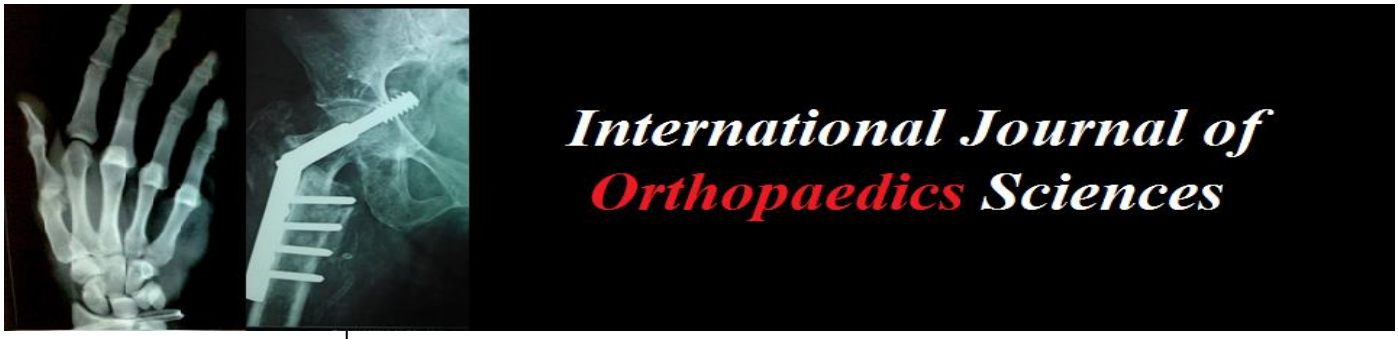

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Comparative study: Interlock nailing versus plating for extra articular distal tibial fractures

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Abstract
Background: Distal 1/3rd tibia is the second most common fracture location in tibia, diaphysis being the first. Subcutaneous location, poor blood supply and less soft tissue cover make it prone for infections and thus are challenging for orthopaedists. There are many options available for management but still there are insufficient evidences on the best surgical intervention.
Materials and Method: We conducted the study of total 60 patients of distal 1/3rd extra articular tibial fractures during the period of October 2018 to April 2020 in the Department of Orthopaedics in tertiary care hospital. Patients fulfilling inclusion and exclusion criteria were the study participants. After obtaining consents, patients were divided in nailing and plating groups. Radiological outcomes and clinical outcomes using lysholm knee score and kaikkonen ankle score system were assessed at 1 month, 3 months, 6 months and 1 year intervals.
Results: A total of 60 patients (30 in each group) participated. The mean age of participants were 40.4 and 43.06 years for nailing and plating respectively and there was no significant difference between numbers of male and female. The duration of surgery for intramedullary nail was significantly less compared to plating. The lysholm knee score was significantly higher in plating group and kaikkonen ankle score was higher in nailing group. Anterior knee pain was more frequent after nailing. Exposed implant was found only in the plating group.
Conclusion: The study found that the duration of surgery as well as the time taken for union was significantly less for nailing group and complications were also less in the nailing group with reduced morbidity. So we prefer intramedullary interlocking nailing in treatment of extra articular distal tibia fractures.

Keywords: extra articular, distal tibia, intra medullary nailing, plating

Introduction
Increased incidence of Road Traffic Accidents are responsible for most of human mortality and morbidity now a days. The injury due to these accidents commonly involve the long bones especially tibia due to its subcutaneous location. After tibial diaphyseal region, distal tibial region is the second most common fracture location, former being the first [1]. Distal tibial fractures are one of the most complex injuries around the ankle joint, accounting for approximately 7% of all tibial fractures [2]. Besides its subcutaneous location, decreased muscular cover and the consequent decreased vascularity leads to complications like delayed bone union, wound complications such as dehiscence and infection in the distal tibial region. Besides Road Traffic Accidents, fall from heights and low energy trauma like twisting injuries are also responsible for distal tibial fractures. Better understanding of the injury patterns, availability of better implants, the concept of early surgical fixation and early postoperative mobilization of joint, all have convincingly improved the functional outcome of the patient to a large extent. These fractures can be managed with various implants like external fixators, intra medullary nails and plates with varying results [3]. The two approaches nailing and plating have some theoretical disadvantages.
Open reduction and plating is a popular method and is used widely, but it is relatively expensive and needs extensive soft-tissue dissection which is often associated with infection, hardware problems and delayed union.
Recently described minimally invasive percutaneous plate osteosynthesis (MIPPO) technique offers the advantage of fracture fixation without disturbing the soft tissue cover, less chances of infection and early mobilization of patient [4, 5].

In MIPPO technique the surgical trauma to the soft tissue is minimized and it provides the biological environment for fracture healing. But this technique requires more skill and is also relatively expensive.

Recently described expert tibia nails and tip locking nails provide fixation of distal tibia with multidirectional screws providing better stability than conventional nails. Also there are less chances of infection due to less trauma to the soft tissue.

There are various options available for the surgical management of distal 1/3rd tibial fractures but still there is insufficient evidence on the best surgical intervention. Hence, our study aims to compare the functional outcomes of distal tibial metaphyseal fractures managed with nailing and intramedullary nailing.

Material and methods

The present study was conducted between October 2018 to April 2020 in the Department of Orthopaedics, G.K. General Hospital, Gujarat Adani Institute of Medical Sciences (GAIMS), Bhuj, Kachchh, Gujarat.

Sixty patients with distal tibia metaphyseal fractures were taken in study after obtaining ethical committee clearance and patients were included in study after informed and written consents. Out of total 60 patients with distal tibia fracture (AO type A1, A2, A3), 30 patients were operated with intramedullary nailing and 30 patients were operated with plating.

All 60 patients presenting with lower extremity injury were evaluated for distal tibial fractures. After stabilizing the patient's general condition, injured limb examination was carried out. Proper history was elicited from the patient and/or attendants to assess the mechanism of injury which indirectly assess the velocity of injury. Co-morbid illness was elicited as a part of history taking because it is considered as a major factor to determine the functional outcome of operative intervention.

On examination the swelling, deformity were noted on inspection and tenderness, abnormal mobility, crepitus were noted on palpation indicating the signs of fracture. Skin status evaluation was carried out and examination around the ankle for the open wound, bruises and soft tissue swelling was done. Development of skin blisters, limb edema, local rise of skin temperature were checked. In the initial period of injury, periodically monitor the capillary refill of the involved extremity was done. Function of the extensor tendon and thorough neurovascular examination was carried out. Distal tibio-fibular syndesmotic injury and the ipsilateral knee joint injuries were ruled out. Then relevant X-rays including the affected leg with knee and ankle joints antero-posterior and lateral views were taken. Fracture patterns were classified based on the AO/OTA classification. The limb was then immobilized in an above knee Plaster of Paris slab till definitive fixation was done. All the routine laboratory investigations like CBC, RBS, S. electrolyte, RFT, LFT, PT-INR and ECG, Chest X Rays were done.

Inclusion criteria

- Adult patient more than 18 years of age and less than 60 yrs of age.
- Closed fractures and grade 1 compound fractures of distal tibia (43-A1, 43-A2, 43-A3 of AO type) without intra articular extension.

Exclusion criteria

- Age less than 18 years and more than 60 years.
- Fractures with intra articular extension.
- Patients with pathological fractures.
- Patient who are medically unfit.
- Patients with congenital deformity.
- Grade 2 and 3 compound fractures of distal tibia.

All patients were operated with intramedullary interlocking nailing or open reduction and internal fixation with plating after randomizing in to two groups, the Intra Medullary Nail Group (IMN) group and the plating group.

All patients were operated under spinal anesthesia with patient in supine position on standard radiolucent table. Patellar splitting approach was used in the patients who underwent intramedullary interlocking nailing. Nailing was done using standard technique under C arm and all fractures were fixed with one/two proximal and two/three distal interlocking screws. Medial approach was used for the patients who underwent plate osteosynthesis and fixed using plates and appropriate screws. Sutures were taken in layers, sterile dressing was done and crepe bandage was applied. Patients were shifted to post- operative ward. Post-operative x-rays were done. Post-operatively limb was elevated over pillow and ice fomentation was given. Active toe movement exercises, ankle foot pump and knee range of motion exercises were started post operatively. Non weight bearing mobilization was started on post op day 1. Weight bearing was started according to fracture pattern and after patient was able to tolerate the pain. Post operatively parenteral antibiotics were given for 3-4 days. Dressing was done on post-operative day 2 and post-operative day 5. Suture removal was done at post-operative day 15. Patients were followed up at 1 month, 3 months, 6 months and 1 year. At each follow up, x-rays were done and patient's lysholm knee score and kaikkonen ankle score was assessed and recorded.

Nailing

Fig 1: Pre op

Fig 2: Immediate x ray

Fig 3: 1 month follow up

Fig 4: 3 months follow up

Fig 5: 6 months follow up

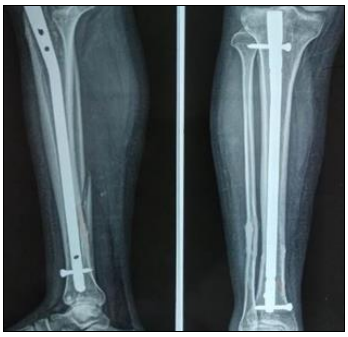

Fig 6: 1 year follow up

Fig 7: Knee flexion

Fig 8: Knee extension

Fig 9: Ankle dorsiflexion

Fig 10: Ankle plantarflexion

Plating

Fig 11: Pre op

Fig 12: Immediate x ray

Fig 13: 1 month follow up

Fig 14: 3 months follow up

Fig 15: 6 months follow up

Fig 16: 1 year follow up

Fig 17: Dorsiflexion

Fig 18: Plantar flexion

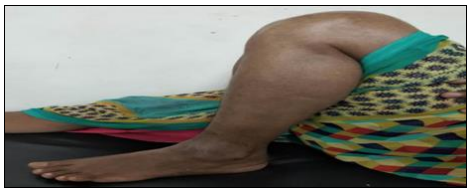

Fig 19: Knee flexion

Fig 20: Knee extension

Results

Table 1: Age Distribution

Age groups (in years)	Nailing		Plating	
	No of patients (N)	Percentage (%)	No of patients (N)	Percentage (%)
18-30	12	40.00	12	40.00
31-40	09	30.00	09	30.00
41-50	06	20.00	08	26.67
51-60	03	10.00	01	3.33
Total	30	100	30	100
Range	19-58 years		23-55 years	

Table 2: Duration of surgery

Duration of surgery (in minutes)	Nailing		Plating	
	No of patients (N)	Percentage (%)	No of patients (N)	Percentage (%)
60-70 min	21	70.00	09	30.00
71-80 min	06	20.00	18	60.00
81-90 min	03	10.00	03	10.00
Total	30	100	30	100

Table 3: Union time (in weeks)

Union time (in weeks)	Nailing		Pating	
	No of patients (N)	Percentage (%)	No of patients (N)	Percentage (%)
16-20 weeks	14	76.66	05	16.66
20-24 weeks	10	23.34	07	23.34
24-28 weeks	5	00.00	16	53.34
>28 weeks	01	00.00	02	6.66
Total	30	100	30	100
Test Values	Nailing		Plating	
	Mean	SD	Mean	SD
	4.86	1.213	6.3	1.178
t-value	4.671			
p-value	< 0.0001			
Significance	Significant			

Table 4: Complications

Complications	Nailing		Plating	
	No of patients (N)	Percentage (%)	No of patients (N)	Percentage (%)
Superficial infections	01	3.33	03	10.00
Exposed implant	00	00.00	01	3.33
Malunion	01	3.33	00	00.00
Nonunion	01	3.33	00	00.00
Total	03	10.00	04	13.33
p-value	0.349			
Significance	Not significant			

Table 5: Results

Result	Nailing		Plating	
	No of patients (N)	Percentage (%)	No of patients (N)	Percentage (%)
Excellent	21	70.00	15	50.00
Good	06	20.00	08	26.67
Fair	03	10.00	06	20.00
Poor	00	00.00	01	3.33
TOTAL	30	100	30	100
p-value	0.349			
Chi square	3.285			
Significance	Not significant			

Discussion

Distal tibial fractures remain one of the most substantial therapeutic challenges that confront the orthopaedic surgeon. Distal tibia fractures results from axial loading mechanism with high energy trauma or torsional injury with low energy trauma. High energy fractures are associated with severe soft tissue injury and comminuted distal tibial fractures. The optimal treatment for these fractures remains controversial. This is due to the associated significant soft tissue injury and precarious vascular supply of distal tibia. Treatment of distal tibia fractures can be challenging because of its subcutaneous location, poor vascularity and limited soft tissue coverage. The present study was undertaken to evaluate and compare the results of nailing and plate osteosynthesis in treatment of distal tibial fractures. These fractures generally require operative management and can be managed with closed reduction and intramedullary nailing or open reduction and internal fixation with plating or closed reduction and percutaneous plating or external fixators [6, 7].

Minimally invasive (MIPPO) techniques are based on principles of limited exposure, indirect reduction methods and limited contact between bone and implant. As a result of these principles, this technique avoided major soft tissue complications and shortened the length of the patient's stay in the hospital. Biological fixation of distal tibia fractures is beneficial and technically feasible. But even MIPPO technique should be performed after the soft tissue heals. With a delay of weeks till the soft tissue heals, MIPPO is not possible in some cases and that is why in our study too, MIPPO could not be carried out in all patients.

AO classification type 43-A1, 43-A2, 43-A3 were taken in our study for fixation. Among 60 patients, 30 patients were treated with multi directional locked nailing and 30 patients were treated with plating. All 30 patients in nailing group were operated with the closed method. Among 30 patients treated with plate osteosynthesis, 29 patients were operated with MIPPO technique and 1 patient needed open reduction and internal fixation.

In our study the peak incidence age group lies between 25 to 50 years with the mean average age incidence was 37.5 years. There was no any significant difference in age groups between both the study groups.

The time duration of surgery in the nail group was shorter than the plate in our study. The mean duration of surgery in interlocking group was 68 min & the mean duration of surgery in plating group was 75 min. Our results were different than the study done by Kumar *et al*. in their study the operating time in the intramedullary nailing group was 57.14 min whereas in plating group it was 66.67min [8].

In our study the average time for union for nailing was around 4.5 months and for plating was around 6 months. Thus union time in nailing group was less as compared to plating group.

The functional outcome assessed was significantly good in the patients who underwent intra medullary nailing when compared to the group with plating. The ankle score in our study in nailing was excellent and for plating it was good. This shows that the ankle function was restored well in all the patients. The results are comparable with the results of ankle function in the study conducted by Shon OJ *et al.* [9]. For ankle score, more numbers of patients were in the excellent group in the patients operated with tibia nailing when compared to patients operated with plating. While knee score was excellent to good in the plating group and was better than tibia nailing group.

The infection rate was 13.33% in the form of superficial infection in 3 cases (10%) and exposed plate in 1 case (3.33%) out of 30 patients of plating group while the infection rate in nailing group was 3.33% in the form of superficial infection in 1 case (3.33%) out of 30 patients. There was no any wound dehiscence noted in either of the study group. The infection rate was higher in the plating group when compared to nailing. Superficial infections were treated with antibiotics. The infection exposing the plate was managed by skin flap.

Malalignment was the major problem in nailing when compared to the plating. In our study, there was 1 case (3.33%) of nonunion and 1 case (3.33%) of malunion in nailing group whose ankle and knee scores were lesser compared to the other patients included in the study. The case of nonunion was managed by osteotomy, bone grafting and exchange nailing and the case of malunion was managed by osteotomy, bone grafting and plating.

Similarly, Nandakumar *et al.* concluded that intramedullary interlocking nailing is a reliable method of treatment for distal metaphyseal tibial fractures with a high union rate and low complication rate [10]. In the study conducted by Tyllianakis M *et al.* and Sean E Nor *et al.*, the average time for union was about 4 to 5 months [11]. In 2013, Xue *et al*. performed a meta-analysis and systematic review comparing nailing versus plating for the treatment of distal tibial metaphyseal fracture. Higher functional score & lower risk of infection were found in the nailing group [12].

According to the results of our study, the fracture union is faster in the nail group but the malunion rate is also higher in the nail group. Due to shorter time of union compared to the plate group the functional exercise started earlier. The infection rate is higher in the plate group leading to complications. Therefore the multidirectional intramedullary nail is better than the plate in treating distal tibia fractures.

Conclusion

Both closed intramedullary nailing and locking compression plating can be used safely to treat fractures of the tibia. Tibia plating can achieve anatomic reduction however it is related with the higher risk of wound infection because of the

minimal soft tissue coverage over the tibia. While 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, therefore we prefer closed intra medullary interlocking nailing in treatment of distal tibia fractures.

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