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FUNCTIONAL OUTCOME OF FRACTURE SHAFT OF FEMUR IN PEDIATRIC AGE GROUP TREATED WITH TITANIUM ELASTIC NAILING SYSTEM

Dr. Vishal Kumar Mishra[1], Dr. Arvind Kumar[2], Dr. Gutha Sethu Kumar[3], Dr. Siddhartha Sarang[4]
[1]Senior Resident, Department of Orthopaedics, AIIMS, Patna.
[2]Senior Resident, Department of Orthopaedics, AIIMS, Patna.
[3]Senior Resident, Department of Orthopaedics, Mandya Institute of Medical Sciences, Mandya, Karnataka
[4]Senior Resident, Department of Orthopaedics, AIIMS, Patna.

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Corresponding author: Dr. Arvind Kumar
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Abstract
Femoral shaft fractures are common fractures in paediatric age group. In children, fractures of the femoral shaft have been traditionally treated mostly by conservatively immobilization in a Spica cast, either immediately or after a period of traction. But this safe form of treatment has major drawbacks. The management of paediatric femoral shaft fractures gradually has evolved towards a more operative approach in the past decade. Elastic stable intramedullary nailing (ESIN) or Titanium elastic nailing system (TENS) is a recent technique which allows stable reduction, maintenance of reduction and early mobilization. . Aim of study is to assess the functional outcome of fracture shaft of femur in pediatric age group treated with titanium elastic nailing system. It is a prospective study which was conducted in the all children between 5-14 years of age with diaphyseal fractures of femur. Outcome of fracture shaft of femur in pediatric age group treated with titanium elastic nailing system was studied studied by observing following, Type of reduction among children with diaphyseal fractures of femur, .Duration for union after surgery , Range of motion after surger, weeks of Weight Bearing started , Limb length discrepancy, Malalignment . From present study we conclude that femur diaphyseal fracture in children between 5-14 years of age can be effectively managed with titanium elastic nails. TENS offers a biological, minimally invasive method of treatment for fracture shaft of femur in children with advantages of sufficient axial stability, early mobilization and more rapid return to function. This technique yields higher rate of excellent functional outcome.
Keywords: Femur, Diaphyseal Fracture, Children, TENS

Introduction

Femoral shaft fractures are common fractures in paediatric age group. Males are affected more commonly than females, they represent 1.6% of all bony injuries in children. In children, fractures of the femoral shaft have been traditionally treated mostly by conservatively immobilization in a Spica cast, either immediately or after a period of traction.[1] But this safe form of treatment has two major drawbacks. First prolonged bed rest separates the child from his normal environment; and the second the cost of such periods in hospital stay is more and the use of beds which might serve other needy patients.[2] Time and experience of many clinicians have shown that children with diaphyseal femur fracture do not always recover with conservative treatment. Angulations, malrotation and shortening are not always corrected effectively. The management of paediatric femoral shaft fractures gradually has evolved towards a more operative approach in the past decade. More recently, there has been a growing trend towards surgical treatment with widening of the indications to include isolated femoral fractures. The methods have included external fixation, compression plating and intramedullary nailing with either rigid or flexible nails. Elastic stable intramedullary nailing (ESIN) or Titanium elastic nailing system (TENS) is a recent technique which allows stable reduction, maintenance of reduction and early mobilization.[3] It aims to develop early bridging callus and contributes to rapid restoration of bone continuity. Titanium elastic nail is advantageous over other surgical methods particularly in 5-14 years age group because it is a simple, is a load sharing internal splint that doesn't violate open physis, allows early mobilization and maintains alignment. Titanium elastic nailing system (TENS) works on the basic principle of three-point fixation —providing flexible, axial, translational and rotational stability. 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 fracture hematoma, there by less risk of infection.[4]Also, minimally invasive and early implant removal as compared to plates. It is necessary to evaluate the efficacy and safety of titanium elastic nails fixation in paediatric long bones fractures of lower limbs. Aim of study is to assess the functional

outcome of fracture shaft of femur in pediatric age group treated with titanium elastic nailing system.

Material and Methods:

It is a prospective study which was conducted in the all children between 5-14 years of age with diaphyseal fractures of femur admitted at peerless hospital & B. K. ROY Research

Centre Kolkata during the period of August 2017 to May 2018. In this study 40 children with diaphyseal fractures of femur were treated with titanium elastic nails.

Inclusion Criteria:

1. Patients with 5-14 years of age.

2. Patients with Diaphyseal fractures.

3. Patients with closed fractures.

4. Patients with fractures presenting within 7 days of injury.

5. Patient with a minimum follow up of 24 weeks

Exclusion criteria:

1. Patients with Metaphyseal fractures

2. Patients with open fractures.

3. Patients with Pathological fractures.

4. Patients with head injury.

5. Fractures with neurovascular deficits.

Ethical approval was obtained from the hospital administration and the department.

All subject's parents were informed of the study procedure, the purpose of the study, any known risks, all gave informed consent. All the patients selected for the study were admitted in our hospital. A detailed history was taken from all children and / or from the informant about mode of injury, duration of injury, associated comorbidities. All the children were examined clinically, both local and systemic. Then plain radiograph of pelvis with both hips (PBH) AP and hip with thigh lateral view and thigh with knee AP and lateral view were taken along with chest x ray. All routine blood investigations like complete hemogram, blood grouping, HIV, HBsAg, renal function test, bleeding time and clotting time were done.

All the children were immobilized with skin traction to affected lower limb or fixed traction or high groin slab. Paediatric fitness was taken and routine pre-anaesthetic check-up was done and informed written consent was taken before surgery and children were operated with titanium elastic nails. Intraoperatively, position of the patient, reduction modalities, duration of procedure, blood loss and any other difficulties during procedure were carefully noted. Goals of treatment is

- To achieve complete union in reasonable period of time.
- To maintain the alignment.
- Restoration of structural stability and maintenance of an acceptable mechanical axis for shaft of femur.
- Avoid complications like infection, malunion and non-union.

Results were evaluated with the help of criteria suggested by Flynn criteria as follows

TENS outcome score (Flynn criteria)[5]

	Poor result	Satisfactory result	Excellent result
Limb length Inequality	>2 cm	<2cm	<1cm
Malalignment	>10 degree	10 degrees	5 degrees
Pain	Present	None	None
Complication	Major and lasting morbidity	Minor and resolved	None

The statistical software SPSS version 20 was used for the analysis. Procedure of the data analysis was transcription, preliminary data inspection, content analysis and interpretation. The categorical variables like age, sex, were expressed as number of patients.

Outcome of fracture shaft of femur in pediatric age group treated with titanium elastic nailing system was studied by observing following:

1. Type of reduction among children with diaphyseal fractures of femur.

2. Duration for union after surgery.

3. Range of motion after surgery.

4. Weight Bearing started.

5. Limb length discrepancy.

6. Malalignment.

Results:

In present study out of 40 patients, 32 were male and 8 were female. Majority of the patients were males (80%) compared to females (20%). From this study we can see that male are more prone to injury because more often boys go out for outdoor playing.

Table 1: Age distribution of children with diaphyseal fracture s of femur

Age (in years)	Frequency	Percentage
5 - 10 yrs.	35	87.5
11 - 14 yrs.	5	12.5
Total	40	100

In present study, age distribution was 5 yrs. to 14 yrs. 35 patients were in 5-10 yrs. group (87.5%). 05 patients were in 11 -14yrs age group (12. 5%). Mean age of the patients was 8.3 years.

Table 2: Type of reduction among children with diaphyseal fractures of femur

Type of reduction	Frequency	Percentage
Open	6	15
Closed	34	85
Total	40	100

In present study, closed reduction was achieved in 34 (85%) patients. Open reduction was done with lateral approach to femur in 6 patients (15%).

Table 3: Duration for union after surgery among children with diaphyseal fractures of femur.

Duration	Frequency	Percentage
7-8 weeks	32	80
9-10 weeks	6	15
11-12 weeks	2	5
Total	40	100

In present study the average duration of union is 8.2 weeks.

Table 4: Range of motion after surgery among children with diaphyseal fractures of femur.

Range of Motion	Frequency	Percentage
7 to 8 weeks	23	57.5
9 to 10 weeks	11	27.5
11 to 12 weeks	5	12.5
More than 12 weeks	1	2.5
Total	40	100

In present study the average weeks for range of motion is 8.7 weeks.

Table 5: Weight Bearing started among children with diaphyseal fractures of femur.

Weight Bearing started	Frequency	Percentage
7 to 8 weeks	22	55
9 to 10 weeks	10	25
11 to 12 weeks	8	20
Total	40	100

In present study the average weight bearing started on 8.7 weeks.

Table 6: Limb length discrepancy among children with diaphyseal fractures of femur.

Limb length discrepancy	Frequency	Percentage
No discrepancy	33	82.5
Lengthening	4	10
Shortening	3	7.5
Total	40	100

In present study, (33 patients /82.5%), there was no limb length discrepancy. There was <1cm shortening only in 3 cases (7.5%), and lengthening in 4 cases (10%).

Table 7: Malalignment in children who underwent surgery with diaphyseal fractures of femur.

Malalignment	Frequency	Percentage
< 5 degrees	31	77.5
5 –10 degrees	8	20
10 - 15 degree	1	2.5
Total	40	100

In present study there, <5-degree malalignment was seen in 31 patients (77.5%), 5-10-degree malalignment was seen in 8 patients (20%) ,10-15degree malalignment was seen in 1 patient (2.5%).

Discussion:

Femoral shaft fractures are a common and temporarily disabling injury in children. Recent advances have led to a

more aggressive approach to the child with a femur fracture. Multiple treatment options are available and controversy over which method is superior in a given situation. However, orthopaedists increasingly have tried a variety of method to avoid prolonged immobilization.The ideal device to treat paediatric femur fracture would be a simple, load-sharing internal splint allowing mobilization and maintenance of alignment for a few weeks until bridging callus formation forms bone, rapid healing and ability to remodel, without risking the physes or blood supply to the femoral head. TEN techniques require balancing the forces of the two opposing flexible implants. Therefore, it is important to select nails 40% of the narrowest diaphyseal diameter, contour the nails with a similar gentle curvature, and use medial and lateral entry point that are at the same level in the metaphysis. To avoid soft tissue irritation, only a small amount of nail is left outside the distal metaphyseal cortex and the nail should not be bent out into soft tissue. The present study consists of 40 patients of diaphyseal fractures of femur in children. The results obtained have been compared with the results obtained by the other works using same technique.

Mode of Reduction:

In present study, closed reduction was achieved in 34 (85%) patients. Open reduction was done with lateral approach to femur in 6 patients (15%). Nishant et al (2010)[6] had similar percentage of results out of total 20 patients 13 cases done close reduction and 7 had open reduction. Jalan et al (2013)[7]had total 30 patients out of which close reduction was done in 24 (80%), in 6(20%) cases open reduction done. Batra et al (2016)[8]had total 50 patients out which in 46 cases close reduction was done and in 4 cases open reduction done.

Duration for Union:

In present study mean duration of union is 8.2 weeks. Study conducted by BHUYAN et al[9] in 2014 mean duration of union was 9 weeks. Study conducted by NARENDRA et al[10] in 2017 mean duration of union was 12.5 weeks.

Weight bearing allowed:

In present study the average duration of weight bearing is 8.7 weeks. Study conducted by SAIKIA et al[11] in 2007 the average duration of weight bearing was 8.8 weeks. Study conducted by HOSSAIN et al[12] in 2014 the average duration of weight bearing was 8 weeks. Study conducted by VENKATARAMANA et al[13] in 2014 the average duration of weight bearing was 12.6 weeks.

Range of motion:

In present study all patient has full range of movement at 24 weeks. The patient was typically taught a home exercises program including a range of motion exercises, hip abductor and knee extensor strengthening exercises during the perioperative period. Similar findings were noted in the study conducted by different authors as mentioned: Kanthimathi et al (2011)[14] in his study all 25 patient had full range of motion. Jalan et al (2013) in his study out of 30 patient majority of them achieved full range of motion of the knee up to 12 weeks. Three cases had terminally restriction of knee flexion (20-30 degree) which was improved after nail removal. Venkataramana et al (2014) in his study 4 had mild restriction of movement. Kumar et al (2014) in his study all 52 patients have full range of motion. Thapa et al (2015)[15]in his study out of 56 patient, 21 cases had full range of movement, 14 cases had range of movement 120 degree, 12 cases had range of movement 110 degree at 24 weeks of follow up. Mani et al (2015) in his study all 32 patients had full range of motion.

Limb length discrepancy:

In present study, (33 patients /82.5%), there was no limb length discrepancy. There was <1cm shortening only in 3 cases (7.5%) and lengthening in 4 cases (10%). Saikia et al (2007) out of 22 patients in 3 cases limb lengthening <1.5 cm. Choudhari et al (2014)[16]out of 53 patients 4 cases had limb lengthening of 0.7 cm. Venkataramana et al (2014) out of 30 patients 2 cases had limb lengthening 1.2 cm. Thapa et al (2015) out of 56 patients 24 had limb shortening of 10mm in 24 weeks, 4 had limb shortening of 12mm. Batra et al (2016) out of 50 patients 5 cases had limb length discrepancy upto 1 cm.

Malalignment:

In present study there, <5-degree malalignment was seen in 31 patients (77.5%), 5-10-degree malalignment was seen in 8 patients (20%) ,10-15degree malalignment was seen in 1 patient (2.5%). Saikia et al (2007) out of 22 patients 2 patient had varus angulation, 1 patient had valgus angulation. Venkataramana et al (2014) out of 30 patients, 2 cases had varus angulation, 1 patient had valgus angulation. Thapa et al (2015) out of 56 patients, 35 had <5 angualtion, 19 had 5-10 angualtion, 2 had >10 degree of angulation. In present study, TENS outcome score is excellent in 26 patients (65 %), satisfactory in 9 patients (22.5%) and poor only in 5 patients (12.5%).

Conclusion:

From present study we conclude that femur diaphyseal fracture in children between 5-14 years of age can be effectively managed with titanium elastic nails. Titanium elastic nailing system is an effective and viable treatment option in selected cases of femoral diaphyseal fractures in 5-14 years of age group. The indication for TEN in paediatric femoral fractures are expanding as their advantages are realized and complications of the operative methods of stabilization are reported. TENS offers a biological, minimally invasive method of treatment for

fracture shaft of femur in children with advantages of sufficient axial stability, early mobilization and more rapid return to function. this technique yields higher rate of excellent functional outcome So, titanium elastic nailing is simple and effective method for management of diaphyseal fractures of femur in children.

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