Introduction

Treatment of long bone fractures in children continues to improve as newer techniques evolve. Previously most of the fractures were effectively managed conservatively & only unstable and displaced fractures were taken up for fixation. Although a number of other intramedullary devices like rush nail or enders nail are available for treatment of paediatric long bone fractures, yet these have poor elasticity, rotational stability and require multiple nails to achieve fracture stability.

There is little controversy over the treatment of adult lower limb long bone shaft fractures with intramedullary nail fixation. Similarly, there is little controversy over the treatment of infants and toddlers with femur and tibia shaft fractures by using spica casting, but the treatment of paediatric and adolescent (age 5 to 15 years) femur fractures remains controversial.

Hence there was an evolution in treatment options for this age group for optimum treatment of fractures. Treatment of paediatric fractures dramatically changed in 1982 when Metaizeau and the team from Nancy, France, developed the technique of elastic stable intramedullary nails. The now favoured Elastic internal fixation in the form of flexible intramedullary nails is effective in 34 (68%) cases, satisfactory in 16 (32%) cases and there were no cases of poor outcome. In conclusion Titanium elastic nailing system leads to rapid fracture union by preservation of fracture hematoma and limited soft tissue exposure. It also helps in preventing damage to the physis. Our study confers all the advantages which the previous studies have shown at various institutes and is fairly a simple, reliable technique with a shorter learning curve imparting lot of advantages over other intramedullary techniques or other methods followed for management of pediatric diaphyseal lower limb fractures.

Materials & Methods:

A prospective study of 50 Children and adolescents between the age group of 5-16 years with femur and tibia shaft fractures who were admitted in department of orthopaedics in Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore, meeting the inclusion criteria were selected. During 24 months period from November 2014 to October 2016. In our study, 60% were males & 40% females, 70% femur shaft fractures and 30% tibia shaft fractures. All patients underwent titanium elastic nailing fixation for the femur and tibia fractures. Patients were followed up for a period of 6 months at 4,8,12 and 24 weeks. Functional evaluation using Flynn's criteria showed excellent in 34 (68%) cases, satisfactory in 16 (32%) cases and there were no cases of poor outcome. In conclusion Titanium elastic nailing system leads to rapid fracture union by preservation of fracture hematoma and limited soft tissue exposure. It also helps in preventing damage to the physis. Our study confers all the advantages which the previous studies have shown at various institutes and is fairly a simple, reliable technique with a shorter learning curve imparting lot of advantages over other intramedullary techniques or other methods followed for management of pediatric diaphyseal lower limb fractures.

ABSTRACT

A prospective study of 50 Children and adolescents between the age group of 5-16 years with femur and tibia shaft fractures who were admitted in department of orthopaedics in Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore, meeting the inclusion criteria were selected. During 24 months period from November 2014 to October 2016. In our study, 60% were males & 40% females,70% femur shaft fractures and 30% tibia shaft fractures. All patients underwent titanium elastic nailing fixation for the femur and tibia fractures. Patients were followed up for a period of 6 months at 4,8,12 and 24 weeks. Functional evaluation using Flynn's criteria showed excellent in 34 (68%) cases, satisfactory in 16 (32%) cases and there were no cases of poor outcome. In conclusion Titanium elastic nailing system leads to rapid fracture union by preservation of fracture hematoma and limited soft tissue exposure. It also helps in preventing damage to the physis. Our study confers all the advantages which the previous studies have shown at various institutes and is fairly a simple, reliable technique with a shorter learning curve imparting lot of advantages over other intramedullary techniques or other methods followed for management of pediatric diaphyseal lower limb fractures.
Inclusion criteria: 5-16 years of age, Diaphyseal fractures, Simple fractures (closed fractures), Ipsilateral fractures, Fracture without head injury

Exclusion criteria: Metaphyseal fractures, Compound fractures, Pathological fractures. Admitted patients are evaluated by the paediatrician for fitness, routine pre anaesthetic check-up will be done and informed written consent will be taken before surgery.

Intra-operatively - Position of the patient, bony landmarks and surgical incision for the nail insertion, reduction modalities under image intensifier, time needed for surgery, blood loss and any other difficulties faced during the procedure is carefully noted, including sizing and suitability of titanium elastic nails as per A.O. guidance. Post-operatively after 24 hours - Wound Inspection, Check X-ray to assess reduction and active static exercises/ passive exercises / active neighbouring joint movement at the earliest. Between 8 to 10 days - wound inspection and suture/staple removal. Patient is called for periodic follow up at 4 weeks, 8 weeks, 12 weeks and at 6 months. Clinical and radiological assessment will be done. Clinical evaluation for - pain, range of movements (hip and knee, ankle), limb length and time of weight bearing (partial/complete) is done. Radiological evaluation for – position of the nail, coronal and sagittal alignment, loss of reduction / deformity and delayed/non-union is done.

OPERATIVE PHOTOS

Position of patient on traction table for femur fracture fixation with TENS

Entry of titanium nail

Fluoroscopy picture of femur fracture reduction with TENS

RADIOLOGICAL AND CLINICAL PHOTOGRAPHS

PRE OPERATIVE FEMUR SHAFT FRACTURE AP

LATERAL VIEW

POST OPP AT 4 WEEKS

POST OPP AT 10 WEEKS
FLEXION

Fluoroscopic picture of tibia entry of titanium nail

Fluoroscopy picture of tibia titanium nail at fracture site

RADIOLOGICAL
AND CLINICAL PHOTOGRAPHS

Position of leg after draping for fixation of tibia fracture with TENS

Entry of titanium nail for tibia
POST OPP AT 10 WEEKS

FULL EXTENSION AND LIMBLENGTH

SQUATTING

Table-1: Complications

<table>
<thead>
<tr>
<th>Complications</th>
<th>No. of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain at the site of nail insertion</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Infection</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Limb shortening &lt;1cm</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Limb lengthening &lt;1cm</td>
<td>1</td>
<td>2</td>
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Table-2: Outcome

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Graph-1: Complications

DISCUSSION

In our study union was achieved in <3 months in all 50 (100%) cases. Average time to union was 10.5 weeks. Oh C.W et al reported average time for union as 10.5 weeks. Aksoy C, et al compared the results of compression plate fixation and flexible intramedullary nail insertion. Average time to union was 7.7 (4 to 10) months in the plating group and 4 (3 to 7) months for flexible intramedullary nailing.
In our study, closed reduction of the fracture, leading to preservation of fracture hematoma, improved biomechanical stability and minimal soft tissue disruption led to rapid union of the fracture compared to compression plate fixation.

**COMPLICATIONS:**

**Pain at the site of nail insertion:**
In the present study, 10(20%) patients had developed pain at site of nail insertion during initial follow up evaluation which resolved completely in all of them by the end of twenty four weeks.

J.M.Flynn et al. reported 38 (16.2%) cases of pain at site of nail insertion out of 234 fractures treated with titanium elastic nails.

**Infection:**
Superficial infection was seen in 3(6%) case in our study which was controlled by antibiotics & regular dressings on alternate days within a week.

J.M.Flynn et al. reported 4 (1.7%) cases of superficial infection at the site of nail insertion out of 234 fractures treated with titanium elastic nails.

**Pin tract infection** is a major disadvantage of external fixation

Bar-on E, et al reported 2 cases of deep pin tract infection in their patients treated with external fixation.

**Range of motion:**
All patients had full range of hip and knee and ankle motion by 10 weeks in the present study.

J.M.Flynn et al. reported 2 (0.9%) cases of knee stiffness out of 234 fractures treated with titanium elastic nails.

**Limb length discrepancy:**
This is the most common sequelae after femoral shaft fractures in children and adolescents. 2(4%) patient had shortening of femur and 1(2%) had lengthening of femur. No patient in our study had major limb length discrepancy (i.e. > ±2cm).

Beaty et al. reported, two patients had overgrowth of more than 2.5 cm necessitating epiphysiodesis, after conservative treatment.

Ozturkman Y. et al observed mean leg lengthening of 7mm in 4 (5%) patients and mean shortening of 6mm in 2 (2.5%) children.

Cramer KE, et al noted average limb lengthening of 7mm (range 1-19mm) in their study. Clinically significant limb discrepancy (>2cm) did not occur in any patient in their study.

John Ferguson et al noted more than 2cm shortening in 4 children after spica treatment of paediatric femoral shaft fracture. In the present study, limb length discrepancy of less than 10mm was present in 2 (10%) cases.

Comparing to limb length discrepancy in conservative methods, limb length discrepancy in our study was within the acceptable limits.

**Assessment of Outcome**
In the present study, the final outcome was excellent in 34(68%) cases, satisfactory in 16(32%) cases and there were no poor outcome cases.

J.M.Flynn et al. treated 234 femoral shaft fractures and the outcome was excellent in 150(65%) cases, satisfactory in 57 (25%) cases and poor in 23(10%) cases.

Hossam M kandil, treated thirty-two children, age 4.9-13.2 years, with femoral shaft fractures, the outcome scoring to evaluate functional results showed excellent results in twenty-six patients (81.25%), satisfactory results in six patients (18.75%), and no poor results.

In K.C. Saikia et al in their study of 22 children with femoral shaft fractures, results were 13 (59%) excellent, in 6 (27.2%) satisfactory and 3(13.6%) poor results.

<table>
<thead>
<tr>
<th>STUDIES</th>
<th>TIME OF UNION (in weeks)</th>
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<tbody>
<tr>
<td>Present study</td>
<td>10.5</td>
</tr>
<tr>
<td>Oh C.W, et al</td>
<td>10.5</td>
</tr>
<tr>
<td>Aksoy C, et al</td>
<td>16</td>
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**CONCLUSION**
Based on our experience and results, we conclude that Titanium Elastic Nailing System is an ideal method for treatment of paediatric femur and tibia fractures. It gives elastic mobility promoting rapid union at fracture site and stability which is ideal for early mobilization with lower complication rate, good outcome when compared with other methods of treatment.

It 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.

Because of early weight bearing, rapid healing and minimal disturbance of bone growth, intramedullary fixation by TENS nails may be considered to be a physiological method of treatment.

Use of TENS for definitive stabilization of femur and tibia shaft fractures in children are considered a reliable, minimally invasive, and more importantly a physseal protective treatment method.

Our study covers all the advantages which the previous studies have shown at various institutes and is fairly a simple, reliable technique with a shorter learning curve imparting lot of advantages over other methods followed for management of paediatric diaphyseal fractures in lower limb.

**References**


