OUTCOME OF SURGICAL MANAGEMENT OF PEDIATRIC FEMORAL SHAFT FRACTURES USING TENS NAIL AT TERTIARY CARE CENTER

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ABSTRACT:

Background: Paediatric femoral shaft fractures are 2.6 times more prevalent in boys than girls, exhibiting a bimodal distribution with peaks at ages 1-3 years (often low energy) and early adolescence (high energy). While the etiology varies with age, falls from height and road traffic accidents remain the primary causes of femur shaft fractures in children. **Material & Methods:** The present cross-sectional, prospective study was carried out at the Department of Orthopedics, at our tertiary care hospital. The study duration was of eighteen month from July 2011 to December 2012. A sample size of 30 was calculated at 90% expected frequency and 90% confidence interval at 10% acceptable margin of error. Patients aged from 5 to 15 years with diaphyseal femur fractures, patients with closed displaced diaphyseal fractures of the femur, and children of both genders treated with TENs nailing were enrolled in the study. **Results:** In the present study, out of the total study participants, based on the complications, limb lengthening was present in 6 cases, out of which 4 cases had <5 mm of limb length discrepancy and 2 had nearly 1 cm of limb length discrepancy. Superficial infection was seen in 1 case, which was controlled by antibiotics. Nail protrusion was seen in 3 cases. There were 3 cases of varus malalignment in our study out of which 2 cases had 10º and 1 case had 12º of malalignment. No cases of valgus, anteroposterior, or rotational malalignment were recorded. The present study, based on the functional outcome using Flynn's scoring system was excellent in 21, satisfactory in 8, and poor in 1 patient respectively. **Conclusion:** We concluded from the present study that the patient's flexible intramedullary nailing using TENS is a good method for treating diaphyseal femur fractures in children. It is easier to introduce a TENS and offers stable fixation. It promotes rapid union and early independent ambulation, shortens the hospital stay, and decreases the patients' dependence and morbidity.

Keywords: pediatric femoral shaft fractures, tens nail, Flynn's criteria

INTRODUCTION:

Pediatric femoral shaft fractures are 2.6 times more prevalent in boys than girls, exhibiting a bimodal distribution with peaks at ages 1-3 years (often low energy) and early adolescence (high energy) **(1).** While the etiology varies with age, falls from height and road traffic accidents remain the primary causes of femur shaft fractures in children **(2).** These fractures, although uncommon, account for less than 2% of all fractures in children, yet pose a significant burden on healthcare systems and families, being the most common fractures necessitating hospitalization in children **(3).**

In skeletally mature adolescents, the standard treatment involves the use of antegrade solid

intramedullary rods. However, determining the best treatment for children between five to fifteen years remains debatable **(4).** For children aged 5 or younger, early closed reduction and spica cast application proves to be an ideal treatment for most diaphyseal fractures. Although alternative modalities such as external fixation, plates and screws, and solid antegrade intramedullary nails are available, complications like pin tract infection, re-fractures, or osteonecrosis make them less favorable choices **(5).** Those managed with traction and spica cast endure adverse physical, social, psychological, and financial consequences due to prolonged immobilization **(6).**

Over the past few decades, various forms of internal fixation, including plate fixation, rigid intramedullary nailing, Enders nailing, and titanium nailing, have been advocated, but controversy persists regarding the ideal implant **(7).** Currently, operative methods are generally favored to enable early ambulation, shorter hospital stays, and to avoid the detrimental psychological and social effects associated with prolonged non-operative treatment, as well as complications **(8)**. An ideal device would be a simple, load-sharing internal splint facilitating mobilization, alignment maintenance, and extremity length until bridging callus formation. Titanium elastic nails (TENs) offer these features, and this prospective study aims to evaluate the results of treating pediatric femoral shaft fractures with Titanium elastic nails (TENs) at our tertiary care center.

MATERIALS & METHODS

The present cross-sectional, prospective study was carried out at the Department of Orthopedics, at our tertiary care hospital. The study duration was one year from July 2011 to December 2012. A sample size of 30 was calculated at 90% expected frequency and 90% confidence interval at 10% acceptable margin of error by epi info software version 7.3. In this prospective study patients aged from 5 to 15 years with diaphyseal femur fractures, patients with closed displaced diaphyseal fractures of the femur, and children of both genders were enrolled for the study. Only those patients who matched the inclusion and exclusion criteria were enrolled in the present study. Institutional Ethics Committee Clearance was obtained before the start of the study and written and informed consent for the procedure was obtained from all the patients. Strict confidentiality was maintained with patient identity and data and not revealed, at any point in time.

Patients less than 5 years and more than 16 years of age, children with open fractures having secondary or suspected deep infections or late presentations (more than 10 days), all metaphyseal fractures with/without involvement of epiphysis, parents/patient not consented for surgery, all pathological fractures, and children suffering from epilepsy, neuro-muscular diseases heart diseases and bleeding diathesis were excluded from the study. All study participants were subjected to routine blood investigation and radiological examination. All individuals were observed until recovery, with an average follow-up period of 9 months (with a range of 6–12 months). A minimum of 1 year of follow-up was completed for fifteen out of thirty patients, and there were no instances of lost follow-up among the patients. All data were entered in the MS Office 2010 spreadsheet and Epi Info v7. Data analysis was carried out using SPSS v22. Qualitative data was expressed as a percentage (%) and Pearson's chi-square test was used to find out statistical differences between the study groups and sensitivity, specificity, positive predictive value, and negative predictive value were calculated. If the expected cell count was < 5 in more than 20% of the cells then Fisher's exact test was used. All tests were done at an alpha (level significance) of 5%; which means a significant association was present if the p-value was less

than 0.05 and highly significant if the p-value was less than 0.01.

RESULTS

In the present study, we enrolled 30 patients aged from 5 to 15 years with closed displaced diaphyseal fractures of the femur, and children of both genders treated with TENs nailing between were enrolled for the study. Only those patients who matched the inclusion and exclusion criteria were enrolled in the present study. Out of the total 76% were males and 24% were females. Study participants were aged from 5 years to 15 years of age with the mean age of the study participants was 9.2 ± 3.4 years. Out of the total study participants, majority of them (50%) were in the age group of 8-11 years, which was followed by (30%) patients in the age group of 11-15 years, (20%) patients were in the age group of 5-8 years. (Table 1)

Table 1: Distribution of study participants according to study parameters.

Parameters	No. of patients
Male	76%
Female	24%
Mean age	9.2 ± 3.4 years
Age group (years)	
5-8	20%
8-11	50%
11-15	30%

In the present study, out of the total study participants, based on the pattern of fracture, the most common type was the transverse type of fracture of the shaft femur which was around 70%, followed by an oblique pattern in 20% and the spiral was in 10% of patients. Based on the frequency of the side, the right femur was the most common injury of the patients which was nearly 60%, and the left was 40%. Based on the time for union, most of the cases united within 10 weeks which was seen in 60% of patients which was followed by 8 weeks and 12 weeks in 20% of patients respectively. (Table 2).

Table 2: Distribution of study participants according to study parameters.

Study parameters		N (%)
Pattern of fracture	Transverse	21 (70%)
	Oblique	6 (20%)
	Spiral	3 (10%)
Frequency of side	Left	12 (40%)
	Right	18 (60%)
Time for union	8 weeks	6 (20%)
	10 weeks	18 (60%)
	12 weeks	6 (20%)

In the present study, out of the total study participants, based on the complications, limb lengthening was present in 6 cases, out of which 4 cases had <5 mm of limb length discrepancy and 2 had nearly 1 cm of limb length discrepancy. Superficial infection was seen in 1 case, which was controlled by antibiotics. Nail protrusion was seen in 3 cases. There were 3 cases of varus malalignment in our study out of which 2 cases had 10^{o} and 1 case had 12^{o} of malalignment. No cases of valgus, anteroposterior, or rotational malalignment were recorded.

The present study, based on the functional outcome using Flynn's scoring system was excellent in 21, satisfactory in 8, and poor in 1 patient respectively.

(Table 3)

Table 3: Distribution of study participants according to study parameters.

Study parameters		N (%)
Complications	Limb lengthening	6 (20%)
	Infection	1(3.3%)
	Nail protrusion	3 (10%)
	Malalignment	3 (10%)
Outcome	Excellent	21 (70%)
	Satisfactory	8 (26.6%)
	Poor	1(3.3%)

DISCUSSION

In the present study, we enrolled 30 patients aged from 5 to 15 years with closed displaced diaphyseal fractures of the femur, and children of both genders treated with TENs nailing between were enrolled for the study. Only those patients who matched the inclusion and exclusion criteria were enrolled in the present study. Out of the total 76% were males and 24% were females. Study participants were aged from 5 years to 15 years of age with the mean age of the study participants was 9.2 ± 3.4 years. Out of the total study participants, majority of them (50%) were in the age group of 8-11 years, which was followed by (30%) patients in the age group of 11-15 years, (20%) patients were in the age group of 5-8 years. Similar findings were reported in a study conducted by Beaty J H al among 31 patients with femoral-shaft fractures out of them 30 were operated with interlocking intramedullary nails. Out of total patients, 19 boys and 11 girls ranged in age from 10 to 15 years (average age was 12 $\pm$ 3 years) at the time of study **(9).**

In the present study, out of the total study participants, based on the pattern of fracture, the most common type was the transverse type of fracture of the shaft femur which was around 70%, followed by the oblique pattern in 20% and the spiral was in 10% of patients. Based on the frequency of the side, the right femur was the most common injury of the patients which was nearly 60%, and the left was 40%. Based on the time for union, most of the cases united within 10 weeks which was seen in 60% of patients which was followed by 8 weeks and 12 weeks in 20% of patients respectively. Similar findings were reported in a study conducted by Saika K C et al among 22 patients and evaluation after a mean of 2 years of follow-up. The radiological union was achieved in a mean time of 8.7 weeks. Full weight bearing was reported in a mean time of 8.8 weeks. The mean time of hospital stay was 9.8 days. The outcomes were excellent in 13 patients, successful in 6, and poor in 3 patients **(10).**

In the present study, out of the total study participants, Based on the pattern of fracture, the most common type was transverse type fracture of the shaft femur which was around 70%, followed by an oblique pattern in 20% and spiral in 10% of patients. Based on the frequency of the side, the right femur was the most common injury of the patients which was nearly 60%, and the left was 40%. Similar findings were reported in a study conducted by J P Metaizeau et al who reported that functional recovery was rapid and the patients were allowed to walk with support after 7-10 days according to the type of fracture **(11).**

The present study, based on the functional outcome using Flynn's scoring system was excellent in 21, satisfactory in 8, and poor in 1 patient respectively. Similar findings were reported in a study conducted by Wudbhav N. Sankar et al. The study, the largest series of its kind at the time, included 19 consecutive patients aged 7.2 to 16 years. Results showed that all patients achieved complete healing within an average of 11.0 weeks, with minimal angulation in the sagittal and coronal planes at the final follow-up. The study concluded that TENs are an effective surgical technique for the rapid healing of pediatric tibial shaft fractures with an acceptable complication rate their functional outcome was assessed using Flynn's criteria and it had 12 excellent, six satisfactory, and one poor results. Complications found in their study were limb length discrepancy, superficial infection knee stiffness, and nail protrusion **(12)**

CONCLUSION

We concluded from the present study that the patient's flexible intramedullary nailing using TENS is a good method for treating diaphyseal femur fractures in children. It is easier to introduce a TENS and offers stable fixation. It promotes rapid union and early independent ambulation, shortens the hospital stay, and decreases the patients' dependence and morbidity.

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