

# Evaluation of Functional Outcome of Titanium Elastic Nail (TENS) in Femoral Shaft Fracture in Children

Khajotia B.L.<sup>1\*</sup>, Sharan Sunil<sup>2</sup>, Bhamboo Ravindra Singh<sup>2</sup>

<sup>1</sup>Professor & Head, <sup>2</sup>PG Resident (IIIrd Year),  
Department of Orthopaedics, S.P. Medical College, Bikaner, Rajasthan, India.

## ABSTRACT

**Introduction:** Diaphyseal Fractures of the femur in children are common orthopaedic problem. The traditional method of treatment was hip spica casting, but in last two decades there have been a shift in the trend towards surgical fixation using titanium elastic nail. The aim of the study is to report our experience in TENS nailing for femur fractures and to compare with similar studies.

**Material & Methods:** This study included 25 children in the age group of 6-15 who underwent TENS nailing for femur shaft fractures between September 2015 to August 2016 in the department of orthopaedics, S.P. Medical College & Associated Group of Hospitals, Bikaner.

**Results:** 21 patients had excellent Flynn score and 4 had satisfactory results. There were no cases of nonunion or delayed union and implant failure. The mean time for full weight bearing was 6.9 week. Hospital stay was a mean of 12 days. Only 5 patients had superficial infection which subsided with appropriate antibiotics.

**Conclusion:** From our experience we found that TENS nailing in paediatric femur shaft fractures is a safe easy reliable

surgery and satisfactory mode of treatment. It avoids the chances of physeal injury, infection and offers rapid healing. It helps in early mobilisation of the patients and independent weight at the earliest. Our study also reported very few complications. Most of the complication can be avoided when nailing is done in the right technique.


**Key words:** Titanium Elastic Nail, Pediatric Femur Fracture.

## \*Correspondence to:

Dr. Khajotia B.L.,  
Professor & Head, Department of Orthopaedics,  
S.P. Medical College, Bikaner, Rajasthan, India.

## Article History:

Received: 06-05-2017, Revised: 24-05-2017, Accepted: 07-06-2017

Access this article online	
Website: <a href="http://www.ijmrp.com">www.ijmrp.com</a>	Quick Response code 
DOI: 10.21276/ijmrp.2017.3.4.013	

## INTRODUCTION

Femoral shaft fractures represent approximately 1.6% of all bony injuries in children (Rockwood and Wilkins). Fractures of femoral shaft in children have been traditionally treated by immobilization in a spica cast, either immediately or after a period of traction. Surgical treatment was limited to open fracture or patient with head injury or multiple injuries.<sup>1</sup>

Conservative treatment necessitates a long stay in hospital for traction and subsequent immobilization in an uncomfortable cast. This treatment is not well tolerated specially in adolescence.<sup>2</sup> Operative treatment results in shorter hospitalization and easy mobilization, which has psychological, social, educational and economic advantages over conservative treatment. More recently there has been a growing trend towards surgical treatment with widening of the indication to include isolated femoral fractures. To some extent this reflects a more interventionist attitude among orthopaedic surgeon but is also due to technical development, notably that of elastic stable intramedullary nailing (ESIN).<sup>3</sup> Operative treatment of femoral shaft fractures is seldom considered for patients less than 5 years of age in whom early reduction and immobilization in a spica cast often are possible

without lengthy hospitalization and complication. A variety of therapeutic alternatives such as external fixator compression plating, rigid intramedullary nailing and elastic stable intramedullary nailing are being used for femoral shaft fractures in children.

With the use of external fixator, there is a high incidence of pin tract infection, refracture after removal of external fixator & stiffness of the knee joint. Also the external fixator is more uncomfortable and difficult for the child.

Compression plating needs two major operations and usually is associated with big scar formation.<sup>4</sup> The device would also allow rapid healing & ability to remodel without risking the physes or blood supply to the femoral head. Elastic Stable Intramedullary Nailing (ESIN) meets the requirements of this ideal device.<sup>5</sup>

Intramedullary titanium elastic nailing is rapidly emerging technique of femoral shaft fracture fixation in children. It involves the insertion of one or two titanium nails into medullary canal to provide stable fixation. The fixation is not rigid but allows enough stress at fracture site to encourage abundant callus formation and promote healing.

The Titanium elastic nail seems advantageous over other surgical methods particularly in the age group of 5-16 because it is simple, a load sharing internal splint that doesn't violate the physis, allows early mobilization and maintains alignment. Micro motion 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, thereby less risk of infection.

## MATERIAL AND METHODS

This study was conducted in the department of orthopaedics S.P. Medical College & Associated Group of Hospitals, Bikaner, patients treated during August 2015 to October 2016. This study included a minimum of 25 cases of diaphyseal fractures of femur

treated with titanium elastic nail. All children's were operated by retrograde titanium elastic nail making an entry with AWL about 2-2.5 cm above the physis in both medial and lateral side and received antibiotics. The nails were pre bend before introducing so that apex of both nails rest at fracture site. Postoperatively advised for non-weight bearing with range of motion exercises and partial to full weight bearing was gradually started after 6 weeks taking in view of pain relief and callus formation radiologically. The patients were followed up at intervals of 2, 6, 12 & 24 weeks. During follow up these patients were evaluated clinically by Flynn's scoring criteria and radiologically for union and callus formation.

**The size of nails was selected using Flynn's formula:**

**Nail diameter = 80% of canal diameter / 2**

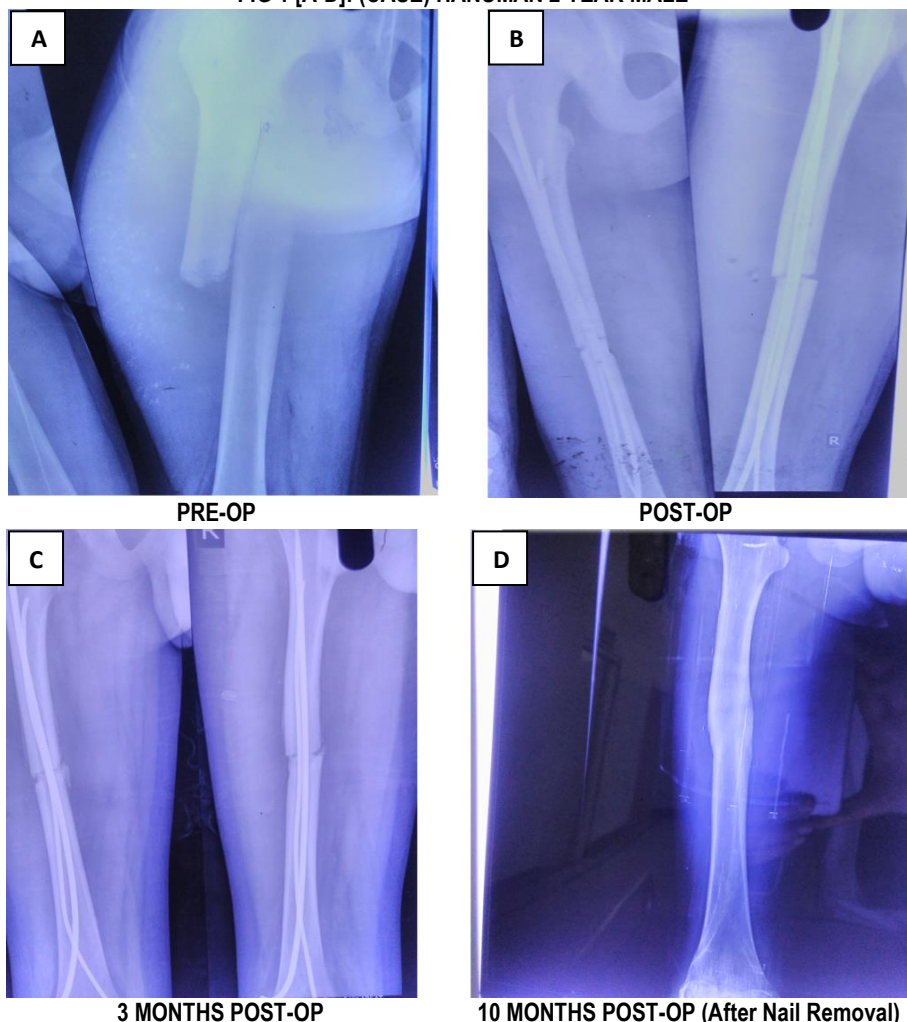
**Table 1: Flynn's scoring criteria.**

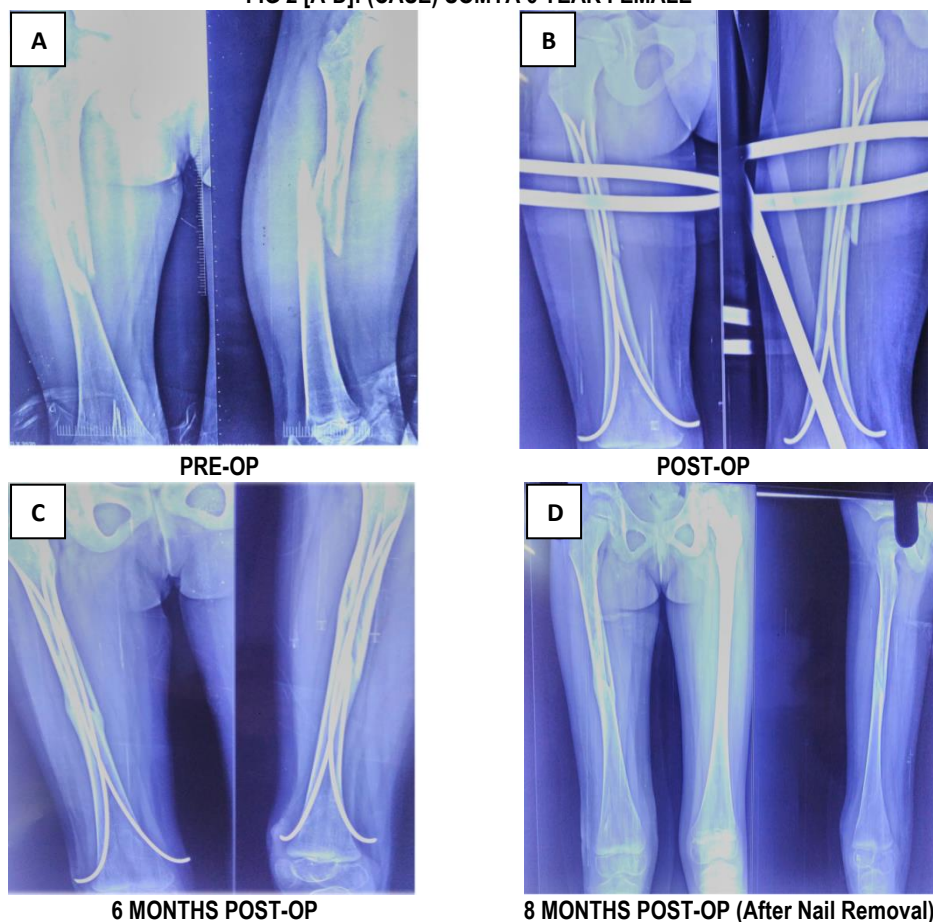
	Excellent	Satisfactory	Poor
<b>Limb length discrepancy</b>	<1cm	<2cm	> 2cm
<b>Angulation in degree</b>	<5	5-10	>10
<b>Pain</b>	Absent	Absent	Present
<b>Complication</b>	Absent	Mild	Major/extended period for resolvable morbidity

**Table 2: The Final Results of Flynn's Criteria**

Outcome	No. of cases	Percentage
<b>Excellent</b>	21	84
<b>Satisfactory</b>	4	16
<b>Poor</b>	0	0

**FIG 1 [A-D]: (CASE) HANUMAN 2 YEAR MALE**



**FIG 2 [A-D]: (CASE) SOMYA 6 YEAR FEMALE**


## RESULTS

There were total 21 male patients and 4 female patients. The youngest patient was 6 yr. old & the eldest patient was 15 yr. old with an average age of 10.6 yr. Nearly two third of cases (60%) were due to road traffic accident. Majority of the cases (92%) were closed injury. Most common site of fracture was middle third (48%). Most common pattern of fracture was transverse (52%). Average duration lag between time of injury & definitive management was 6 days. Open reduction was required in 12 % cases. In 96% cases two nails were used to fix the fractures. In majority of patients both medial and lateral entry portal was used. The average hospital stay was 12.2 days. Time of union ranged from 6-12 wk with an average duration of 6.9 wks. The average period of full weight bearing was 6.9 wks.

Majority of patients (80%) had full range of knee movement upto 12 wks. Shortening was seen in 5 (20%) patients. In majority of the patients (3 case), shortening was 1 cm while in 2 patients shortening was 1.5 cm. Out of the 5 patients in which shortening was seen, 4 patients was less than 10 yr. age old. Angulation was seen in 8 patients. In 4 cases angulation was 5° while in 4 cases angulation was 10°. The commonest complication encountered in this series was soft tissue inflammation at nail insertion site in 2 (8%) cases, followed by superficial infection in 1 (4%) cases & skin ulceration at nail insertion site in 2 (8%) cases. (Table 1) The final result as evaluated by Flynn criteria showed that among a total of 25 cases, 21 (84%) had excellent results & 4 (16%) had satisfactory results. No patient showed poor results. (Table 2)


**FIG 3 [A,B]: RANGE OF MOVEMENT AT FINAL FOLLOW UP**

## DISCUSSION

Fractures of femoral shaft in children have been traditionally treated by immobilization in a spica cast, either immediately or after a period of traction. More recently there has been a growing trend towards surgical treatment for pediatric femoral shaft fractures. A variety of therapeutic alternatives such as external fixator, compression plating, rigid intramedullary nailing & ESIN& TENS are being used for femoral shaft fractures in children.

The average age of the patients was 10.6 yrs. This age group was greater than the mean age of 8.5 yrs. in study conducted by Cramer et al (2000)<sup>6</sup>, 9.5 years in study conducted by Flynn et al (2001)<sup>5</sup> and 10 yrs. in study conducted by Ligier et al (1988)<sup>7</sup>, but lesser than the study conducted by Mann et al (1986)<sup>8</sup> where the mean age group was 12.7 years.

In our series, road traffic accidents, accounted for the highest incidence of these injuries (60%), followed by fall from height (36%). Similar high percentages of these injuries were seen in study of Mann et al (1986).<sup>8</sup> Cramer et al (2000)<sup>6</sup> also noted a high incidence of road traffic accidents resulting in these fractures accounting for 75% of all the cases included in his series.

In our series the most common site of fracture shaft femur was middle third (48%) followed by upper third (40%) & distal third (12%). This incidence was similar to the study conducted by Flynn et al (2001)<sup>5</sup> (Middle third shaft femur fractures 72%) & Cramer et al (2000)<sup>6</sup> (Middle third shaft femur fractures 70%). In our series the most common pattern of fracture was transverse fracture (52%) followed by oblique fractures (44%). This was similar to the study conducted by Cramer et al (2000)<sup>6</sup> (Transverse fracture 60%) & Mann et al<sup>8</sup> (Transverse fracture 56%).

The average hospitalization time noted in this series was 12.2 days. This prolonged hospitalization time reflected the delay in management of the patients operated electively. Similar average hospitalization time of 8 days was noted in the study conducted by Kissel et al (1989).<sup>9</sup> But this hospitalization time was prolonged because of associated injuries as children without associated injuries were usually treated by conservative methods. Galpin et al (1994)<sup>10</sup> also noted hospitalization time of 5 days for isolated femoral fractures and prolonged hospitalization time for patients with associated injuries. This was in contrast to study conducted by Ligier et al (1988)<sup>7</sup> who noted the average hospitalization time of 4.6 days.

The average time of full weight bearing was 6.9 wks. The average time of full weight bearing in study conducted by Flynn et al (2001)<sup>5</sup> was 8.5 wks, while that in study conducted by Mann et al (1986)<sup>8</sup> was 8.6 weeks.

The average follow up duration was 7.2 months with minimum of 6 months & maximum of 15 months.

The average time of union was 6.9 wks. In the study conducted by Galpin et al (1994)<sup>10</sup> the average time of union was 9.1 wks. In the study conducted by Cramer et al (2000)<sup>6</sup> all fractures were healed within 12 weeks. As in Flynn, Mann, Cramer & other studies, in our study too there was no case of delayed union & nonunion.

In our study Shortening was seen in 5 (20%) patients. In 3 patients shortening was 1 cm while in 2 patients Shortening was 1.5 cm with an average shortening of 2.4mm. In the study conducted by Ligier et al (1988)<sup>7</sup>, the average lengthening was 1.2 mm while in the study conducted by Cramer et al (2000)<sup>6</sup> the average lengthening was 7 mm. However no lengthening was

seen in study conducted by Mann et al (1986)<sup>8</sup> & Bar on et al (1997).

Angulation was seen in 8 (32%) patients in this study. No patient had angulation of more than 10°. Angulation of >5° was seen in the study conducted by Flynn et al (2001)<sup>5</sup> in 10.2% cases, Ligier et al (1988)<sup>7</sup> in 22.4%. In Mann et al (1986) in 31% cases.

Skin irritation at the entry portal due to prominent nail was noted in 2 cases (8%) in this study. In 2 cases it resulted in skin ulceration. Similar result was seen in the study conducted by Flynn et al (2001)<sup>5</sup> who noted this complication in 6.8% of cases. Ligier et al (1988)<sup>7</sup> who reported the incidence of skin irritation by prominent nails in 10.5% of cases. one patient in this study was found to have infection at the entry portal of the nails, which subsided by 4 weeks after antibiotic therapy. Similar complication was seen in study conducted by Ligier et al (1988)<sup>7</sup> who noted in one case (0.8%). No infection was reported by Mann et al (1986).<sup>8</sup>

All cases were assessed by Flynn criteria. We noted excellent results in 18 cases (72%) and satisfactory results in 7 cases (28%). No patient showed poor result. In the study conducted by Flynn et al (2001)<sup>5</sup> excellent results were seen in 38 cases (65.5%), satisfactory results in 18 cases (31.3%) and poor results in 1 case (1.7%). In the study conducted by Galvankar and Patond (2004)<sup>11</sup> excellent results were seen in 15 patients (71%), satisfactory results in 5 patients (24%) and poor results in one patient (5%).

## CONCLUSION

Finally we conclude that TENS is an ideal device to treat pediatric femoral shaft fractures TENS is a simple, safe, minimal invasive technique, has fewer complications, does not interfere with growth & blood supply of femoral head, leads to non-interference of fracture hematoma, minimal periosteal stripping and rapid bone healing.

It is associated with shorter hospital stay, rapid return to daily activity & school, avoids long & uncomfortable immobilization & cosmetic damage is minimal being limited to small scars at the sites of introduction of nails.

## REFERENCES

1. Bar-On E, Sagiv S, Porat S. External fixation or flexible intramedullary nailing for femoral shaft fracture in children. *J Bone Joint Surg Br.* 1997 Nov; 79(6):975-8.
2. Metaizeau, J.P. Stable elastic intramedullary nailing for fracture of the femur in children. *J Bone Joint Surg (Br.)* 2004; 86-B: 954-957.
3. Barry M & Paterson JMH. Flexible intramedullary nails for fracture in children. *J Bone Joint Surg (Br.)* 2004; 86-B: 947-953.
4. Linhart WE, Roppasch A. Elastic stable intramedullary nailing for unstable femoral fractures in children: preliminary results of a new method. *J Trauma* 1999; 47: 372-8.
5. Flynn JM, Hresko T, Reynolds RAK, Blasier RD, Davidson R, Kasser M. Titanium elastic nails for pediatric femur fractures: a multicenter study of early results with analysis of complications *J Pediatr Orthop* 2001;21:4-8.
6. Cramer KE, i'oinetta F, Spero C, Alters S, Moraijakbar H, ieeffy J. Ender Rod fixation of femoral shaft fractures in children. *Clin Orthop* 2000;376:119-123.

7. Ligier JN, Metaizeau JP, Prevot J, Lascombes P. Elastic stable intramedullary nailing of femoral shaft fractures in children. J Bone Joint Surg 1988; 70B: 74-77.
8. Mann DC, Weddington J, Davenport K. Closed Ender nailing of femoral shaft, fractures in adolescents. J Pediatr Orthop 1986; 6: 651-655.
9. Kissel EU, Miller ME. Closed ender nailing of femur fractures in older children. J Trauma 1989; 29:1585-1588.
10. Galpin AD, Wills RB, Sabano N. Intramedullary nailing of pediatric femoral fractures. J Pediatr Orthop 1994; 14 (2): 184-9.
11. Galvenkar A and Patond K R. Elastic stable intramedullary fixation of pediatric femoral fractures: An alternative to titanium nails. Delhi, Journal of orthopaedics 2004; 1: 59-62.

**Source of Support:** Nil.

**Conflict of Interest:** None Declared.

**Copyright:** © the author(s) and publisher. IJMRP is an official publication of Ibn Sina Academy of Medieval Medicine & Sciences, registered in 2001 under Indian Trusts Act, 1882. This is an open access article distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Cite this article as:** Khajotia B.L., Sharan Sunil, Bhamboo Ravindra Singh. Evaluation of Functional Outcome of Titanium Elastic Nail (TENS) in Femoral Shaft Fracture in Children. Int J Med Res Prof. 2017; 3(4):59-63. DOI:10.21276/ijmrp.2017.3.4.013