



Outcomes in tibial diaphyseal fractures in adolescent age group managed by titanium elastic nailing system

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Abstract

Objectives: *In this prospective study we studied radiological and functional outcomes of unstable tibial shaft fractures in adolescent age group that were managed by titanium elastic nailing. Although most pediatric tibial shaft fractures are managed by closed reduction and casting, surgical treatment may be required in unstable or open fractures. Titanium elastic nails (TENs) have emerged as a suitable surgical modality for pediatric tibia fractures owing to the benefits such as easy surgical technique, early weight-bearing, early union and early discharge from hospital.*

Materials and Methods: *In this prospective study we managed 25 patients of unstable tibial diaphyseal fractures by TENs nailing. The mean age at injury was 10 years and 6 days (range of 8–17) years. In each patient, ante-grade nailing was performed by inserting a TENs nail in the medial and another TENs nail in the lateral side of the proximal metaphysis. Modified Flynn's criteria were used to assess union, alignment, leg-length inequality and complications.*

Results: *All the patients' fractures got united and the healing time was 10 weeks and 5 days in average. No case of nonunion or significant malunion or epiphyseal injury was encountered. No patient had a sagittal or coronal angulation of over 10°. Among patients with open fractures, four had superficial surgical site infections and one had a deep wound infection. All the infections were successfully treated with appropriate antibiotics. Patients with open fractures took longer time to heal than close fractures. Nearly full range of motion was achieved at knee and ankle in all cases. 16 (64%) patients had an excellent outcome, and 9 (36%) patients had a satisfactory outcome.*

Conclusion: *For unstable tibial shaft fractures in adolescent age group, TENs is a safe and effective treatment modality. It is minimally –invasive, thus causes less soft tissue injury, short surgery time, rapid recovery and fewer complications.*

Keywords: *Unstable tibial diaphyseal fractures, Adolescent age group, TENs.*

Introduction

Tibial diaphyseal fractures are common pediatric fractures with an incidence of 15%^[1]. Mainstay treatment in these fractures is conservative management by closed reduction and casting^[2]. Rigid intramedullary nails are not recommended in children due to an increased risk of proximal tibial epiphyseal injury. Therefore, in children, titanium elastic nails (TENs) are used instead, which are inserted into the metaphysis without causing epiphyseal injury. TENs is preferable owing to minimal proximal tibial epiphyseal injury, less soft-tissue injury, stable and flexible mobility, short surgical time and low cost^[4-9]. In this study, radiological and functional outcomes were observed in pediatric patients with unstable closed or open fractures who could not be treated with conservative methods and underwent a fixation with TENs.

Materials and Methods

This prospective study was conducted on 25 patients with unstable tibial- shaft fracture admitted in our hospital. In emergency room, analgesia, splintage and other resuscitation measures were given initially. In open fractures wound wash/debridement plus I/V antibiotics were administered. Proper history (including laterality, mode of trauma and the mechanism of injury), systemic examination and local examination were recorded as per proforma.

Pre-operative sagittal and coronal angulation, and follow-up complications, time to partial weight-bearing, time to union, final coronal and sagittal angulation, knee and ankle range of motion, and leg-length discrepancies were reviewed for each patient. The clinical outcomes were evaluated based on the criteria defined by Flynn et al.^[13].

Surgical Technique

All patients were operated within 3 days of presentation. Surgery was preceded by adequate preoperative preparation including I/V antibiotic prophylaxis (Cefuroxime one dose one hour before procedure 20mg /Kg). Closed reduction

technique using c-arm was used^[14]. Medial and lateral mini-incisions were made 2 cm distal to the proximal epiphysis of the tibia to create an entry point for the insertion of a TEN. Using a guide an intramedullary TEN with a diameter of 2–4 mm (depending on the patient's age and bone size) was percutaneously inserted from the lateral side to the fracture line. After confirming fracture reduction with C-arm, TEN was advanced to the distal side of the fracture. Next, a second intramedullary TEN with an appropriate diameter was inserted through the proximal medial end of the tibia. After confirming fracture reduction and positioning of TENs with C-arm, the tips of the TENs was bent and cut beneath the skin and posterior slab was applied.

Postoperatively physiotherapy with SQE, toe movements and walker assisted non-weight bearing ambulation was started and patients were discharged within 1 to 2 days.

Each patient was followed up for minimum of 1 year. Final assessment was done at the end of one year. Regular checkups were made roughly at 24 hours, 2nd day, 3wks ,6 weeks, 9 weeks ,3 month, 5month , 6 month , 9 month and finally at one year .

At the 3rd week, check X-ray was obtained to assess fixation, reduction and posterior POP slab was removed and knee and ankle range of motion exercises were started.

At each follow-up examination problems like pain, irritation, pus discharge, malunion, nonunion and LLD were observed. Final radiological and functional assessment was done at one year.

Results

The operation time was 20-60 min (45 min in average), and the bleeding was 40 - 60 ml. All the fractures got united and the average healing time was 11 weeks and 2 days. Ankle/ knee ROM completely returned to normal. 3 patients had affected extremity shortening (less than 1 cm). 15 patients had their intramedullary nails taken out after six months and 10 after one year, no re-fracture has happened since then. The 25 patients

comprised 17(68%) boys and 8 (32%) girls with a mean age at injury of 11 years and 5 days (range of 8–17) years. The mechanism of injury was motor vehicle accident in 18 (72%) patients and fall from heights in 7 (28%) patients. 11 (44%) out of 25 fractures were open fractures. The fractures were located in the right tibia in 14 (56%) patients and in the left tibia (44%) patients. 16 patients had a tibial shaft fracture accompanied by a fibular fracture. Each patient was followed up for one year. No patient had an angulation of over 10° but four patients had a leg-length inequality of 10 mm. Among patients with compound fractures one patient had a deep wound infection which was managed by I/V antibiotics and 4 patients had superficial infections. 4 patients had insertion site

irritation that required no intervention during healing but subsequently were removed after 6 -9 months. The mean time to partial weight bearing was 5 weeks (range of 4 -6 weeks), and the mean time to union was 11 weeks and 2 days (range of 7–19 weeks). No patient had a restricted range of motion of the ankle and knee joints. According to Flynn's criteria, 16 (64 0%) patients had an excellent outcome and 9 (36%) patients had a satisfactory outcome. No significant difference was observed between patients with open and closed fractures with regard to the clinical and radiological findings, although patients with open fractures had a significantly higher infection rate and more duration of healing time.



Pre and Post-Op Xrays after Tens Nailing of a Tibia Fracture

Discussion

A closed reduction followed by casting is the mainstay treatment in most pediatric patients with tibial shaft fractures. But in cases like polytrauma,

neurovascular injury, open fractures, and unstable fractures surgical intervention is necessary. Different fracture fixation methods such as intramedullary nails, crossed Kirschner wires (K-

wires) or external fixators can be used for these fractures. External fixators are preliminarily used in fractures having severe soft-tissue loss. Their use is limited by complications such as pin-tract infections, delayed union, malunion, and leg-length inequality^[3,4]. Titanium elastic nails (TENs) have recently emerged as an alternative method for management of tibial shaft fractures^[17-19]. An intramedullary fixation with TENs was initially performed in closed fractures alone. However, over time, it became preferable in open fractures as well, and similar outcomes have been reported thus far^[5-7]. However, TEN has also several pitfalls such as decreased stability in complex fractures, delayed union in advanced-age pediatric patients^[10,11]. Debnath et al.^[20] evaluated 30 patients with diaphyseal tibial fractures and obtained an excellent outcome in 50%, an acceptable outcome in 36%, and a poor outcome in 14% of the patients. Sankar et al.^[18] studied 19 patients with unstable fractures and got an excellent outcome in 63%, an acceptable outcome in 32%, and a poor outcome in 5% of the patients. In our study, a complete union was achieved in all the fractures, an excellent outcome was obtained in 64% of patients, and an acceptable outcome was obtained in 36% of the patients.

Başaran et al.^[21] evaluated the use of TENs in the treatment of patients with compound tibial diaphyseal fractures and achieved excellent outcomes in 45% of patients and satisfactory outcomes in 55% of the patients. In our study, open fractures were present in 44% of the patients and a complete union was achieved in all the fractures, whereas an excellent outcome was obtained in 43% and a satisfactory outcome was obtained in 57% of the fractures.

O'Brien et al.^[17] reported union in an average of 9 weeks in closed fractures and in an average of 15 weeks in open fractures. In our study, the mean time to union was longer in open fractures, 9 – 18 weeks, compared to closed fractures, 7- 14 weeks, although no significant difference was found.

TENs can produce malunion by allowing angulation during healing. O'Brien^[17] et al.

utilized TENs and reported an angulation of over 5° in 2 (12.5%) of the patients, with one patient having an angulation of 6° in the coronal plane and the other patient having an angulation of 10° in the sagittal plane.

A treatment with TENs is likely to cause skin irritation. Onta et al.^[19] and Sankar et al.^[19] reported that 22% and 26% of patients had nail-entry site irritation, respectively. In our study, 28% of the patients had nail-entry site irritation and healed spontaneously without causing any problems after the removal of the TENs.

Leg-length inequality can be seen sometimes after tibial shaft fractures. Walamastha et al.^[23] reported that they found a leg-length inequality of <15 mm in 3.6% of the patients. In our study, only three patients had leg-length inequality of 10 mm and were asymptomatic.

Conclusions

TENs is safe and effective surgical modality of treatment for unstable diaphysis fracture in adolescent age group. TENs has the advantages of causing small incision, less soft tissue injury, short surgery time, rapid recovery and few complications.

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