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A PROSPECTIVE STUDY : CLINICAL OUTCOME OF TIBIA DIAPHYSEAL FRACTURE IN PEDIATRIC AGE GROUP MANAGED WITH TITANIUM ELASTIC NAILING SYSTEM

Orthopaedic

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ABSTRACT

Introduction : Pediatric tibial fractures are the third most common pediatric long bone fracture after the femur and forearm[1]. They representing 15% of all pediatric fractures[2]. The most common location of tibia fractures is in the distal third of the tibia (50-70%) followed by middle and then proximal (less common) thirds. This study was performed to find out clinical outcome of tibia diaphyseal fracture in paediatric age group managed with titanium elastic nailing system. **Material And Methods :** This hospital based prospective, randomized, single centre study was conducted in the Department of Orthopaedics, JLN Medical College & Hospitals, Ajmer during the December 2018 to December 2020. These cases including close, open grade 1 and 2 paediatric tibia diaphyseal fractures and fractures with inability to achieve close reduction. **Results & Observations :** In our study, 32 patients of paediatric age group with tibia diaphyseal fractures were managed with TENS. According to FLYNN'S criteria the final outcome was excellent in 84.35% (27 out of 32), satisfactory or good in 12.5 % (4 out of 32) cases and poor outcome was reported in 1 case (3.15%) only. **Conclusion :** TENS which is safe and effective method to maintain the reduction of displaced tibial fractures including length and rotation. It is simple, rapid and safe procedure with advantages of early union, early mobilization and early return to function with minimum complications. Elastic medullary nailing advantages make it a valuable choice to consider in managing children shaft tibial fractures.

KEYWORDS

Paediatric age group, tibia diaphyseal fracture, Titanium Elastic Nailing System

INTRODUCTION

Pediatric tibial fractures are the third most common pediatric long bone fracture after the femur and forearm.[1] They representing 15% of all pediatric fractures.[2]The average age of occurrence is 8 years of age.[3] Tibia fractures are most common in male.[4] The ratio of incidence in boys and girls is 2:1.[5] Low energy falls and torsional forces as on body rotates on planted foot, causing spiral, and oblique fractures in toddlers and younger children aged 1-4 years. Direct high energy motor vehicle accidents (RTAs)-either a crash or pedestrian struck and indirect sport related injuries predominate in older children, aged 4 -14 years and adolescents. Most tibial fracture are short oblique or transverse fractures of the middle or distal third of the shaft. Concomitant ankle and foot are most common injuries associated with tibia. There is possibility of loss of reduction, shortening, angulations and malunion after closed reduction and casting. Surgery is required in patients with open fractures, polytrauma, neurovascular injury, and unstable fractures causing unacceptable angulation. Management of pediatric tibial shaft fracture is individualized based on age, co-existing injuries, and associated soft tissue and neurovascular injury. Titanium elastic nailing system (TENS) produces following four properties: flexural, axial, translational and rotational stability. The aim of present study was to assess the results of management of tibial shaft fractures in children with titanium elastic intramedullary nails.

MATERIAL AND METHODS :

This hospital based prospective, randomized, single centre study was conducted in the Department of Orthopaedics, JLN Medical College & Hospitals, Ajmer during the December 2018 to December 2020.

32 patients were included in this study. All patients were operated under general anesthesia. All patients of diaphyseal fracture of tibia in children were included in this study.

Inclusion Criteria

1. Age 5 to 15 years, Closed tibia diaphyseal fractures
2. Open tibia diaphyseal fractures grade I, II
3. Loss of reduction after close treatment
4. Inability to achieve reduction with close treatment

Exclusion Criteria:

1. Patients with malunited, non-union tibial fractures.
2. Patients who are medically unfit.
3. Open fractures Gustilo-Anderson grade 3 fractures.
4. Patients with age < 5y years and > 15 years.
5. Pathological fractures

TENS nail 1.5 to 4 mm were used. Follow up in post-operative period were done at 3 weeks, 6 weeks, 12 weeks and 6 months. In each visit patient is assessed by clinical examination and radiological examination. Clinical assessment was done on pain, range of movements, measurement of limb length, time of weight bearing. Radiological assessment done on the basis of appearance of callus, visibility of fracture line and alignment in both plane.

Final outcome after 6 months is graded as excellent, satisfactory, or poor based on criteria described by Flynn et al. and need for early removal of TENS would be required.

Table 1 : TEN outcome scoring (Flynn *et al*)[2,4]

RESULTS	Excellent	Satisfactory	Poor
VARIABLES at 24 weeks			
Limb- length inequality	<1.0 cm	<2.0 cm	>2 cm
Mal alignment	5 degree	10 degree	>10 degree
Unresolved pain	absent	absent	present
Other complications	none	minor and resolved	major and lasting morbidity

Table 2 : Acceptable Alignment Of Tibia Fracture In Children[6]

Patient age	< 8 years	> 8 years
Valgus	5 degrees	5 degrees
Varus	10 degrees	5 degrees
Angulation anterior	10 degrees	5 degrees
Posterior angulation	5 degrees	0 degrees
Shortening	10 mm	5 mm
Rotation	5 degrees	5 degrees

RESULTS AND OBSERVATIONS

Demographic patterns of patients, fractures, mode of injury, side, pattern, level of fracture were mentioned in Table 3. The mean age of patient in our study was 10.81 years and average time taken to heal the fracture 12.4 weeks. Complications encountered in our study were shown in Table 4 and the final outcome according to Flynn's criteria is shown in Table 5.

Table 3 : Demographic Patterns Of Patients And Fractures

Parameters	n (%)
Gender	
Male	26 (81%)
Female	6 (19%)

Mode of Injury	
RTA	23 (71.87%)
Self-fall	6 (18.75%)
Sport related injury	3 (9.37%)
Side	
Right	16 (50%)
Left	16 (50%)
Pattern	
Transverse	15 (46.88%)
Short oblique	17 (53.12%)
Level of Fracture	
Proximal shaft	0 (0)
Middle shaft	17 (53.12%)
Distal shaft	15 (46.88%)

Table 4 : Complications After Operative Intervention

Complications	**No. of cases**	**Percentage**
Nail site irritation	2	6.2
Pain	0	0
Infection		
Superficial	1	3.1
Deep	2	6.2
Recurrent fracture	1	3.1
Delayed union and nonunion	1	3.1
Limb lengthening		
<2 cm	1	3.1
>2 cm	0	0
Limb shortening		
<2 cm	1	3.1
>2 cm	0	0
Nail back out	0	0
Malalignment		
a. Varus angulation	1	3.1
b. Valgus angulation	2	6.2
c. Anterior angulation	1	3.1
d. Posterior angulation	0	0
e. Rotational malalignment	2	6.2
Bursa at the tip of the nail	1	3.1
Sinking of nail into the medullary canals	0	0

Table 5 : Final Outcome

Outcome according to Flynn's criteria	**Number of patients (n=32)**	**%**
Excellent	27	84.35
Satisfactory	4	12.5
Poor	1	3.15

DISCUSSION

The traditional method of managing pediatric tibial fracture conservatively given good functional results. The difficulties of non –surgical treatment while keeping children in plaster cast needs an alternative approach. Working parents, nuclear family with challenging home care, academics leaves and patient discomfort need to be considered while opting for non-surgical treatment.

The ideal implant to treat pediatric tibial fracture, should be load sharing. It should maintain alignment, allow early mobilization, and should not cross the physis.

Since 1995, titanium elastic intramedullary nails to stabilize pediatric long bone fractures in use where surgery is indicated. Advantage of TENS nail include immediate fracture stabilization, minimal soft tissue damage, low rate of infection, early mobilization and more rapid return to daily function than conservative treatment with immobilization alone.

Tens nail is effective treatment to obtain and maintain alignment and stability. The better functional outcome may be due to early fracture union leading to an early return to activities. Early mobility also reduces school absenteeism.

The most common complications associated with ESIN included infection, over growth, entry site skin irritation and refracture.

In our study 7 (21.88%) of the patients were 5-8 years, 9 (28.12%) were 9 to 11 years and 16 (50%) were 12 to 15 years age group with the average age being 10.81 years, which is similar to observation of Pandya NK et al[7] (between 2003 to 2010).

In our study, out of 32 case maximum number of patients were male 26 (81%) and female were 6 (19%). Similar observation made by Wudbhav N. Sankar et al[8] (2007).

In the present study RTA was the most common mode of injury accounting for 23(71.87%) cases, self-fall accounted for 6 (18.75%) cases and sport related injury accounted for 3 (9.37%) of the cases which is similar to series of J. M. Flynn et. al[9] (2002).

In our study, transverse fractures accounted for 15 (46.88%) cases, short oblique fractures - 17(53.12%), spiral, communited and there were no long oblique, spiral and segmental fractures which is similar to series of Wudbhav N. Sankar[8] (2007).

Fractures involving the middle 1/3rd accounted for 17 (53.12%) cases, distal 1/3rd – 15 (46.88%) and there was no proximal one third fracture of tibia cases in our study which is similar to Wudbhav N. Sankar et al[8] (2007).

In our study most of the patients 31 cases (96.9%) underwent surgery less than 7 days after trauma, and 1(3.1%) patient after 7 days. Average duration between trauma and surgery was 2.7 days in our study which is similar to observations of K C Saika et al.[10] (2007).

In the present study, duration of surgery was 30-60 minutes in 25 (78.1%) cases, 61-90 minutess in another 7 (21.9%) cases. The average duration of surgery in our study was 48.9 minutes which is similar to study of Griffet J et al[11] (2011).

The duration of stay in the hospital < 7 days for 29 (90.6%) patients, 8-10 days for 3 (9.4%), no patient stay for >10 days. The average duration of hospital stay in the present study is 4.4 days. In the observations of Griffet J et al[11] (2011) the mean hospital stay was 12 days.

In our study the mean time for union found to be 12.4 weeks. Delayed union seen in one case only at 26 weeks. Mean time to union was 11 weeks (range 6 -18 weeks) in the series of Sankar et al[8] (2007).

The average time of full weight bearing was 12.3 weeks in our study. Wudbhav N. Sankar[8] et al in their study allowed full weight bearing between 5.7 – 11.6 weeks an average of 8.65 weeks.

Superficial infection was seen in only 1 (3.1%) case in our study which was resolved with oral antibiotics administration. Deep infection or osteomyelitis seen in 1 case only, infection was not controlled by antibiotics, but it did not affect the union time after complete union implants removal done. J.M. Flynn et al.[9] reported 4 (1.7%) cases.

30 patients had full range of knee and ankle motion in the present study and 2 (6.25%) patients had mild restriction in ankle dorsiflexion at 24 weeks, but normal range was achieved after physiotherapy. J.M.Flynn et al.[9] (2001) reported 2 (0.9%) cases of knee stiffness out of 234 fractures treated with titanium elastic nails.

Two cases (6.2%) in the present study limb length discrepancy was reported. Wudbhav N. Sankar[8] in their study of 19 tibial shaft fractures reported no leg length discrepancy which is similar to our results.

The varus and valgus malalignment occurred in 3 (9.3%) cases in our study while J.M. Flynn et al.[9] (2002) reported 10 (4.3%) cases of minor angulation out of 234 fractures treated with titanium elastic nails.

In the present study, 1 (3.1%) patient had anteroposterior angulation. Ozturkman Y et al[12] (2002) noted an anterior angulation of 7° and a posterior angulation of 6° in 2 patients respectively.

A difference of 10° has been the criterion of significant rotational deformity occurred in 2 (6.2%) patients. Heinrich SD, et al[13] out of 183 fractures studied, reported 8^0 out toeing in 4 children and two children with 5^0 in toeing following flexible intramedullary nailing.

In the present series, nail back out was not seen in any of the cases. Carrey T.P. et al[14] out of 38 cases, noted nail back out in one case in their study, which necessitated early removal.

Irritation at nail entry site was present in 2 (6.2%) cases and Bursa at the tip of the nail in 1 (3.1%) case out of 32 in our study. In series of

Wudbhav N.Sankar et al[8] (2007) irritation was present in five patients (26%).

In the present study, the final outcome was excellent in 27 (84.35%) cases, satisfactory in 4 (12.5%) cases and there 1 (3.1%) poor outcome case. Wudbhav N. Sankar[8] (2007) in their study of 19 tibial shaft fractures reported 12 (63.15%) excellent, 6 (31.57%) satisfactory and 1 (5.26%) poor result.

CONCLUSION

The conservative method of managing pediatric tibial fractures gives good results. TENS which is safe and effective method to maintain the reduction of displaced tibial fractures including length and rotation. It is simple, rapid and safe procedure with advantages of early union, early mobilization and early return to function with minimum complications. Elastic medullary nailing advantages make it a valuable choice to consider in managing children shaft tibial fractures.

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