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## Distal tibial treatment with multidirectional locked nailing and plating: An observational comparative study at Rajasthan based teaching hospital

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### Abstract

**Background:** We Assessed patients with Functional recovery between two treatment modality intramedullary interlocking nail and locking plate fixation in the surgical management of extra-articular distal tibia fracture. In high energy distal tibial fractures younger age groups are involved due to road traffic accident and fall from height. Axial loading, compression and torsional forces are involved in the mechanism of injury. Distal tibial fractures are very commonly encountered by orthopaedic surgeons.

**Aims and Objectives:** To study and compare clinical and radiological outcome in extra articular fractures of distal tibia treated by multidirectional interlocking intramedullary nails and anterolateral locking compression plates with reference to rate of healing, functional outcome and complications.

**Material and Methods:** In this study 26 patients with distal tibia extra-articular fractures, AO type 43 A1, 43A 2,43A3 were randomly selected and 13 of them were operated with multidirectional interlocking nailing and remaining 13 with anterolateral locking compression plate. The patients were regularly followed up for a period of one year and were evaluated clinically and radiologically with respect to tenderness at fracture site, abnormal mobility, infection, pain on movement of knee, ankle joints and anteroposterior and lateral radiographs of the leg for union of the fracture.

**Results:** About 42 to 52% complication rate was attributed in internal fixation device and extensive surgical procedure due to soft tissue injury. Therefore ankle spanning external fixation became popular to maintain the articular surface of tibia with minimal internal fixation. In multidirectional Interlocking intramedullary group average time for union was 4.5 months compared to 6.4 months in plating group which was significant (p value<0.00). Also the average time required for partial and full weight bearing in the nailing group was 4.2 weeks and 9.6 weeks respectively which was significantly less (p value <0.00) as compared to 7.12 weeks and 13.42 weeks in the plating group. Lesser complications in terms of implant irritation, ankle stiffness and infection (superficial and deep) were seen in interlocking group as compared to plating group.

**Conclusion:** Here we will conclude lateral radiographs of the distal third of the tibia are of great importance for the diagnosis. The management of these fractures is usually operative. Plate fixation for distal tibia fracture is associated with non-union, delayed union, sloughing of overlying skin, and infection. Interlocking intramedullary nailing is now more preferred weight bearing, early union of the fracture and decreased implant related problems and closed in treatment of distal tibia fractures.

**Keywords:** Stiffness, distal tibiofibular, distal tibia fractures, fibular fixation, locking plate, interlocking nailing, intramedullary interlocking nailing, no-union, delayed union

### Introduction

The subcutaneous location of the antero-medial surface of the tibia means that severe bone and soft tissue injury is not infrequent, and there is a high incidence of open fractures compared with other long bones [1]. Surgical stabilization of fractures and early mobilization of the patient provides best clinical outcome. Although treatment planning for fracture should be considered individually to achieve the optimal results, the effect of decision must be considered in the light of overall injury status and general condition of the patient. Distal Tibia fractures continue to be one of the most controversial fractures that we treat. Most of the controversy resides in the treatment techniques regarding the choice of implants, as the indication for surgery is fairly clear. Some surgeons treat the fracture based on fracture pattern and level of the fracture, mostly on external fixation if soft tissue injury is found, whereas others use predominately plate fixation and some prefer nailing techniques [2].

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On the other hand, several investigations support the superiority of IMN over the plate treatment. For instance, IMN is confirmed to be a viable alternative to plate osteosynthesis in the management of distal tibial fractures. Distal tibial fractures represent less than 7% [3, 4] of all tibial fractures. Of all lower extremity fractures less than 10% [5, 6] belongs to distal tibial fractures. It is more common in males in the age group [7] of 30-50 years. The spectrum of injuries vary from low energy to high energy injuries. The low energy distal tibial fractures are mainly seen in older age group, usually due to rotational forces [8]. The spiral fracture with or without intra articular extension is commonly encountered in these mechanism of injuries. In high energy distal tibial fractures younger age groups are involved due to road traffic accident and fall from height [9]. Axial loading, compression and torsional forces [10, 11, 12] are involved in the mechanism of injury. The distal tibial fractures are mainly due to road traffic accident, fall from height and twisting of ankle. Fractures around the ankle joint are difficult to manage because of precarious vasculature in nature. In addition the tibia is subcutaneously in plane which adds further difficulty in the fracture management. Internal fixation devices such as locking compression plates, Intramedullary Nails (IMN) are used for the fracture fixation of distal tibia. It is critical to understand the fracture pattern occurring in the distal tibia and the form of fixation available. 85% distal tibial fractures was associated with the fibula fractures. The fixation of fibula is a debate according to many literature. In case of rigid fixation like multidirectional interlocking nailing the fibular fracture need not be fixed, but for better reduction the fibula fracture may be fixed. The comorbid conditions like diabetes mellitus, peripheral vascular diseases, smoking and alcoholism complicates this delicate situation. In 1980, Ruedi *et al.* made a gold standard decision to fix all distal tibial fractures by means of internal fixation by plate osteosynthesis. High complications like wound dehiscence, sepsis, chronic osteomyelitis associated with open reduction and internal fixation with plating were noted in high energy fracture pattern. About 40 to 50% complication rate was attributed in internal fixation device and extensive surgical procedure due to soft tissue injury. In 1990, the ankle spanning external fixation became popular to maintain the articular surface of tibia with minimal internal fixation. To maintain the length and axial alignment the fibular fractures were fixed with plate osteosynthesis. Monolateral external fixator was replaced by hybrid external fixators due to the advantage of the early weight bearing and stability. Management of open distal tibial fractures with external fixators as a definitive procedure has its own complication like ankle stiffness, pin tract infection, secondary loss of reduction and stability. With the better understanding the management of soft tissue injury and the poor outcome results in the external fixation technique, makes to reconsidered that, after the soft tissue recovery open reduction and internal fixation can be done. Non surgical management [13, 14] have a limited role in medically unfit patient. For those patient the treatment modalities are traction or plaster of paris but the complication rate is higher like shortening, malunion, secondary osteoarthritis of the ankle and limited range of movements. In addition to the long bed ridden patient are more prone for pneumonia, deep vein thrombosis and pressure sores are encountered. Tscherné classification of soft tissue injury was accepted by the AO group to grade and evaluate each component the skin, neurovascular tissue and the musculotendinous structure gave way for reconsideration of open reduction and internal

fixation of distal tibial fractures. For distal tibial fractures various modalities of internal fixation have been described. They are anterior plating using tplates, AO medial plating using medial buttress plate, cloverleaf plate and dynamic compression plates. Each plate osteosynthesis has their own advantages and their complications. One of the major disadvantage of AO medial buttress plating is the wound dehiscence over the sub cutaneous border, lead on to flap cover by the plastic team and this procedure limits the lateral surgical approach for the fixation of the fibular fracture. The locking compression plates with the anatomical contoured version is now available for better reduction of the distal tibia fracture. Use of low profile medial locking compression plate still address the problem of wound dehiscence and deep infection with low complication rate than the standard AO plating. In the Minimally Invasive Percutaneous Plate Osteosynthesis technique (MIPPO), the surgeons address minimal soft tissue injury in the management of distal tibial fractures. The union rate ranges from 80 to 100% in the MIPPO technique. In MIPPO procedure the surgical trauma to the soft tissue is minimised and it provides the biological environment for fracture healing. The complication like hard ware failure, non union, angular deformity, malreduction has been reported Anterolateral approach described in the past was not popularized in the late century, anteroplating on the lateral surface of the tibia becoming popular for the fixation of distal tibial fractures and improved soft tissue coverage and low rate of wound. Hey-Groves used solid metal rods for femur fractures and achieved healing at appropriate time, preservation of soft tissues, and periosteum as well as abolition of prolonged plaster cast immobilization. Rush brothers presented their technique with multiple flexible intramedullary pins in 1927. The most important contributions to intramedullary fixation, however, came from Gerhard Küntscher (1900- 1972) who performed a number of animal experiments and explained not only the nailing technique but also the implant shape and design. He suggested a tight fit between nail and bone to achieve a higher stability. To extend the area of contact within the medullary cavity, he started to ream the canal in order to insert thicker, longer, and slotted cloverleaf nails. In 1950, Herzog *et al.* introduced the tibia nail with a proximal bend and lateral slots at the distal end to accept antirotational wires. Klemm and Schnellmann in Germany and Kempf *et al.* in France further developed the idea and were precursors to today's interlocking nails. In 1958 the AO/ASIF (Association for the study of internal fixation) formulated the four basic principles which have become the guidelines for the internal fixation. In general, in particular to the intramedullary nailing they show anatomic reduction, stable fixation, preservation of blood supply and early mobilization.

### Materials and Method

However multiple methods have been introduced into the management of distal tibial fracture, including surgical technique such as open reduction and nonsurgical techniques such as internal fixation with screws or plates, external fixations with mono-lateral or circulated external fixators. Although the surgical technique possesses incomparable advantages in anatomical reduction and remains the mainstay for distal tibial fracture treatment, limitations still exist. For example, surgical dissection often causes soft tissue stripping that can result in infection, wound necrosis and delayed or non-union. The present study was conducted in the Department of Orthopaedics, National Institute of Medical

Sciences & Research, Jaipur, Rajasthan, India, by retrospectively and prospectively.

**Selection Criteria**

1. Adult patient more than 18 years of age and less than 70 years of age.
2. Closed fractures and grade I compound fractures of distal tibial fractures (43-A1,43-A2,43-A3 OF AO type) without intra articular extension.

**Exclusion Criteria**

1. Age less than 18 years and more than 70 years
2. Grade II, III Compound fractures of distal tibia.
3. Fractures with intra articular extension. A total of 26 cases (13 males and 13 females) with distal tibial fractures were used for our study.

**Statistical Method:** We used SPSS 16.01 Version, paired sample t test, Mc Nemar Chi Square statistical methods for data analysis and statistical significance was accepted when P value is <0.05.

**Results and Observation**

**Table 1: Age distribution**

Age group in years	Nailing		Plating	
	No. of Pt.	%	No. of Pt.	%
25-35	3	23	1	8
36-45	4	31	4	31
46-55	6	46	6	46
>55	0	0	2	15
Total	13	100	13	100

**Table 2: Sex distribution**

Sex	Nailing	Plating
Male	5	8
Female	8	5
Total	13	13
Sex ratio 42:58 58:42	42:58	58:42

**Table 3: Nailing and plating**

Status	Nailing	Plating
Closed	10	
Open	3	13
Total	13	

**Table 4: Mode of Injury**

Mode of injury	Nailing	Plating
Fall From Height	2	1
Road Traffic Accident	11	10
Twisting of Ankle 0 2	0	2
Total	13	13

Twisting of ankle is the cause for distal tibial fractures in the old age and it is about 15.40% in the plate group and zero percent for nail group. The sex ratio for the nailing is 42:58 and for plating is 58:42

**Table 5: Weight Bearing**

Weight bearing	Nailing	Plating
Delayed	3	13
Immediate	10	0
Total	13	13

**Table 6: ROM ankle**

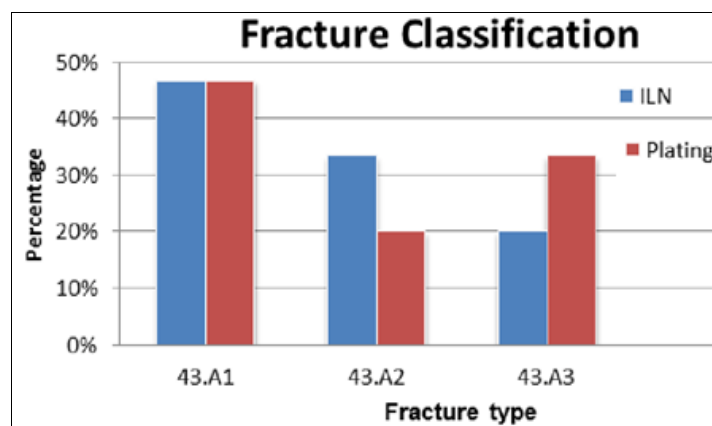
ROM ankle	Nailing	Plating
Full	9	7
Near Normal	4	3
Mid Range	0	3
Total	13	13

**Table 7: ROM knee**

ROM knee	Nailing	Plating
Full	9	13
Near Normal	4	0
Total	13	13

**Table 8: Complications**

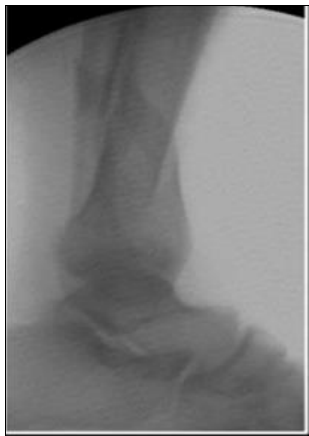
Complications	Nailing	Plating
Delayed Union	2	0
Implant failure and non union	0	1
Plate exposure	0	1
Superficial infection	1	2
Wound dehiscence	0	3
Malunion	3	0
Total	6	7



**Fig 1: Fracture classification**



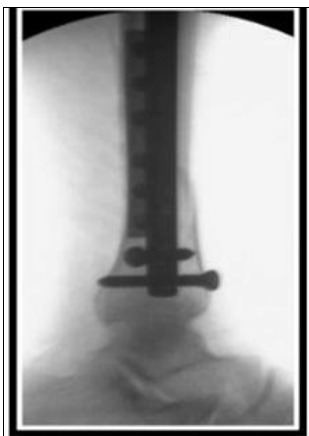
**Fig 2:** Pre Op AP view



**Fig 2:** Pre op Lateral view



**Fig 3:** Immediate post op AP



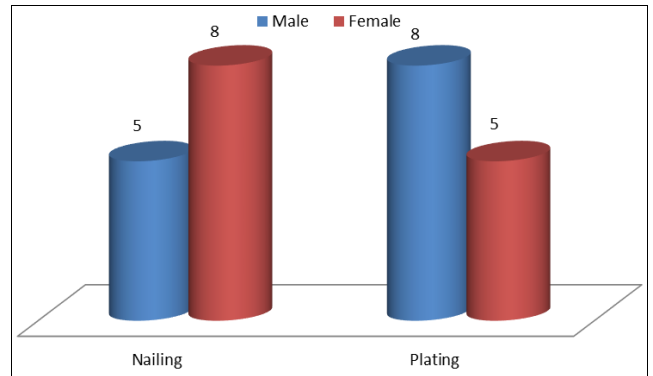
**Fig 3:** Immediate post op Lateral view



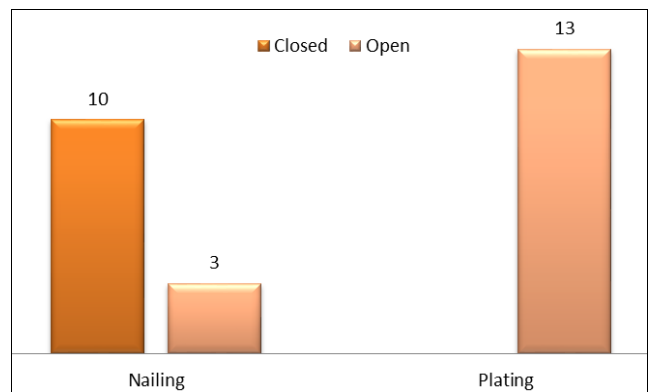
**Fig 4:** Complete union AP view



**Fig 4:** Complete union Lateral view



**Fig 5:** Sex Distribution in ILN and Plating



**Fig 6:** Open vs closed of ILN and Plating

**Discussion**

According to Imgi *et al.* [15] anatomic reduction of the fracture

is necessary to get good functional outcome. Early range of motion should be started after giving adequate, stability and alignment with fixation. We also agree GS Kulkarni *et al.* [16] that early motion is necessary in order to obtain good result. Stiffness is usually the result of immobilization. In surgically treated patient mobilization should begin within 5 to 7 days. This, however, should not be carried out at the expense of the reduction or at the expense of wound healing. In our study Fractures with intra articular extension. A total of 26 cases (13 males and 13 females) with distal tibial fractures were used. Table 1 age distribution done in a way, most of cases of 36years to 55years have been taken in both nailing and plating as we have shown ap/lateral view pre operating, clearly indicating case planning. Figure 2.

Figure 3 post operating ap/lateral view of the case is indicating much more efficacy of the case.

Fast recovery happens post follow up of such cases around 3months to 6months times which is mediocre for full and strength reunion. Figure 4

Table 2 and Figure 5 as we have done sex distribution which 5 males in slot one in nailing against 8females in plating and vice –versa in next slot.

Table 3 and Figure 6, indicating, as we have done closed nailing and open too respectively 10,3 cases as against we did open all the 13 cases of plating. The management of these fractures is usually operative. Plate fixation for distal tibia fracture is associated with non-union, delayed union.

Things are to be noticed in our study complications might be lesser in nailing except in delayed union, implant failure and non union, plate exposure, superficial infection, Wound dehiscence, malunion, as against in plating most of complications indicated are higher in ratio and terms except in delaying process Table 8. Figure 1.

**Ankle Score:** The ankle score for both the nail and plate group range from excellent to fair group. In the nail group the ankle score was good to excellent. In the plate group the ankle score was fair to good. The t-value is 8.75 and the p-value is 0.0 and it is significant.

**Knee Score:** The knee score for the nail and the plate group range from 60 to 90 out of 100. The nail group range from 60 to 80 and the plate group range from 70 to 90. The mean for nail group was 70.73 and the mean for plate group was 82.92. the t-value is 4.76 and the p value is 0.0 and it is significant for plate group. The knee score the plate group was better than the nail group.

## Conclusion

Locked intramedullary nailing has an advantage in restoration of ankle motion and reduced wound problems. Misalignment with nailing was more probably due ankle joint is near and difficult reduction. Better alignment can be achieved with the use of locked intramedullary nails by careful attention to the technique of central guide wire placement and avoiding eccentric reaming and use of blocking screws improves alignment and strength of bone implant construct. The management of these fractures is usually operative. Plate fixation for distal tibia fracture is associated with non-union, delayed union, sloughing of overlying skin, and infection. Interlocking intramedullary nailing is now more preferred technique for these fractures. To achieve good functional result proper alignment must be obtained so that nail will be central in both proximal and distal fragment. Factors leading to non-union are a disturbance of local blood flow by high

energy trauma, damage to soft tissue, comminution of fractures, and open reduction method along with other independent additive factors such as. Hence distal tibial fractures can be effectively treated by interlocking intra medullary nails with multi directional locking options with excellent results. The operative technique was simple and short. Very minimal complications were encountered in our study. No cases of non-union were found. The post operative infection rate was low. Wound healing problems were not encountered. As nails are weight sharing devices, immediate weight bearing could be initiated. The post operative outcome as measured by ankle and knee scores and range of movements were good to excellent. Fibular fixation can be combined with nailing in indicated cases for excellent results. Hence, interlocking intra medullary nailing combined with multi directional locking can be considered a very effective modality of treatment of indicated distal tibial fractures.

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