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# A comparative study of intramedullary interlocking nailing & minimally invasive plate osteosynthesis in extraarticular distal tibia fractures

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**Abstract**

**Introduction:** Distal tibial fractures are very commonly encountered by orthopaedic surgeons. They are one of the perplexing injuries encountered due to its poor blood supply and limited soft tissue cover.

Our aim is to study and compare clinical and radiological outcome in extra articular fractures of distal tibia treated by IMILN and MIPPO locking compression plates with reference to rate of healing, functional outcome, and complications.

**Material and Methods:** This was a prospective observational study, with a sample size of 30, 15 randomly assigned to MIPPO group and the remaining to the IM nailing group. The patients one year with clinical and radiological assessment. The data was then recorded in a semi-structured pro forma and entered in an MS Excel Spreadsheet. Statistical analysis was performed using SPSS v20.

**Results:** Most of the population was over the age of 55 years for IMILN group, but younger in MIPPO i.e. 30-55 years. The most common mode of injury was RTA in both the study groups. 80% cases of IMILN had associated fibular fracture compared to 46.7% in the MIPPO group. Average time for fracture union was 5.4 months in IMILN group vs 65.3 months in the MIPPO group, which was not statistically significant. We observed fewer complications in terms of implant irritation, ankle stiffness and infection (superficial and deep) were seen in interlocking group as compared to plating group.

**Conclusion:** MIPPO with a medial distal tibial locking plate and closed reduction with intramedullary nailing are equally viable options for management of extra-articular fractures of the distal tibia.

**Keywords:** distal tibia fracture, fibular fixation, MIPPO locking plate, interlocking nailing

## Introduction

Distal tibial fractures represent less than 10-12% of all tibial fractures [1]. Distal tibial fractures contribute to less than 10% of all lower extremity fractures [2]. They are more prevalent in males between the age groups of 30-50 years [3]. Injuries may vary across the spectrum, from low energy to high energy injuries. In older age group, usually due to rotational forces low energy distal tibial fractures are commonly seen [4]. Spiral fractures with or without intra articular extension are commonly encountered by these mechanisms of injuries. In high energy distal tibial fractures are encountered in young age individuals following fall from height and road traffic accidents. The mechanism of injury that are involved in these injuries are axial loading, compression, and torsional forces [4].

Fall from height, road traffic accident and twisting ankle can lead to distal tibial fractures. Distal tibia fractures are difficult to manage because of its precarious vasculature. The subcutaneous nature of the tibia further adds to the difficulty in its fracture management. For the fracture fixation of distal tibia internal fixation devices such as intramedullary nails & locking compression plates, are regularly used. 85 % distal tibial fractures have associated fibula fractures; however, the need for fixation is debateable [5].

The nutrient vessels and the metaphyseal vessels supply the remaining two third of the bone cortex and the periosteum. The destruction of the endosteal vessel occurs while reaming but the vessels grows in between the nail and the bone widening the haversian canal. Simultaneously the cortical bone receives the periosteal blood supply. Hence comparatively the blood supply at the fracture site preserved in the nailing technique [6].

In 1980, Ruedi *et al* decided for fixation of all distal tibial fractures by internal fixation with plate osteosynthesis and was considered the gold standard.

Chronic osteomyelitis, sepsis, wound dehiscence in high energy fracture pattern are complications associated with open reduction and internal fixation with plating. Approximately 40-50% of complication rates were attributed to internal fixation device and extensive surgical procedure due to injury to soft tissues [6, 7].

Distal tibial fractures were classified by the AO group using the Tscherne classification system of soft tissue injury to evaluate and grade each component such as the skin, the musculotendinous structure and the neurovascular tissue was considered [7].

Various modalities of internal fixation have been described in the treatment distal-third tibial fractures. Dynamic compression plates, AO medial plating using medial buttress plate, anterior plating using t- plates and cloverleaf plate are some of the different modalities available for the treatment of these fractures [8]. In the AO/ASIF (Association for the study of internal fixation) formulated four basic principles which have become the guidelines for the internal fixation. In general, the intramedullary nailing shows anatomic reduction, stable fixation, preservation of blood supply and early mobilization.

Anatomically contoured locking compression plates help in better reduction of these fractures. Low profile medial locking compression plate prevents deep infection, wound dehiscence and has fewer complications than the standard AO plates. Minimally Invasive Percutaneous Plate Osteosynthesis technique (MIPPO) addresses the management of distal tibial fractures with minimal soft tissue injury [9].

The MIPPO technique provides a union rate ranging from 80 to 100%. The surgical soft tissue trauma is minimal in the MIPPO procedure and it aids in fracture healing. Complications like malreduction, hardware failure, angular deformity and non-union can occur.

## Methods and Materials

This is a prospective observational study conducted in the hospital affiliated to the Department of Orthopaedics at Adichunchanagiri Institute of Medical Sciences, during the October 2017 to March 2019 with extra-articular distal tibial fractures satisfying the inclusion and exclusion criteria. Patients age more than 18 years with Tibial fracture involving region between mid

1/3rd-distal 1/3rd junction to 5-6 cm proximal to the ankle joint, Closed and Gustilo & Anderson type I & II open lower one-third fractures of the Tibia.

30 patients were selected, and randomly assigned to each group by Lottery method.

The complete data collected from the patients included history of presenting illness and detailed clinical examination and relevant investigations. Before subjecting the patients for investigations and surgical procedures written/informed consent was obtained from each patient/legal guardian. Post operatively all the cases were followed up at regular intervals for a minimum period of 12 months. Results were analysed both clinically & radiologically and functional outcome at the end of one year.

The data was collected using a semi-structured pro forma and entered into an MS Excel Spreadsheet.

Qualitative parameters shall be expressed as percentage/ proportion, while Quantitative variables shall be expressed in terms of mean and SD. The data was then analyzed using SPSS software Categorical variables were compared using the chi-square test, and continuous variables using the Wilcoxon test. For all outcomes, a nominal P value of less than .05 was considered to indicate statistical significance.

## Results

In this study, it was observed that 33% of the population was over the age of 55 years in the IMILN group (33%). However, 20% of the patients in the MIPPO group were between 46-55 years. In this study population, 66.7% were males in the MIPPO group, and 80% males for IMILN group. There was no statistically significant difference in both groups in terms of the sex distribution.

The most common mode of injury in the study population was RTA for both the study groups; 66.7% in IMILN group & 86.7% in MIPPO group. There was no statistically significant difference between the two groups for mode of injury.

The mechanism of injury considered in our study was categorised as High and Low energy impact. In this study, it was observed that the most common mechanism of injury was a high energy impact in both groups, and hence there is no statistical significance between the two groups.

Considering the type of fractures in the two study groups, it was observed that closed fracture was seen in over 2/3rd of the study population, which was comparable between the two groups (closed-73.13% for IMILN and 66.7% for MIPPO groups while 26.7% in IMILN and 33.3% for MIPPO were found to be open). There was no statistically significant difference between the two groups.

There were two operations that were considered as the main groups of this study, IMILN and MIPPO. The mean age of the IMILN group was found to be 48.47% slightly higher than that of the MIPPO group 45.27% with a Pvalue of 0.57; however, this difference didn't achieve a statistical significance.

In case of associated fibula fracture, we find that in the IMILN group there were 80% cases of associated fibular fracture, which was compared to 46.7% in the MIPPO group.

In this study, Open Tibial fractures were classified using GA classification. The most common was type 2 in the IMILN group (77.7%) compared to Type 1 in the MIPPO group (66.7%); this difference was not statistically significant.

In case of simultaneous Fibula Fixation between the two groups, it was observed that there were 53.3% patients that underwent a fibula fixation in the same operation in the IMILN group, which was only 20% in the MIPPO group. However, there was no statistically significant difference.

Considering the location of the Tibia fracture between the two groups, it was observed that in the IMILN group the most common location was Distal 1/3 fracture of one side and both bone fracture(27.7%); however distal 1/3rd fracture was the single most common fracture found in such cases in the MIPPO group(40.0%)

Post-operatively, considering the weight bearing, it was observed that in the IMILN group, patients were started on immediate weight bearing (86.7%). However, in case of the MIPPO group, it was delayedn(100%). This difference was found to be statistically significant with a P value of <0.01.

Post-operatively considering the range of motion (ROM) at the ankle, it was found that most patients in both study groups had a full ROM (53.3% in both IMILN as well as MIPPO); there was no statistically significant difference.

Post-operatively when we consider the range of motion (ROM) at the knee, we find that most

Patients in both study groups had a full ROM (53.3% in IMILN, 73.3% in MIPPO) with a Pvalue of 0.58, hence there was no statistically significant difference.

In this study, the post-operative complications was evaluated in the two study groups, and it was observed that majority of patients didn't have any complications (66.7% in IMILN group and 86.7% in MIPPO) which was followed closely by superficial infection in IMILN group(26.7%) and delayed union in MIPPO group(13.3%) with Pvalue=0.09.

Comparing the rate of fracture union between the two groups, there was no statistically significant difference; mean union rate of 5.40 IMILN as well as 5.3 in MIPPO. This shows that both methods are comparable in their fracture union rates.

When we compare the ankle scores between the two groups, we find that the mean ankle score is higher in the MIPPO (mean score 87.87) than in the IMILN group (mean score=82.0) with a P value=0.02, which was a statistically significant difference.

## Case details

**Fig 1:** Pre-op X-ray showing Tibial fracture


**Fig 2:** Follow up Xray-1 (3 months)

**Fig 3:** Follow Up Xray – 6 months and 1 year

Plantar Flexion

Dorsi Flexion

Squatting

Knee flexion

Dorsi Flexion

Plantar Flexion

## Discussion

Distal tibia fractures result from low energy torsional or high energy axial-loading mechanisms. High energy fractures are commonly associated with severe soft tissue injury, comminution of metaphyseal and articular fracture fragments of tibial plafond and comminuted distal fibula fractures [1, 2].

In our study the distal tibial fractures are treated with intramedullary Interlocking Nail and MIPPO plating. The fracture fixation was delayed for about two to three days to prevent soft tissue injury complication. For plating universally, the 3.5 mm locking compression plate used for tibia fixation and one third tubular plate for fibular fracture fixation [9].

Among 30 patients the 15 patients are treated with Intramedullary Interlocking nail and 15 patients are treated with MIPPO plating. In our study the peak incidence age group lies between 35 to 55 years when analysed, mean age of Jassen *et al*. study mean age was 43.3 years, and Mohammed *et al*., in which mean age of cases was 42 years. The result was also comparable to that of Kumar *et al*., 10 Ram *et al*., [11] Li *et al* [12] and Vallier *et al*.

In our study, predominant male involvement was encountered with almost 80% of the study

subjects in the nailing group were male compared to 20% of the study subjects being female, though 66.7% of the patients were male in the MIPPO group and 33% of the subjects were female in the same group, male preponderance was found to be higher which can be attributed to more outdoor activities and heavier labour undertaken by males as compared to females in our Indian set up. Similar results were observed by Daolagupu AK *et al* in their study [12].

Largest incidence of these fractured happened following RTA in our study amounting to 66.7% in the nailing group and 86.7% in the plating group of the patients in our study followed by other means of injury these findings were similar to the results found in the studies done by Ram *et al* [13].

In our study only 26.4% of the patients presented with open fractures in the nailing group and 33% in the plating group with a larger portion of the study subjects presented with closed fractures, these results were found to be comparable with other studies done by Kumar *et al* [14].

There were 4 superficial infections (26.7%) noted in the nailing but no superficial infection in the plating group. The infection rates are found to be higher in our study than in a study done by Sean E Nork *et al*, where the superficial infection rate in the nailing group was as low as 7%.

Other studies by similar studies by Guo *et al.* [15]

In the study conducted by Sean E Nork *et al* [16] and Tyllenakis *et al*. [17], the average time for union was about 4-5 months. In our study, it was about 5-6 months in both groups.

Comparatively, in a study done by Vallier *et al* [18], the mean union times were 22.6 weeks in nailing group and 27.8 weeks in the plating group.

Within our study it was found that 80 % of the study subjects also suffered from a concurrent fibula fractures compared to 46.7% of the study subjects that suffered from a fibula fracture in the plating groups similar to the study by Ram GG *et al* [13].

In the study conducted by Boos N *et al* [18], 60 in 51 cases of distal tibial fracture with interlocking nail, there was incidence of 16% malunion. Comparatively, the rate of malunion was lower in our study.

In our study the average time for immediate weight bearing was 86.7% in the intramedullary interlocking group and was not advised in plating group, similarly only 2 patients in our study were advised delayed weight bearing accounting to 13.3% in the nailing group and all the patients in the plating group were advised delayed weight bearing. These findings were similar to a study done by Prasad *et al* [19].

The ankle score in our study for nailing was good but was excellent for plating. This shows that the ankle function was restored well in all the patients. We also find that the ankle score was significantly higher in the MIPPO group. Hence, it shows that MIPPO is superior to IMILN. The results are comparable with the results of ankle function in the study conducted by Shon OJ *et al* [20].

Because of restrictions of intramedullary nailing technology plating was preferred in the past.

More and more often the intramedullary nail being performed now-a-days because this technique protects the blood supply, lower the incidence of infection, reduce the soft tissue destruction and lower the incidence of delayed healing.

Many authors recommend the intramedullary nail because the risk of infection was increased in plate fixation. There are different blood supplies outside and inside the tibia. The anterior and posterior tibial vessels give the periosteal blood supply nourishing the one third of lateral side of cortical bone.

## Conclusion

Based on our study, we conclude that both minimally invasive percutaneous plate osteosynthesis (MIPPO) with a medial distal tibial locking plate and closed reduction with intramedullary nailing are both equally viable options for management of extra-articular fractures of the distal tibia, with each having its own merits and demerits although closed nailing has the advantage of shortened operating time, early weight bearing, decreased wound problems, early union of the fracture, decreased implant related problems and overall reduced morbidity.

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