



## Outcomes of Open Pediatric Tibial Fractures by Titanium Elastic Nail Versus External Fixation

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### ABSTRACT

#### Background

Tibial fractures are the third most common pediatric long bone fractures after forearm and femur fracture. Approximately 50% of pediatric tibial fractures occur in the distal third of the tibia. This is followed by midshaft tibial fracture (39%), and least commonly, the proximal third of the tibia is involved. Tibial fractures in a skeletally immature patient can usually be treated without surgery but tibial fractures resulting from high energy traumas are of special importance considering the type of the selected treatment method affecting the children future. Manipulation and casting are regarded as definite treatment for children fractures. They are used following compartment syndromes in polytrauma, neurovascular damage, open fractures and fasciotomy cases.

#### Objectives

In children, most open fractures occur due to high energy trauma and inappropriate treatment of the fractures may result in several complications. Flexible intramedullary nailing is one of the popular options as an effective method of treating long-bone fractures in children. The external fixator is used in cases with severe injuries and open fractures. The present study aims at comparing results of these two treatment methods in the pediatric tibial open fractures.

#### Materials and Methods

In the descriptive analysis study, 32 patients with open tibial fractures were treated with either external fixator (n=18) or TEN nails (n=14) during 2012-2015. Some patients were treated with a combination methods of TEN and pin. The results were evaluated considering infection, union, malunion and refracture and the patients were followed up for 2 years.

#### Results

Mean time required for fracture union was 12.5 (11-14) and 11.8 (10-12) weeks for the external fixator and TEN groups, respectively. There was no statistical difference in time of union between the two methods. The main complications in external fixation were infection around the pin 4 (22.2%), leg length discrepancy (11.1%) and re-fracture 4 (22.2%). In the TEN group, 2 cases (14.2%) of painful bursitis were observed at the entry point of TEN and the pin was removed earlier. There was not only report of mal union requiring correction in the groups. No complications was seen in 6 patients treated with a combined method of pin and flexible intramedullary nails.

#### Conclusions

Although external fixation in open pediatric fractures and severe injuries is recommended, intramedullary nailing is also an effective method with low complications. Combining pins and flexible intramedullary nails is effective in developing more stability and is not associated with more complications.

**KEYWORDS :** actures, Open, External Fixator, Fracture Fixation, Child

#### Background

Tibial fractures are the third most common pediatric long bone fractures after forearm and femur fractures 1. Approximately 50% of pediatric tibial fractures occur in the distal third of the tibia 1. This is followed by midshaft tibial fracture (39%), and least commonly, the proximal third of the tibia is involved 1. Tibial fractures in a skeletally immature patient can usually be treated without surgery but tibial fractures resulting from high energy traumas are of special importance considering the type of the selected treatment method affecting the children future 2,3. Manipulation and casting are regarded as definite treatment for children fractures 4. They are used following compartment syndromes in polytrauma, neurovascular damage, open fractures and fasciotomy cases 4. Flexible intramedullary nails (FIN) have been increasingly used since the 1980s for the management of pediatric tibial and femoral fractures 4. Short term immobilisation, returning joints range of motion, lack of any stiff joint, short term hospitalisation and low costs are regarded as advantages of the flexible nails. According to the study by Pandya et al. Immediate flexible nailing of open pediatric tibial shaft fractures can be safely performed with minimal risk of wound or infectious complications 5. Prolonged bone healing should be expected in patients who undergo immediate flexible nailing of their open fractures 5. External

fixators are used in open fractures resulting from high energy traumas as well as cases of several damages 4. However, they are associated with some complications including pin tract infection and scar where the pins are located 4,6. There are few studies comparing the results of these two surgical methods in grade 3 tibial fractures of children. Therefore it was tried to compare the results of the two-mentioned methods.

#### Objectives

In children, most open fractures occur due to high energy traumas and inappropriate treatment of the fractures may result in several complications. Flexible intramedullary nailing is one of the most popular options as an effective treatment of treating long bone fractures. The external fixator is used in cases with severe injuries and open fractures. The present study aims in comparing results of the two treatment methods in open pediatric tibial fractures.

#### Materials and Methods

The retrospective descriptive study was done during Oct-2012-Oct 2014. In this study, 32 children (<14 years old) suffering from Gustilo grade A and B 3 open fracture of tibia were admitted at the emergency department of the center and evaluated.

The patient was followed up at least for two years. Children with Gustilo grade 3 A and B tibial open shaft fractures were selected. Children with history of lower extremities fractures, systemic and metabolic diseases, and skeletal congenital diseases were excluded. The fracture often resulted from high energy motor vehicle accidents. The children were matched considering age, gender, damage mechanism and open fracture type(grade 3) and associated damaged as well neurovascular complications were recorded for all patients.

While the children were admitted at the emergency department, they underwent prophylaxis using first generation antibiotic of cephalosporins and gentamicin. In severe cases, third antibiotic(penicillin group) were added to the treatment regime ,if required. All patients underwent washing and primary debridement operation within 1st 6 hours of admission at emergency department followed by external fixator or intramedullary nails during the first day of hospitalisation. Union of the fracture was controlled through clinical examinations such as lack of pain, tenderness, crepitation at the fractured area as well as using radiography of both lateral and anteroposterior view during the follow-up period. Delayed union was regarded as non-union for more than 2 months. When intramedullary nails were inserted, surgical treatment was controlled through fluoroscopy. In some cases, pins were used to fix the fractured area. Unilateral monotube system was used to stable the fracture in external fixation method. Eligible patients who provided consent was included in the study. All statistical analysis was performed using SPSS. In this study, p<0.05 was regarded meaningful

**Results**

In this study,32 children with tibial open fractures treated with external fixation method(n=18) and flexible intramedullary nail(n=14) were compared. Pins were used to increase the stability of the fractured area in 6 patients(42.8%) treated with flexible intramedullary nails. Demographic findings of the understudy children and the associated damages are shown in table 1

**Table 1. Comparing demographics findings and other associated complication between two groups treated with external fixator and intramedullary nails.**

Variable	External Fixator group(n=18)	Intramedullary nail(n=14)
Age	10.5+-3.2	11+-3.7
Female/Male	10/8(55.5/44.5)	8/6(57.1/42.9)
Head Closed Damage	3(16.6)	1(7.1)
Thorax and abdomen damage	2(11.1)	0(0.0)
Pelvic Fracture	1(5.5)	0(0.0)

Follow up results have been summarised in table 2. There was not any meaningful difference between two groups considering deep infection of the fractured area and osteomyelitis was not observed in any group.

**Table 2. Comparing Complications between two treatment methods of external fixator and intramedullary nailing.**

Variable	External fixator group(n=18)	Intramedullary nail(n=14)
Mean time of union	12.5+-1.4	11.8+-1.2
Infection surrounding pins	4(22.2%)	0(0.0%)
Painful bursitis	0(0.0%)	2(14.2%)
Sagittal plane angulation(>10 degree recurvatum)	1(5.5%)	0(0.0%)
Coronal Plane angulation(>10 degree varus)	1(5.5%)	0(0.0%)
Re-fracture	4(22.2%)	0(0.0%)
Malunion	0(0.0%)	0(0.0%)
Limb Length difference>1 cm	2(11.1%)	0(0.0%)

Infection surrounding pins created some problems in 4 cases(22.2%) and it was necessary to change the place of the pins. In the TEN group,2 cases(14.2) of painful bursitis was observed at the entry point of TEN and the pin was removed earlier. There were four cases (22.2%)

of tibial refracture in the external fixator group. Leg length discrepancies of between 1.5 cm and 2 cm following external fixator of multi-fragmentary tibial fractures occurred in 2 (11.1%) patients and were treated by epiphysiodesis of the contralateral leg. There was not any report of malunion requiring correction in none of the groups. No infection was seen in those patients treated with a combined method of pin and flexible intramedullary nails. No patients demonstrated evidence of growth arrest after intramedullary nail insertion. In our samples were not any compartment syndromes.

**Discussion**

Pediatric shaft tibial fractures usually are not complicated and can be treated with reduction and casting 1. Patients with displaced fractures in the operating room with fluoroscopy to facilitate the reduction 1. Tibial fractures have been treated non surgically within the last two decades and immobilisation using cast was regarded as a standard treatment 1,7. However surgical treatment is recommended in cases with several damages, high energy trauma, open fractures, and compartment syndromes 8. Although cast immobilisation remains the standard treatment for appropriate fractures of the tibia, fixation is particularly beneficial for children who have sustained multiple injuries from high energy trauma. Developing flexible intramedullary nails brought great evolutions in treating children long bone fractures and several advantages have been mentioned for using the techniques in treating long bone fractures 4. Intramedullary nails make alignment and appropriate rotation possible in treating the fractures. In addition to elasticity and appropriate stability, they result in micro-motion at the fractured ends ,strengthening osseous calculus formation and finally, acceleration of union process. Small incision is used in surgical treatment and there is a weak probability of infection 8,9. According to the results of our study, the union time is not different between two methods in children. Major complication in external fixator are more than intramedullary nail. Re-fractures and Leg length discrepancies are the two major complication which were observed in our patients who were treated with external fixator. There are few studies in the literature on the management of diaphyseal fractures of the tibia in children with intramedullary fixation especially in open fractures. Vallamsheta et al. 4 showed that fixation is an easy and effective method of management of both closed and open unstable fractures of the tibia in children. In this study, the average time of union in intramedullary nail was 10 weeks and the major complications were included residual angulation of the tibia, leg length discrepancy, deep infection and failures of fixation. Unlike this study, such complication were not observed in our patients, but the union time was similar. Deakin et al 10 study in 35 adolescent patients underwent flexible intramedullary nails for tibia was not any malunion/non-union and the union time was higher(17 weeks) than our study. Kubiak et al 11. Recommended when surgical stabilisation of tibial fractures in children is indicated ,fixation with elastic stable intramedullary nailing is preferred. Griffet et al 8 study in 86 children with tibial fractures was expressed, the fixation of pediatric diaphyseal fractures with elastic stable intramedullary nailing is a rapid, well codified and effective method for treating long bone closed fractured in children.

Advantages over other fixation techniques includes a lower infection rates, a lower re fracture rate, ease of management, and an aesthetically pleasing scar. However external fixator was associated with quick stability of long bone fractures. External fixator is one of the effective ways in treating open fractures with severe damage of soft tissues. It lacks some complications of dioxator such as infection surrounding pin, need to care and re-fracture. In our study, combination of pin with flexible intramedullary nails developed maximum stability in severe crush cases. It is a new point considering the previously conducted studies and may be helpful in appropriately treating open fractures. TEN nails method was regarded as an effective method comparable with external fixator in treating open fractures. Combination of pin with TEN nails results in more stability of fracture and is not associated with more complications.

Although external fixation in open fractures and severe injuries is recommended , intramedullary nailing is also an effective method with low complications. Combining pins and flexible intramedullary nails is effective in developing more stability and is not associated with more complications.

**Footnotes**

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