

A Prospective Observational Clinical Outcome Assessment of Managing Forearm Fractures Using Titanium Elastic Nailing System (TENS)

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Conflict of interest: Nil

Abstract

Aim: The aim of this prospective study was to evaluate the clinical outcome of managing paediatric forearm fractures using Titanium Elastic Nailing System (TENS).

Methods: The current study was done at the Department of Orthopaedics at Darbhanga Medical College and Hospital in Darbhanga, Bihar, India, from August 2020 to August 2022. One hundred patients were included in the study if they were between the ages of 6 and 14, had a fracture that was displaced or grossly rotated, and had failed closed manipulation. They also had to be followed up for at least six months. Patients with a single forearm bone fracture, multiple fractures, or a fracture that caused nerve or blood vessel damage were not considered.

Results: In this study, there were 20 females and 80 males. 48 of them were between 6 and 10 years old, and the rest were between 11 and 14 years old. In 88 people, the injury was simple or closed. 48 people had a fracture at the middle 1/3rd level. CRIF surgery was done 92% of the time. Based on the criteria set by Price CT et al., 95 patients had good results and 5 patients had excellent results. None of the patients' results were fair or bad. The result showed that most patients who used TENS got good results from it.

Conclusion: The titanium elastic nailing system (TENS) works well and looks good on x-rays. Because it is minimally invasive, keeps the fracture hematoma, doesn't strip the periosteum, takes less time during surgery and in the hospital, and has a lower chance of refracturing when the implant is taken out, it can be used instead of ORIF with plate osteosynthesis to treat forearm fractures in adults.

Keywords: Functional outcome, Intramedullary fixation, TENS, paediatric forearm fractures

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Introduction

By allowing flexion and extension of the elbow and wrist, as well as pronation and supination through the proximal and distal radioulnar joint, the forearm plays a significant part in the positioning of the hand in space. [1] Because of this, a broken bone in the forearm has the

potential to cause substantial dysfunction if it is not treated properly. [2] Because of this, proper anatomical reduction of these fractures and internal fixing of them are required in order to restore function. [3] The incidence of diaphyseal forearm fractures in adults over the age of 20

remains below 2 per 10,000 individuals on an annual basis, on average. [4,5] Several studies have indicated that males have a significantly higher risk of suffering a forearm fracture compared to females. The percentage of male patients can range anywhere from 63 percent to 91 percent. [6] The majority of forearm fractures happen in the first four decades of a person's life, specifically between the ages of 24 and 37. [7,8] Accidents involving motor vehicles and other high-energy impacts, such as those that occur in sports, are the most common causes of forearm fractures. [9-11]

These fractures are traditionally treated conservatively with closed manipulation and above-elbow plaster cast immobilization for 4–6 weeks. Malunion and joint stiffness are common despite the fracture uniting easily. [12] Re-displacement, especially in older children, is another issue. [13] Internal fixation is recommended to preserve fracture reduction till bone union and improve functional result. Extramedullary implants like plates have bigger incisions, more soft-tissue dissection, increased infection risk, and a similar-sized resurgery to remove the implant, which is not recommended for youngsters. Alignment, little invasiveness, and few problems are optimal for fixing. [14] This pushed surgeons to utilize intramedullary fixing devices. Titanium elastic nailing system (TENS) is a minimally invasive treatment that spares physis and provides three-point fixation without Plaster of Paris (POP) splint/cast, allowing early mobilization and excellent functional outcomes. TENS is better than Kirschner wires/pins/nails for intramedullary fixation. [15]

TENS is not only cost-effective, but it also entails a simple approach that requires just a little amount of soft tissue dissection. Moreover, early fracture union can occur as a result of its elasticity and repeated micro-motion at the fracture site. [16,17] The transcutaneous electrical nerve

stimulation (TENS) operates as an internal splint to align the fracture pieces. Moreover, it is possible to pre-bend it in order to accomplish the three-point fixation. [18,19] The primary objective of this prospective study was to examine the clinical result of treating paediatric forearm fractures with the Titanium Elastic Nailing System (TENS).

Materials and Methods

The current investigation was carried out at the Department of Orthopaedics at Darbhanga Medical College and Hospital in Darbhanga, Bihar, India from August 2020 to August 2022. A total of one hundred patients met the inclusion criteria, which included an age range of 6-14 years, a displaced fracture or a grossly rotated fracture, a previous attempt at closed manipulation that was unsuccessful, and a minimum of six months of patient follow-up. Individuals who had a forearm bone fracture that was isolated, had compound fractures, or had a fracture that was associated with neurovascular damage were not considered.

The study was approved by the ethical committee of the institute. Proper pre-operative anaesthetic checkup and investigations were conducted in all patients. Pre- and post-operative cephalosporin antibiotics were administered for 3 days with dosage as per weight of patient.

Operative Technique

The closure reduction was performed under image intensifier while the patient was under general anesthesia. After the reduction had been completed to the surgeon's satisfaction, the ulna was stabilized by antegrade nailing through the lateral surface of the olecranon around 1.5 to 2 cm distal to the physis. The radius was stabilized by performing a retrograde nailing procedure through the dorsal portion of the distal radius. This procedure was performed proximal to the radial physis and just medial to lister's tubercle.

Extensor tendons and the superficial radial cutaneous nerve were protected with extreme caution during this procedure. The tip of the nail was initially bent at an angle of thirty degrees, and then an extra gentle bend was applied in such a way that it overlaps with the fracture site. The length of the nails as well as their diameter were adjusted, and this was monitored via an image intensifier. At those places where it was necessary to do so, limited open reduction was carried out in order to accomplish precise reduction. In every instance, the ends were curved and cut close to the bone, but sufficient length was left over to allow for eventual removal and burial beneath the skin. Throughout the

course of this research, we utilized the same group of surgeons to perform the operations, and they adhered to the same post-operative procedure. The vast majority of patients did not require any external immobilization after their surgery. However, in certain patients with more comminuted fractures, a POP splint was given for a maximum of three weeks. This length of time was determined by the stability of the fracture.

Early range of motion exercises was started and results were evaluated at 2, 4, 8, 12 and 24 weeks. Clinical results were evaluated as per scale developed by Price CT et al., for pain and range of motion of supination and pronation. [13]

Outcomes	Symptoms	Loss of Forearm Rotation
Excellent	No complaints with strenuous activity	<15°
Good	Mild complaints with strenuous activity	15°–30°
Fair	Mild complaints with daily activities	31°–90°
Poor	All other results	>90°

Results

Criteria	Observations	Percentage
Age		
		Mean age = 11.7 years
6-10 years	48	48
11-14 years	52	52
Sex		
Male	80	80
Female	20	20
Type of injury		
Simple/ Closed	88	88
Compound/ Open	12	12
Level of fracture in shaft of both bones		
Proximal 1/3rd	44	44
Middle 1/3rd	48	48
Distal 1/3 rd	8	8
Type of Surgical Procedure		
CRIF	92	92
ORIF	8	8
Results		
Excellent	95	95
Good	5	5
Fair	-	-
Poor	-	-

The population that was being studied had a mean age of 11.7 years. In this particular study, there were a total of 80 male participants and 20 female participants. 48 of the patients were between the ages of 6-10 years, and the remaining patients were between 11-14 years. There was a simple or closed injury present in 88 individuals. 48 patients had a fracture at the middle one third of the bone. The CRIF procedure was

performed in 92% of the patients. According to the criteria developed by Price CT et al., 95 patients achieved outstanding results, while 5 patients achieved good results. None of the patients got findings that were either average or unsatisfactory. TENS was able to produce very favorable outcomes for the vast majority of patients, as demonstrated by the study's findings.

Table 2: Radiological union time in weeks

Time in weeks	N%
4-5	32 (32)
5-6	25 (25)
6-7	30 (30)
7-8	7 (7)
8-9	5 (5)
9-12	1 (1)

The radiological bony union occurred 9.2 weeks after the start of treatment, with a range of 4–12weeks.

Discussion

The fracture of the bones in the forearm is rather common in children, occurring in around one in one hundred kids each year. This condition is seen in the pediatric population. The age group from 6-14 years old sees the highest incidence of the disease, which accounts for roughly 34% of all cases. Forearm fractures that involve both bones account for approximately 5.4% of all fractures that occur in children under the age of 16 years.²⁰ Children between the ages of 12-16 years old have a higher incidence of cases compared to other children in the pediatric age group. [21] The management of these fractures gets more challenging when they occur in youngsters who are a little bit older. Even after a successful closed reduction, the fracture can still move because it is located in the proximal part of the bone. This is an additional source of frustration for the surgeon. [22]

Similar findings were obtained in the study carried out by Chouhan et al [23], in which male predominance was discovered among 78.33% of the study group. In this investigation, it was found that males

(80%) were more likely to sustain injuries than females. In the current study, there were a total of 100 patients; 88 of these patients had simple (closed) fractures, making up 88% of the total patients, and 12 of these patients had compound (open) fractures, making up 12% of the total patients. Gustilo and Anderson grade I fractures. In their study, Kang SN et al. also reported that 9% of their patients had open fractures, while the remaining 91% were closed. This could be because the injuries that youngsters sustain are ones that require less energy to heal from. [24]

The radiological bony union occurred 9.2 weeks after the start of treatment, with a range of 4-12 weeks. When compared to the findings of the study carried out by Ali et al., in which bony union was observed after 10 weeks, our findings are superior. [25]

In the current investigation, a fracture of the shaft of the forearm bones was found in 44 patients (44%) at the proximal one-third, a fracture of the forearm was found in 48 patients (48%) at the middle one-third, and a fracture at the distal one-third was found in 8 patients (8%). In the study

that was carried out by Celebi L. and colleagues, the incidence of proximal third fractures were comparable and the mean age of the patients was 10.6 year, which is comparable to the mean age group in our study i.e., 11.7 years. These data are suggestive of the notion that proximal fractures are more likely to take place in children who are older than 10 years old, whereas distal fractures are more prevalent in children who are younger than 10 years old. [26] In the current investigation, 95 (95%) of the patients had an excellent functional outcome, whereas 5 (5% of cases) had a good outcome. In the end, all of the subjects were able to reach a normal range of motion and did not have any complaints or functional deformities. The ultimate result is comparable to a study that was carried out by Parajuli and colleagues, in which 94% of patients experienced great results and 6% experienced decent results. [27,28]

Conclusion

The titanium elastic nailing system, often known as TENS, has been shown to have positive radiological and functional outcomes. It is possible to use this technique as an alternative to open reduction and internal fixation (ORIF) with plate osteosynthesis in the treatment of adult forearm fractures due to its minimal invasiveness, preservation of fracture hematoma, lack of periosteal stripping, minimal operative time and duration of hospital stay, and reduced risk of refracture during implant removal.

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