Original Research Paper

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EXTENDED INDICATIONS OF TIBIA INTERLOCK NAILING IN LOWER THIRD LOWER FOURTH TIBIA FRACTURES

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ABSTRACT **Background:** The fracture of the distal 3rd tibia is an extraarticular injury leading to difficulty in weight bearing and performing activities of daily living and thus needs surgical management. There are various modalities of management of distal third tibia fracture in adults like closed interlock nailing or minimally invasive plate osteosynthesis or external fixator.The aim of the present study is to clinically evaluate the results of closed interlock nailing fixation methods.

Methods: This study was conducted at tertiary care medical college and hospital,Aurangabad where 30 adult patients who underwent surgical treatment by closed interlock nailing in distal 3rd tibia fracture patients between September 2019 to October 2021 were included. Patients were assessed using AOFAS and LEFS score.Patients were followed up on 1 st , 3rd and 6 th month postoperatively.

Results: In our study we found maximum incidence of these fracture between 41 to 50 years (46.67%) ,with mean age was 43.73 years ,with 66.67% males and 33.33 % females, right side was involved in 60 % and left side in 40 % cases .Mean union time was 18.3 Wks.Complications were found in 5 patients Functional evaluation was carried out using AOFAS score which was excellent(more than 90) and in 2 patients,score was below 80.

Conclusion: Several options exists for the management of distal 3rd tibia fractures.Present study recommends use of tibia interlocking nail for comminuted fractures or oblique and transverse fractures of (extra-articular)distal 3rd tibia fractures.

KEYWORDS : distal 3rd tibia fractures,extra-articular,IMN ,AOFAS(American Orthopaedic Foot And Ankle Society) score

INTRODUCTION

Fractures of the distal tibial metaphysis are often results from high energy trauma and combined with extensive soft tissue damage. Distal tibial metaphyseal fractures accounts for about 10% of all Tibial fractures[2]. Due to its subcutaneous position and structural anatomy open fracture occurs commonly in tibia[3]. Treatment of distal tibial fractures are complicated by contusion, infections, delayed union and non-union, all these may lead to revision surgeries[1]. Distal tibial metaphyseal fracture needs a stable fixation while minimizing damage to the soft tissues by the surgical dissection and implants. The optimal method of fixation remains debatable.In spite of advances in both operative and nonoperative care, distal tibial fractures remain a subject of controversy. The alignment of fracture, limb length and early functional recovery by various methods is the goal.Treating Distal tibial metaphyseal fractures can be challenging as fractures of this region had not been perfectly distinguished from other fractures like pilon fractures[5]. Injury mechanisms, treatment principles and prognosis of metaphyseal fractures are different from proximal diaphyseal fractures and distal intra articular pilon fracture and should be distinguished from each other[4]. The selection of treatment depends upon the proximity of the fracture to the plafond, comminution, soft tissue injury and fracture displacement. Various treatment modalities available are:MIPO,IMN,External fixator.Traditional methods like ORIF have been associated with infections, devitalisation of soft tissues and hence have poor results[6].Complications like unacceptable deformity and loss of range of movements in ankle were seen when patient is treated conservatively[7,8].Minimally invasive techniques were developed to avoid complications like soft tissue devitalisation while providing the stability and alignment with internal fixation. MIPPO techniques reduces these risks but increases risk of skin necrosis due to plate prominence especially in thin individuals[9].External fixator is used in emergency management of open fractures but when used as a definitive management, not patient compatible and has cosmetic issues. Intramedullary nail spares the extraosseous blood supply, avoids soft tissue dissection and load sharing and aids in better radiological and clinical outcome[10]. Its use in distal tibial fractures is limited as it is more difficult to control the distal segment with conventional intramedullary implant because of metaphyseal flare above plafond which amplifies the bending movements leads to primary and secondary malalignment.

METHODS:

All patients with displaced distal 1/3rd tibia fractures above 18 years of age admitted in government medical college and hospital,Aurangabad between September 2019 to October 2021 were included in the study.This is a prospective type of study done to analyse functional outcomes of surgical management of fractures of distal 1/3rd tibia in adults.30 patients with extraarticular distal tibial fractures were treated with intramedullary tibia nail after obtaining valid informed and written consent.The inclusion criteria were as follows:age group adults (>18 years), radiologically diagnosed fractures distal 1/3rd tibia,consent to participate in the study and Open fractures up to Gustilo Anderson type ll.;whereas the exclusion criteria were as follows: age group < 18 years , fractures of distal tibia with compartment syndrome needing fasciotomy,open fractures of Gustilo Anderson type III, fracture associated with vascular injury.The statistical software SPSS version 26 was used for the analysis of the data. Microsoft word and Excel have been used to generate graphs, tables etc.Pre-operative x rays of the knee,leg and ankle (AP and lateral view) were taken for assessing the fracture pattern.Genral work up of the patient was done along with any specific investigation if advised by physician and anaesthetist.The functional outcome of the patients were assessed using AOFAS Score.

Operative technique:

The surgery was performed under Spinal anaesthesia. With the patient in supine position, knee in either fig of 4 pattern or leg hanging by the side of table and the C arm coming in from the same side. The surgical site was extensively treated with betadine and spirit before being wrapped.Reduction of fracture done by closed method by manual traction, manipulation. In some case fibular plating were done to align and reduce tibia fracture.Through Patellar tendon splitting approach a vertical skin incision is made in line with medullary canal extending from inferior pole of patella to tib ial tuberosity. Bone entry made by

using Awl along the axis of medullary canal and with lateral tubercle of intercondylar eminence in AP view and at the anterior edge of tibial plateau in lateral view. Through entry point ball tipped guide wire inserted under fluoroscopy guidance in line with medullary canal in AP view and at angle of 10° to tibial shaft in lateral view. After reduction of the fracture advance the guide wire to distal fragment, and its position should be in the centre of the distal segment and it tip lies at distal Physeal scar. Serial reaming done using reamer by increasing the size of reamer by 1mm.After reaming of medullary canal of appropriate size, Flexible Teflon tube were passed over ball tipped guide wire and it was exchanged with smooth tipped guide wire for insertion of nail. The length and diameter of nail per-operatively determined by fluoroscopic measurements.After selecting the appropriate nail size, usually the diameter of nail 1mm less than the size of last reamer used, then selected nail were mounted on Insertion handle and hyperflex the knee for easy insertion of nail into medullary canal and insert the nail over guide wire in slight rotational movements under C-arm control.Nail passage across the fracture site were monitored closely under C-arm. The distal tip of nail should be positioned approximately 0.5 to 1cm from subchondral bone of ankle joint or at physeal scar.Distal locking of nail is done by free hand technique under C-arm control. The position of C arm was changed for Anterio-posterior and Medio lateral screw placement.Biplanar screw fixation gives more stability in distal tibial fractures.Proximal locking done with help of jig. Usually two proximal locks were done from lateral to medial. Before doing proximal lock, fracture reduction checked and if there is distraction at fracture site reverse jamming is done. The associated fibular fractures are fixed according to surgeon decision. The reduction was checked under the C-arm, and the joint's stability was tested by moving it. The surgical incision was irrigated completely and closed in layers before receiving a sterile dressing and compression bandage. Inj. Cefotaxime 1gm twice daily for 5 days, followed by Tab Cefixime 200mg daily for 5 days, was given to all of the patients. In some cases, Inj. Amikacin 500 mg was given three times a day for three days. From the third post-operative day thereafter, knee movements were recommended. Check dressing done on 3rd post operative day,and suture removed on 11 th day. Regular follow up done at 1 ,3 6 ,9 and 12 months.

RESULTS :

Majority of the patients were male (66.67 %) in the age group of 41–50 years (46.67%) with right sided predominance(60%) .Transverse and oblique were the most common fracture patterns observed.

Fig 1 : Distribution of study group as per age group

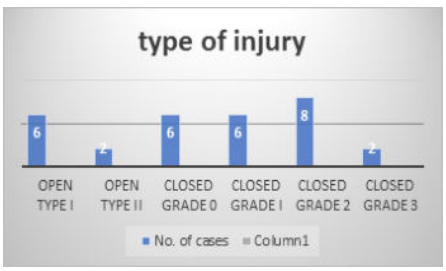


Fig 2 :type of injury distribution

FIBULA FRACTURE:

	NO OF CASES	PERCENTAGE	
PRESENT	18	FIXED –10	60%
		NOT FIXED – 8	
ABSENT	12		40%

SEX	NO OF PATIENTS	PERCENTAGE
Male	20	66.67%
Female	10	33.33%

SIDE	NO OF PATIENTS	PERCENTAGE
Right	18	60%
Left	12	40%

Mean union time was 18.3wks

The follow up ranges from 8 to 24 months with mean of 12 months. Average distance from tibial plafond to distal extent of fracture is 4.3cm with ranges from 3.2 to 5.3 cm.Fibular fractures were present in 24 patients where 13 of them were fixed, in all cases fibula were fixed first followed by tibia nailing. Three locking bolts were used in distal fragment for 11 patients and 2 locking bolts for 19 patients.In our study, out of 30 patients, six was lost to follow up. In remaining cases radiological evidence of union were achieved with mean union time of 18.3 weeks with ranges from 14 to 28weeks.In all cases only closed reduction of tibia was done and fixed with IMN with acceptable alignment in all of them. Four patients had change in alignment on follow up when compared to immediate post op alignment, out of which two had malalignment both in coronal and sagittal planes but went on for union.All four patients had fibular fracture, in two cases fibula were fixed. Out of remaining two cases, one had developed malunion, in both cases there was segmental fibular fracture and fibula was not fixed in both.

The additional procedures like dynamization were done in one patient for delayed union which went on union at 24 weeks and bone grafting done in none of the patients.Complications like malunion occurred in two patients in which one case proximal locking bolt were found to be loosening and implant exit were done.Infections were occurred in three cases with superficial infection in two case which were subsided with intravenous antibiotics and dressing, deep infection were found in one cases which settled only after implant exit in all three cases union occurred eventually after average union time when compared to other patients.Anterior knee pain in three patients and restricted ankle movements in two patients which were managed conservatively by physiotherapy.The functional assessment was done using AOFAS score and found to be good with average score of 90 with ranges from 75 to 98

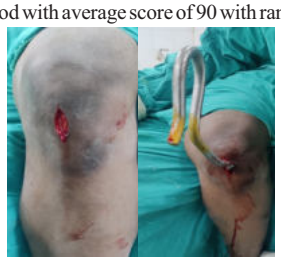
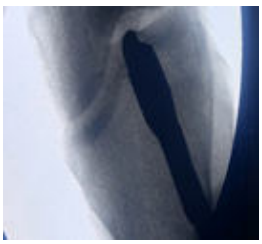
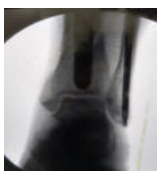


Fig 6: Intraoperative clinical photograph and fluoroscopic ap and lateral view

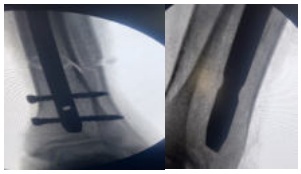


6.1 Incision & entry using bone awl

6.2 Guide wire insertion



6.3 distal position of nail(before locking image)



6.4 Distal c arm images after locking

Fig 7: Pre-operative ,post-operative,12 week follow up x ray and clinical picture

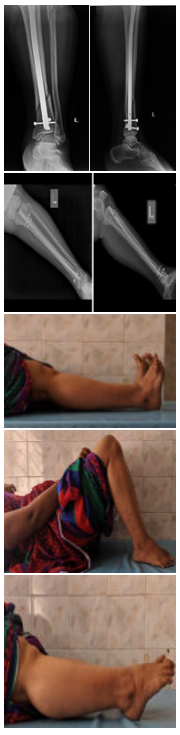
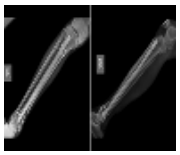


Fig 8 : Pre-operative ,post-operative

12 week follow up x ray



clinical pictures

DISCUSSION:

Distal tibial fractures in metaphyseal region are resulted from axial and rotational forces. Distal tibia fractures continue to pose problems for surgeons in choosing the apt treatment protocol. Major challenges for surgeons treating this type of fractures are its anatomical location, soft tissue injury, high degree of comminution and vascularity in this region.

The treatment principles for distal metaphyseal extra articular fractures are different and it must be differentiated from those for intra articular pilon and diaphyseal fractures.

The primary Goal of surgical management of this type fractures is to maintain fracture alignment within acceptable range and to achieve adequate stability at fracture site to allow for fracture union and early mobilization.

When distal tibial fractures are treated with internal fixation with plates, complications like skin necrosis, deep infections, delayed union and refractures may occur.

Intramedullary nailing provides better option for treating these type fracture by providing load sharing property, without disturbing fracture haematoma results in faster union and aids in early mobilization.

The conventional intramedullary tibia nail offers better option for treatment of metaphyseal fractures but problems with conventional nails are-difficult manipulation of fractures in metaphyseal regions with these nails, single plane locking screws in majority of nails, lower level of Herzog bend and the distal locking screw holes are not present at nail tip.Pascarella R et al cut/sawed the distal tip of nail so that the distal locking screws should cross the fracture site.

Ricci WM et al used poller screws to prevent nail translation in distal segment[11].

These difficulties are overcome by use of ETN as it has multiplanar interlocking options and locking holes in close proximity to nail tip provides angular stability despite short distal segment, also has provision for compression, and it has optimum Herzog's bend.

All the above features make ETN an ideal implant of choice for metaphyseal fractures especially in distal tibia.

Mean age in our study was 43.3 years with maximum patients (46.7 %) in 4th decade. Gregory and Sandersin their series has mean age of 30 years and in series by Duwelius et al the mean age was 40.5 years.

High energy trauma is the most common cause for this type of fractures accounting for about 80% which were comparable to studies by Gregory and Sanders[16] (85.10%) and Krettak et al[18] (71%).

The malunion in our study is 10%, according to Trafftton[47] acceptable malalignment of valgus-varus angulation <5^{o}, anteroposterior angulation <10^{o}, Rotation of <10 deg. Markmiller et al[12] in his study reported nearly half of study patient had malalignment. Egol et al[19] reported malalignment of 10% of his study population and Rene Attal Et al[13] found in his study malalignment rate of 5.4% and Nork et al in his study of fractures located within 5cm from tibial plafond treated by IMN had an malunion rate of 8% which were comparable to our study.When there is fibular fracture at the level of tibial fracture, the fibula fixation provides additional stability at fracture site, reduces angular deviations and also helps in better union[13]. It also prevents the windshield effect between locking hole and locking screw which favours valgus / varus movements of screw. Tyllianakis et al[22] and Mosheiff et al[21] reported low trend of tibial malalignment when fibula was fixed. Dogra et al[14] has 20% of malunion as they not fixed fibula which is higher rate than this study. Schmidt et al[15] reported that fibular fixation before tibial nailing helps restoration of alignment when tibia is grossly comminuted.

In our study 18 patients (60%) has fibular fracture and fibula were fixed in 10 patients(33.3%), malunion developed in 2 patients(6.67%) in whom fibula were not fixed and remaining six patients(20%) had achieved union within acceptable alignment.

The mean time for radiological union in our study is 18.3 weeks with range from 14 to 28 weeks. Other studies in literature shows radiological union after IMN for tibia ranging from 17 to 22.6 weeks[20] was comparable to our study.

Additional procedures like Dynamization were done in one patient (5%) for delayed union and subsequently fracture united and bone grafting not performed in any cases.

Rene Attal Et al[13] in his study reported about 3.2% screw breakage rate,

Markmiller Et al[12] in his study reported of about 14% screw breakage rate. In our study there is no screw breakage in any case.

COMPLICATIONS

Complications	Gregory and Sanders[16]	Duwelius et al[17]	Krettek et al[18]	Present series
Malunion	9%	9%	-	10%
Delayed Union	5%	10%	-	5%
Infection	5%	-	1.65%	10%
Implant failure	15%	-	9.7%	None

Many studies suggested the importance of maintaining the fracture reduction, during fixation of distal tibial fractures and allowing for early mobilisation. No randomized trails, prospective studies for treating this type of injury have been done till now.

CONCLUSION:

***we have all advantages of closed intramedullary nailing such as:**

a. Preservation of fracture hematoma(which is essential for fracture healing)
b. Less blood loss as compared to open procedures
c. Less soft tissue damage of fracture fragment
d. Less chance of infection

We routinely use thick polar k wires for central placement of guide wire and later on nail over guide wire. For distal tibial metaphyseal fractures without involving articular surface, IM nailing with ETN or distal tip locking nails provides adequate stability at fracture site and aids in achieving earlier fracture union and earlier functional recovery.

We strongly recommend fixation of fibula within 10cm of ankle mortoise for better functional outcome & give mechanical stability,as tibia & fibula fracture are almost at same level which makes it inherently unstable.

The maintenance of short distal segment within acceptable alignment while fixing fracture is necessary for good functional outcome. Recognition of inherent stability of distal fragment is necessary to enable adequate stable fixation and avoiding loss of reduction on follow up.

Randomized clinical trails are needed before considering ETN or distal tip locking nails as an IMN option for treating distal Tibial metaphyseal fractures.

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