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Fixation of adolescent diaphyseal tibial fractures with flexible intramedullary nailing

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Objective:

to evaluate the results of fixation of diaphysealtibial fractures with flexible intramedullary nail in adolescent.**Methods: 20** patients complaining of diaphyseal fracture tibia were managed by flexible intramedullary nail in our department between Jule **2015** to April **2016** .Mean age of patients is **14** years old ranging between **(10 – 17)** years old .They are fourteen males and six females. Twelve cases were simple fractures and eight cases were compound fractures.**Results** : All patients of our study were followed up in our outpatient clinic with mean time of follow up was **36** weeks .All fractures achieved full union at a mean of **12.7** weeks with range from **10** to **18** weeks .Only one case suffered from nonunion and it was followed up. One patient had postoperative fracture angulation that was less than **5** degrees in the coronal and sagittal planes and postoperative valgus angulation of about 5 degrees.

Conclusion: The use of elastic intramedullary nails in treatment of diaphyseal tibial whether simple fractures or open fractures (Gustillo and Anderson Type **1** and Type **2**) in adolescents provide satisfactory results for the patient and his family and for surgeon.

Keywords *: diaphysealfracture,tibia,adolescent, flexible nails.*

Introduction

Diaphyseal tibial fractures are the most common lowerextremity fractures in pediatrics. There are many options for treatment of pediatric tibial shaft fractures includingconservative treatment, percutaneous pinning, platting, external fixation and lastly elastic intramedullary nails.(**1)** Conservative treatment was the standard treatment for pediatric tibial fractures twenty years ago. **(2, 3)**Casting with immobilization for six weeks would produce adequate results. However, the long period of immobilization with its psychological impact of the child, failure to get accurate alignment and cast complications were the major disadvantages. Indications for surgical intervention were open fractures, those associated with neurovascular compromise, those associated with polytrauma and fractures failing to meet acceptable closed reduction.**(2)**Plate fixation and external fixation were frequently associated with infection, overgrowth, and increase of refracture rate.**(4)**Nowadays elastic intramedullary nails have gained popularity in all pediatric fractures.**(5)**Advantages include immediate fracture stabilization, percutaneous technique, early mobilization, rapid return to school activities, avoid disruption of family life with its psychological impact on the child and avoid the longtime of knee immobilization in casting.**(6, 7)**In fact there is a strong debate regarding fixation of pediatric diaphyseal tibial fractures in particular in older children (more than **12** years) Most studies in the literature done on pediatric tibial fractures assessed the outcome of flexible intramedullary nailing on patients till the age of **12** years.**(8)**Few studies dealt with patients more than **12** years.**(9)**In this study we are going to evaluate the results of fixation of pediatric tibial shaft fractures with elastic intramedullary nails in the age from ten years to eighteen years.

Patients and Methods

This is a prospective study that was done in a tertiary level university hospital. There were twenty patients with tibial shaft fractures were included in our study. Their age range from **10** years to**18** years.All fractures whether simple or open fractures (Gustillo-Anderson type **I, II**. AO classification type A & B & C) were included in our study. Patients with open tibial shaft fractures Gustillo- Anderson Classification type

III and those with pathological fractures were excluded. Patients less than **10** years or more than **18** years were excluded. The study was approved by our Scientific and Ethical Committees.On admission, Data were taken and registered in excel sheet for every patient and it included age, sex, mode of trauma, affected side, type of the fracture, soft tissue status according to Gustillo and Anderson classification, associated fractures, neurovascular deficits if present. Every child was fully evaluated to exclude other system affections and referred to respective departments if indicated and necessary treatment was given. Plain radiograph including anteroposterior and lateral view of the affected limb were done.All operations were done under spinal anesthesia. Two elastic intramedullary nails of the same size were introduced in an ante grade procedure after fracture reduction under fluoroscopic guidance.Each nail diameter is should not be less than **40%** of the diameter of the narrowest portion of the intramedullary canal. Prebending is essential step before nail insertion to achieve the three points contact effect. The two nails were inserted anteriorly **2** cm distal to physeal plate and within the medial and lateral metaphyseal bone cortices on each side of the tibial tuberosity.The operated side was place in below knee splinatage which removed at **2** weeks. All patients were followed up at **2** weeks to remove stitches, **4** weeks**, 3, 6, 9** monthspost-operative.At every visit, every patient had clinical and radiological examination to assess fracture union, knee and ankle function, walking ability, deformity and limb length discrepancy and for the presence of complications. All results were recorded in Excel sheet for all patients. Patients was allowed for partial weight bearing at six weeks or until a good callus appears in the follow up radiographs.

Results

Twenty patients were included in our study.Most common mechanism of injury was Road traffic accident followed by falling from height. There were fourteen males and six females. Fourteen patients were seen in the age group of **10-14** years. The youngest patient in our study was **10** years old while the oldest was **17** years old in the study. The right side was affected in **12** case while the left sided was affected in **8** cases. **60%** of the cases had simple fracture (**12** patient) while **25%** of cases (**5** patients) had type **I** open fractures and **15 %** of the cases (**3** patients) had type **II** open fractures respectively. All patients were operated on the same day of admission to hospital.Ten patients had transverse fracture while the other ten cases had oblique fracture.Two patients had associated injuries, the first patient had associated ipsilateral shaft femur fracture and the second patient had associate distal radius fracture.

During the follow up stage, no wound complications were observed in our study our limb length discrepancy. Partial weight bearing for all patients was started at **4**weeks while complete weight bearing was allowed at **6** weeks and it depended on clinical examination and radiological evaluation. All fractures achieved full fracture union at a mean of **12.7** week with range from **10 to 18** week. Only one case suffered from nonunion and it was followed up. One patient had postoperative fracture angulation that was less than **5** degrees in the coronal and sagittal planes and postoperative valgus angulation of about **5** degrees. At the last follow up, all patients had normal knee and ankle range of motion

Discussion

Pediatric lower extremity factures represent a challenge to all orthopedic surgeons.Pediatric tibial diaphyseal fractures represent **10 to 15%** of these fractures.**(10)**The need for accepted fracture alignment and early healing is very important in pediatric population. The ideal fixation method in pediatric patients which maintain alignment,allow early mobilization of the nearby joints, does not cross physeal plate, easy to insert and to remove and allow rapid fracture healing. Conservative treatment which include manipulation and casting was the principle treatment for pediatric diaphyseal tibialfractures for a long time however the

incidence of complications motivated theorthopedic surgeons to search for another method of treatment to avoid thesecomplications.Tibial platting is the method of choice to achieve perfect anatomical reduction, the associated soft tissue damage, periosteal stripping would delay fracture healing with high incidence of wound infection and nonunion rate.(**11)**Elastic Intramedullary Nailing were developed and first used at Nancy, France by Ligier et al.**(12)**The principle of elastic intramedullary nailing is to allow accurate prebending of the nail so as to the apex of the bend of both nails will lie at the fracture site. The two nail should be of the same diameter to provide an opposed curve at the facture site otherwise differential loading of opposite cortices may lead to an angular deformity.**(13)**The diameter of the nail should be two-fifths of the internal diameter of the medullary canal.**(5)**Despite the triangular cross-section of the tibia makes it difficult to place nails in the symmetrically opposed configuration necessary for the technique to work properly.**(5)**Elastic intramedullary nails have gained widespread popularity because of its clinical effectiveness and low risk of complications.Elastic intramedullary nailing allows a certain amount of movement at the fracture site thus ensuring optimal development of the external callus by reducing shear and converting it into compression and traction forces.**(14)**Kubiak et al in their retrospective study to compare the results of both external fixation and elastic intramedullary nailing in treatment of diaphyseal tibial fractures.**(15)**The mean time to union was **7** weeks in the elastic intramedullary nail group compared to **18** weeks in the external fixation group. Complications like nonunion, malunion and delayed union were more prominent in external fixation group compared to the elastic intramedullary nail group.In our study, mean time for fracture union was **12.7** week with no difference between closed or open fractures. There is some controversy regarding criteria for time of fracture union. Some use radiological criteria, some use radiological and clinical union while other had used Flynn scoring criteria for bone union. In our study we had observed that clinical union is usually preceding radiological even still there was weak callus formation at the fracture site. So we have used criteria for union as presence of bridging callus at fracture site (radiological union). Most of the fracture circumference with density similar to adjacent cortical bone. Clinical union was judged by the absence of pain at fracture site and weight bearing.In some studies, the average time to union for those tibial shaft fractures in the study that healed without further intervention was **20.7** weeks.**(16)**While in union rate in another study was **16.1** weeks**.(8)** In another one it was **11** week.(**17)**It was reported that older children and adolescents have a higher rates of delayed tibia fracture union or nonunion with this technique**.(18, 19)**However we did not encounter this complication in our study. we had only one case of no union in child with the of **12** years despite there were older children in our study. We had allowed partial weight bearing for all our cases at **4** weeks. we advise not to allow early weight bearing before **4** weeks even in transverse fracture as in some studies to avid the complication of malunion and angulation. elastic intramedullary nails can allow stabilization and alignment of the fracture however it could not bear the stress of body weight so it will result in bone angulation.

Conclusion

The use of elastic intramedullary nails in treatment of diaphyseal tibial whether simple fractures or open fractures (Gustillo and AndersonType **1** and Type **2**) in adolescents provide satisfactory results for the patient and his family and for surgeon. This satisfactory functional outcome with low complication rate encourage all orthopedic surgeons to manage these cases with elastic intramedullary nails.

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