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Original Research Article

Paediatric Long Bone Fractures Managed with Elastic Intramedullary Nails

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Abstract

Background and Aim: For the treatment of different paediatric long bone fractures, an alternate technique known as titanium elastic nailing, or elastic intramedullary nailing, is used. For youngsters older than six, titanium nails are favoured over stainless steel and plaster cast nails. The purpose of the current study was to examine the clinical results of children treated with elastic intramedullary nails for long bone fractures.

Material and Methods: In this study, the medical records of children (ages 2 to 15) who had two years of hospitalisation and treatment for unilateral femur, tibial, or forearm fractures treated with elastic intramedullary nails were retrospectively evaluated. All of them were treated with intramedullary elastic nailing. The medical records revealed the union times and problems.

Results: There were sixty patients in the trial during its duration. Of these, 66.6% were men and 51.6% were under the age of ten. Thirty percent reported a car accident, and one incidence (3.33%) involved physical abuse. With a range of 6 to 12 weeks, the average period of union was 10 weeks. For 35%, it was 6 to 8 weeks; for 33.3%, it was 9 to 10 weeks; and for 31%, it was 11 to 12 weeks.six of the patients. A functional status evaluation was conducted 24 months after surgery using the Flynn criteria. 36.6% of respondents rated it as great, 43.3% as good, and 20% as fair. There were no examples with inadequate functional results.

Conclusion: Our experience leads us to believe that TEN should be the initial approach to treating paediatric long bone fractures, particularly in older children (above the age of six and up to 16). Moreover, surgical therapy with TEN may be favoured in situations where sustaining reduction with closed casting presents a difficulty or interferes with nursing care and rehabilitation.

Keywords: Children, Elastic Intramedullary Nailing, Long Bone Fracture, Road Traffic Accident.

Introduction

Children are prone to injury; each year, up to 25% of all children sustain an injury. [1] A fracture occurs from one in every four of these injuries. [2]. Numerous writers have examined a variety of risk factors for fractures in children, including age, gender, bone density, home safety design, participation in sports, physical abuse, and family socioeconomic situation. [3]

The ever-evolving treatment protocols for paediatric long bone fractures have demonstrated a predilection for the application of intramedullary elastic nails. Conservative approaches are being used to treat most long bone fractures in the skeletally young. Since children's immature bone has a remarkable capacity to rebuild, conservative treatment is still the gold standard for long bone fractures in children under the age of six. [4] It is debatable, therefore, how long bone fractures should be treated in children between the ages of six and sixteen. [5]. Metazziau proposed the use of plaster casting for long bone fractures in children under six years old and intramedullary nailing for adolescents over sixteen. Due to their low immobilisation tolerance and discomfort from the cast, older children were better candidates for elastic intramedullary nailing.

Additionally, in older adolescents approaching adolescence, there is less chance of correcting

malalignment in long bone fractures. In order to maintain reduction and preserve function, surgical options were necessary for unstable fractures, which are defined as those in which close manipulation is unable to sustain the reduction with a release of the reducing force, resulting in shortening of more than 10 mm or angular and rotational deformity of more than 15 degrees. [6] There are several ways to stabilise lengthy bone fractures in children, however the use of flexible elastic nails has fundamentally altered the way that children's shaft-of-femur fractures are managed. [7,8]

When fixing diaphyseal fractures in long bones when the medullary canal is limited or implant flexibility is crucial, the Titanium Elastic Nail (TEN) for Elastic Stable Intra-medullary Nailing (ESIN) is used. Because of its flexibility, TENs can be placed in paediatric applications at an angle that prevents damage to the bone growth plate. For open, unstable, or irreducible fractures, the use of an intramedullary device is advised. The purpose of the current study was to examine the clinical results of children treated with elastic intramedullary nails for long bone fractures.

Material and Methods

In this study, the medical records of children (ages 2 to 15) who had two years of hospitalisation and treatment for unilateral femur, tibial, or forearm fractures treated with elastic intramedullary nails were retrospectively evaluated. The Tertiary Care Teaching Institute of India's orthopaedics department was the site of the study. Children with spina bifida, cerebral palsy, pathological fractures, or other neuromuscular disorders were not allowed. After informing the patients of the study's goal, signed informed permission was acquired. The institutional ethics committee gave its approval to the project.

Under aseptic measures, intravenous and regional anaesthesia were used for intramedullary nailing. A single intravenous dose of cefazolin (12.5 mg/kg) was given to each patient 30 to 60 minutes before to skin incision. Using the three point fixation method, two bent nails were combined to treat fractures of the femur, tibia, and forearm. One of the writers carried out every surgery. TEN was applied in each instance. The nail diameter was maintained at 0.4 times the intramedullary canal's smallest inner diameter for femur and tibia fractures.

Nails were bent when it was predicted that they might irritate the extensor pollicis longus. Following surgery, the patients were transferred to recovery wards, where oral antibiotics were administered for the following seven days and intravenous antibiotics were continued until the first dressing was completed. Forearm fracture patients received treatment above the elbow slab, while femur or tibia fracture patients received treatment above the knee slab. Two weeks later the sutures were taken out. Partial weight bearing commenced thereafter. Every two weeks for the first month following surgery, and then every month for the next three months, clinical and radiological evaluations were conducted. Following the achievement of clinical bone union, full weight bearing and range of motion were initiated. Following surgery, all patients were monitored for a minimum of 18 months to see whether any problems had developed.

A pre-made semi-structured study proforma was used to record the findings once the data were taken out of the medical records. For every child, demographic data such as age and gender were recorded. The mode of damage was identified from the medical data. Clinician notes included the bone involved, the time it took for the bone to union, any complications that arose after the surgery, and the functional status after 24 months.

Postoperative radiographs were evaluated at 1, 2, and 6 months to determine fracture union. Removing hardware was advised based on the circumstances. Flynn grading standards for assessing how well children receiving TEN treatment fared with long bone fractures.Six

Statistical analysis

The collected data was combined, input into a spread sheet using Microsoft Excel 2007, and exported to the SPSS version 15 data editor page (SPSS Inc., Chicago, Illinois, USA). Depending on how they were distributed, quantitative variables were defined as means and standard deviations or median and interquartile range.

Counts and percentages were used to display the qualitative factors. The significance threshold and confidence level for each test were set at 5% and 95%, respectively.

Results

There were sixty patients in the trial during its duration. Of these, 66.6% were men and 51.6% were under the age of ten (Table 1). At the time of surgery, the patient's age ranged from 6 to 15 years, with a mean of 10 years. Thirty patients (33.3%) each had problems with their femur, tibia, and forearm bones. With the exception of two cases of compound grade I tibia injuries involving soft tissue damage, all injuries were closed. Anatomical reduction and fracture instability led to the decision to proceed with surgery. Falling from a height was the most frequent cause of injury (66.6%). Thirty percent reported a car accident, and one incidence (3.33%) involved physical abuse. With a range of 6

to 12 weeks, the average period of union was 10 weeks. Of the patients, 35% had it for 6 to 8 weeks, 33.3% for 9 to 10 weeks, and 31% for 11 to 12 weeks.

According to Table 2, the average time for the femur and tibia to unite was 11.40 and 11.15 weeks, respectively. Forearm, it was noticeably lower. There were no cases of non-union, delayed union, malalignment, or surgical site infection in any of the patients. A functional status evaluation was conducted 24 months after surgery using the Flynn criteria. 36.6% of respondents rated it as great, 43.3% as good, and 20% as fair. There were no examples with inadequate functional results.

Table 1: Baseline characteristics of the patients

Variables	Number	Percentage (%)
Age group (years)		
6-10	31	51.6
11-15	29	48.3
Gender		
Male	40	66.6
Female	20	33.3
Bone involved		
Femoral	20	33.3
Tibial	20	33.3
Forearm	20	33.3
Mode of injury		
Fall from height	40	66.6
Road traffic injury	18	30
Physical abuse	2	3.33

Table 2: Union time of different bone fractures

Time to union (weeks)	Number	Percentage (%)
6 to 8	21	35
9 to 10	20	33.3
11 to 12	19	31.6
Bone	Mean union time (weeks)	P alue
Femoral	11.40±2.10	0.02*
Tibial	11.15±1.65	
Forearm	6.39±2.12	

* indicate statistically significance at p≤0.05

Discussion

Long bone fractures make up the majority of emergency cases in most trauma centres. While closed reduction and casting is usually sufficient for the treatment of most childhood long bone shaft fractures, surgical stabilisation becomes necessary on occasion. The preferred course of treatment in the past has been external fixation; nevertheless, there are dangers involved, such as nonunion, refracture, and pin-track infections. [9,10]

51.6% of the patients in the current study were under the age of ten, and 66.6% of them were men. Raut et al. studied the functional result and consequences of TEN-assisted healing of long bone fractures in children. [11] The study found that 36.7% of the patients belonged to the 6 to 8 age group, and the mean age at the time of surgery was 9.67±2.68 years. Sixty-six percent of the study population was male. Lakavath et al. conducted a similar study in which they retrospectively examined the therapeutic results of using TEN to treat 28 children who had lengthy bone fractures. [12]

In their investigation, the mean age of the male subjects was 7.25±2.12 years, while the mean age of the female subjects was 8.21±1.26 years. Fifty-three percent of the patients were male. Khuntia et al. conducted a retrospective evaluation of paediatric long bone fractures treated with an elastic intramedullary nail in a recent study. [13] Using TEN, Gavaskar and Singh conducted a prospective study to assess the surgical results of paediatric diaphyseal fractures in the 5–12 age range. [14] Of the patients in their study, 70% were male and 47% were younger than 8 years old.

Forearm, tibia, and femur fractures were found in the current investigation in comparable amounts (33.3% each). According to the Flynn criteria, the functional outcome was satisfactory in every instance. According to Raut et al. (2011), 4% of the study population had a humerus fracture, 23% had a tibia fracture, 23% had a femur fracture, and 50% of the study group had a radius ulna fracture.

Additionally, according to the authors, 90% of the patients achieved full union by 4 to 6 weeks following surgery, compared to 2 (6.7%) and 1 (3.3%) patients who had full union in 4 weeks or less and 6–8 weeks, respectively.

It's challenging to keep the reduction in the plaster cast in youngsters who are overweight or very muscular. Again, immobilization should be avoided in kids with neuromuscular disorders or weak bones. When compared to plating, TEN is still the preferred option since it circumvents the pressure-prone area that forms at the junction of the brittle cortical bone and the stiff plate. The nails prevent bone deformation by acting as a scaffold. TEN should be used over cast immobilisation in cases of multiple fractures, polytrauma, head traumas, and other conditions requiring acute nursing care. [15]

It took an average of 5.25±1.10 weeks to reach union. Flynn criterion showed that 16.7% of patients had good results and 83.3% of patients had exceptional results. There were no subpar outcomes. There were fifteen femur fractures, six tibia fractures, eight forearm fractures, and one humerus fracture in the Khuntia et al. [13] study. The average duration to union was 9.93 weeks, with the long bone involved and fracture pattern having an impact on the range of 6 to 16 weeks. The average length of time for the femur and tibia to unite was 11 weeks. Less time was needed for upper limb fractures to unite a mean of eight weeks. Based on Flynn criteria, the authors reported satisfactory outcomes in every case.

When comparing our experience with TEN usages in paediatric long bone fractures to published data, we did not encounter any unusually severe consequences. The issues surface infection, growth, and noticeable hardware that caused irritation—were all addressed promptly and had no negative impact on the children's functional success.

We acknowledge that our study has limitations because it is retroactive, lacks a control group, and does not compare with alternative treatment approaches. We had a small sample size as well.

Conclusion

We would suggest from our experience that TEN can become the first method of management of pediatric long bone fractures, especially in older children, more than six years and up to 16 years. Also, in cases where maintaining reduction with closed casting is a challenge or hindrance to rehabilitation and nursing care, surgical management with TEN can be preferred.

All patients achieved bony union, without delay, malunion, malalignment or infection. Functional outcome was also satisfactory in all cases. Thus, having a minimally invasive approach (as compared to traditional plating) does not compromise on the final clinical outcomes of the patients. Thus, we recommend the use of TEN in managing long bone fractures in children.

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