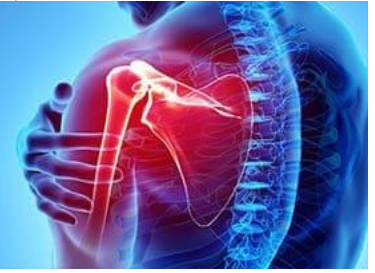


# International Journal of Orthopaedics and Traumatology



ISSN Print: 2664-8318  
ISSN Online: 2664-8326  
Impact Factor: RJIF 5.42  
IJOT 2024; 6(1): 15-18  
[www.orthopedicsjournal.in](http://www.orthopedicsjournal.in)  
Received: 13-11-2023  
Accepted: 18-12-2023

**Imran Ahmed Hajam**  
Department of Orthopedics,  
GMC, Jammu, Jammu and  
Kashmir, India

**Abhishek Bral**  
Junior Resident, Department  
of Orthopedics GMC Jammu,  
Jammu and Kashmir, India

**Zubair Ahmad Lone**  
Department of Orthopedics,  
GMC, Jammu, Jammu and  
Kashmir, India

**Mohammad Farooq Butt**  
Department of Orthopedics,  
GMC, Jammu, Jammu and  
Kashmir, India

**Fareed Hussain Malik**  
Department of Orthopedics,  
GMC, Jammu, Jammu and  
Kashmir, India

**Aakash Deep**  
Junior Resident, Department  
of Orthopedics, GMC, Jammu,  
Jammu and Kashmir, India

**Corresponding Author:**  
**Aakash Deep**  
Junior Resident, Department  
of Orthopedics, GMC, Jammu,  
Jammu and Kashmir, India

## Outcome of percutaneous titanium elastic nailing system for paediatric femur fracture

**Imran Ahmed Hajam, Abhishek Bral, Zubair Ahmad Lone, Mohammad Farooq Butt, Fareed Hussain Malik and Aakash Deep**

DOI: <https://doi.org/10.33545/26648318.2024.v6.i1a.39>

### Abstract

Fractures in the patients aged between 5–15 years. 10 patients were followed up for the mean period of 12 months and evaluated using Flynn's criteria. All the fractures united between 8–12 weeks. 2 patients had knee stiffness, 1 patient had shortening > 2 cm and 1 had superficial infection. We conclude that TENs is simple, rapid & effective treatment for displaced pediatric femoral shaft fractures between 5–15 years of age with very less complication rate.

**Keywords:** Pediatric femoral shaft fractures, titanium elastic nails, percutaneous

### 1. Introduction

Femoral shaft fracture is the most common major pediatric orthopedic injury requiring hospitalization. It represents about 1.6% of all the bony injuries in children (Including sub-trochantric & inter-trochantric fractures). They are more common in boys than girls (2.6:1)<sup>[1]</sup>. There is a little disagreement concerning the treatment of long bone fractures in children less than 5 years i.e with hip spica application and adolescents older than 15 years i.e with interlocking intramedullary nailing. But controversy persists regarding the patients aged between 5-15 years, with several available options like traction followed by hip spica, external fixation, flexible stable intramedullary nails (Ender or titanium), plate fixation, and locked intramedullary nailing with no clear consensus for the preferred treatment. Over the past two decades the advantages of fracture fixation and early mobilization has been increasingly recognized. Thus there is increasing trend towards internal fixation of the pediatric femoral fractures. In 1882 Mataizeau & his team from France developed and revolutionized the technique of flexible stable intramedullary pinning (FSIP) using titanium pins which is now popularly known as TENS has become the choice of operative management for pediatric femoral shaft fractures<sup>[3]</sup>. The aim of this prospective study is to evaluate the results of treatment of pediatric femoral shaft fractures with titanium elastic nails (TENs).

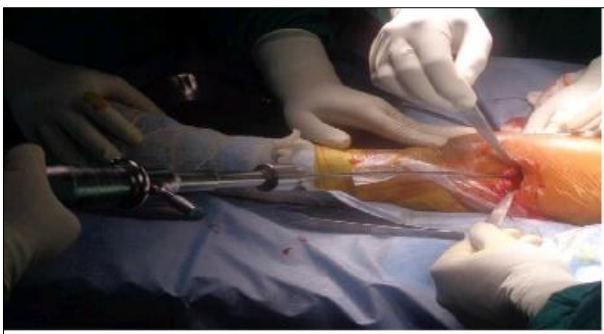
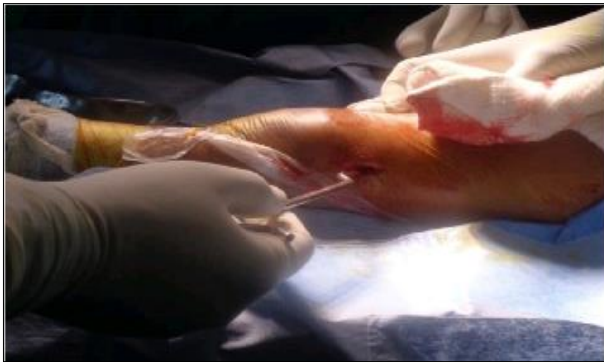
### 2. Materials and Methods

Study was done in GMC Jammu from 2020 to Dec 2022. Patients aged between 5 years to 15 years with femoral shaft fractures both closed and open were treated with closed reduction and internal fixation with titanium elastic nails (TENs). Patients with extreme proximal or distal femoral fractures closer to the epiphyseal plate (10cm), patients with grade III C open femoral fractures and patients with pathological fractures were excluded from the study. The pre-operative radiographs were evaluated to determine the location and pattern of the fracture.

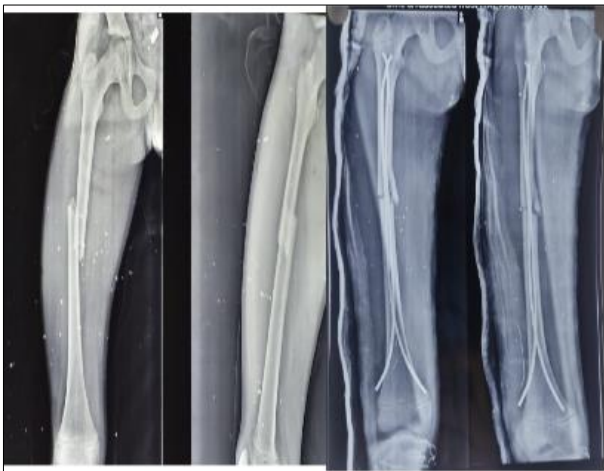
#### 2.1 Surgical technique

Two retrograde TENs were used in all femoral fractures. A traction table was used for all the patients. Intra-operatively fracture was reduced under x-ray image intensifier. A 1-2-cm longitudinal skin incision was made over the medial and lateral surface of the distal femur, starting 2 cm proximal to the distal femoral epiphyseal plate and entry was made in the femur with the help of bone owl.

A proper sized nails (Not less than 40% of the narrowest diameter of the diaphysis) were used. To achieve good three point contact the TENs are pre-bent over the length of the bone three times the diameter of the medullary canal. Nail was introduced with a T-handle by rotation movements of the wrist. Under image intensifier control, the nail was driven with rotatory movement or with a hammer to the fracture site which was aligned to anatomical or near anatomical position and the nail was advanced to the proximal fragment. At the same time the second nail was advanced to enter the proximal fragment from the other entry point and in the meantime any traction was released to avoid any distraction. Fracture reduction was checked under image intensifier, end of the nail were buried and wound closed.



**Fig 1, 2:** Intra operate images showing Entry point made with surgical Awl and Entry of Tens Nail into the femur



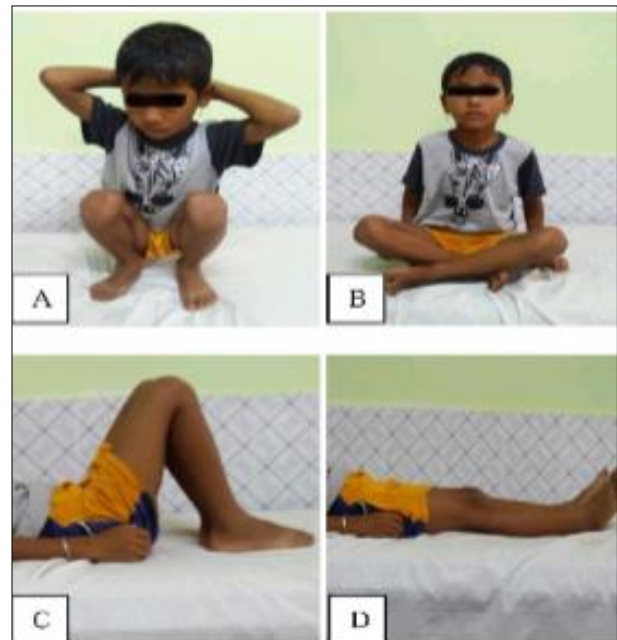
**Fig 3:** Pre-operative and post-Operative Radiographs AP and lateral view

Moved after 2 weeks as the fracture gets sticky and thus TENS alone can provide sufficient stability at this point. Antibiotic prophylaxis was given for 3 days. Knee

mobilization started after removing the slab. Non weight bearing mobilization with walker was started from 2nd post op day or as per tolerance of the patient. Patients were kept non weight bearing till 4 wks and partial weight bearing was started from 4 wks. Complete weight bearing was allowed after bony union.

Study was conducted in department of Orthopedics GMC Jammu between Jan 2020 to Sep 2022. Ten less than 7 days old pediatric femoral shaft fractures in 12 patients (8boys & 2 girls) were fixed with titanium elastic nails (TENs). 7 fractures were closed and 3 fractures were open (Grade I, II and IIIa; Gustilo-anderson type). There were 5 left sided, 5 right sided. Surgery was performed within 3 days of hospital admission. Results were evaluated using Flynn's scoring criteria<sup>1</sup> (Table 1) & radiological union was assessed by Anthony *et al*<sup>[4]</sup> scale for grading callus formation.

**Follow-up after 1 Year - A) Squatting (B) Sitting cross legged( C) Flexion at hip and (D) Extension at hip and knee**



Eleven Patients (9 boys and 2 girls) were available for follow up. The predominant mode of injury was due to road traffic accident (RTA) (55%). Right-sided involvement was seen in 5 cases (45%) and left side in 6 cases (55%). Mid-diaphyseal fracture of femur was found in 8 patients (73%), 2 patients (18%) had fracture in distal one-third of femur and 1 patient (9%) had sub-trochanteric femoral fracture. 6 patients (55%) had transverse fracture, 3 patients (27%) had oblique fractures, 1 patient (9%) had spiral fracture and 1 patient (9%) had butterfly fragment (Comminuted). Patients were followed up for the mean period of 12 months (6 months -18 months). All the fractures united radiologically between 8 weeks to 12 weeks (Mean 9 weeks) (Fig. 3 & 4). Full weight bearing was possible after 12 weeks after surgery.

Average operating time was 50 min and average hospitalization time was 6 day. Results were excellent in 6 patients, satisfactory in 4 patients & poor in 1 patient according to Flynn's scoring criteria. 3 patients had post-operative knee stiffness as the patients did not co-operate for knee mobilization exercises in early post-operative period

and even after removal of boot and bar plaster at 2 weeks. So patients were put on regular physiotherapy including continues passive motion (CPM). All the patients regained complete range of knee motion after average duration of 2 weeks of physiotherapy and none of the patients had residual knee stiffness. One patient had shortening of more than 2 cm, this patient had a spiral fracture and the patient started weight bearing early. One patient had superficial infection at entry site which healed on regular dressing & antibiotics also two patients had severe skin irritation at entry site for which the nail had to be removed after 6 months in 1st case and 7 months in 2nd case. There were no instances of osteitis or septic arthritis, rotational de

### 3. Discussion

Over the past 20 years, pediatric orthopedic surgeons have tried a variety of methods to treat pediatric lower limb fractures to avoid prolonged immobilization and complications. Each method has had its own complications: spica cast immobilization alone or following traction had resulted in limb-length discrepancy, angulations, rotational deformity, psychological and economic complications<sup>[5, 6]</sup>. External fixation had resulted in pin-tract infection, loss of knee range of motion, delayed union, non-union, and refracture after fixator removal<sup>[7, 8]</sup>. Solid antegrade intramedullary nailing had resulted in avascular necrosis of the femoral head, trochanteric epiphysiodesis, and coxa valga.

The ideal device to treat paediatric femoral and/or tibial fractures should be a simple, load sharing internal splint, allowing early mobilization while maintaining length and alignment for several weeks until bridging callus forms, without endangering the blood supply to the epiphysis<sup>[1, 2]</sup>. TENs has all the above properties and thus serves as the ideal implant for pediatric femoral fractures. TENs fixation was used as early as 1982 by French surgeons; one of the main criticism was the cost of treatment.

Buechsenschuetz *et al*<sup>[2]</sup> in their study including 71 femoral shaft fractures in 68 patients compared clinical and functional results of 90-90 traction and spica casting with elastic stable intramedullary nail found no difference between the two groups for standard clinical/functional criteria but elastic nailing group was associated with a lower overall cost than traction and casting group also it resulted in better scar acceptance, and higher overall parent satisfaction.

Ligier *et al.*<sup>[9]</sup> and Flynn *et al.*<sup>[1]</sup> in their studies have reported that TENs can give rotational stability if good care is taken intra-operatively during nail insertion and postoperatively, especially for comminuted, spiral, and long oblique fractures.

Notable advantages of this technique are early union due to micro-motion at fracture site, early mobilization, early weight bearing, scar acceptance and high patient and parent satisfaction rate. Besides these TENs due to its retrograde entry do not injure or affect either the epiphysis or the blood supply to femoral head. The excellent biocompatibility and elasticity of titanium have further enhanced the utility of TENs. More importantly elasticity promotes callus formation by limiting stress shielding thus leading to early weight bearing and faster union.

### 4. Conflict of Interest

Not available

### 5. Financial Support

Not available

### 6. References

- Shannak AO. Tibial fractures in children: Follow-up study. *J Pediatr Orthop.* 1988;8:306-310. DOI: 10.1097/01241398-198805000-00010. [PubMed] [CrossRef] [Google Scholar]
- Siegmeth A, Wruhs O, Vecsei V. External fixation of lower limb fractures in children. *Eur J Pediatr Surg.* 1998;8:35-41. DOI: 10.1055/s-2008-1071116. [PubMed] [CrossRef] [Google Scholar]
- Tolo VT. External skeletal fixation in children's fractures. *J Pediatr Orthop.* 1983;3:435-442. DOI: 10.1097/01241398-198309000-00004. [PubMed] [CrossRef] [Google Scholar]
- Bar-On E, Sagiv S, Porat S. External fixation or flexible intramedullary nailing for femoral shaft fractures in children. *J Bone Joint Surg Br.* 1997;79:975-978. DOI: 10.1302/0301-620X.79B6.7740. [PubMed] [CrossRef] [Google Scholar]
- Carey TP, Galpin RD. Flexible intramedullary nail fixation of pediatric femoral fractures. *Clin Orthop.* 1996;332:110-118. DOI: 10.1097/00003086-199611000-00015. [PubMed] [CrossRef] [Google Scholar]
- Flynn JM, Hresko T, Reynolds RA, Blasier RD, Davidson R, Kasser J. Titanium elastic nails for pediatric femur fractures-a multicenter study of early results with analysis of complications. *J Pediatr Orthop.* 2001;21(1):4-8. DOI: 10.1097/01241398-200101000-00003. [PubMed] [CrossRef] [Google Scholar]
- Metaizeau J. Stable elastic intramedullary nailing of fractures of the femur in children. *J Bone Joint Surg Br.* 2004;86:954-957. DOI: 10.1302/0301-620X.86B7.15620. [PubMed] [CrossRef] [Google Scholar]
- Goodwin RC, Gaynor T, Mahar A, Oka R, Lalonde FD. Intramedullary flexible nail fixation of unstable pediatric tibial diaphyseal fractures. *J Pediatr Orthop.* 2005;25(4):570-576. DOI:10.1097/01.mph.0000165135.38120.ce. [PubMed] [CrossRef] [Google Scholar]
- Kubiak EN, Egol KA, Scher D, Wasserman B, Feldman D, Koval KJ. Operative treatment of tibial shaft fractures in children: are elastic stable intramedullary nails an improvement over external fixation? *J Bone Joint Surg Am.* 2005;87:1761-1768. DOI: 10.2106/JBJS.C.01616. [PubMed] [CrossRef] [Google Scholar]
- O'Brien T, Weisman DS, Ronchetti P, Piller CP, Maloney M. Flexible titanium elastic nailing for the treatment of the unstable pediatric tibial fracture. *J Pediatr Orthop.* 2004;24(6):601-609. DOI: 10.1097/01241398-200411000-00001. [PubMed] [CrossRef] [Google Scholar]
- Salem K, Lindemann I, Keppler P. Flexible intramedullary nailing in pediatric lower limb fractures. *J Pediatr Orthop.* 2006;26(4):505-509. DOI: 10.1097/01.bpo.0000217733.31664.a1. [PubMed] [CrossRef] [Google Scholar]
- Ligier JN, Metaizeau JP, Prevot J, Lascombes P. Elastic stable intramedullary pinning of long bone fractures in

- children. *Z Kinderchir.* 1985;40:209-212. [PubMed] [Google Scholar]
13. Yuan P, Pring M, Gaynor T, Mubarak SJ, Newton PO. Compartment syndrome following intramedullary fixation of pediatric forearm fractures. *J Pediatr Orthop.* 2004;24:370-375. DOI: 10.1097/01241398-200407000-00005. [PubMed] [CrossRef] [Google Scholar]
14. Luhmann S, Schootman M, Schoenecker PL, Dobbs MB, Gordon JE. Complications of titanium elastic nails for pediatric femoral shaft fractures. *J Pediatr Orthop.* 2003;23:443-447. [PubMed] [Google Scholar]
15. Sink E, Gralla J, Repine M. Complications of pediatric femur fractures treated with titanium elastic nails: a comparison of fracture types. *J Pediatr Orthop.* 2005;25:577-580. DOI: 10.1097/01.bpo.0000164872.44195.4f. [PubMed] [Cross Ref] [Google Scholar]

**How to Cite This Article**

Hajam IA, Wani SA, Lone ZA, Butt MF, Malik FH, Deep A. Outcome of percutaneous titanium elastic nailing system for paediatric femur fracture. *International Journal of Orthopaedics and Traumatology.* 2024;6(1):15-18.

**Creative Commons (CC) License**

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.