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Distal metaphyseal tibial fractures: Is an IMIL nail an adequate implant? An observational study on the functional and radiological outcome

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Abstract
The purpose of this study is to evaluate the functional outcome as well as radiological outcome of distal metaphyseal tibial fractures treated with intramedullary interlocking nail after 6 months post surgery in terms of degree of functionality preserved and degree of malalignment respectively.
This was an observational study conducted with 38 patients. Data was retrieved from the MRD. Patients were clinically assessed at 6 months interval and as and when needed by Karlstorm and Orleud Score. Fracture alignment post operatively and radiological union in two standard perpendicular (AP & Lateral) views were assessed. In patients operated in the past, their immediate post-operative and 6 month follow up x-ray was accessed. Functionality was assessed by available information in the patient chart and from present followup.
6 cases (20%) had excellent results, 16 cases (55%) had good results, 7 cases (24%) had fair result (satisfactory/moderate) mostly for minor complaints of knee pain, ankle stiffness. 7 patients were unavailable for assessment of functionality. 1 patient had expired due to natural causes in conclusion Interlocking Intramedullary Nailing for Distal Metaphyseal Tibial Fractures is an acceptable line as it helps with early mobilization of the patient which helps in healing of the fracture and prevents joint stiffness thereby restoring complete motion. The construct is biomechanically stable. Fibular fixation with rush nails predisposed to delayed union, hence plating is recommended or revision of rush nailing to plating when feasible.

Keywords: Intramedullary nailing, tibia, functional, metaphyseal

Introduction
Fractures of distal tibia metaphysis have not been clearly distinguished from pilon structures, and the literature contains relatively little information on their treatment. Proximity of the fracture to the plafond can make it difficult to achieve stable fixation in the distal fragment with nailing or plating techniques. Distal tibial metaphyseal fractures can be wholly extra-articular or with undisplaced extension into the ankle joint. Considering these fractures proximity to the joint, subcutaneous nature of tibia, need for anatomic reduction and stable fixation, preservation of soft tissue integrity, possibility of extending fracture to the ankle joint while intervening surgically, managing these fractures is challenging and is not clearly distinguished in literature.

Aims and Objectives
The purpose of this study is to evaluate the functional outcome as well as radiological outcome of distal metaphyseal tibial fractures treated with intramedullary interlocking nail after 6 months post-surgery in terms of degree of functionality preserved and degree of malalignment respectively.

Materials and methods
This observational study was conducted with 38 patients sustaining distal metaphyseal fractures of tibia presenting to the Department of Orthopaedics, Bangalore Baptist Hospital (BBH), Shri Atal Bihari Vajpayee Medical College and Research Institute (SABVMCRI) and

Sanjay Gandhi Institute of Trauma and Orthopedics (SGITO) treated with reamed interlocking intramedullary nailing. All the cases were traumatic in nature. Entire data of patients with distal metaphyseal fracture of the tibia presented to BBH, SGITO and SABVMCRI since admission to regular follow-up were maintained and retrieved from the Medical Records Department (MRD). This study took into consideration patients who presented since 2014 fulfilling the inclusion criteria.

Inclusion criteria: Age above 18 years, patients operated and who have undergone distal metaphyseal tibial fracture fixation with IMIL nail with or without fibula fixation.

Exclusion criteria: Patients who underwent intramedullary interlocking nailing for non-union, patients who sustained refractures.

Patients were then clinically assessed at 6 months interval and as and when needed by Karlstorm and Orleud Score. Fracture alignment post operatively and radiological union in two standard perpendicular (AP & Lateral) views including the ipsilateral knee and ankle joint were assessed. Malunion was recorded when there was over 1 cm of shortening or more than 5 degree of angular deformity in relation to the ankle joint.

In patients operated in the past, their immediate post-operative and 6 month follow up x-ray was accessed from a database used for evaluation. Functionality was assessed by available information in the patient chart and from present followup.

Adjunctive fibular fixation and secondary procedures like Dynamization and Bone Grafting was done as and when needed.

Observation and Results

The patients included in the study were of the age group of 19 years to 75 years. The average age in the series was 43 years. Majority of the patients were male 27 (71%) and females were 11 (29%). Mode of injury prevalence indicated slip and fall as the highest modality of injury followed by RTA

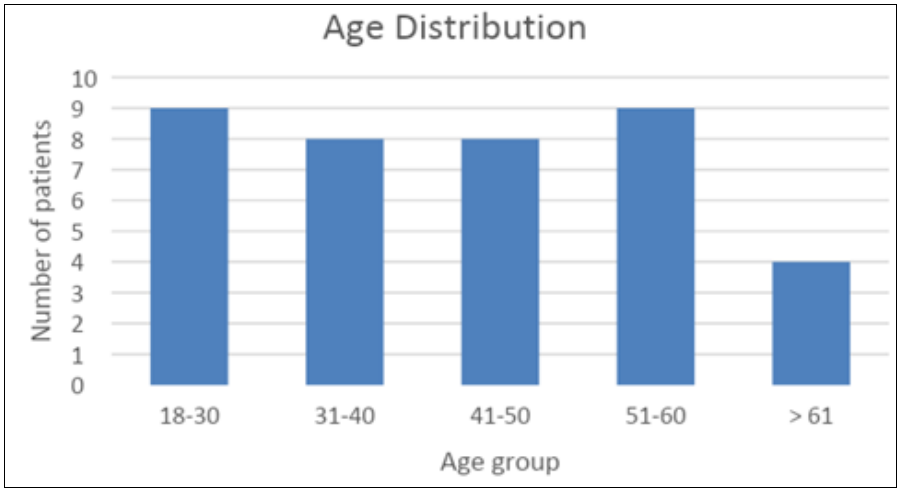

Fig 1: Age distribution

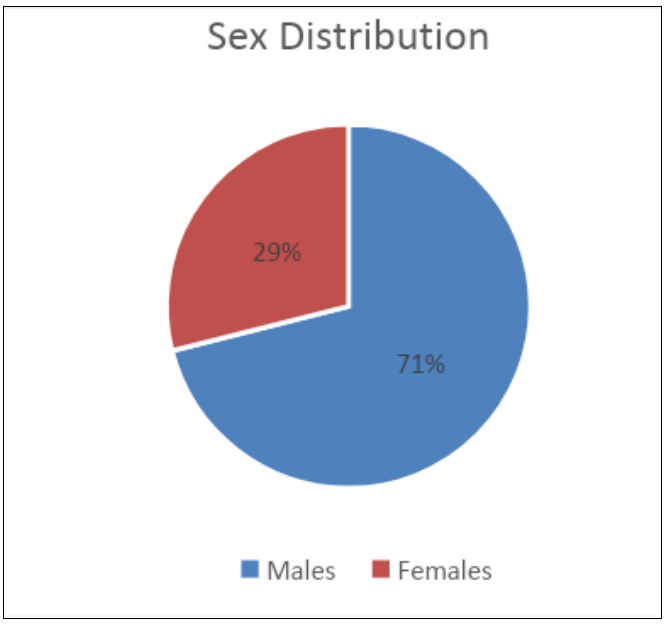

Fig 2: Sex distribution

Right tibial fractures constituted the majority of the patients (~66%). Majority of the fractures were of Ruedi Allgower (RA) Type I (86%) followed by type II (10%), and Type III fractures constituted 2.6%. The maximum duration of hospital stay was 32 days (Due to polytrauma nature of injury) while the minimum duration of stay was just 3 days. The mean duration of stay was 5.1 days.

The duration of follow up in the OPD ranged from the time of discharge upto 3 years. The mean duration of follow up was 13 months. 29 Patients (76%) sustained closed injury and others (24%) had sustained open fractures. However, the open nature of injury did not significantly predispose towards development of complications in the postoperative period. As none of the open injury patients developed postoperative infections, they were included in the study. A high number of fractures (79%) were associated with concomitant injury. Most common was fibular fractures. Patients who sustained fibular fractures around 5cm and below the joint line were plated for additional stability. 2 patients who had open fracture with associated distal fibula fracture had rush nailing done as the open injury compromised the incision site for fibular fixation. The 2 patients who underwent rush nailing showed higher incidence of delayed union and required secondary procedures in the form of bone grafting and dynamization of the nail. Also, both the patients who had rush nailing performed for the fibula fracture, had a type 1 open injury predisposing the fracture to a delayed union sequelae.

Dynamization of the nail was done in 4 patients (10%), bone grafting was done in 2 patients (5%).

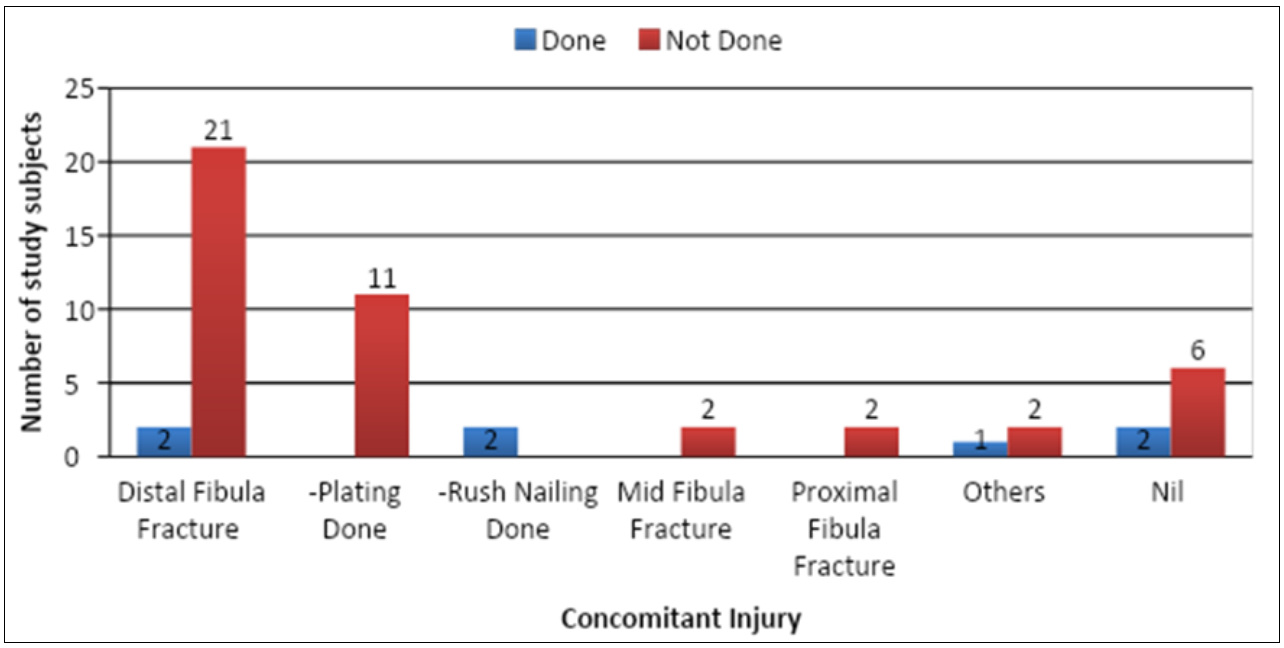

Fig 3: Concomitant Injury and secondary Procedures (Bone grafting, dynamization, implant removals)

In our study all cases were mobilized with NWB crutch walking/walker on first postoperative day. For most of the patients PWB was started by 7 (mean) weeks postoperatively. Comparative early weight bearing (<4 weeks) was initiated in those patients who had metaphyseal fractures not involving the joint and with stable fixation. Those patients with comminuted articular distal tibia fractures were delayed in their weight bearing protocol depending on fixation and radiological appearance of the uniting fracture. The mean duration of commencement of FWB was 14 weeks which was the average duration considered for union. FWB was commenced only after there was callus formation noted at the fracture site. The variation in commencement of full weight bearing duration is same as that as mentioned in the partial weight bearing protocol.

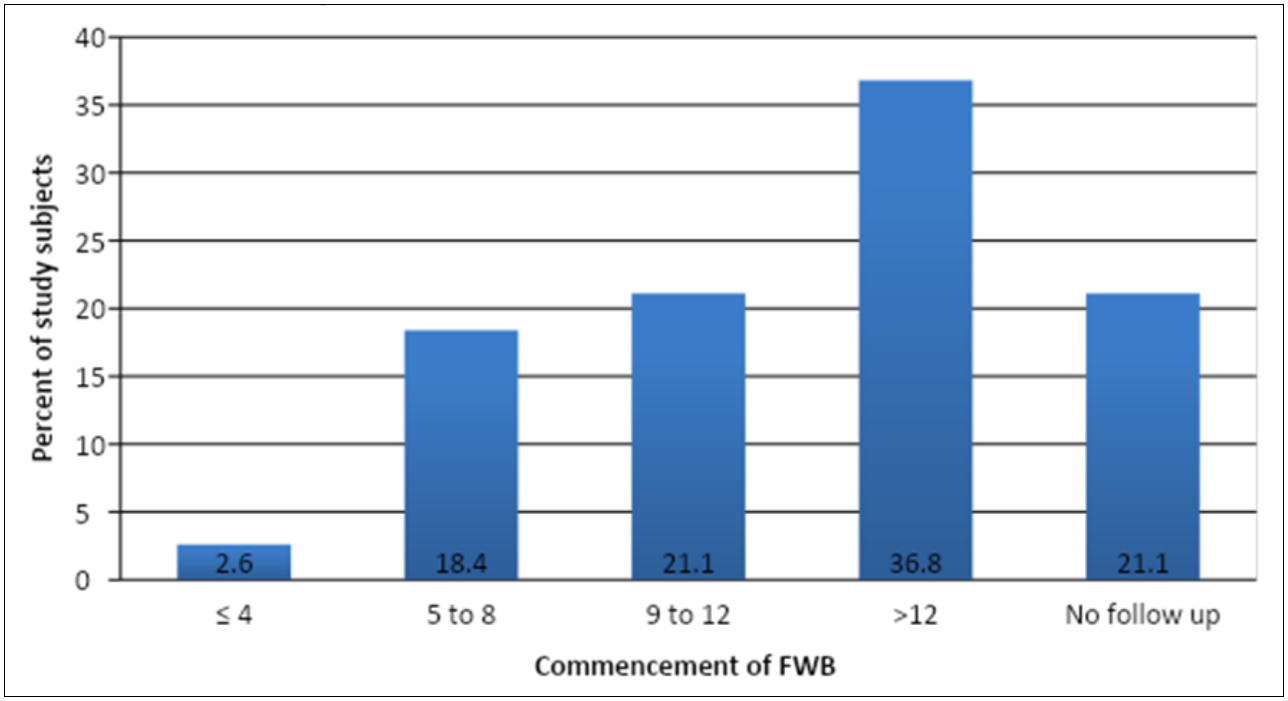

Fig 4: Commencement of Full Weight Bearing

In our series patients who followed up until union of fracture without secondary procedure, united in an average time of 14 weeks of injury. Union took an average of 19.5 weeks in patients who underwent secondary procedures for delayed union.

A malunion was defined as angulation in either coronal plane (varus-valgus) or the sagittal plane (anterior - posterior) of >5 degree and/or 1 cm of shortening, In our series 3 patients had developed concomitant valgus and recurvatum deformity. There was a significant association found between fracture configuration and malunion. Associated fibular fracture was a reckoning factor and also, larger working length of the implant. Inadequate restoration of normal alignment intraoperatively due to the communited nature of fracture and associated fibular fracture predisposed these cases to develop further malalignment on followup.

In our series there was one case of implant removal for

complaints of chronic knee pain.
In our series, no patient developed fat embolism, neurovascular injury, compartment syndrome, postoperative infection or reflex sympathetic dystrophy.
Most patients (73%) were able to return to their previous work status, the rest were not involved in any active occupational work and had minor associated complaints such as knee pain, stiffness in the operated leg whereas 1 patient (2%) was unable to achieve his full occupational functional capacity (due to polytrauma nature of injury).

These results are comparable with the early results of reamed interlocked intramedullary nailing of distal metaphysis of tibia fractures from other centres [1- 3].
Detailed analysis of function of the patient was done on the basis of Karlstrom Olerud scoring. The results of this series were as follows: 6 cases (20%) had excellent results, 16 cases (55%) had good results, 7 cases (24%) had fair result (satisfactory/moderate) mostly for minor complaints of knee pain, ankle stiffness. 7 patients were unavailable for assessment of functionality. 1 patient had expired due to natural causes

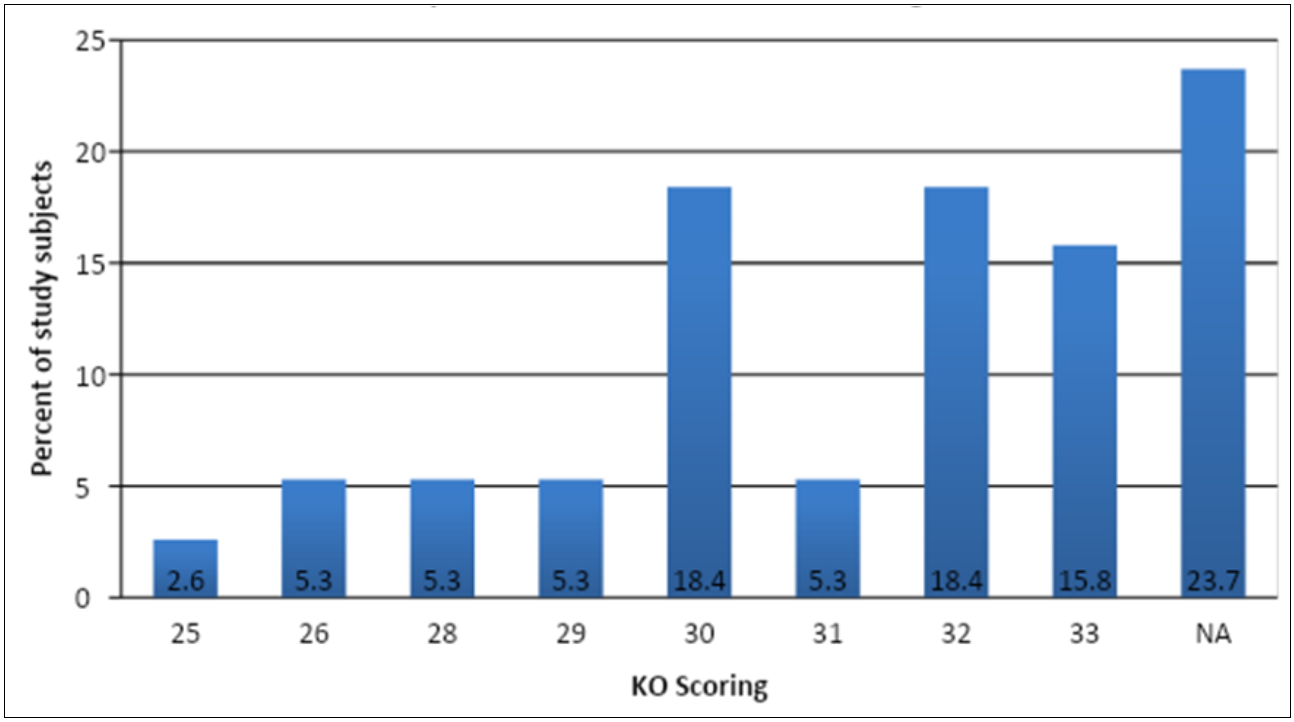

Fig 5: KO Scoring

Although age is a reckoning factor in terms of union and attaining preoperative functionality, in our study however, it did not play a significant role. Fracture union took place independent of age criteria and most patients were able to return to their preinjury status of functionality.
This study has limitations like

1. Sample group was small
2. Observational study
3. Fracture patterns ranged from simple to comminuted to open, which influenced post-operative rehabilitation and thereby outcome on the whole.

Discussion

The average age of cases in this series was 43 years. This can be explained because of active engagement and exposure to outdoor life, road traffic accidents in this active age group. These findings are consistent with almost every series of studies regarding distal tibia fracture for example: Mean age of Jassen *et al.* study [4] mean age was 43.3 years, and Mohammed *et al.* [5], in which mean age of cases was 42 years
Though most of the fractures were from RTA in any group, slip and fall was most common in the elderly age group. In the study by Bahari *et al.* [6] 57% of the patients sustained injury due to fall from height. In this study Road traffic accidents and fall are the most common mode of injury for fracture distal tibia in both the groups of patients with both amounting to almost 1/3rd-1/3rd of the cases.

In our study, anterior knee pain was in acceptable limits according to the literature, and pain was mild and did not affect life or working quality in any of our patients. Asheesh Bedi *et al.* [7] found that 82.3% of patients either had no or mild pain. This complication is seen exclusively in nailing group. We suggest that protection of the patellar tendon, appropriate nail length, and correct nail entry point were essential for decreasing the complaints. The complication are comparable with the results of study by Janssen *et al.*, 2006 [4], Bahari *et al.*, 2007 [6].
Kasper *et al.*, [4] in his study found 25% delayed union with nailing and 16.5% plating. Kasper *et al.* study mean time of radiographic union was 19 weeks with plate group and 21 week with nail group, however in a study by Ibrahmi *et al.* [2] had an average union time of 17.5 weeks in the tibia nailing group. In our study, it was observed that time to union was an average of 14 weeks showing that probably nailing is a better option compared to plating. Delayed union in our case series was either due to concomitant open injury status or severe degree of communition at the fracture site and that of the fibula.
Some studies have suggested concurrent fibular fixation and reported some beneficial effects of fibular fixation in same level combined tibial and fibular fractures. A study by Teitz *et al.* [8] showed that sparing the fibula may result in rapid union of the fracture because of the inhibiting cyclic compression theory, however, chances of malunion was higher. Another study by Varsalona *et al.* [9] reported that fibular fixation would preserve reduction of tibia. In our study we found that frequency of

varus/valgus angulation and anterior-posterior angulation during the follow-up period was comparable irrespective of fibular fixation. However, we recommend distal one third fibula fracture fixation (plating) to restore length, maintain alignment until union was achieved on followup.

In this study, 20% (6) had excellent results, 55% (16) had good, 24% (7) had fair results as per our KO scoring system. Most of the patients could return to their same occupation as before injury and few patients had to change to a simpler job.

Conclusion

In conclusion Interlocking Intramedullary Nailing for Distal Metaphyseal Tibial Fractures is an acceptable line as it helps with early mobilization of the patient which helps in healing of the fracture and prevents joint stiffness thereby restoring complete motion. There is minimal blood loss and minimal risk of infection thereby promotes early union as it does not disturb the anatomy and physiology of vascularity at the fracture site. The construct is biomechanically stable.

Fracture Dynamization is needed at 8-12 weeks if union does not progress to prevent the unwanted complications of nonunion or delayed union. It is recommended that locking all the proximal and distal holes to avoid malunion and fatigue of locking bolts is necessary especially in the distal locking where at least 2 interlocking screws, mediolateral or anteroposterior are inserted. Strict adherence to technical principles during nailing will prevent complications. Use of special nails, specifically those with tip locking properties and incorporation of indirect reduction techniques like poller screw trans fibular blocking screw to aim anatomical reduction will improve results. We also recommend reduction and fixation of fibula fracture before nailing of tibia. Fibular fixation with rush nails predisposed to delayed union, hence plating is recommended or revision of rush nailing to plating when feasible.

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