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## A study on management of paediatric femoral diaphyseal fractures with TENS in children and adolescents at tertiary care centre

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### Abstract

**Introduction:** Femoral diaphyseal fractures constitute 1.6% of all paediatric bony injuries. The choice of treatment modality based on the age of the patient, type of fractures, fracture site diameter of intramedullary canal, the severity of the injury, and surgeon's preference. Titanium elastic nailing (TENS) is becoming popular treatment for femur diaphyseal fractures in children and adolescents. The objective of the study was analyzing the clinical profile of the patient and assessing the results of titanium elastic nailing as a primary procedure in femoral diaphyseal fractures.

**Methods:** In a prospective study of 34 patients, aged 6 to 16 years with fracture shaft of femur were treated with Titanium Elastic Nailing (TENS) at Basaveshwara Medical College and Hospital, Chitradurga, Karnataka from July 2012 to June 2015.

**Results:** In this study 20 patients (58.82%) were between 9-12 years of age with mean age being 10.2 years. There were 21 (61.76%) boys and 13 (38.24%) girls. Road traffic accidents constituted for 24 (70.58%) of the patients. Middle 1/3<sup>rd</sup> of the femur shaft was affected in 22 (64.70%) cases. Transverse fractures accounted for 20 (58.82%) cases, Oblique fractures in 8 (23.53%) cases and spiral fractures in 6 (17.65%) cases. Most of the cases were stabilized with two 2.5 mm, 3 mm and 3.5mm titanium nails. Duration of operation was between 52- 120 mins. Time for clinical and radiological union of fracture was between 10 to 12 weeks.

**Conclusion:** Titanium elastic nailing (TENS) of femoral diaphyseal fractures in paediatric age group (6-16 years) is the best and effective method of surgical treatment.

**Keywords:** Paediatric, femur, diaphyseal fractures, intramedullary nail, TENS

### Introduction

Paediatric femur diaphyseal fractures are common injuries of lower extremity which require hospital admission. Femoral diaphyseal fractures constitute 1.6% of all paediatric bony injuries [1]. The choice of treatment modality based on the age of the child, type of fractures, fracture site diameter of intramedullary canal, the severity of the injury, and surgeon's preference. Management of femur diaphyseal fractures include fixed traction, spica casting, external fixation, and internal fixation in the form of plating, flexible and rigid intramedullary nails. Surgical management with titanium elastic nailing (TENS) is becoming popular treatment for femur diaphyseal fractures in children and adolescents. This is because of rapid functional recovery, early mobilization and discharge from the hospital [2].

Titanium elastic nail fixation is thought to be load sharing device which helps in maintaining reduction. This fixation allows micro motion at fracture site which helps in callus formation. Introduction of the nails is easy to perform in the femur because wide intramedullary canal of femur [3]. TENS fixation is found to have reduced post-operative complications which may occur in conservative management. Complications like risk of joint stiffness, prolonged immobilisation and delayed functional recovery are not seen in surgical treatment with TENS [4].

The main objective of the study was to analyze the clinical profile of the patient and evaluation of titanium elastic nailing in femoral diaphyseal fractures in children and adolescents.

### Materials and Methods

A prospective study of 34 patients, aged 6 - 16 years with femoral diaphyseal fracture were treated with Titanium Elastic Nailing (TENS) at Basaveshwara Medical College and Hospital,

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Chitradurga, Karnataka from July 2012 to June 2015. Postoperatively follow up checkups were done at 1<sup>st</sup> month, 2<sup>nd</sup> month, 3<sup>rd</sup> month and at 6 months. The children aged between 6 – 16 years, with stable diaphyseal femoral shaft fractures, closed and type I open fractures, patients fit for proposed surgery were included. Patients who were not willing to give consent, with type I and type III open fractures, with comminuted fractures, with metaphyseal fractures and pathological fractures were excluded from the study.

As soon as the patients were arrived to emergency department the patients were initially evaluation with airway, breathing, circulation, disability, exposure (ABCDE) approach. Resuscitative measures were taken which include IV fluids, continuous oxygen inhalation, fracture splintage with Thomas splint or skin traction, and monitoring for untoward complications like fat embolism and hypotension. Type I Wounds were washed thoroughly and antibiotics, analgesics, blood transfusion given as needed. Detail patient's history in relating to age, sex, mode of injury, and associated illness was taken. X-ray of AP and lateral views of affected femur including hip and knee were taken. Routine blood investigations were done. Once the general condition was stable patients were operated with titanium elastic nailing (TENS). Intra operative findings and post-operative follow up check-up findings were recorded as per Proforma. Follow ups were done at 1<sup>st</sup> month, 2<sup>nd</sup> month, 3<sup>rd</sup> month and at 6 months. Patients were assessed clinically and radiologically findings. Functional evaluation of each patient was done as per Flynn Titanium elastic Nail scoring system. The data thus collected was compiled and analysed using Statistical package for social services (SPSS vs 20).

### Results

In this study, 20 patients (58.82%) were between 9-12 years of age, followed by 8 (23.52%) patients were between 12- 16 years and 6 (17.65%) patients in 6 to 9 years. The mean age was 10.2 years. There were 21 (61.76%) boys and 13 (38.24%) girls. Road traffic accidents constituted for 24 (70.58%) patients and self-fall while playing in 10 (29.41%) patients. Right femur was fractured in 22 (64.71%) patients and left femur in 12 (35.29%) patients. Middle 1/3rd of the femur shaft was affected in 22 (64.70%) cases, proximal 1/3rd in 9 (26.47%) patients and 3 (8.83%) patients at distal 3<sup>rd</sup> of femur. 32 (94.12%) patients had closed fractures and 2 (5.88%) were open fractures (Gustilo type I). Transverse fracture seen in 20 (58.82%) cases, 8 (23.53%) were oblique and 6 (17.65%) were spiral.

In this series, 30 (88.23%) patients had closed reduction and in 4 (11.77%) patients, fracture site had to be opened to achieve reduction. We used 2 mm nails in 2 cases (58.82%), 2.5mm diameter nails in 8 (23.53%) fractures of femur. 3 mm diameter nails used in 11(32.35%) patients. 7 (20.59%) fractures were fixed with 3.5mm nails and 6 (17.65%) fractures were stabilized with 4mm diameter nails. Total duration of operation including anesthesia was ranged between 52- 120 mins. Average time was 82 mins. Time for clinical and radiological union of fracture was between 10 to 12 weeks. 3 cases had intraoperative skin bruises due to pressure from the inserter. Nail entry site pain and irritation due to protruded nail was seen in 5 cases during Postoperative period. Malunion was observed in 2 cases.

### Discussion

Management of paediatric diaphyseal fractures is still controversial. Surgical management with titanium elastic

nailing (TENS) is becoming popular treatment for femur diaphyseal fractures in children and adolescents. This is because of rapid recovery, early mobilization and discharge from the hospital. Maximum numbers of cases were observed in 9-12 years. Mean age is 10.2 years. The age group of our study is compared with that of other studies [5-7]. There were 21 (61.76%) boys and 13 (38.24%) girls in the present study. Road traffic accidents constituted for 24 (70.58%) patients and fall while playing in 10 (29.41%) patients. The commonest mode of injury of our study is compared with other studies [8-10]. In this study, 32 (94.12%) cases were closed fractures and 2 (5.88%) cases were open fractures of Gustilo type I. The type of fractures in our study is compared with that of other studies [8, 11, 12]. In this series, middle 1/3rd of the shaft was involved in 22 (64.70%) cases and proximal 1/3rd in 9 (26.47%) cases and 3 (8.83%) cases at distal 3<sup>rd</sup>. The site of fractures of this study is compared with other studies [6, 11, 13]. Most of fracture pattern was transverse type in 20 cases followed by oblique type in 8 cases. The fracture pattern distribution in this study can be compared with that of other studies [10, 13, 14].

### Type of reduction

There were total 34 cases, of which 30 (88.23%) fractures were reduced by close technique, 4 (11.77%) fractures had to be open for reduction of fracture where difficulty was encountered during nail entering to the proximal fragment. Titanium nail introduced by retrograde method in 31 (91.18%) cases antegrade method in 3 (8.82%) cases because fracture in the distal 3<sup>rd</sup>. Paediatric femoral fractures fixation with titanium elastic nail by retrograde method in 123 patients by Ligier and metaizeau *et al.* (1985) [15]. Heinrich *et al* (1994) reported 64 fractures were stabilized by retrograde method and 12 were by antegrade method in his 78 patient's series. [8] Houshian *et al* (2004) reported 31 femoral fractures stabilized by retrograde method [11].

### Type of nail used

In this study, we used 2mm diameter nails in 2 cases (58.82%), 2.5mm diameter nails in 8 (23.53%) fractures of femur. 3 mm diameter nails used in 11(32.35%) patients. 7 (20.59%) fractures were fixed with 3.5mm nails. 4mm diameter nails were used in 6 (17.65%) cases. Most of fractures were stabilized with 2.5mm, 3mm and 3.5mm nails. Ligier *et al.* (1988) reported 3mm, 3.5mm, or 4mm elastic stable intramedullary nails were used to fixation of femoral diaphyseal fractures [15]. Goodwin *et al.* (2005) used two 4mm TENS in Transverse, oblique, spiral and comminuted paediatrics femoral fractures [16].

### Duration of operation

In this study duration of operation was ranged between 52-120 mins with average time was 82 mins. Houshian *et al* (2004) reported that duration of surgery was ranged about 40-100 mins with average time 60 mins [11]. In the study of Heybeli *et al* (2004), duration of operation was between 25-100 mins [10].

### Type of postoperative immobilization

Physiotherapy exercises were started from first post-operative day. Active hip and knee joint strengthening exercises was started between 3<sup>rd</sup> and 5<sup>th</sup> day. All patients were mobilized with support as soon as pain subsided. Mobilization with partial weight bearing started after 1week. After 3 weeks full weight bearing was started depending on pain at operated

limb. The time for clinical and radiological union of fracture was ranged from 10 to 12 weeks with average time of union was 10.5 weeks. 100% union occurred in all cases<sup>[17, 18]</sup>.

This study achieved excellent results in 22 cases (64.7%), successful in 10 cases (29.41%), and in 2 cases (5.88%) shows poor results. Poor results were seen in 2 cases due to angulations >10°. Flynn *et al* (2002) confirmed 57 cases either excellent or satisfactory results in 58 patients. Heybeli *et al* (2004) found excellent result in 25 (71.4%) patients, satisfactory result in 9 (25.7%) patients and in 1 patient (2.9%) shows poor result.

### Complications

Most common complication observed in our study was pain at nail entry site due to irritation from protruded nail that was seen in 5 cases. Three cases had intraoperative skin bruises due to pressure while putting nail, which recovered well with dressing and medication. Any superficial and deep infection at nail entry site was not encountered in this study. Malunion in terms of varus and valgus angulation was observed in 2 cases. This was significantly associated with the use of smaller diameter of nails and also the site of fracture (distal 3<sup>rd</sup>). External deformities are not seen in these cases. Nascimento *et al* (2010) reported acute complications (6.7%) include migration of a nail in one patient and soft tissue irritation due to protruded nail in other patient<sup>[19]</sup>. They noticed valgus angulation in 12 (40%) patients and varus angulation in 3 (10%) patients. Five degree varus angulation was seen in one patient and average valgus malalignment of 6° seen in 11% of fractures in the study of Heinrich *et al* (1994). Flynn *et al* (2002) noticed 7° average varus angulation in one patient<sup>[5]</sup>.

### Conclusions

This study had shown that titanium elastic nailing provides rapid union, lower complications rate and early mobilization there by reduces absent days in school going children. We conclude that, titanium elastic nailing (TENS) of femoral diaphyseal fractures in paediatric age group (6-16 years) is the best and effective method of surgical treatment.

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