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Clinical and Radiological Outcome of Titanium Elastic Nail Fixation in Diaphyseal Fractures of Tibia in Children

Authors

***Jaya Someswar Narreddy[1], BLS Kumar Babu[2], Biju Ravindran[3]**

Department Of Orthopedics, Narayana Medical College and Hospital, Chintharedypalem, Nellore-524002

Corresponding Author*

Dr. Jaya Someswar Narreddy M.S

Associate Professor of Orthopedics, Narayana Medical College and Hospital, Chintharedypalem, Nellore-524002

Email: *jsnarreddy@gmail.com, Ph: 9440280925*

Abstract

Background: *In children, major tibial fractures cases managed by closed reduction and casting. From time to time, surgical intervention is needed due to excessive shortening, angulations, or malrotation at the fracture site. Titanium elastic nailing system (TENS) is a modern technique which allows secure reduction, maintenance of reduction of skeletally immature long bone fractures. To this reason we also evaluated the clinical and radiological outcome of diaphyseal fractures of tibia in children treated with titanium elastic nailing system.*

Methods: *This open label study was conducted at a Tertiary care hospital, Andhra Pradesh during the period of 2008-2010. Children age between 5-16 years with simple, closed; ipsilateral diaphyseal fractures of tibia admitted to orthopedics department were enrolled. Closed reduction and internal fixation with TENS nails was done. Follow-up was done at 3,6,12 and 24 weeks. On every follow-up visit, patients were evaluated clinically, radiologically and complications were noted. Based on these data the final outcome was assessed using Flynn's criteria. Data was described as actual numbers and percentages using Graph pad Prism Version -5.*

Results: *Most patients were discharged home on postoperative day two or three. 6 weeks after surgery, casts were removed. In our series, the entire the patients achieved complete radiographic healing (evidence of tricortical bridging callus) at a Mean of 11.0 weeks (range 6–18 weeks). As expected, closed fractures healed more quickly (mean 9.7 weeks) than open fractures (mean 13.8 weeks). The common complications noted following nail insertion was irritation at the nail entry site in five patients (26%).*

Conclusion: *Closed pediatric tibial shaft fractures can be successfully treated with titanium elastic nails with satisfactory rate of complications.*

Keywords: *Pediatric tibial diaphyseal fractures, Titanium elastic nailing system (TENS), Flynn's criteria*

INTRODUCTION

In children, major tibial fractures cases managed by closed reduction and casting. From time to time, surgical intervention is needed due to excessive shortening, angulations, or malrotation at the fracture site.[1] Titanium elastic nailing system (TENS) is a modern technique which allows secure reduction, maintenance of reduction of skeletally immature long bone fractures.[2] It works on the basic principle of -three point fixation - providing flexural, axial, translational and rotational stability.[3] It aims to develop early bridging callus and contributes to rapid restoration of bone continuity and allows early mobilization. J.M.Flynn et al[4] studied 230 fractures of shaft of femur in children between 3 and 18 years using TENS, the outcome was excellent in 150 (65%), satisfactory in 57 (25%), and poor in 23 (10%). To this purpose we also evaluated the clinical and radiological outcome of diaphyseal fractures of tibia in children treated with titanium elastic nailing system.

METHODS

This open label study was conducted at Narayana Medical College 2008-2010.All children between 5-16 years of age with simple, closed; ipsilateral diaphyseal fractures of tibia admitted to orthopedics department were enrolled. Institutional ethical committee permission and consent from the parents was obtained. Patients with metaphyseal fractures, compound fractures, pathological fractures and fracture with head injury were excluded from the study. Pre-operative anesthetic evaluation was done after obtaining consent from the parents. Under anesthesia, closed reduction and internal fixation with TENS nails was done using c-arm. Post-operatively long leg cast applied, mobilized without weight bearing on 5th to 7th day, partial weight bearing started at three weeks. After 6-8 weeks full weight bearing was advised, depending on the fracture pattern, callus reaction and associated injuries. Patient follow-up done following 3,6,12 and 24 weeks. Every follow-up, patient was evaluated clinically, radiologically and complications are noted. Based on these data the final outcome was assessed using Flynn's criteria.[4]

STATISTICAL ANALYSIS

The data was entered into excel spread sheet -7 and analyzed with Graph pad Prism Version -5. Data was described as actual numbers and percentages.

RESULTS

Most patients were discharged home on postoperative day 2 or 3. Casts were usually removed 6 weeks after surgery. All the patients in our series achieved complete radiographic healing (evidence of tricortical bridging callus) at a mean of 11.0 weeks (range 6–18 weeks). As expected, closed fractures healed more quickly (mean 9.7 weeks) than open fractures (mean 13.8 weeks). One patient who had sustained an open tibia fracture was started on a bone stimulator 12 weeks postoperatively because of concerns of inadequate fracture callus; the patient eventually achieved radiographic union 18 weeks after the index

operation. In those patients with isolated tibia fractures, patients were progressed to full weight bearing by a mean of 8.4 weeks (range 5.7–11.6 weeks). All patients had their elastic nails removed at an average of 23.1 weeks after the initial surgery.

Irritation at the nail entry site was the most common complications following nail insertion, occurring in five patients (26%). One child required early removal of the nails for this complaint. No patients developed obvious rotational abnormalities, leg length discrepancies, or physeal arrests as a result of treatment. One child developed full thickness skin necrosis from the second postoperative cast, well away from the nail entry sites, which required a free flap.

Table-1- Clinical, radiological profiles and outcomes of children treated with Tens (n=26)	
Age (yrs)	9.4±3.6 yrs
5-10 years	15 (58%)
11-16 yrs	11 (42.30%)
Gender	
Male	20 (77%)
Female	6 (23%)
Cause of Fracture	
Fall	20 (77%)
RTA	6 (23%)
Fracture Location	
Upper 1/3	3 (11.50%)
Middle 1/3	20 (77%)
Lower 1/3	3 (11.50%)
Time to union (weeks)	8.6±2.8
Length of hospital stay (days)	2±1.4
Complications	
Angulations	3±1° (0-6)
Valgus	6° in one patient
Varus	12 ° in one patient
Shortening of limb	Nil
Irritation at entry site	6 patients
Flynn's criteria at 24 wks	
Excellent	20 (77%)
Good	4 (15.38%)
Poor	2 (7.62%)

DISCUSSION

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.[5]

It is necessary to evaluate the efficacy and safety of titanium elastic nails fixation in pediatric long bones fractures of lower limbs.

Economedes et al concluded in his study that Closed and open pediatric tibial shaft fractures can be successfully treated with titanium elastic nails. Open fractures treated with titanium elastic nails

have a significantly longer time to union, require additional operative procedures, and result in longer hospital stays. [6]

Kubiak et al. reported superior functional outcomes and patient satisfaction in the cohort treated with TENS. [7]

In another study, Wudbhav N. Sankar et al[1] observed outcome on Flynn's criteria in 19 children between 7.2 and 16 years of age treated with elastic stable intramedullary nailing for unstable tibial shaft fractures and found 12 had excellent, 6 satisfactory, and 1 poor result.

CONCLUSION

Pediatric Tibial shaft fractures can be treated by various surgical methods; out of which, closed Titanium Elastic Nailing system (TENS) has evolved as a superior method with satisfactory rate of complications. It avoids the probability of physeal infection, injury and offer quick healing.

CONFLICT OF INTEREST: NONE

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