Study of Ender's Nailing in Paediatric Tibial Shaft Fractures

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ABSTRACT

Background: Closed reduction & plaster is standard and effective form of treatment in majority of paediatric tibial shaft fractures. Operative intervention is necessary in unstable fractures, open fractures, poly trauma patients and compartment syndrome or severe soft tissue compromise. Historically, external fixation and plating were the treatment options available, but having complications like infection, overgrowth and refracture. Reamed locked intramedullary nails pose unnecessary risk to the proximal tibial growth plate. Flexible intramedullary nailing in long bone fractures in children has gained wide spread popularity because of its clinical effectiveness & low risk of complications. **Methodology:** This is a study of 15 patients of unstable tibial shaft fractures in children treated with Ender's nailing. 12 were closed & 3 were open grade I fractures with only punctured wounds. Age was ranging from 7 to 16 yrs. There were 8 middle third, one upper third and 6 distal third shaft tibia fractures. In all patients 3.5 Ender's nails were used, two nails in 11 patients and three nails in 4 patients there was no post-operative wound infection. Average operative time was 40 minutes and average blood loss was 35 cc. **Results:** Average union time was 9 wks. All fractures united without 2^{nd} operative intervention. In 2 patients there was some proximal migration of nails causing some knee irritation. In all patients implant removed 6 to 7 months after surgery. At final follow-up there were full knee & ankle movements. 2 patients had more than 5^0 malalignment in A-P or M-L plane. No rotational deformity, no limb length discrepancy or physical arrest. **Conclusion:** Ender's nailing is an effective method of treatment in these cases, which allows rapid healing of tibial shaft fractures with an acceptable rate of complications. There is short learning curve with this treatment and implants are inexpensive.

Key Words: Paediatric tibial shaft fractures, Ender's nailing, Closed reduction.

Introduction:

For majority of paediatric tibial shaft fractures, closed reduction & plaster is standard and effective form of treatment. Occasionally, fracture reduction can't be maintained due to excessive shortening, angulation or malrotation at the fracture site, making operative intervention necessary[1]. In other cases, surgical treatment is warranted because of open fracture[2], polytrauma, compartment syndrome or severe soft tissue compromise.

Historically, external fixation and plating were the treatment options available for those unstable tibial shaft fractures that required operative fixation. Complications associated with this technique include infection, overgrowth and refracture[3,4]. Reamed locked intramedullary nails, while shown to be effective in the skeletally mature, pose unnecessary risk to

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the proximal tibial growth plate, and have limited indications in those children with open physes.

Flexible intramedullary nailing of long bone fractures in the skeletally immature has gained widespread popularity because of its clinical effectiveness and low risk of complications. Many studies have supported the use of this technique in the femur, citing advantages that include closed insertion, preservation of the fracture haematoma and a physeal sparing entry point[5,6]. Few studies have also described the use of flexible intramedullary nails in the tibia[7,8,9]. But most of those studies are for titanium elastic nails. The purpose of our study was to present results of fixation of unstable tibial shaft fractures in children with Ender's nailing.

Materials and methods:

This is a study of 15 patients of unstable tibial shaft fractures in children treated with Ender's nailing. 12 were closed fractures & 3 were open grade one fractures with only punctured wounds. Age was ranging from 7 to 16 yrs. Average age was 12.5 yrs. 10 boys & 5 girls were there.

Table 1 Cause of fracture:

Road traffic accident	8 patients
Fall from height	2 patients
Domestic fall or sports related injury	5 patients

Table 2 Site of tibial shaft fractures:

Upper Third	1 pt.
Middle Third	8 patients
Distal Third	6 patients

Table 3 Types of fractures:

Transverse or short oblique	8 patients
Long oblique	2 patients
Spiral	4 patients
Comminuted	1 pt.

In 13 patients tibia fracture was an isolated injury, one had associated same side clavicle fracture and one had associated same side lower end radius fracture. 10 patients had concomitant fibula fractures.

On admission patients were given above knee slab, elevation, analgesics and antibiotics (in open fracture). Pt. was prepared for surgery. During surgery, after proper anaesthesia pt. is taken on fracture table. Debridement of wound done and thorough was given in open fracture. Traction is given to achieve reduction. Under IITV proximal tibial physis is seen. Nail size is determined by keeping it on leg under IITV. Nail should be 1.5 to 2 cm distal to proximal epiphysis & should end 1.5 to 2 cm proximal to distal epiphysis. Nails are inserted in antegrade (proximal to distal) direction. The starting point of nail insertion is 1.5 to 2 cm distal to the physis, sufficiently posterior in the saggital plane to

avoid injury to the tibial tuberosity apophysis. First hole is made at that level either medially or laterally. The owl is further advanced in proximal medullary canal. We used 3.5 Ender's nails in all patients the nail is given slight bending at the tip & slight general bending then introduced into the proximal tibia. Reduction checked under IITV and then the nail is advanced across the fracture site into the distal fragment. At this stage reduction may not be perfect but it gets corrected by rotating the nail at time, and at other times by introducing other nail. The nail is pushed up to 1.5 to 2 cm proximal to distal tibial epiphysis. The second nail is introduced similarly from opposite side. In 11 out of 15 patients two nails & in 4 patients three 3.5 Ender's nails were introduced. In all patients close procedure was done. Proximal end of nails must not protrude much from the hole, otherwise later on with slight proximal migration it may cause knee irritation.

Average operative time was 40 minutes & average blood loss was about 35 cc. No patients had post-operative wound infection. No patients had post-operative systemic or other local complication. Patients were given above knee slab post-operative. After stitch removal on 11^{th} post-operative day, patients were either continued with slab or given above knee cast, which were continued up to 6 weeks post-operative. After slab/cast removal at 6 weeks post-operative, patients started partial weight bearing physiotherapy. One patient with comminuted fracture started partial weight bearing at 8 weeks post-operative.

Results:

After plaster removal monthly follow up of all patients were done. In each visit patient was assessed by clinical and radiological examination. Clinical examination included incision site (infection, dehiscence), severity of pain, swelling, tenderness, distal neurovascular status, deep infection, range of motion, muscle power and any back out of nails. Radiological examination included position of fragments, amount of callus, status of implant and any other complication.

Average time for fracture union was 9 weeks (range 6 to 15 weeks). All fractures united without 2^{nd} operative intervention. Slight nail back out occurred in many patients, but only in 2 patients significant proximal migration of nails occurred causing some knee irritation, but not requiring any operative intervention before fracture union. In all patients implant removed 6 to 7 months after surgery. No implant breakage found in any case. There was no wound infection found in any case. At final follow-up no pain or swelling was found in any case.

There was some restriction of knee movements in 2 patients in which nails were significantly backed out, but after implant removal full knee movements achieved in all patients there was full ankle movements in all patients at final follow-up. At final follow up only 2 patients had more than 5^0 malalignment, one having 6^0 recurvatum and one having 7^0 varus. No patients developed obvious rotational abnormality, limb length discrepancy or physeal arrest as a result of treatment.

Discussion:

paediatric tibia fractures account for approximately 15 % of all fractures in children after radius/ulna and femoral fractures. Historically operative treatment has been recommended rarely for tibial shaft fractures in children. However in the last decade there has been an increased interest in surgical stabilization, particularly for unstable closed tibial fractures as well as open fractures[2] or those

with associated soft tissue injuries. Various treatment methods are cast immobilization and operative procedures like external fixator[3,4], intramedullary nailing and plating.

Cast immobilization has been a standard treatment for vast majority of uncomplicated paediatric tibial shaft fractures. But muscle atrophy and reduction in tissue oedema may allow fracture to displace into unacceptable malalignment. Isolated tibial shaft fractures may develop varus and tibia fractures associated with fibula fractures may develop valgus & shortening. Cast wedging or change of cast after remanipulation under general anaesthesia may be indicated to obtain acceptable alignment. Flexible intramedullary nailing avoids these complications.

With external fixation[3,4], there is a risk of pin-track infection, non-union and refracture. Reamed locked intramedullary nails, while shown to be effective in the skeletally mature, pose unnecessary risk to the proximal tibial physis, so not useful for those children with growth remaining. Plating is an open procedure having increased risk of infection & delayed union. Owing to subcutaneous anatomy of tibia, plate might cause hardware prominence especially in thin & lean children.

Ender's nailing gives three point fixation & acts as internal splint[10]. It gives relative axial, translational & rotational stability. Dynamic controlled motion at fracture site stimulates healing by external callus. In this procedure complete healing with return to pre-injury activity level occurs early. Decreased hospitalization, low cost of implants, less potential damage to the growth centre, decreased blood loss and operative time and early mobilization suggest that Ender's nailing has merits over other procedures and in addition there is less soft tissue disruption and smaller scars. The aim of this biological, minimal invasive fracture treatment is to achieve a level of reduction and stabilization that is appropriate to the age of the child.

The most common & the only complication in our study was proximal nail end irritation which is a minor complication[11], which can be decreased by not keeping proximal nail ends much out from the bone. There was more than 5^0 malalignment in two patients in our study, which can remodel with growth of child. Partial weight bearing walking is usually started around 6 weeks, but it depends on fracture pattern, fracture stability, patient compliance and any other associated injuries.

Conclusion:

Although the indications for operative fixation of paediatric tibial shaft fractures are rare, occasionally surgical treatment is needed particularly in unstable fractures, open fractures and polytrauma cases. Based on our results, Ender's nailing is an effective method of treatment in these cases, which allows rapid healing of tibial shaft fractures with an acceptable rate of complications[11]. Being closed procedure there is minimal risk of infection. It has advantage of causing small incision, slight injury of soft tissue, short surgery time and minimal blood loss. It is a load sharing implant & gives relative axial, translational & rotational stability. There is a short learning curve with this treatment & implants are inexpensive.

Although initially patient's limb require immobilization with either slab or cast, but weight bearing can be started earlier as compared to treatment with reduction & cast and plating. In some cases there is slight malalignment, which remodels as child grows. In some cases there is some knee

irritation due to back out of nails, but in long run there is no problem of joint stiffness. There is no limb length discrepancy. Second surgery of implant removal is mandatory after fracture unites.

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