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Original research article

Functional outcome of distal tibia fracture treated by intramedullary nailing

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Abstract

Introduction: Extra-articular distal tibia fractures account for approximately 5-10% of all tibial shaft fractures. A significant rate of malalignment has been reported with intramedullary nailing of such fractures. The Expert Tibia Nail System (ETNS) is novel design aimed at reducing these problems. It features multi directional locking options in distal and proximal part of the nail. The benefits of using ETNS include load sharing, sparing of the extra osseous blood supply, and avoidance of additional soft-tissue dissection, and thereby minimizing the risk of postoperative complications.

Methods: Our study is a prospective interventional study conducted from July 2021 to December 2022. This study was conducted on 45 skeletally mature patients with distal one third extra-articular fractures of the tibia treated with Expert Tibial Nail. Patients were evaluated clinically and radio-logically according to AOFAS scoring system at the interval of 4weeks, 6months and 12months.

Results: In our study, patients were in the age group of 20-65 years. The incidence of male was more compared to females (3:1) with right sided injury (65%) being more common than left side (35%). According to AOFAS follow-up mean scores at 4 weeks was 78.6, at 6months was 84.6 with 24% patients having excellent results and 60% good results and 16% with acceptable results.

Conclusion: From this study, after evaluation of the score with AOFAS scoring system showed that expert tibia nail is effective method for treating distal tibia fracture in terms of less operating time, early weight bearing, early union of fracture, decrease complication like skin infection, skin necrosis, ankle stiffness and other implant related problems and rigid fixation avoiding less implant failure and malunion.

Keywords: Distal third extra articular tibia fracture expert tibia nail, multi-directional locking, intra-medullary nailing, surgical site infection

Introduction

Rising incidence of high velocity trauma due to motor vehicle accidents usually results in fractures of long bones. The tibia is the most commonly fractured long bone in the body [1]. Due to its location, structural anatomy and sparse anteromedial soft tissue coverage the tibia is exposed to frequent injuries, also open fractures are also common in tibia than any other long bone in the body [2].

Distal Tibia Fractures Constitute 5 to 10% of all tibial Fractures [3]. Treatment of these Fractures remains challenging due to their inherent instability, scarcity of soft tissues, subcutaneous nature and poor vascularity of bone. A significant number of cases are of distal tibia which are generally comminuted in nature and are unstable. As these fractures occur in proximity of weight bearing surface of ankle joint, a slight maladjustment in inclination of ankle joint may lead to permanent disability. The goal of orthopedic surgeons is to restore the tibial anatomy, to fix the epimetaphseal block with diaphysis and to avoid complication [4].

Many osteosynthesis techniques can be used for these fractures such as traditional open reduction and internal fixation (ORIF), minimally invasive plate osteosynthesis, intramedullary nailing, external fixators, retrograde nailing etc. Despite progress of surgical procedures, outcomes are not always excellent and complications affect 20-30% of patients.

Materials and Methods

The retrospective study of 30 patients of distal Tibia fractures was conducted from June 2020 to September 2022 at Department of Orthopedics Narendra Modi medical college and LG Hospital. Patients

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were recruited once written informed consent had been provided.
Here patient between 18-65 and having distal tibia fracture within 5 cm from the ankle joint Gustilo Anderson type 1 and 2, extra articular fractures were included. Patient below 18 and above 65, suspected pathological fractures and peri-implant fracture or associated with neurovascular injuries, patient having uncontrollable diabetes or systemic disease or having Gustillo Anderson type 3 were excluded from the study.

Preop Assesment
Clinical Examination was carried out on all patients in orthopedic OPD/emergency trauma ward. Ankle AP Lateral and Mortise views were taken to identify the fractures. A CT SCAN may be required to find out any Intra-articular fractures. The ankle was immobilized by above knee slab till definitive fixation done. Patient were given analgesics and bohler elevation and frequent ice application was done. All the cases were taken for early primarily fixation with locking expert intramedullary nail.

Procedure
Patients was operated with help of tibia traction table and for ease of insertion of distal screws Steinmann pin was inserted in calcaneus for traction. Proximally knee was fixed with table using crepe bandage to prevent its movement during reaming. 3-4 cm long incision between lower pole of patella and tibia tuberosity taken, then patellar tendon was splitted in midsubstance, then entry with curved owl taken and confirmed in iitv and ball tip guide wire inserted and passed beyond fracture site and docked into the distal tibia up to epiphyseal scar and reduction confirmed in iitv. Then gradual reaming with flexible reamer done and reduction maintained. In some patients reduction was not achieved due to direction of nail so polar st pin used to correct direction of nail and to achieve proper reduction. After it appropriate size of nail inserted and distal locking done using free hand technique generally 3 distal lock is must and proximal dynamic locking done, static lock added to give more stability in some of patients. Distal locking is preferably carried out first, enabling the use of the backstrike technique to prevent diastasis. The nail must have been inserted to the sufficient depth beforehand. If primary compression or secondary dynamisation are planned, it is recommended to over insert the nail by more than 7 mm, which corresponds to the maximum distance between the positions in static and dynamic modes. After it incision site given proper wash by normal saline and patellar tendon repaired with vicryl 1.0 with interrupted suture and subcutaneous suture by vicryl 1.0 and skin by ethion 2.0 done.

Postop Protocol
Intravenous antibiotic given for 1 days and after that oral antibiotic was given and suture was removed on day 10-14 and below knee slab was given for 7 days for pain relief. Patient was advised for leg elevation and prescribed analgesics. Quadriceps strengthening exercise, hamstring strengthening exercise, active knee bending, ankle rom and ankle pump were started on first post op day with non-weight bearing for 4-6 weeks.

Followup
The patient were assess clinically, functionally using AOFAS (American orthopedic foot and ankle society) scoring system at follow up of 6 weeks, 3 months and 6 months and 1 yr. weeks. Partial weight bearing done after 4-6 week based on radiological union and complete weight bearing was done generally after 8-10 weeks. Stair climbing was advised after 10 weeks and return to heavy activity after 12 weeks. The fracture were designated as united when there was periosteal bridging callus at a fracture site at least in 3 cortices in AP and Lateral views.

Implant Details
The Expert Tibia Nail has unique biomechanical characteristics that maintain reduction and prevent malalignment of extra-articular proximal tibial fractures. The nail has a more proximal Herzog curve which is designed to limit posterior displacement of the fracture. This new, multidirectional locked intramedullary system involves multiple locking options in different planes at the proximal ends. The angular stability locking system in these nails enhance the axial and lateral stability of the fracture fragments and has also shown to increase construct stiffness and decrease interfragmentary motion.
Expert intramedullary nailing system was used with nail diameter ranging from 8-12 and length 28-38. One oblique locking option, placed very distally allowing optimized bone purchase and preventing damages of soft tissues Two Mediolateral and one antero-posterior (AP) locking options for better stabilization of the distal fragment. Oblique option has angle of 30. Zig assembly having suprapatellar option and we can rotate zing for proximal screw insertion.

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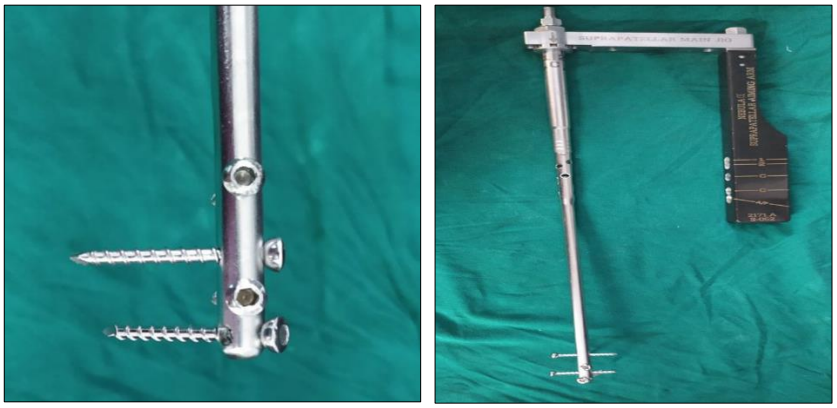

Fig 1

Ankle-hindfoot scale

Parameter	Points
Pain (40 points)	
None	40
Mild	30
Moderate	20
Severe	0
Function (50 points)	
Activity limitations	
None	10
Limitations on recreational activities	7
Some limitations on daily and recreational activities	4
Severe limitations on daily and recreational activities	0
Maximum continuous walking distance	
600m or more	5
400 m to less than 600m	4
100 m to less than 400m	2
Less than 100m	0
Walking surfaces	
No difficulty on any surface	5
Some difficulty on uneven terrain, stairs, inclines	3
Severe difficulty or inability to walk on uneven terrain, stairs, inclines	0
Gait abnormality	
None or slight	8
Obvious (walking possible but gait abnormality obvious)	4
Marked (walking difficult and gait abnormality obvious)	0
Sagittal motion (flexion plus extension)	
Normal or mild restriction (30° or more)	8
Moderate restriction (15°–29°)	4
Severe restriction (less than 15°)	0
Hindfoot motion (inversion plus eversion)	
Normal or mild restriction (75%–100% normal)	6
Moderate restriction (25%–74% normal)	3
Severe restriction (less than 25% normal)	0
Ankle-hindfoot stability (anterior drawer, varus-valgus stress)	
Stable	8
Unstable	0
Alignment (10 points)	
Good, plantigrade foot, well aligned	10
Fair, plantigrade foot, mild to moderate degree of malalignment	5
Poor, nonplantigrade foot, severe malalignment	0

Fig 2

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Table 1: Fracture distribution

Age distribution	No of patients	Total
18-30	6	30
30-40	10	
40-50	6	
50-60	4	
60>	4	
Sex		
Male	22	30
Female	8	
SITE		
Right	18	30
Left	12	
Mode of injury		
rta	19	30
fall	8	
assualt	3	

AO ota fracture types	No of patients	Total
A1	14	30
A2	12	
A3	06	

Case 1

Case 2

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Case 3

Results

Total no of pt included in study were 45

Table 2: Total no of pt included in study were 45

AOFAS scale (Fuctional outcome)	Out come	No of patients
>90	excellent	8
75-89	Good	16
50-74	Accepatable	6
<50	Bad	-

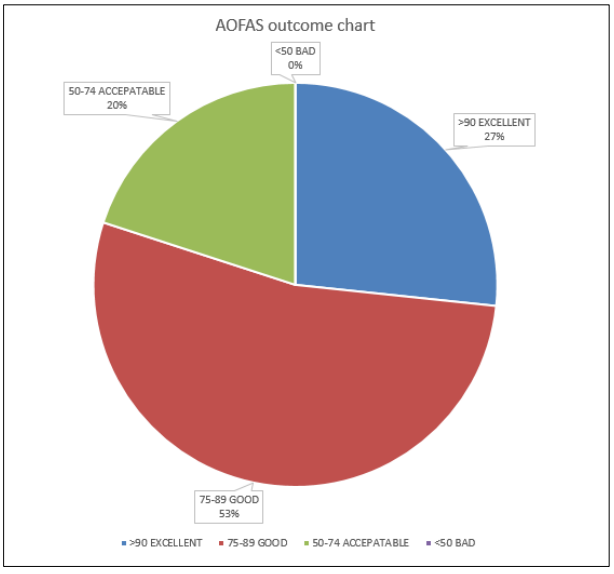

Fig 3: AOFAS outcome chart

Radiological fracture union time

In our study the average time taken by the patient for fracture union was 18.6 weeks.
Nonunion was not seen in any patient. The results of our study were comparable with other studies.

Table 3: Avg. time of radilological union

Study	Avg. time of radilological union
Collinge *et al*.	21
JJ Guo *et al*.	17.6
Redfern *et al*.	23
Our Study	18.2

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Functional Outcome

In our study mean AOFAS score was 84.8 at 6 months. The comparative study with other studies for similar fractures was as follows:

Table 4: Mean AOFAS Score

Study	Mean AOFAS Score
Collinge *et al*.	85
JJ Guo *et al*.	83.9
our study	84.80

Complications

Following are the complication listed in our study. Ankle stiffness was most common complication and was seen in 20% patients. Ankle stiffness ranged from restriction of ankle movement by 20-40degrees.

Table 5: Shows complication and no of patients

complication	no of patients
superficial wound infection	3
ankle stiffness	7
non-union	0
delayed union	1
anterior knee pain	6
malunion	0
deep infection	1
distal screw back out	2

Discussion

Most of distal tibia fractures occur due to high energy trauma like road traffic accidents and fall from height in young males but injuries due to low energy trauma like fall by slipping are also seen in elderly population. The goals of surgical treatment are to achieve osseous union and to restore length, alignment, and rotation of the fractured tibia. The treatment of extra-articular distal tibia fractures can be operative and non-operative. Non-operative treatment includes functional cast bracing but it has variety of complications. Patient related complications include complications of immobilization like decubitus ulcer, urinary tract infections, muscle atrophy, contractures leading to prolonged hospital stay. Other complications include malunion [5], non-union, rotational deformity or stiffness of adjacent joints [6]. The advantages of operative treatment such as anatomical reduction and early mobilization have been emphasized in many recent reports. In the past, such fractures usually were treated with a cast, with good intermediate-term results in the majority of patients. Fracture union often occurs with some angulation after such treatment, and it has been suggested that this may predispose the patient to osteoarthritis by altering load transmission ankle joints. There has been a trend in recent years toward operative treatment of distal shaft fractures, and such treatment has been associated with a lower incidence of angular malunion.

Operative treatment includes half pin external fixation, intramedullary implant, plate fixation or a combination of these techniques. In recent years, closed reduction with minimally invasive plating and locked intramedullary nailing have both become widely used treatment modalities for distal tibia extra-articular fractures. However, intramedullary nailing offers the benefits of load sharing, sparing of extra osseous blood supply and avoidance of additional soft tissue injury in a vulnerable injury zone. We note that the determining prognosis in high-energy distal tibia fractures are the diaphyseal and metaphyseal communition and dissociation and the integrity of soft tissue envelope. These fractures need special attention as they have a greater propensity for malalignment [7]. The close proximity of these fractures to the articular surface of the knee make fracture reduction and alignment crucial for the development of long term complications like ankle pain and consequent development of ankle stiffness. Biomechanical studies have demonstrated that closer the reduction alignment is to the joint axis of the ankle; the more uniform the distribution of contact pressures is through the weight-bearing articular surfaces.

Internal fixation of metaphyseal fractures of the tibia with plates may lead to ulceration of skin overlying plate, deep infection leading to osteomyelitis and refracture and delayed union. Intramedullary nailing offers an attractive treatment option, however there are some problems in treatment of fracture tibia with conventional intramedullary interlocking nailing like difficulty in manipulating fractures of distal 1/3rd tibia comminuted metaphyseal fractures. These shortcomings of conventional intramedullary interlocking nail in managing distal third fractures have been overcome by the introduction of Expert Tibial Interlocking Nail due to modifications in operative techniques, its design and advancement in locking screws. Thus expert tibial nail design allows better control in metaphyseal tibial segments through multiple interlocking holes in close proximity to either end of the nail. Multidirectional interlocking screws ensure that alignment can be well maintained and stability preserved despite a short proximal or

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distal fragments. We evaluated our results and compared them with those obtained by various other studies.

In our study, the mean age of patients in present study was 41.4 years and majority of patients were Males accounting for 22 males (72%). In our study, Road traffic accidents being the commonest mode of injury leading to these high velocity fractures. In 69% of cases, mode of trauma was road traffic accidents and in 21% of the cases, mode of mode of trauma was fall from standing height and 10% cases mode of trauma was assault.

The mean interval of radiological union in the present study was 18.2 weeks while the average time of radiological union in various studies described in table.

In our study, joint mobilization and muscle strengthening exercises were started for all patients on post-operative day 1. Patient was allowed partial weight bearing depending on the fracture configuration, reduction and alignment. Full weight bearing was started after radiological and clinical evidence of union wherein 30% of the patients were allowed after 4 weeks and rest of the patients were allowed partial weight bearing after 6weeks with full weight bearing at 8-10 weeks. Benefits of early mobilization gives better results in terms of good range of motion, less stiffness and also promotes healing.

Functional results were graded according to AOFAS. The mean at 4 weeks was 78 and mean at 6 months was 84.6, the results showed that the functional and radiological outcomes of patients treated with expert tibia nailing at 4 weeks and 6 months is better.

Complications resulting from expert tibia nailing in our study were ankle stiffness in 7 (22%), superficial wound infection in 3 cases (10%), anterior knee pain in 6 cases (20%) and deep infection in 1 patient (3%). Ankle stiffness was the most common complication. None of the patients had wound dehiscence, deep vein thrombosis, Compartment syndrome or non-union. Complication of distal screw back-out was also noted in 2 patient (6%). This was seen in distal screw which was placed antero-posteriorly.

Conclusion

Study showed that expert tibia nail is effective method for treating distal tibia fracture in terms of less operating time, early weight bearing, early union of fracture, decrease complication like skin infection, skin necrosis, ankle stiffness and other implant related problems and rigid fixation avoiding less implant failure and malunion.

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