



# Clinical Study on Management of Diaphyseal Fractures of Femur in Children with Titanium Elastic Nailing System (Tens) at VIMS

<sup>1</sup>Dr. Gagan D J, <sup>2</sup>Dr. ChannabasavannaHegade, <sup>3</sup>Dr. Akshaya, <sup>4</sup>Dr. Anurag Patil, <sup>5</sup>Dr. Ullas Mahesh

<sup>1</sup>Consultant Orthopaedic Surgeon, Roorkee, Uttarakhand, India

<sup>2</sup>Assistant Professor, KLE JGMM Medical College Hubli, Karnataka, India

<sup>3</sup>Senior Resident, Sanjay Gandhi Institute of Trauma and Orthopaedics, Bengaluru, Karnataka, India

<sup>4</sup>Senior Resident, RVM Institute of Medical Sciences and Research Center, Siddipet, Telangana, India

<sup>5</sup>Professor, Department of Orthopaedics, Malla Reddy Medical College, Telangana, India

## Abstract:

**Background:** Management of femoral diaphyseal fracture in the age group of 5-16 years is controversial. The purpose of this study is to demonstrate the effectiveness of intramedullary fixation of femoral shaft fractures by using titanium elastic nailing system (TENS).

**Materials and Methods:** Between November 2018 and November 2019, 20 pediatric patients (12 boys, 8 girls) aged 5-16 years with diaphyseal femoral fractures were treated by retrograde TENS fixation. Fractures were classified according to level of fracture as Proximal 1/3 shaft (n=5) Mid 1/3 shaft (n=13) and Distal 1/3 shaft (n=2). The final results were evaluated by using Flynn's criteria.

**Results:** All fractures were radiologically united at 9-16 weeks' period (mean 12.15 weeks) and full weight bearing was possible in a mean time of 14.15 weeks. According to Flynn's criteria, excellent result was found in 15 patients (75%) and satisfactory in 5 patients (25%). Limb shortening was noticed in 2 cases, varus mal- alignment was in 1 cases.

**Conclusion:** TENS is a safe and effective method for the treatment of pediatric femoral shaft fractures, because it is minimally invasive, relatively easy to use and shows very good functional and cosmetic results.

**Keywords:** Femur, Fracture, Children, Titanium Elastic Nails, Flexible Intramedullary Nailing, Elastic Stable Intramedullary Nailing

DOI Number: 10.48047/nq.2023.21.6.nq23200

NeuroQuantology2023;21(6):2025-2028

## Introduction

Femoral shaft fractures are among the most common major pediatric injuries treated by orthopedic surgeons. They represent 1-2% of all fractures in the pediatric population [1]. Most pediatric fractures are treated conservatively, as nonsurgical management has been the standard care of treatment for youngest children historically, because of rapid healing and spontaneous correction of angulation.

In children 5 years or younger, early closed reduction and application of Spica cast is an ideal treatment for most diaphyseal fracture. In skeletally mature adolescents, use of antegrade solid

intramedullary rod has become standard treatment. But, the best treatment for children between five to sixteen years of age is still debated.

There are several different options for treating femoral shaft fractures in children, including early or immediate application of a hip Spica cast, skeletal or skin traction followed by Spica cast, minimally invasive plate osteosynthesis, elastic intramedullary nailing, external fixation, plate fixation, and internal fixation with the insertion of intramedullary nails [2,3]. Each method has its own set of advantages and disadvantages.

Children managed with traction and Spica cast as a treatment modality has to undergo various adverse

2025



physical, social, psychological and financial consequences, of prolonged immobilization. The risk of certain complications, particularly pin tract infection and re-fractures after external fixation or osteonecrosis with solid nails.

Pediatric diaphyseal femur fractures should be treated by Titanium Elastic Nailing System (TENS) in children over three years of age, even complex spiral fractures as long as sufficient stability can be achieved. This results in rapid recovery and rehabilitation and avoids prolonged immobilization [4]. Titanium Elastic Nailing System (TENS) meets all the criteria of minimally invasive bone surgery: shorter operating time, minimal soft tissue dissection, smaller incisions and thus smaller scars, less pain, earlier mobilization and relative easy implant removal [5].

Titanium Elastic Nailing System (TENS) of long bone fractures in the skeletally immature has gained widespread popularity because of its clinical effectiveness and low risk of complications. Many studies have supported the use of this technique in the femur, citing advantages that include closed insertion, preservation of the fracture hematoma, and a physeal-sparing entry point [6,7,8]. The

purpose of this study was to present our results following fixation of femur shaft fractures with titanium elastic nailing system.

**Methodology**

**Source of Data**

The proposed study is a hospital based prospective study centered in VIMS Ballari, during the period from November 2018 to November 2019.

**Method of Collection of Data**

The complete data is collected from the children in a specially designed Case Record Form (CRF) by taking history of illness and by doing detailed clinical examination and relevant investigations.

Finally, after the diagnosis the children are selected for the study depending on the inclusion and exclusion criteria. Post operatively all the cases are followed until fracture union occurred for the minimum period of 6 months to 12 months. Results were analyzed both clinically & radiologically.

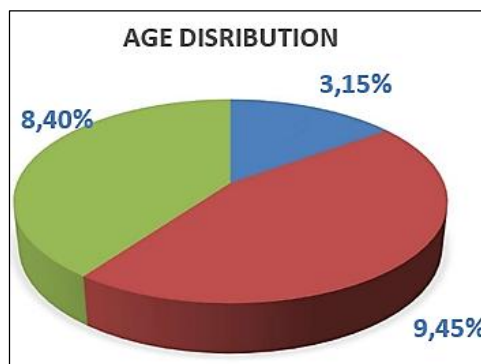
**Results**

**Study Design:** An outcome surgical study with 20 patients with Diaphyseal fractures is undertaken to study the outcome of Titanium elastic nails fixation in femur.

2026

**Table 1: Age distribution of patients**

Age in years	Number of patients	%
5-8	3	15
9-12	9	45
13-16	8	40
<b>Total</b>	<b>20</b>	<b>100.0</b>



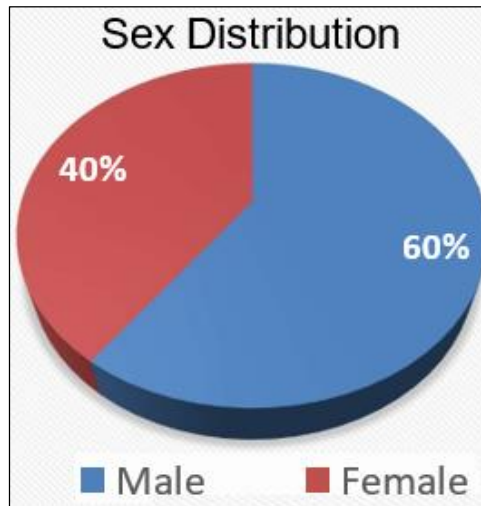
**Pi-Chart 1: Age Distribution**

In the present study 3(15%) of the patients were 5-8 years, 9 (45%) were 9 to 12 years and 8(40%) were

13 to 16 years' age group.

Gender	Number of patients	%
Male	12	60.0
Female	8	40.0
<b>Total</b>	<b>20</b>	<b>100.0</b>





Pi-Chart 2: Sex Distribution

In our study there were 8(40%) girls and 12(60%) boys in the present study. The sex incidence is comparable to other studies in the literature.

#### 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.

The ideal device to treat paediatric femoral 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. TENs has all the above properties and thus serves as the ideal implant for pediatric femoral fractures.

#### Age Incidence

In the present study 3(15%) of the patients were 5-8 years, 9 (45%) were 9 to 12 years and 8(40%) were 13 to 16 years' age group with the average age being 11.85 years which is comparable to that of previous studies done by Bhuyan B *et al.* studied children ranged from 5-16 years with a mean of 10.5 years<sup>9</sup>. Pogorelić Z *et al.* studied children ranged from 3- 17 years with a mean of 9 years<sup>10</sup>.

#### Sex Incidence

There were 8(40%) girls and 12(60%) boys in the present study. The sex incidence is comparable to other studies in the literature.

In their study Bhuyan B *et al.* out of 40 cases, had 31(77.5%) boys and 9 (22.5%) girls<sup>9</sup>. In their study, Pogorelić Z *et al.* out of 103 patients, there were 76(73.79%) male and 27 (26.21%) females.<sup>10</sup>

#### Mode Of Injury

In the present study RTA was the most common mode of injury accounting for 13 (65.0%) cases, self-fall accounted for 4 (20.0%) cases and fall from

height accounted for 3 (15%) of the cases.

Bhuyan B *et al.*, in their study consisting of 40 cases, 28 (70%) were following RTAs, and 12 (30%) were as a result of fall from height.

Pogorelić Z *et al.*, in their study assessing 103 cases, 49 (47.57%) were following RTAs, 4(3.8%) were following self-fall and remaining 33(32.03%) were as a result of fall from height.<sup>10</sup>

#### Pattern of Fracture

In our study, transverse fractures accounted for 4(20.0%) cases, oblique fractures-9(45.0%), spiral fractures-6 (30.0%) and comminuted fractures-1(5.0%). There were no segmental fractures.

In a study by Bhuyan B *et al.* out of 40 femoral fractures studied 11 (27.5%) were transverse fractures, comminuted fractures-5 (12.5%), oblique fractures-15(37.5%), spiral fractures-9 (22.5%) and there were no segmental fractures.<sup>9</sup>

#### Level of Fracture

Fractures involving the middle 1/3rd accounted for 13 (65.0%) cases, proximal 1/3<sup>rd</sup>-5 (25.0%) and distal 1/3<sup>rd</sup>-2(10.0%) fractures in our study.

In their study Bhuyan B *et al.* among 40 femoral shaft fractures, 10(25.0%) fractures were in the proximal 1/3<sup>rd</sup>, 26(65.0%) in the middle 1/3<sup>rd</sup> and 4 (10.0%) were in the distal 1/3<sup>rd</sup>.<sup>9</sup>

#### Time Interval Between Trauma and Surgery

In the present series, 3 (15.0%) patients underwent surgery within 2 days after trauma, 11(55.0%) in 3-4 days, 5(25.0%) in 5-7 days and 1(5.0%) patients after 7 days. Among 1 cases in which duration was more than 7 days-one was case no.8-operated 10 days after trauma (admission) as patient had associated pelvic fracture on same side at the time of trauma.

Another case was case no. 5-operated 7 days after trauma (admission) as the patient had head injury and was treated conservatively & surgery was done once she was stable.

2027



Average duration between trauma and surgery was 4.1 days in our study. In their study Bhuyan B *et al.* average duration between trauma and surgery was 3.8 days.

### Summary

Twenty patients with diaphyseal fractures of the femur in children were treated with titanium elastic nailing between NOVEMBER 2018 to NOVEMBER 2019 at VIMS Hospital, Ballari.

Children and adolescents aged between 5 to 16 years were included in the study. 15% of patients were between 5-8 years, 45% were between 9-12 years and 40.0% were between 13 to 16 years' age group with the average age being 11.85 years.

60% of the patients were boys and 40% girls. RTA was the most common mode of injury accounting for 13 (65.0%) cases followed by self-fall-4 (20.0%) and fall from height-3(15.0%).

Transverse fractures accounted for 4(20.0%) cases, oblique fractures-9(45.0%), spiral fractures-6(30.0%) and comminuted fracture-1(5.0%).

Fractures involving the middle 1/3rd accounted for 13 (65.0%) cases. All the patients were prepared and operated as early as possible once the general condition was stable and the patient was fit for surgery.

### Conclusion

Based on our experience and results, we conclude that TITANIUM ELASTIC NAILING SYSTEM technique is an ideal method for treatment of pediatric femoral diaphyseal fractures. It gives elastic mobility promoting rapid union at fractures site and stability which is ideal for early mobilization. It has lower complication rate, good functional outcome when compared with other methods of treatment.

TENS is a simple, easy, rapid, reliable and effective method for management of paediatric femoral fractures between the age of 5 to 16 years, with shorter operative time, lesser blood loss, lesser radiation exposure, shorter hospital stay, and reasonable time to bone healing.

In our study we observe that early weight bearing, rapid healing and minimal disturbance of bone growth concludes TENS may be considered as more biological method of treatment.

Use of TENS for definitive stabilization of femoral shaft fractures in children is a reliable, minimally invasive, and physeal-protective treatment method. Our study results provide new evidence that expands the inclusion criteria for this treatment and shows that TENS can be successfully used regardless of fracture location and fracture pattern.

### References

- [1] Loder RT, O' Donnell PW, Finberg JR. Epidemiology and Mechanism of Femur Fracture in Children. *J PediatrOrthop.* 2006; 26(5):561- 566.
- [2] Rapp M, Kaiser MM, Grauel F, Gielok C, Illing P. Femoral shaft fractures in young children (<5 years of age): Operative and Non-operative treatments in clinical practice. *Eur J Trauma Emerg Surg.* 2016; 42(6): 719- 724.
- [3] Khan JA, Singh GP, Pandey A. Outcome of Titanium Elastic Intramedullary Nail in the Treatment of Shaft of Femur Fracture in Children. *Kathmandu Univ Med J (KUMJ).* 2015;13(51):195-9.
- [4] Kaiser MM, Zachert G, Wendlandt R, Eggert R, Stratmann C, Gros N, *et al.* Increasing stability by pre-bending the nails in elastic stable intramedullary nailing: a biomechanical analysis of a synthetic femoral spiral fracture model. *J Bone Joint Surg Br.* 2012;94(5):713-8. 2028
- [5] Pogorelić Z, Kadić S, Milunović KP, Pintarić I, Jukić M, Furlan D. Flexible intramedullary nailing for treatment of proximal humeral and humeral shaft fractures in children: A retrospective series of 118 cases. *OrthopTraumatol Surg Res.* 2017;103(5):765-770.
- [6] Carey TP, Galpin RD. Flexible intramedullary nail fixation of pediatric femoral fractures. *Clin Orthop.* 1996 332:110–118.
- [7] Flynn JM, Hresko T, Reynolds RA, Blasler 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.
- [8] Metaizeau J. Stable elastic intramedullary nailing of fractures of the femur in children. *J Bone Joint Surg Br.* 2004; 86: 954–957.
- [9] Bhuyan B, Singh S. Titanium elastic nailing in pediatric femoral diaphyseal fractures in the age group of 5-16 years: A short term study. *Journal of Clinical Orthopaedics and Trauma.* 2014;5(1):203-210.
- [10] Pogorelić Z, Vodopić T. Elastic Stable Intramedullary Nailing for Treatment of Pediatric Femoral Fractures: A 15-Year Single Centre Experience. *Bull Emerg Trauma* 2019;7(2):169-175.

