

# MANAGEMENT OF PEDIATRIC BOTH-BONE FOREARM FRACTURES BY TITANIUM ELASTIC NAILING SYSTEM

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### Abstract:

Diaphyseal fractures of the radius and ulna are common in the pediatric population. The standard management for pediatric forearm fractures remains conservative management with closed reduction and immobilization with above-elbow plaster cast. Although the fracture unites readily, malunion is very common. Stiffness of joints and compartment syndrome are other complications of conservative management with plaster cast. The introduction of titanium elastic nailing system (TENS) has changed the treatment scenario of fracture of both-bone forearm.

**Aims:** The aim of this study is to evaluate the functional and cosmetic outcome of the management of fracture both-bone forearm by closed reduction and internal fixation with titanium elastic nail system.

**Subjects and Methods:** A total of 50 patients aged 4-12 years with fracture of both radius and ulna were managed by internal fixation with titanium elastic nail. Closed reduction under image intensifier control was achieved in most of the patients.

**Results:** Results were analyzed in reference to union, symptoms, and range of motion of adjacent joints using Price et al. criteria for outcome evaluation. In our study, 84% of patients showed excellent, 12% showed good, and 4% showed fair outcome.

**Conclusion:** Better functional and cosmetic outcome with minimal complications is achieved with internal fixation with titanium elastic nail system. TENS may be considered as an alternative to conservative treatment.

**Keywords:** Both-bone forearm fracture, results, titanium elastic nail system

### Introduction

Diaphyseal fractures of both-bone forearm are common in pediatric age group. The standard management of these fractures remains conservative treatment with closed manipulation and immobilization with above-elbow plaster cast for 4-5 weeks.<sup>[1]</sup> Although the fracture unites readily, malunion is very common. Stiffness of joints and compartment syndrome are other complications of conservative management with plaster

cast.<sup>[2]</sup> Other modalities of treatment have been proposed for the treatment of both-bone forearm fractures in children and adolescents such as closed reduction and K-wire fixation and open reduction with plate fixation. The advent of elastic nail fixation has revolutionized the treatment of displaced fractures of both-bone forearm. Surgical management with elastic intramedullary nail in pediatric both-bone forearm fracture has been first described by Metaizeau and Ligier.<sup>[3]</sup> Biomechanically, these implants have shown to act as internal

splints.<sup>[4]</sup> The titanium elastic nailing system (TENS) provides the following four properties: flexural stability, axial stability, translational stability, and rotational stability. All four properties are essential for achieving optimal results.<sup>[5]</sup> The elastic stable intramedullary nailing has benefits of immediate stability to the involved bone segment which permits early mobilization and returns to normal activities with low complication rate.<sup>[6],[7]</sup>

## Subjects and Methods

From Nov. 2015 to Oct. 2017, 50 pediatric patients with displaced diaphyseal forearm fracture were treated with titanium elastic nail system. The following criteria were followed while selecting participants.

### Inclusion criteria

- Age: 4-12 years
- Displaced diaphyseal forearm fractures.

### Exclusion criteria

- Children <4 years and >12 years
- Physeal injury
- With proximal and distal radioulnar joint disruption.

### Surgical technique

A patient was put in the supine position on operating table with the affected arm placed on a radiolucent arm table. Titanium elastic nails of appropriate diameter were chosen. The nail diameters were about two-thirds of the medullary isthmus of each bone. Then, the awl was used to make entry point in the bones. Entry point in the radius was either just proximal to the radial styloid or through Lister's tubercle<sup>[2]</sup> The antegrade entry point in the ulna can be either at the posterior aspect of the olecranon or a lateral approach through the proximal metaphysis.<sup>[2]</sup> The retrograde entry point in the ulna was through the distal metaphysis. Because the radius is often more difficult to reduce, it should be splinted first. Radial nail was inserted manually with the inserter for TEN into the medullary canal, with the nail tip at right angles to the bone shaft. Then, the nail was rotated through 180° with the inserter,

and the nail tip was aligned with the axis of the medullary canal. The nail was advanced up to the fracture site with oscillating movements. The radial nail tip was aligned with the medullary canal of the proximal fragment. Then, the nail was advanced with smooth oscillating movements until the tip reaches the proximal fragment metaphysis. Ulna nail was then introduced and progressed in similar manner such as radius nail. When the nails were correctly positioned in the opposite metaphysis, protruding nail ends are cut approximately 1 cm from the bone. In most of our cases, closed reduction was done. In few cases, where closed reduction could not be achieved, mini-incision was given over fracture site for the reduction of fracture and internal fixation with titanium elastic nail done. Postoperatively, majority of the patients required no external immobilization. However, in some patients, plaster of Paris slab was given for 2 weeks to encourage soft-tissue healing. Patients were followed up at 1,2,4,6,12, and 24 months. Early range of exercises was started, and results were evaluated as per Price et al.<sup>[8]</sup> [Table 1] criteria taking pain and range of motion of forearm (supination/pronation) into consideration.

**Table 1: Price et al. criteria**

Outcomes	Symptoms	Los Of Forarm Rotation (°) (Supination / Pronation)
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

All the fractures united at an average 10–12 weeks without any malunion, 5 patients had superficial infection and 8 patients had pain due to nail prominence. 8 patients had restriction of supination and Pronation. Elbow flexion and extension, palmar flexion, and dorsiflexion at wrist were normal. As per Price et al. criteria,<sup>[8]</sup> 84% (42) of patients showed excellent results, 12% (6) showed good results, and 4% (2) showed fair result.

## Discussion

In our study, out of 50 patients, fractures involved proximal third of shaft of forearm bones in 15 (30%), fracture middle third in 28 (56%), and distal third involved in 7 (14%) patients [Table 2]. Closed reduction and internal fixation with titanium elastic nail system was achieved in 42 patients (84%) under image intensifier guidance. In 8 patients, closed reduction failed, so mini-incision was given over fracture site and internal fixation with titanium elastic nail system done [Table 3]. In a study by Kapila et al., out of 50 cases, closed reduction and intramedullary fixation in 47 patients (94%) under image intensifier guidance and 3 (6%) patients required open reduction and intramedullary fixation.<sup>[9]</sup> Mean radiological union in our series was 10.4 weeks. A study conducted by Ali et al. and Parajuli et al. also had radiological union at 10 weeks.<sup>[10],[11]</sup> On our final follow-up, 42 patients had loss of movement at forearm by  $<15^{\circ}$ , 6 patients had loss of movement at forearm by  $15^{\circ}$ – $30^{\circ}$ , and 2 patient had loss of movement at forearm by  $>30^{\circ}$  [Table 4]. A study conducted by Kapoor et al. found restriction of movement of the forearm in 9 (18%) out of 50 patients.<sup>[12]</sup> 5 patients in our study had superficial infection which was subsided by dressing and intake of antibiotics. 8 out of our 50 patients had pain due to nail prominence. The study conducted by Ali et al. and Parajuli et al. also faced complications such as superficial infections and prominence.<sup>[10],[11]</sup> We did early implant removal after bony union. Meantime of implant removal was 9 months (range: 6–12 months).



**IMAGE (Pre OP, Post Op, After 6 Month)**

**Table 2: Level of fracture**

Level of fracture in shaft of both bones	Numbers Of Patients (%)
Proximal one-third	15 (30%)
Middle one-third	28 (56%)
Distal one-third	7 (14%)

**Table3: Type of reduction**

Type of surgical procedure	Numbers Of Patients (%)
Close reduction	42 (84%)
Open reduction	8 (16%)

**Table 4: End results**

Results	Number Of Patients (%)
Excellent	42 (84%)
Good	6 (12%)
Fair	2 (4%)
Poor	-

## Conclusion

Although the fracture of both bones of the forearm in children can be managed conservatively, they often lead to malunion with restriction of movements at either elbow or wrist joint. In comparison to conservative method, titanium elastic nail system showed excellent results in terms of bony union, functional outcome with minimal complications, and cosmesis. Therefore, this minimally invasive method of TENS may be considered as an attractive and effective alternative for displaced forearm fractures in pediatric age group.

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