

Study of Flexible Intramedullary Titanium elastic Nail fixation in a Paediatric shaft of Femur fracture

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ABSTRACT

Background: Paediatric shaft of femur fracture account for 1.4 to 1.7 percent of all the paediatric fractures. There are many treatment options for fracture shaft of the femur. Treatment decision depends upon children age, fracture character and social status. Initially, surgical treatments for fracture shaft of the femur were confined to polytrauma patients. Now due to early mobilization, less hospital stay and early return to home and school, treatment tends toward surgery. **Aims:** The study was done to see the outcome of fracture shaft of femur in paediatric age group with titanium elastic nail. **Material and Methods:** There were total of 33 patients with fracture shaft of the femur enroll for this study. They all are treated with flexible intramedullary titanium elastic nail fixation. Their outcome was evaluated at different time interval. **Statistical analysis:** The data was analyzed by using SPSS for Windows (version 16.0) **Results:** The mean age of patients in this study was 8.70 ± 2.51 years. All patients had the union of fractures by the end of 7 weeks with excellent outcome seen in 22(66.67%) cases and satisfactory outcome seen in 9(22.27%) cases. Six patients had the poor outcome with acceptable range of deformity and skin irritation. **Conclusion:** TENS is an easy, cost- effective modality of treatment. Proper patient and case selection provides an excellent outcome.

Keywords: Paediatric shaft of femur fractures, TENS, Flexible nail.

Introduction

Femoral fractures consist 1.6% of all children fractures. It is the third most common long bone fracture after forearm and tibia.[1] Road Traffic Accident is the common cause for fracture, however, fall from tree and hills is one of the common cause in western part of Nepal. There are various modalities of treatment for fracture shaft of the femur in children. The treatment methods include from simple plaster application to various methods of fixation. Children less than 5 years of age are treated conservatively by most of the orthopaedic surgeons. [2] Unlike younger children, patients above 6 years of age have the high risk of mal-union, shortening, and moreover missing several weeks of school.[3]

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For such, children operative treatment option is gaining popularity because of less hospital and home stay, enabling them in early mobilization and early return to school. This will reduce the psychological adverse impact in children and parents. For age groups, 5-14 years surgical treatment like plating external fixators, intramedullary rush nails, flexible nails is gaining popularity since last few years. [4, 5] Titanium elastic Nail (TENS) fixation for a pediatric shaft of femur fracture is a safe and satisfactory mode of treatment. It is a less invasive procedure and relatively easy to perform. [6] Here we study the outcome of intramedullary flexible nail fixation in fracture shaft of a femur for the age of 5-14 years. Our main objective is to see the outcome of fracture shaft of femur treated with intramedullary nail fixation in children of school going age in our population considering their height, weight and age.

Materials and Methods

It is a prospective study conducted in the Department of Orthopaedics Manipal Teaching Hospital, Pokhara

and Fishtail Hospital & Research Centre Pokhara. The study was conducted from June 2015 to May 2018, for 3 years. There were total 33 cases of fracture shaft of the femur. They were treated with flexible intramedullary titanium elastic nail.

Inclusion criteria:

1. All femur shaft fractures age of 5-14 years.
2. Closed fracture shaft of the femur.
3. Fractures in the patient with polytrauma, Multiple fractures and other injuries like head injury, abdominal trauma chest trauma after the patient become stable.
4. Displaced fractures with minimal comminution.
5. Gustillo and Anderson type I & II open fracture shaft of the femur.

Exclusion criteria:

1. Children below 5 years of age.
2. Undisplaced fractures.
3. Gustillo & Anderson type III open fracture.
4. Infection at the local site.
5. Previously fractured femurs.
6. Grossly comminuted fractures.
7. Children with bleeding disorders.
8. Children with weight more than 50 kilograms.

Data Analysis: The data were analyzed by using SPSS for Windows (version 16.0)

All the cases of fracture shaft of the femur in pediatric age group were admitted in the hospital and treated with closed intramedullary titanium elastic nail.

Pre-operative workup: All the cases of fracture shaft of femur who met the inclusion criteria were included in the study. Informed consent of parents was obtained regarding the whole procedure. Routine blood investigation was carried out. X-ray of the affected thigh both AP and the lateral view was taken. Pre-operative planning was carried out for proper selection

Results

There were a total of 33 patients with fracture shaft of the femur. The mean age of the patients is $8.70 \pm$

of titanium elastic nails of the same size. Below knee skin traction were applied for all patients who were waiting for surgery.

Operative procedure: All the operations were carried under the general anesthesia, in the supine position. Prior to the surgery, one single dose of intravenous antibiotic was given (Injection Cefazoline, 25-50 mg/kg) at the time of induction. Two incisions were given on the medial and lateral side of the distal thigh just above the metaphysis. Under C- arm guidance entry portal was made in the distal femur, proximal to the physis and angled gradually so that the awl becomes almost parallel to shaft. A previously selected intramedullary nail was gradually pushed up slowly into the medullary cavity till the fracture site under C-arm guidance. The fracture was reduced and nails advanced further such that pre-bend portion of nail face toward the entry site. With the same procedure, a nail was inserted from another site. The Wound was irrigated with a normal saline solution. An intramedullary nail was buried under the skin and the wound was closed. A short unilateral POP extending from the groin to just above the knee was given when required.

Post operative management

Post-operative hemoglobin checkup was done. The dressing was done on the 3rd day, and the patient was discharged. Knee range of motion was started. Quadriceps exercise was encouraged before discharge. Sutures were removed in two weeks. Weight bearing was permitted in transverse and short oblique fractures and slightly delayed in comminuted and long oblique and spiral fractures.

Follow-up: Post operation patients were followed up at 3 weeks, 6 weeks and 12 weeks interval. Healing status, callus and knee range of motion were recorded. Last follow up was done after 6 months. Any sign of infection and skin irritation in entry site were noted.

2.51 years, range from 5 years to 14 years. Among 33, 22 (60.6) were boys and 13 (39.4) were girls. Demographic characteristic of patients and fractures is shown in table 1

Table no.1: Demographic characteristic of patients and fractures of 33 patients

Variables		Results	
		Number	Percentages
Mode of injury	Fall from tree	6	18.2
	Fall from height	8	24.2
	Injury while playing	8	24.2
	Road traffic accident	9	27.3
	Fall of a heavy object	2	6.1

Pattern of fracture	Transverse	12	36.4
	Oblique	12	36.4
	Spiral	6	18.2
	Small comminuted	3	9.1
Side of fracture	Right	17	51.5
	Left	16	48.5
Open/closed Fracture	Closed	30	90.9
	Open	3	9.1
Site of Fracture	Proximal	11	33.3
	Middle	14	42.4
	Distal	8	24.2

The most common mode of injury is fall injury including fall from height and tree in this study. The mean time of the first presentation in the hospital emergency is 1.24 ± 0.44 days from the time of injury. Most of the patients attend to hospital emergency within 24 hours of injury. The mean time of surgery was 3.30 ± 1.19 days from the time of injury. The mean

operative time was 47 ± 10.56 minutes. None of our patients required blood transfusion. Five patients required minimal open for fracture reduction and insertion of tens. The mean time of total hospital stay in our study was 4.97 ± 0.81 days. The final results of outcome according to Flynn et al [2] criteria following TENS fixation is shown in table 2, 3 and 4.

Table no. 2: Flynn et al [2] criteria for the assessment of results

Criteria	Excellent	Satisfactory	Poor
Limb length discrepancy	< 1cm	1-2 cm	> 2 cm
Angulations	< 5 degree	5-10 degree	> 10 degree
Pain	Absent	Absent	Present
Complication	Absent	Minor and solved	Major and /or residual morbidity

Table no. 3: Satisfactory and Poor outcome according to Flynn et al criteria

Satisfactory outcomes	No. of cases	Poor outcomes	No. of cases
1-2 cm Limb length discrepancy	3	More than 2 cm Limb length discrepancy	0
5-10 degree varus/valgus angulations	2	More than 10 degree varus/valgus angulations	1
5-10 degree anterior/posterior angulations	1	More than 10 degree anterior/posterior angulations	0
Soft tissue irritation by hardware	3	Complication like delay union, nonunion, refracture	1 refracture
Total	9	Total	2

Table no. 4: Total results according to Flynn et al [2] criteria for the assessment of results

Flynn et al criteria outcome	Results	Percentage
Excellent	22	66.67
Satisfactory	9	27.27
Poor	2	6.06
Total	33	100

The partial weight bearing was started as callus seen. The minimum time of partial weight bearing was 4 weeks and a maximum of 8 weeks. The mean time of full weight bearing after TENS fixation is 6.85 ± 1.03 weeks. The minimum time of full weight bearing was 5 weeks and a maximum of 9 weeks.

At the three weeks follow up, all cases had more than 20 degree of knee range of motion. The mean range of movement was 36.48 ± 7.93 degrees in three week's

period. At the six weeks follow-up most of the cases had the range of movement more than 45 degrees. The mean range of movement was 58.09 ± 11.23 degrees in the six weeks period. The range of movement was more than 90 degrees in the final follow up. The mean range of movement was 112.73 ± 11.73 degrees. Superficial Infection seen in 3 cases due to skin irritation, were managed with oral antibiotics. Fracture shaft of femur treated with TENS and final x ray of union shown in fig no.1& 2.

Figure no. 1 Fracture shaft of femur treated with TENS and final x ray of union



Figure no. 2: Titanium elastic nails with pre bend tips



Discussion

There are various modalities of treatment for fracture shaft of femur from conservative to operative treatment. The ideal treatment of pediatric shaft of the femur is to maintain length and alignment and also early mobilization and return to home so that children will have least the psychological impact as a result of short hospital stay. [6, 7]

Since past few years, operative treatment of fracture of shaft of the femur tending as patients have to stay lesser days in the hospital after operative treatment as compared to the conservative treatment with prolonged immobilization with traction. In this study, we operated children from age 5 -14 years with TENS fixation and all children had a union of fracture without any

deformity and short hospital stay which is similar to the study of Singh P et al. [8]

Early fixation not only helps for early return to home but also child can go to school as early as possible. It provides early mobilization and psychological support in a home environment. [4, 7]

Titanium elastic nails (TENS) are load sharing devices which provide good fixation. It provides relative stability and there will be indirect bone healing with callus formation. [9] TENS are flexible, pre-bend tip nail (table/fig 6) that can be inserted intramedullary which provides more biological fixation, short operative procedure, minimal soft tissue handling and no epiphysis injury. Since TENS do not need pre-bending, it is flexible and easy for insertion.[9, 10,11]

Good outcome were seen in more than 90 % of cases in this study, which is similar to the study of Navdeep et al, and Flynn et al. [2, 6] The angular deformity is the common complication seen in TENS fixation. The best way to avoid this from happening is by not using it for elderly patients weighting more than 50 kg. And if there is any doubt regarding the stability, external support in form of slab or immobilizer should be given. In this study, 4 patients had angular deformity and all those were above 12 years.

TENS doesn't provide adequate stability in severely communities, long oblique, spiral fractures. Most common complication of TENS is skin irritation in the entry site. In this study, 3 patients had skin irritation, which is similar to the study of Nisar A et al. [11] Proper bending of TENS and adequate soft tissue coverage helps to avoid these complications. Minimal opening of fracture site (in 5 cases) or not opening of fracture site, closed methods of reduction and minimal tissue handling is the reason for no postoperative severe infection seen in this study. Infections seen in this study were superficial infections that were managed with oral antibiotics.

Patients have the issue of the stiffness of knee in TENS fixation. [12] Our cases also had knee stiffness immediately after surgery. Regular physiotherapy was required. Some-times the bend portion of the nail may hamper in the early mobilization of knee. But after removal of TENS, patients can do physiotherapy more easily. All patients had almost full range of motion in final follow up.

The mean time of radiological healing in our study is 4.97 ± 0.81 . All the patients had a union at end of 7 weeks which is similar to the study of Hossain MM et al [13]. The relative stability provided by the TENS fixation help in early callus formation thus provide early fracture stability and strengthening of diaphyseal fractures. [14] TENS provide an excellent outcome with minor complication. We had more than 90 percent good outcome following TENS fixation with short hospital stay (less than 7 days in this study) which is similar to studies done by Singh P et al and Lee YH et al. [15,16]

Conclusion

TENS is easy and cost effective safe modality of treatment for fracture shaft of Femur in pediatric population that avoids prolong hospital stay and early return to home and school. It also provides a union without any obvious deformity.

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