



ISSN: 2395-1958
IJOS 2018; 4(4): 612-616
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www.orthopaper.com
Received: 21-08-2018
Accepted: 22-09-2018

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Study of titanium elastic nailing system in long bone fractures in children at Pravara rural hospital, Loni

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DOI: <https://doi.org/10.22271/ortho.2018.v4.i4h.71>

Abstract

Globally, traumatic injuries of long bones shaft fractures in children are the most leading causes of fractures in children. Now a days the use of elastic stable intra-medullary nails has dramatically increased with the introduction of a variety of nails for paediatric fractures^[1]. The Titanium Elastic Nail (TEN) is intended for fixation of diaphyseal fractures of long bones where the medullary canal is narrow or flexibility of the implant is paramount. The aim of this study of biological, minimally invasive fracture treatment is to achieve a level of reduction and stabilization that is appropriate to the age of the child. The biomechanical principal of the Titanium elastic nailing is based on the symmetrical bracing action of two elastic nails inserted into the metaphysis, each of which bears against the inner bone at three points. This was a prospective longitudinal study done over a period of one year in children between 5-14 yrs age groups. The complication rates associated with Titanium elastic nailing have been reported to be minimal.

Keywords: Prospective longitudinal study, long bones shaft fractures in children between 5-14 yrs age groups, titanium elastic nailing system (TENS)

Introduction

Globally, traumatic injuries of long bones shaft fractures in children are the most leading causes of fractures in children, with most of the burden borne by low- and middle income countries, in particular in the developing world. Majority of the children are treated non-operatively with union rates of more than 90% and 100% full functional recovery. Occasionally, reduction cannot be maintained due to excessive shortening, angulation, or malrotation at the fracture site, making operative intervention necessary. Now a days the use of elastic stable intra-medullary nails has dramatically increased with the introduction of a variety of nails for paediatric fractures^[1]. The Titanium Elastic Nail (TEN) is intended for fixation of diaphyseal fractures of long bones where the medullary canal is narrow or flexibility of the implant is paramount. The aim of this study of biological, minimally invasive fracture treatment is to achieve a level of reduction and stabilization that is appropriate to the age of the child. The biomechanical principal of the Titanium elastic nailing is based on the symmetrical bracing action of two elastic nails inserted into the metaphysis, each of which bears against the inner bone at three points. The Titanium elastic nailing has the benefits of early immediate stability to the involved bone segment, which permits early mobilization and return to the normal activities of the patients, with very low complication rate.

Treatment of long bone fractures in children continues to improve as newer techniques evolve. Conservative treatment remains the mainstay, given the excellent remodelling ability of the immature bone in children. However, Unstable fractures of long bones require operative treatment to maintain alignment and preserve function.

Paediatric trauma represents one of largest challenges in paediatric healthcare as well as great opportunity for positive impact on the same. Outpatient and inpatient musculoskeletal trauma comprises largest share of paediatric injuries. The incidence of paediatric trauma is highest among developing nations.

Treating long bone fractures in children is special challenge to the Orthopaedic surgeon. Various methods are used to treat paediatric long bone fractures and these includes traction,

splints, orthosis, plaster casts, external fixation, open reduction and internal fixation using plates and screws or intramedullary stabilization with a rod.

The difficulties of non-surgical treatment while keeping children in plaster casts is an alternative approach. These modalities are not without complications. This has led to recent shift towards operative management that appears to produce better results than non-operative treatment.

Recent times have witnessed an upheaval rising trend in the use of intramedullary fixation in the paediatric age groups by the orthopaedic community. This intervention attitude among the paediatric orthopaedic surgeons could be attributed to many factors including impositions by the modern world as well as the major technical developments in field of implants including Titanium elastic nailing.

The complication rates associated with Titanium elastic nailing have been reported to be minimal. The purpose of the study is to study the clinical, functional and radiological outcome in long bone fractures such as Femur, Tibia, Humerus and Radius / Ulna in children treated using elastic intramedullary nail and report the complications associated with the same.

Materials and Methods

Study design

This was a prospective longitudinal study done over a period of one year from July 2017 to July 2018, conducted in Pravara Rural Hospital, Loni, Maharashtra.

Study population:

All children patient between 5-14 years of age with fractures of long bones admitted at Pravara Rural Medical College and Hospital, Loni, during the mentioned study period, and fulfilling the selection criteria mentioned below were recruited for the study.

Inclusion criteria

1. Diaphyseal fractures
2. Simple fracture (closed fractures)
3. Ipsilateral fractures
4. Patient's guardian giving consent.
5. Patient compliant and willing to have their surgery at Pravara
6. Rural Hospital, Loni.

Exclusion criteria

1. Metaphyseal fractures
2. Compound fractures
3. Pathological fractures associated with bone tumour, cerebral palsy, neuromuscular disorders or osteoporosis.
4. Patient not willing to give consent
5. Patients lost to follow up.

Sample Size

20 Patients were recruited for this study. Before recruitment, informed written consent was obtained from this patient's guardian.

Mode of Injury of Patients Studied

Mode of injury	Number of patients	percentage
RTA	10	50 %
Self-fall	7	35 %
Fall from height	3	15 %
Total	20	100 %

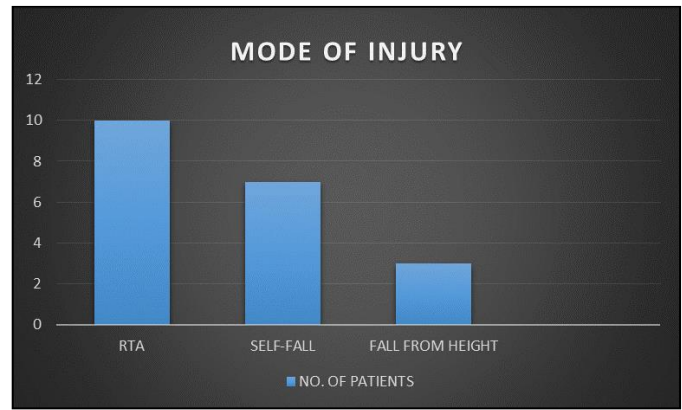


Fig 1

Scoring Criteria for Tens

	Excellent	Satisfactory	Poor
Limb length inequality	<1cm	1-2cm	>2cm
Malalignment	<5°	5-10°	>10°
Pain	none	None	present
Complications	none	Minor & resolved	Major & lasting morbidity
No. of patients	15	4	1

Methodology

Pre-operative care

As soon as the patient was brought to casualty, patient's airway, breathing and circulation were assessed. Then a complete survey was carried out to rule out other significant injuries. Plain radiographs of AP and lateral views of the involved extremity involving including one joint above and one joint below were taken to assess the extent and geometry of the fracture, and thus the fulfilment of the criteria.

On admission to ward, a detailed history was taken, relating to age, sex, occupation (if any), mode of injury, and past and associated medical illness.

Systemic examination was performed to recognize any pre-existing medical and surgical illness especially cardiovascular, respiratory or renal disease. Local examination was conducted to know about the deformity, extent of swelling, local tenderness, and abnormal mobility. The neurovascular status was recorded in each case. Any associated injury was recorded and treatment carried out accordingly.

Routine blood investigations were done for all patients. These included haemoglobin, bleeding time, clotting time, complete blood count, urine examination, blood urea, and blood sugar, X-ray chest was also done to diagnose any pre-existing chest disease. Patients were operated as early as possible once the general condition of the patient was stable and patient was fit for surgery.

Post-Operative Care

- Patients were kept nil per-orally 4 to 6 hours post-operatively.
- IV fluids were given as needed.
- Analgesics were given according to the needs of the patient. The limb was kept elevated over a pillow.
- IV antibiotics and injectibles given.
- Sutures were removed on the 15th post-operative day and patients were discharged.

Post-Operative Immobilisation

The period of immobilization was followed by active hip and knee or knee and ankle immobilization with non-weight bearing crutch walking for lower limb fractures, active shoulder and elbow/elbow and wrist mobilization for upper limb fractures. Full weight bearing was started by 8-12 weeks depending on the fracture configuration and callus response.

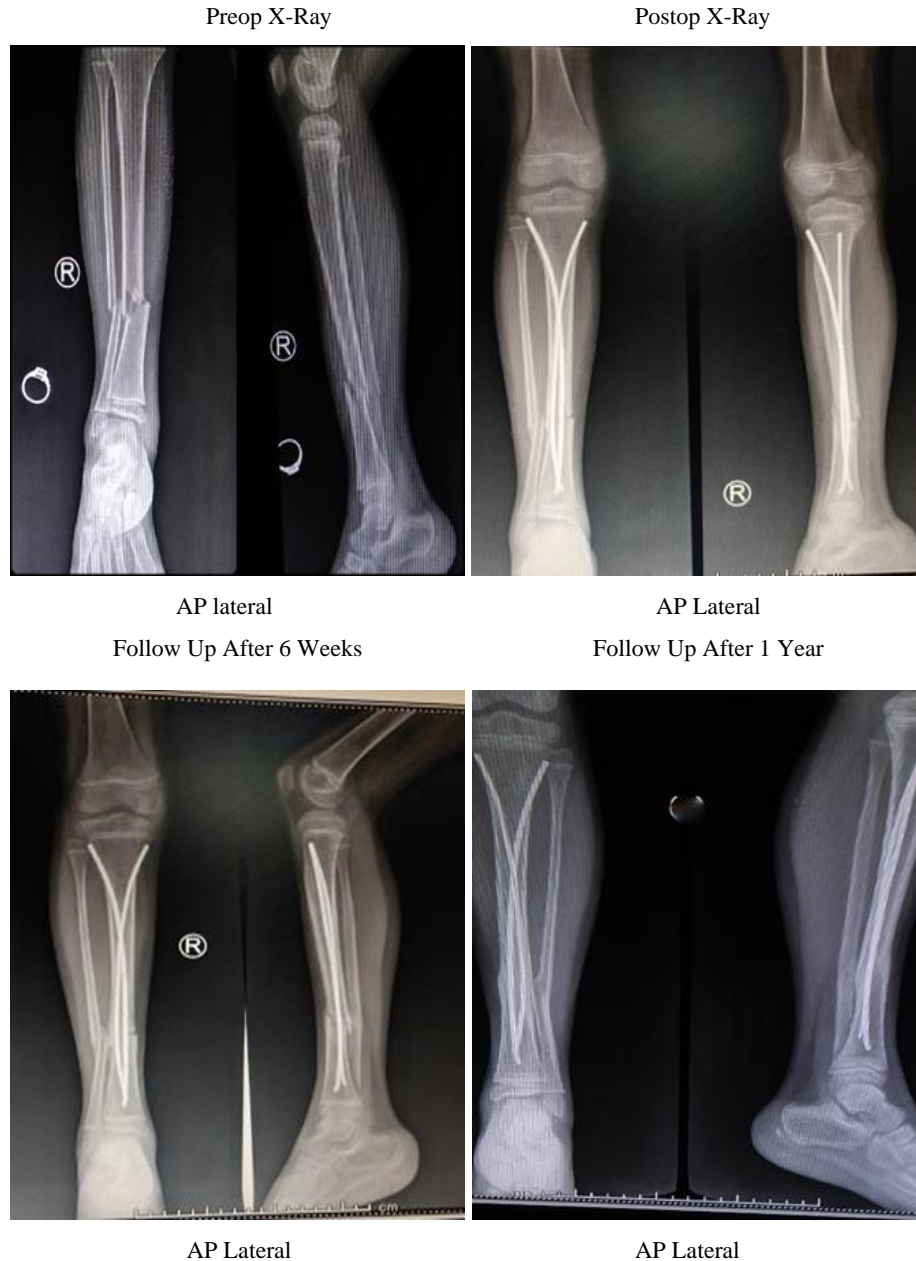
Complications

1. Entry site skin irritations.
2. Protrusions of the wires through the skin
3. Delayed union

4. Non union
5. Malunion
6. Osteomyelitis

Observation

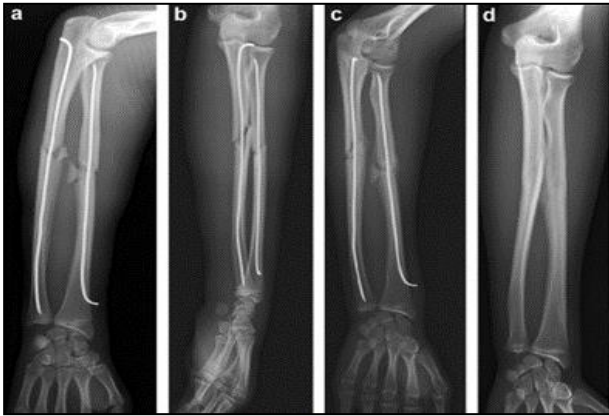
A prospective longitudinal study was conducted over a period of one year to evaluate the outcome of flexible intramedullary nail fixation for diaphyseal long bone fractures in children. 20 children between 5-14 years of age with fractures of long cylindrical bones and fulfilling the selection criteria were recruited for the study.



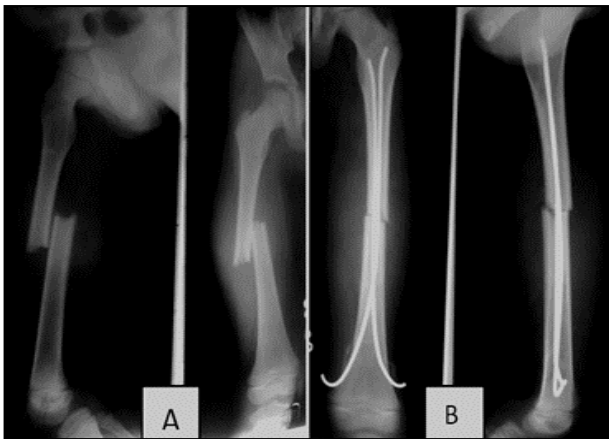
Results

All children achieved union in a mean time of 10 weeks (range from 6 to 16 weeks) depending on the type of long bone. Full weight bearing was possible in a mean time of 9 weeks. Mean duration of hospital stay was 10 days. The mean

follow-up period was 28 months (17-48 months). Complications were recorded in 1(5%) patient and included protrusion of the wires through the skin. The results were excellent in 75% and satisfactory in 20% patients.



Both Bone Forearm Operated with Shaft Femur with Operated Titanium Elastic Nailing.



Shaft Femur with Operated Titanium Elastic Nailing

Discussion

Paediatric trauma represents a great opportunity for positive impact on paediatric healthcare. Management of paediatric long bone fractures presents special challenges to the orthopaedic surgeons owing to smaller size, the presence of Open diaphysis and immature vascular pattern. Various methods for treatment include traction, splints/orthosis, plaster casts, external fixation, open reduction and internal fixation using plates and screws or intramedullary stabilisation with a rod.

Skeletal traction and application of a cast had remained the preferred method for treatment of diaphyseal fractures in children for a long time due to relatively conservative approach and a low incidence of permanent function impairing complications. The difficulties of non-surgical treatment while keeping children in plaster casts called for an alternative approach. Working patients, nuclear family with challenging home care, academics leaves and patient discomfort need to be considered while opting for non – surgical treatment. This has led to recent shift toward operative management that appears to produce better results than non-operative treatment, but this paradigm in treatment has not been without some controversy.

We conducted a prospective longitudinal study at Pravara Rural Medical College and Hospital, Loni, over a period of one year to evaluate the clinical, functional, and radiological outcome of flexible intramedullary nail fixation for diaphyseal long bone fractures in children, and report the complications associated with the same. 20 children and adolescents between 5-14 years of age with fractures of long cylindrical bones and fulfilling the selection criteria were recruited for studies.

Conclusion

Orthopaedic surgeons have been motivated to consider alternatives to traction and cast to avoid adverse physical, psychological and social consequences of prolonged immobilisation of school aged children.

Based on our experience and results, we conclude that Titanium Elastic Nailing System as a minimal invasive procedure appears to be safe and reliable, method that has good long term results in the treatment of paediatric diaphyseal fractures of long bones in children aged 5-14 years.

There are distinct advantages in terms of short operative time, short duration of hospital stay, fracture stability and early return to function, reasonable bone healing time, good functional outcome and low incidence of complications.

Intramedullary nailing can be thought of as an internal splint that maintains length and alignment but permits sufficient motion at fracture site to generate excellent callus formation and stability, which is ideal for early immobilization.

Because of early weight bearing, rapid healing and minimal disturbance of bone growth, Titanium Elastic Nailing may be considered to be a physiological method of treatment.

Use of Titanium Elastic Nailing for definitive stabilization of diaphyseal fractures of long bones in a children is reliable, minimally invasive, and physal protective treatment method. Our study results shows that Titanium Elastic Nailing can be used successfully regardless of fracture location and fracture pattern. We believe that understanding the principles of this technique is paramount to achieving good results.

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