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### **Evaluation of pediatric femoral shaft fractures managed with intra-medullary titanium elastic nails [TENS]: A prospective study**

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#### **Abstract**

Paediatric femoral shaft fractures are most commonly encountered fractures in orthopaedic practice which can be treated by various modalities of management each of which have their own advantages and disadvantages. With the advent of Titanium Elastic Nailing System we are able to overcome most of the complications associated with other treatment modalities. The aim of our study is to analyse the clinical, functional and radiological outcomes of paediatric femoral shaft fractures by Titanium Elastic Nailing System. 30 children with paediatric femoral shaft fractures were managed with Titanium Elastic Nailing system and were on periodic follow-up until complete fracture union. FLYNN Scoring system was used to assess the outcome. As per scoring system 13 patients had excellent results, 14 patients had good results and 3 patients had fair results. Based on our study we found Titanium Elastic Nailing System an ideal modality of management in paediatric femoral shaft fractures.

**Keywords:** TENS (Titanium Elastic Nailing System), PFSF (Paediatric Femoral Shaft Fractures), ENS (Elastic Nailing System)

#### **Introduction**

Pediatric femoral shaft fractures are one of the most commonly encountered fractures in orthopedic practice, accounting for almost 2% of all pediatric fractures. Management of these fractures have been vastly decided upon by factors such as the age of the patient, the fracture pattern, the stability of the fracture and the amount of fracture displacement.

In children less than 5 years of age the principal modality of management has been conservative with a hip spica cast.

However in patients between 6 and 18 years the management varies from POP spica casts to Open reduction and internal fixation with various plating options. In this age group POP casts are cumbersome to apply, difficult to maintain, have poor patient compliance and associated with complications such as loss of reduction and pressure sores.

Open reduction and plating has been associated with the requirement of extensive surgical exposure, wound healing complications, prolonged hospital stay and possible post-op infection. Traditional intra-medullary nailing options are not Feasible in this age group in view of the physal plate.

These complications with the above mentioned modalities of treatment have been vastly overcome by the introduction of Titanium Elastic Nails. This nailing system avoids damage to the physis, provides adequate structural stability, is minimally invasive, reduces hospital stay and ensures early return of functionality of the limb.

#### **Aim of the study**

To analyze the clinical, functional and radiological outcome of paediatric femoral shaft fractures which are managed by titanium elastic nail system (TENS).

#### **Materials and Methods**

This is a prospective study consisting of 30 children with Fracture shaft of the femur managed

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with Titanium Elastic nails conducted at MVJ Medical College & Research Hospital, Bangalore from May 2016 to October 2018. Patients were reviewed periodically both clinically & Radiologically for minimum at 6 weeks interval to minimum of 6 months for fracture union and functional outcome. The Scoring system which was used Flynn Scoring System <sup>[6]</sup>.

#### Inclusion criteria

Age group: 6-17 years

Closed fractures

Open fractures: Gustilo-Andersons type: I, II

#### Exclusion criteria

Age less than 6 years or more than 17 years.

Open fractures: Gustilo-Andersons type: IIIA/B/C

Significant Systemic Co-morbidities / Injuries

Patients parents not willing to participate in the study.

Patients unfit for surgery/Anaesthesia

Children whose parents have not given consent for the study

#### Operative technique

Patients between age of 6-17yrs presenting with femoral shaft fractures admitted to our hospital <sup>[11]</sup>. A thorough history was elicited from the patient/attenders with regards of the nature of the injury (mechanical fall or due to any other causes). The affected limb was placed in a THOMAS SPLINT <sup>[12]</sup>. Consent for surgery was taken. All preoperative investigations were carried out Blood CBC, ESR, FBS/PPBS/HBA1C/RBS, RFT, LFT, Serum Electrolytes, HIV, HBsAg, BT, CT, APTT, INR, Urine Routine, Blood grouping/ Rh typing + Cross matching. X-rays- of the femur Antero-posterior & Lateral views were taken. After Paediatric and anaesthetic fitness patient was posted for surgery <sup>[13]</sup>. All other injuries were investigated and managed appropriately.

The patient was put on fracture table and fracture reduction done under C-Arm guidance<sup>14</sup>. The size [diameter] of nail was selected intra-operatively under C-arm guidance. Both the nails were of same size or 0.5mm less <sup>[15]</sup>. Two small incision were given proximal to the epiphysis on medial and lateral side and TENS nail introduced and anchored to the neck of femur and greater trochanter under C-Arm guidance. Appropriate antibiotics and analgesics given. Post operatively

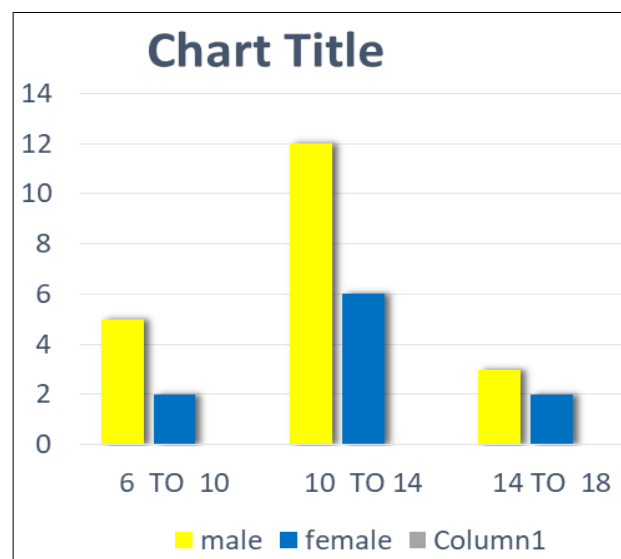
patient was put on long knee brace. Staples were removed at the end of two weeks. The patients were started on active knee mobilization exercises at end of post-op 10-14 days in stable fractures whereas in unstable fractures at end of 3 weeks <sup>[16]</sup>. Patients were advised to continue non weight bearing ambulation with a walker or axillary crutches. Partial weight bearing started once callus formation noted. Serial Check x rays were done at six weeks interval. During follow up Clinical & radiological evaluation done to assess fracture union. The functional outcome assessed as per Flynn Scoring System <sup>[6]</sup> & graded accordingly.

#### Results

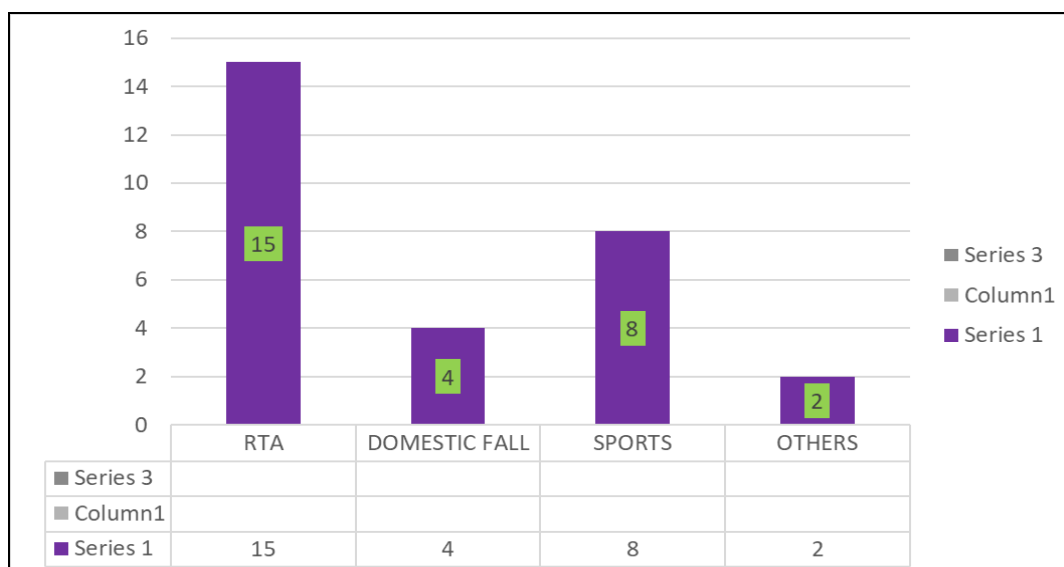
The following observations were made from data collected during study.

- Total cases: 30
- Average age: 12 yrs
- Male / Female: 2/1
- Side: Right: Left 3:2.

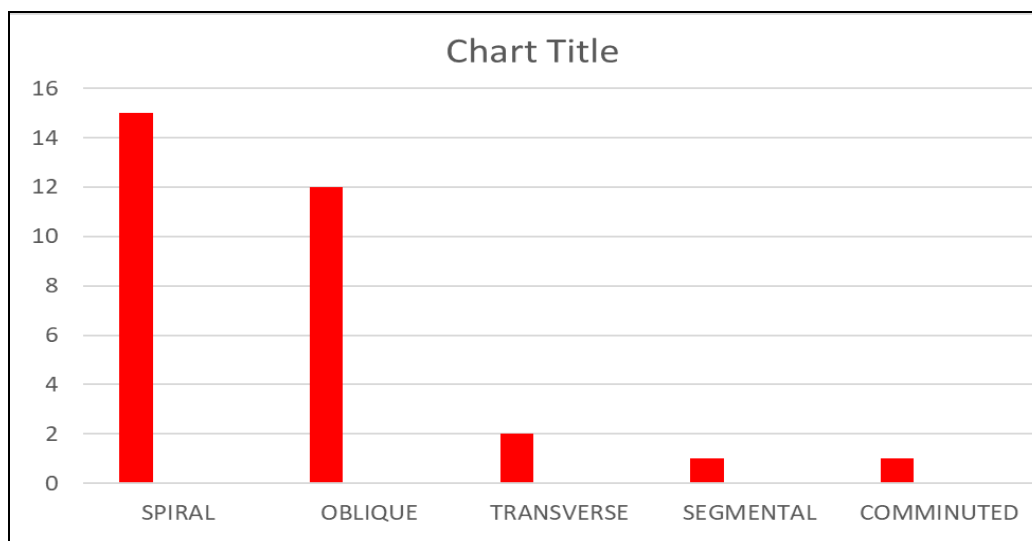
We did not encounter any case with an open fracture during this study.



**Fig 1:** This was the sex incidence noted in our study.

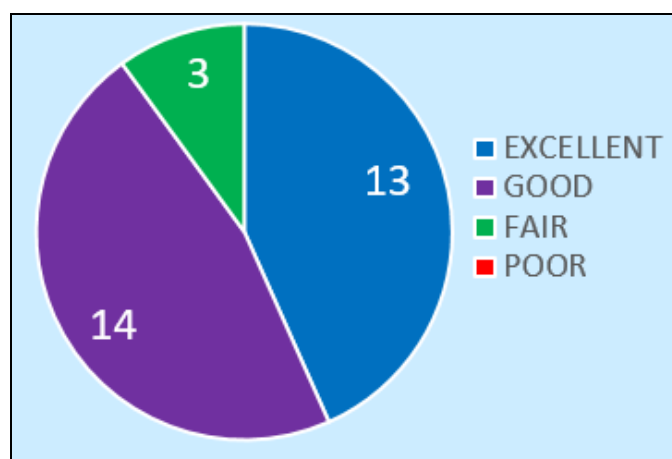


**Fig 2:** This was the mechanism of injury noted in our study



**Fig 3:** These were the fracture patterns noted in our study

In the present study of 30 cases with an average age of patient is 12 years with Male to Female ratio of 2:1; the outcome was found to be 43% (13) excellent, 47% (14) satisfactory, 10% (3) poor, with FLYNN scoring system.



**Fig 4:** Flynn Scoring System

### Complications

There were no intra operative complications observed in this study. Post-op complications which include a case of limb length discrepancy less than 2 cm. 2 cases of angulation at fracture site & a case of bursae formation which presented with severe pain. There was no non-union. For all the cases union occurred in 16-18 wks.



**Fig 5:** Pre-op x-ray



**Fig 6:** Immediate post-op x-ray



**Fig 7:** 6 months follow up X-Ray

### Discussion

Until recently conservative treatment was the preferred method for the treatment of diaphyseal fractures in children and young adolescents [17]. Plate osteosynthesis is associated with a large exposure, relatively longer duration of

immobilization and the risks of delayed union, infection and a large dissection for plate removal so less preferred <sup>[18]</sup>. The external fixator provides good stability and early mobilization, but is associated with the risk of pin tract infections. Intramedullary K-wire fixation has also been used for pediatric femoral fracture <sup>[19]</sup>.

But stability and fracture angulation is a disadvantage to be taken care of. Interlocking nail is ideal for skeletally matured children. But in skeletally immature patients there is a risk of avascular necrosis of femoral head, coxa valga and limb length discrepancy <sup>[20]</sup>.

Titanium elastic nail seems advantageous over other surgical methods particularly in this age group because it is simple, is a load-sharing internal splint that doesn't violate open physis, allows early mobilization and maintains alignment <sup>[21]</sup>. Micromotion conferred by the elasticity of the fixation promotes faster external bridging callus formation. The periosteum is not disturbed and being a closed procedure there is no disturbance of the fracture hematoma as it improves osteogenic potential and less risk of infection due to minimal exposure.

**Table 1:** The average age incidence in our study was 12 yrs which are comparable with similar studies

Author	Average Age
Gregory RJ <sup>[22]</sup>	14
Sponseller PD <sup>[13]</sup>	10
Flynn JM <sup>[24]</sup>	12
Present study	12

### Sex Incidence

In the present study male: female was 2:1 there was a male sex preponderance seen in our study which is similar to other studies of the following authors.

**Table 2:** The patients of sex male and female

Study	No of Patients	Male: Female	%Males
Letts M <sup>[25]</sup>	40	11:9	55
Buford D <sup>[26]</sup>	60	3:2	66
Present	30	2:1	63

**Table 3:** Bone union time

Author	Average Bone union time (wks)
Buechsenschuetz KE <sup>[27]</sup>	16 wks
Ligier JN <sup>[28]</sup>	20 wks
Heinrich SD <sup>[29]</sup>	14 wks
Lascombes P <sup>[30]</sup>	18 wks
Present Study	16 wks

### Conclusion

In view of results obtained from similar studies TENS nail is ideal in the management of paediatric femoral shaft fractures as it is simple, minimally invasive, provides good structural stability, allows for early rehabilitation and has lesser chances of infection.

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