%) were operated within 2 days of trauma. Close reduction attempted initially in all our cases and it was successful in majority 93.33% of all cases. Majority of the patients (93.33%) in our study were treated with two ender's nails, while only two cases of mid shaft femur fractures (6.67%) were treated with three ender's nails. The mean time duration of surgery was 46.2 minutes ranged from 36 minutes to 64 minutes. The period of hospitalization in our study ranged from 2-14 days, with average of 8.2 days. The time for radiological union of fracture in our study ranged from 5 weeks to 12 weeks, with a mean of 8.23 weeks having no case of non-union. Only 2 cases showed mild restriction of movement, rest all other cases (93.33%) had achieved full range of movement at joints proximal and distal to fracture site in all our cases at final follow up (24 weeks). Majority of the cases (93.33%) had excellent outcome at 24 weeks, according to Flynn's criteria, two cases (6.67%) were having satisfactory outcome, while none had poor outcome. Our study reported minor complications in two cases, superficial infection of stitch line(easily resolved by antibiotics) in 1 case and delayed union (showed radiological union at around 12 weeks) in another case. No major complication or mortality was reported. No case of non-union, limb length discrepancy, angulation deformity, neurological damage, compartment syndrome or nail back out reported in our study.

CONCLUSION

We conclude that use of Ender's nail for definitive stabilization of long bone fractures of lower limb in children is very reliable, minimally invasive and a physeal protective treatment method. The result of our study shows that Ender's nail, keeping its principles and technique into consideration, can be used successfully in treating fractures of long bones of lower limb in children, producing good and uniform results.

Representative Case: A Case of Closed Fracture Middle 3rd Shaft Tibia-Fibula Right Side Operated by Closed Reduction+Ender's Nailing.

Fig. 12: A Representative Case from Our Study

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