



Extra-articular Distal One Third Tibia Fracture Treated With Intramedullary Interlocking Nailing Versus Distal Tibia Plating

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Abstract

Introduction: Tibial fractures are most common type of long bone fractures following road traffic accidents, with higher predilection towards being an open injury.

In this study, difference in functional outcome in extra-articular distal tibia fractures that were treated either with intramedullary nailing or minimally invasive percutaneous plate osteosynthesis (MIPPO) has been compared.

Aims and Objectives: To evaluate clinical and functional outcome in distal tibia fracture treated with intramedullary interlocking nailing or MIPPO and study post-operative range of motion at ankle joint and complications, if any with fixation of distal tibia fractures.

Materials and Methods: 60 adult patients presenting with extra-articular distal tibia fracture were included and randomly divided into two equal groups, first group was treated with intramedullary interlocking nailing and second group was treated with MIPPO, and followed up at 1, 2, 3 and 6 months, and clinical and radiological confirmation of bony union was evaluated at each follow-up visit.

Results: 82% patients reported excellent or good results. Only 6.7% patients reported poor outcome at six months. P-value for difference in functional outcome amongst two groups was calculated by non-parametric tests was found to be 0.250, while p-value for difference in time interval from trauma to surgery and total duration of stay in hospital was less than 0.05.

Conclusion: Functional outcome in distal tibia fractures treated with intramedullary interlocking nailing and MIPPO shows no statistically significant difference.

Time interval between trauma to surgery and length of hospital stay is significantly shorter with intramedullary interlocking nailing as compared to MIPPO

Keywords: Extra-articular distal tibia fracture, intramedullary interlocking nailing, minimally invasive percutaneous plate osteosynthesis

Introduction

The process of rapid and unplanned urbanization has resulted in an unprecedented increment in the number of motor vehicles worldwide. There has been an alarming increase in morbidity and mortality owing

to road traffic accidents globally. (1) In India, over 80,000 persons die in the traffic crashes annually, over 1.2 million are injured seriously and about 300000 disabled permanently. The wage-earning age

group comprised of more than half of the road traffic casualties. (2) Fractures are the commonest injury among road traffic accident survivors and these patients commonly suffer injuries to the bones of the lower extremity. Tibial fractures are the most common type of long bone fractures following road traffic accidents, with a higher predilection towards being an open injury as well. On the basis of the fracture location in the bone, distal tibia fractures have the second highest incidence of all tibia fractures. (3) The relatively tenuous blood supply, subcutaneous location of the tibia, mechanism of injury, and use of certain treatment methods contribute to a relatively high incidence of post traumatic complications following tibia fractures. (4) These complex open fractures frequently pose a challenge to orthopedic surgeons. Considerable advances in the methods and concepts of internal fixation along with newer innovations in implants helped to meet the need of the hour. The landmark paper by Ruedi and Allgower (1969) (5) which showed 74% of their patients pain free and with good functional outcome at four years follow-up, revolutionized the management of distal tibia fractures. Thereafter, the 1970's and 1980's saw the widespread application of the principles of Open Reduction and Internal Fixation in the management of these challenging fractures.

In biological osteosynthesis, the fracture hematoma and soft tissue attachment of the comminuted fragments are left intact, thereby preserving the osteogenic capacity and vascularity of the fragments. The recognition of the optimum requirements for bone healing have now been understood with biological fixation taking precedence, and mechanical stabilisation being less rigid while still allowing painless function and reliable healing.

Intramedullary nailing of open and closed tibial shaft fractures has been associated with high rates of radiographic and clinical success, but the use of this procedure has not become widely accepted for distal metaphyseal fractures. (6) Because fractures distal to the tibial diaphysis and within 5 -6 cm of the ankle joint may represent a different injury, they have been excluded from reports on intramedullary nailing of tibial shaft fractures. (7) Recent changes in intramedullary nail design have extended the spectrum of fractures amenable to this type of fixation. (8) But there are valid concerns about using

intramedullary nailing as the gold standard treatment for distal tibia metaphyseal fractures because of difficulties with reduction, risk of distal propagation of the fracture, hardware failure, and inadequate distal fixation leading to loss of reduction and malalignment.

In this study we report our experience with sixty patients of extra-articular distal tibia fractures that were treated either with intramedullary nailing or minimally invasive percutaneous plate osteosynthesis.

Materials And Methods

This was a prospective study done for comparing the two surgical modalities for the management of an extra-articular distal tibia fractures with or without a concomitant fibula fracture, carried out between December 2018 to May 2020 at Mahatma Gandhi Mission Medical college and Hospital, Kamothe, Navi Mumbai. A total of 60 patients were included in the study over the entire one and a half years of the duration of the study. All the patients above the age of 18 years presenting with an extra articular distal tibia fracture, either closed or compound that is up to Gustilo Anderson Grade 2 injury were included in the study after a detailed written informed consent. Patients with concomitant ankle dislocation, old untreated fractures, pathological fractures secondary to an underlying skeletal pathology, other associated limb injuries, segmental tibia fractures and those who did not give consent for participating were excluded from the study. All the patients presenting to the casualty were clinically assessed and an X ray of the injured leg in antero-posterior and lateral view and ankle joint in antero-posterior, lateral and mortise view were taken. Patients with 43-A1, A2, A3, type distal tibia fractures according to the AO/OTA classification were included in the study. The status of the fibula was also assessed along with the tibia. All suprasyndesmotom fibular fractures were planned to be conserved. All infrasyndesmotom and transsyndesmotom fibular fractures were planned to be operated. The extent of the fracture and the need for a CT scan to rule out intra-articular extension and the involvement of the posterior malleolus of the tibia was judged on the basis of these radiographs. If deemed necessary, a CT scan was performed and only fractures that were confirmed to be extra-articular were included in this study.

These patients were randomly divided into two groups 30 patients were treated with intramedullary interlocking nailing with Tip Locking Tibia nails (with the option of Anteroposterior and oblique distal locking bolt) in lengths from 260mm to 400mm and diameters from 8mm to 12mm. (Figure 1, 2) and the remaining 30 patients were treated with minimally

invasive plate osteosynthesis technique with a 3.5 mm LCP Medial Distal tibia plate in lengths from 4 to 14 screw holes. Fibula Fixation was done using a 3.5 mm LCP Anatomical Distal fibula plate or 3.5mm 1/3rd tubular plate in lengths from 3 to 10 screw holes. (Figure 3,4)

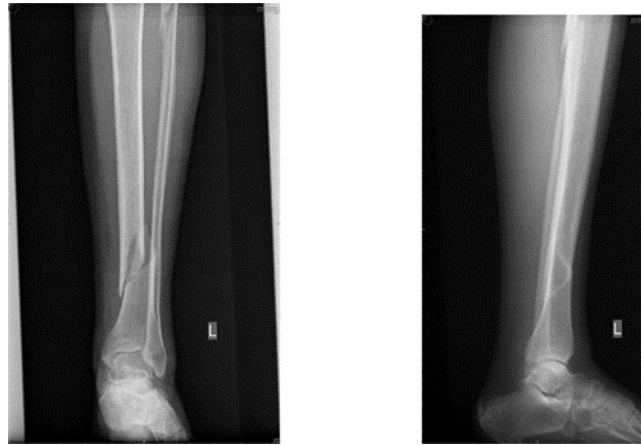


Figure 1: Pre operative X ray radiograph of the left leg showing distal tibia fracture in antero-posterior and lateral view



Figure 2: Post operative X ray showing a left sided distal tibia fracture treated with intramedullary interlocking nailing



Figure 3: Pre-operative X ray of left leg showing distal tibia fracture



Figure 4: Post operative X ray radiograph showing distal tibia fracture treated with an anatomical medial distal tibia plate

Patients were kept nil by mouth for 4 hours post operatively. Anti-biotics were given twice daily for 48 hours post operatively intravenously. Analgesics were given for 48 hours intravenously and then by the oral route as per the patient's need. Knee range of motion, ankle range of motion, hip range of motion exercises and Nil weight bearing walking as tolerated by the patient was started on the day following surgery. The wound was inspected on the third post-operative day. Sutures were removed on day 14 post-operatively. Patients were discharged between 5-8 days post operatively. Patients were asked to follow up at 2 weeks, 1 month, 2 months, 3 months and 6 months post-operatively. In the nailing group, patients were made to walk nil eight bearing for the

first 4 weeks. Partial weight bearing in relatively stable fracture patterns without comminution was started at 4 weeks post operatively and full weight bearing by 8 weeks post operatively. For more comminuted fractures, weight bearing was restricted and was not started till clinical and radiographic signs of union were confirmed. In the plating group, patients were made to walk nil weight bearing until clinical and radiological signs of union were confirmed. After confirmation, patients were rehabilitated beginning from toe touching, partial weight bearing till full weight bearing as per their comfort and ability to comply with the physiotherapy regimen. Check X rays were made at 1 month, 2 months, 3 months and 6 months post operatively. A

follow-up check X rays were performed at 1 month, 2 months, 3 months and 6 months post operatively. And at every follow-up visit. At each visit, the patient was assessed on the basis of the following parameters local examination of the operative site to assess the status of the wound, skin temperature, tenderness around the fracture site and overall condition of the limb. X rays (AP and Lateral view) of the tibia were made. Rehabilitation and physiotherapy as appropriate in accordance to the stage of fracture union and the date of surgery. Olerud and Molander scoring system was used to assess the patient's functional recovery. Each patient was followed up at least till clinical and radiological confirmation of bony union.

Results

In this study the mean age of the participants was 37.68 years. 45 males and 15 females were participated at the ratio of 3:1.

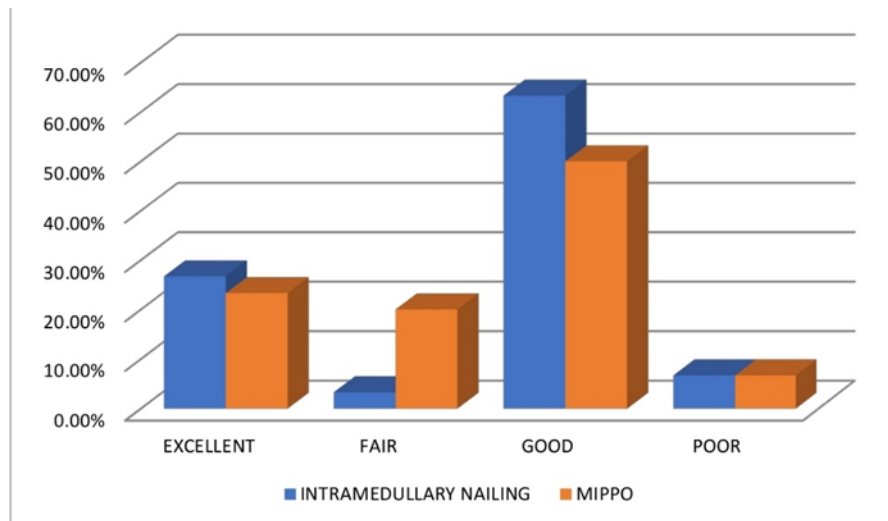
On assessment of the mode of injury, 38 patients sustained their injuries as a result of RTA, 20 patients sustained their injury as a result of a fall, and 2 patients sustained their injuries as a result of assault. There was no statistically significant difference in mode of injury between our study groups.

61.7% of our patients had a suprasyndesmotom fracture of the fibula. 18.3% had a trans-syndesmotom fracture and 16.7% had an infrasyndesmotom fracture. 3.3% patients had an intact fibula. Collinge et al, Vallier et al and Casstevens et al did not comment on the location of fibular fracture. There was no statistically significant difference in the outcome of

the patients on the basis of the status of fibula between our study groups.

Four complications each in both the groups were observed in this study. In the nailing group, one patient suffered from a superficial infection responded well to a single debridement followed by culture-specific antibiotic administration. One patient suffered a malunion that was largely asymptomatic, while two patients were diagnosed as delayed union at 16 weeks. Both these patients required a secondary bone grafting procedure and showed clinical and radiological signs of union at 24 weeks. In the plating group, we reported two cases of deep-seated wound infection that required repeated debridement with the application of a Vacuum Assisted Closure (VAC) dressing and finally a local rotational flap after the eradication of infection. Two patients suffered from non-union, and underwent a secondary bone grafting procedure. All 4 patients had an unsatisfactory outcome at the 6 month follow up mark. In the study by Vallier et al, one patient developed acute respiratory distress syndrome, and one patient had a deep infection that had to be treated with secondary debridement. In the study by Collinge et al, there was one instance each of deep and superficial infection, one patient has post-operative nerve palsy, one patient each had a varus and valgus malalignment, and two patients died within two months of surgery due to medical conditions.

A Chi-square test was done to analyze the statistical significance of the functional outcome on the basis of the complications which gave a p-value of 0.721 indicating that there was no significant difference (Graph 1)



Graph 1: A three-dimensional bar graph comparing the functional outcome of patients with distal tibia fractures, treated with Intramedullary nailing (blue) and Minimally invasive plate osteosynthesis – MIPPO technique (orange)

The functional outcome graded as Excellent, Good, Fair and Poor on the basis of Olerud and Molander scoring system and a Chi-square test gave a p-value of 0.250 indicating that there was no statistical significance in the functional outcome of the two management modalities. (Table 1)

	TIME INTERVAL BETWEEN TRAUMA AND SURGERY	DURATION OF STAY IN HOSPITAL	REHABILITATION STARTED IN	TIME TO UNION	OLERUD AND MOLANDER SCORE
Mann-Whitney U	109.000	162.000	405.000	391.500	416.500
Wilcoxon W	574.000	627.000	870.000	856.500	881.500
Z	-5.152	-4.294	-.993	-.890	-.496
p-value	.000	.000	.321	.373	.620
Interpretation	Significant	Significant	Non-Significant	Non-Significant	Non-Significant

Table 1: Non Parametric tests to check for significance in the parameters of comparison in between the two groups.

The statistical significance in between the two groups on the basis of time from trauma to surgery, duration of hospital stay, time needed for beginning the post operative rehabilitation, time to union and the Olerud and Molander score was analysed by plotting the values for each parameter in a table and a Mean rank was calculated and non-parametric tests like Mann-

Whitney U test and Wilcoxin W test were used to analyse the significance. A P-value less than that of 0.05 indicated significance of difference between two groups in terms of time interval between trauma and surgery and duration of hospital stay, otherwise the difference in duration of rehabilitation, time to union

and the Olerud and Molander score was non-significant.

Discussion

Both Intramedullary nailing and Minimally invasive percutaneous plate osteosynthesis are both established methods of treatment of extra-articular distal tibia fractures. Both have their respective advantages and disadvantages and may orthopedic surgeons advocate a patient to patient approach on selecting the optimum implant of choice. Nailing of extra articular distal tibia fractures is challenging, technically demanding and should be approached with caution. (9) Apart from malalignment which is recognized in the immediate postoperative period, primarily due to difficulty in controlling the short distal fragment and technical errors, loss of reduction can occur during the follow up due to unrecognized instability. (10) Critical surgical tenets such as central placement of the guide wire and reamers, maintenance of the reduction at the time of nail passage and placement of nail in subchondral region, are described to avoid intraoperative malalignment. (11) Plating of extra articular distal tibia fracture is an equally challenging procedure. Multiple instances of wound dehiscence have been reported in literature, a common complication for any procedure around the ankle. Non-union has been documented in multiple series, but, however, malalignment appears to be a less frequent problem. The observations and results of this study were compared to similar studies performed in the past by Cory Collinge et al, Vallier et al, and Casstevens et al. (12,13,14,15)

The observed average time to union was 14.4 weeks. In the nailing group the average time to union was 14 weeks and in the plating group the average time to union was 14.8 weeks. This difference was not found to be statistically significant. In the study by Collinge et al, the average time to union was 16 weeks, by Vallier et al, it was 15 weeks, while by Casstevens et al it was 14.1 weeks.

In this study, 82% of the patients reported excellent or good results. Only 6.7% patients reported a poor outcome at the end of six months.

No statistically significant correlations in the results with respect to the age, sex, side injured, mechanism of injury, the status of the fibula, associated injuries, the fixation of the fibula, and the time taken to begin

rehabilitation were found. It appears that high energy trauma is commoner in a younger age group, while low energy trauma is more likely in the age group above 50 years.

This potential bimodal distribution in terms of the mechanism of injury may be masking the effect of age on the outcome of distal tibia fractures.

The time to union was at a mean of 14 weeks in the nailing group and 14.8 weeks in the plating group. The mean Olerud and Molander score was also fractionally higher in the nailing group (65.23 in the nailing group and 62.27 in the plating group.) However, these results were not found to be statistically significant.

Interestingly, statistically significant differences were noted in two parts of the study. The mean time interval between trauma and surgery was 3.3 days in the nailing group and 5.9 days in the plating group.

The mean duration of stay in the hospital was 8.8 days in the nailing group and 12.93 days in the plating group. We attribute the difference in time to surgery to the cautious approach of all orthopedic surgeons towards a swollen ankle.

Intramedullary nailing avoids the potentially devastating complications of wound healing associated with surgeries around a swollen ankle. This delay in turn led to a longer stay in hospital for patients in the plating group. The socio-economic impact of these findings on the public health system deserves to be studied on a larger scale.

Conclusion

In this prospective cohort study, it may be concluded that the functional outcome of intramedullary nailing and MIPPO in extra-articular distal tibia fractures are similar. However, MIPPO appears to be associated with a greater time interval between injury and surgery and a lengthier hospital stay. However, this study is possibly too small to conclude anything definitely and a larger study to analyze the veracity of this hypothesis and its possible socio-economic impact on public healthcare may be warranted.

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