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Original Research Article

A Prospective Study of Plating and Nailing in Distal Tibia Fractures Fixation

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Abstract:

Tibia is characterized by an exposed bone with vulnerable soft tissue and is prone to cause local soft tissue breakdown. Tibial fractures are the most common long bone fractures, while distal tibia fractures are even more complicated due to its proximity to ankle, and the close relationship with thin soft tissue envelope and severe comminution. Additionally, distal tibial fractures are associated with posterior malleolus fractures.[1]The present study aim to compare clinical outcome of Intramedullary Nailing versus Plating in distal tibia fracture in adults. Among 50 patients the 25 patients are treated with intramedullary nailing and plating (MIPO/open) each. In AO type classification distal tibia fractures of type 43 A1, 43 A2, 43 A3 were used in our study for internal fixation. The ankle score in our study in intramedullary nailing was good and the ankle score for plating was good to excellent. 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 [2](Average IOWA ANKLE rating score was excellent).

Keywords: Distal tibia, nailing, plating.

Introduction

In India, more than 1.3 million lives are lost due to road traffic accidents every year (WHO global safety report 2022)[3]. According to WHO Report in 2022 road traffic injuries were ranked as the ninth cause of death in all and ranked as fourth cause of death in 2008. In India it is ranked as 6th leading cause of death.[4] A 4.4-fold increase has been detected in the number of road traffic accidents between the years 1970- 2020. Subsequently the number of deaths has increased by 9.8 folds and the number of injuries by 7.3 folds. To note is that one third of fatalities in India involve the pedestrians and two wheelers who are called as the 'vulnerable road users'.[5] Under developed and developing countries account for 91.8% of DALY's lost to road traffic injuries worldwide.

Closed fractures of the tibial shaft traditionally have been treated with closed reduction and a cast. Since the late 1950s, open reduction and internal fixation (ORIF) was reserved for situations in which an adequate reduction could not be obtained or maintained by conservative means. ORIF often necessitates extensive dissection and tissue devitalisation, creating an environment less favourable for fracture union and more prone to bone infection. As a result, other, less invasive methods were developed to treat diaphyseal fractures of the tibia.[6]In recent years, some minimally invasive techniques, such as MIPO and IMN, have been reported to treat the distal tibia fractures. Compared with ORIF, IMN and MIPO have been used preferentially for the management of these fractures because of minimal invasiveness, reduced blood loss during surgery, and lower surgical infection rate. Some studies had reported their comparison results of the treatment of extra-articular distal tibia fractures by using IMN and MIPO.

However, results of these studies are inconsistent and sometimes show the conflicting opinions. To date, there was no consensus on the choice of IMN or MIPO to treat extra-articular distal tibia fractures.[7]Although intramedullary nails are the treatment of choice for diaphyseal tibial fractures1 and have the advantage of not disturbing the soft tissue envelope, there are concerns about technically achieving and maintaining fixation of more distal fractures. Stability of such fractures depends on interlocking screws and less on the principle of friction because of the broader medullary cavity. In this situation, distal interlocking bolts may fail to maintain alignment of the distal segment.2–5 Other

potential concerns with nail insertion include knee pain, iatrogenic comminution, or propagation of fractures to the distal tibia articular surface.[8] As a result, plate and screw fixation has been preferred by many surgeons. Potential complications associated with plates, however, include nonunion because of disturbance of the periosteal blood supply, wound dehiscence, infection, and implant irritation even with minimally invasive percutaneous osteosynthesis (MIPO) techniques. [10]

Material and Method

This Comparative Prospective study was conducted in the Department of Orthopaedics, NIMS University, Jaipur, in the time duration of 18 months on cases of distal tibial fractures which were treated by two different modalities of internal fixation i.e. Plate or Intramedullary Nail. Patients were studied from the day of admission through the pre, intra and post-operative period to the complete follow up till the patient achieves maximum possible functions of the injured limb. The variable factors associated with patients in the two groups such as age, sex, mechanism of injury, type of fracture and nature of injury were compared so that results of operation could be evaluated and compared properly.

Inclusion Criteria:

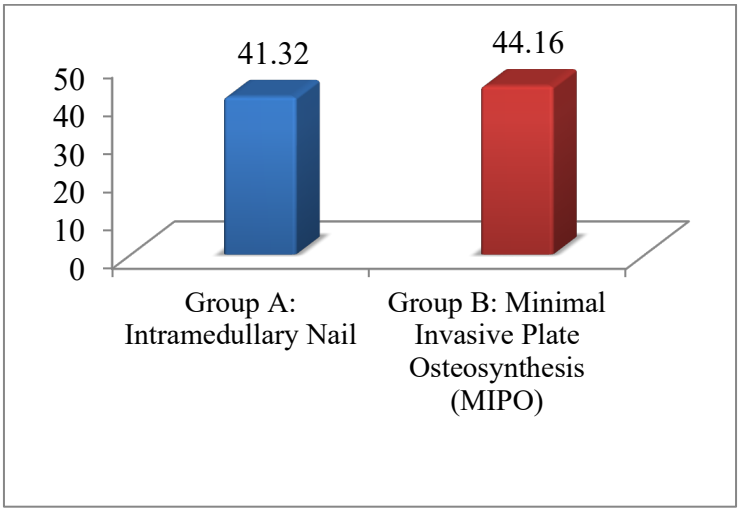
Patients of age >18 years of either sex, Acute and uni/bi-lateral fractures, closed extra-articular distal tibia fractures (OA type 43-A1, A2, A3), Gustilo-Anderson Classification: grade I fractures, Duration of injury to operation < 2 weeks; Intact neurological and vascular status, Fracture line locating in or extending to 10 cm long region of metaphysis of distal tibia, Treatment with IMN or Plating, Patients willing to take part and give consent.

Exclusion Criteria: Polytrauma, Old fractures (definitive surgery more than 4 weeks after the injury), Pathological fractures, Open fractures, Diabetes patients with poor glycemic control, Gustilo-Anderson Classification: grade II and III fractures, Less than 6 months follow-up, Follow-up information was incomplete

Result

Table 1: Mean age distribution of both the groups

Groups	N	Mean	Std. Deviation	P value
Group A: Intramedullary Nail	25	41.32	13.726	0.466
Group B: Minimal Invasive Plate Osteosynthesis (MIPO)	25	44.16	13.588	(NS)

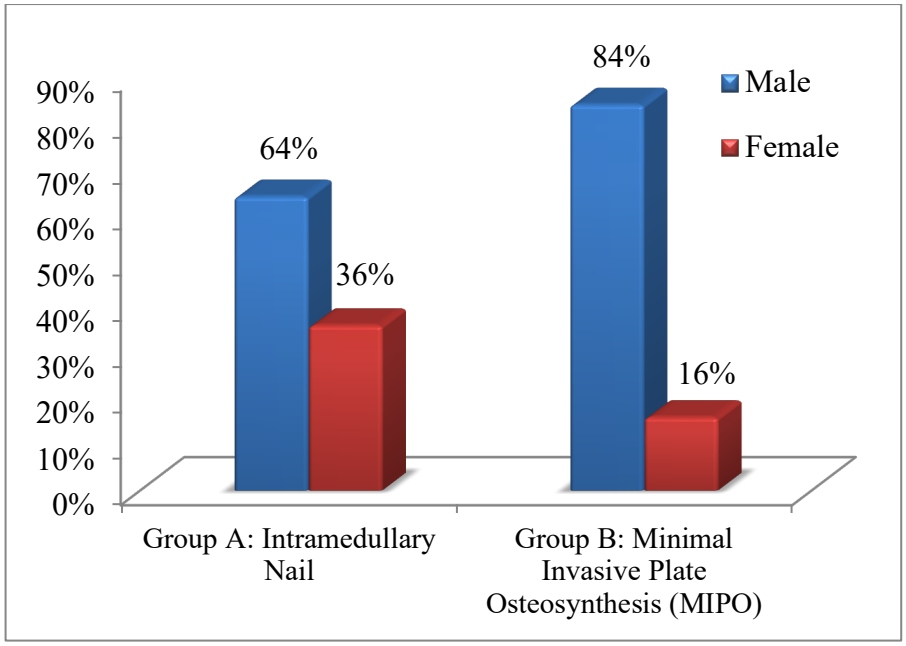


Graph 1: Mean age distribution

The age ranges for intramedullary nailing and minimal invasive plate osteosynthesis (MIPO) from 18-60 years and 25-68 years respectively. The mean age of group A was 41.32±13.726 and group B was 44.16±13.588. Using t-test, this results was statistically not significant difference between both the groups in terms of age (P>0.05; P=0.466).

Table 2: Gender distribution

Gender	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
Male	16	64%	21	84%	$\chi 2=2.599$
Female	9	36%	4	16%	P=0.107 (NS)
Total	**25**	**100.0%**	**25**	**100.0%**	

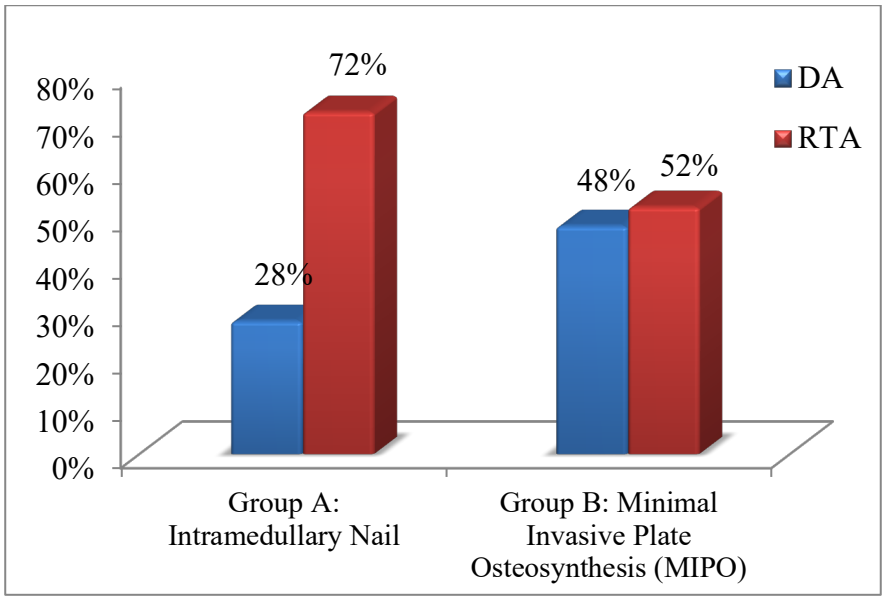


Graph 2: Gender distribution

A majority of the patients in both the groups presented with male category which included 16 (64%) patients in Group A and 21 (84%) patients in Group B, while 9 (36%) patients in Group A and 4 (16%) patients in Group B in female category as shown in above table. Using chi-square test, this results was statistically not significant difference between both the groups in terms of gender (P>0.05; P=0.107).

Table 3: Mode of Injury

Mode of Injury	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
DA	7	28%	12	48%	$\chi 2=2.122$ P=0.145 (NS)
RTA	18	72%	13	52%	
Total	**25**	**100.0%**	**25**	**100.0%**	

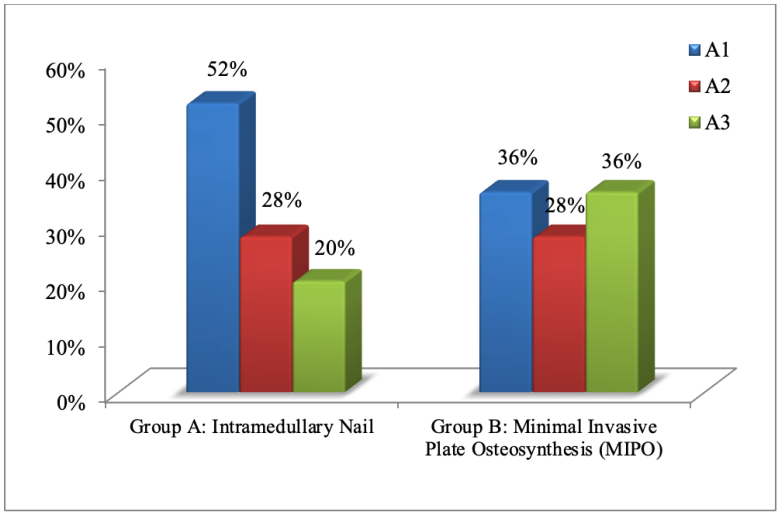


Graph 3: Mode of Injury

Road traffic accident predominates as the major cause for both the groups. Majority of the 18 (72%) patients in Group A and 13 (52%) patients in Group B had road traffic accidents. Using Chi-square test, this results was statistically not significant difference between the two groups in terms of mode of injury (P>0.05; P=0.145).

Table 4: AO classification

AO classification	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
A1	13	52%	9	36%	$\chi 2$=1.890 P=0.393 (NS)
A2	7	28%	7	28%	
A3	5	20%	9	36%	
Total	**25**	**100.0%**	**25**	**100.0%**	

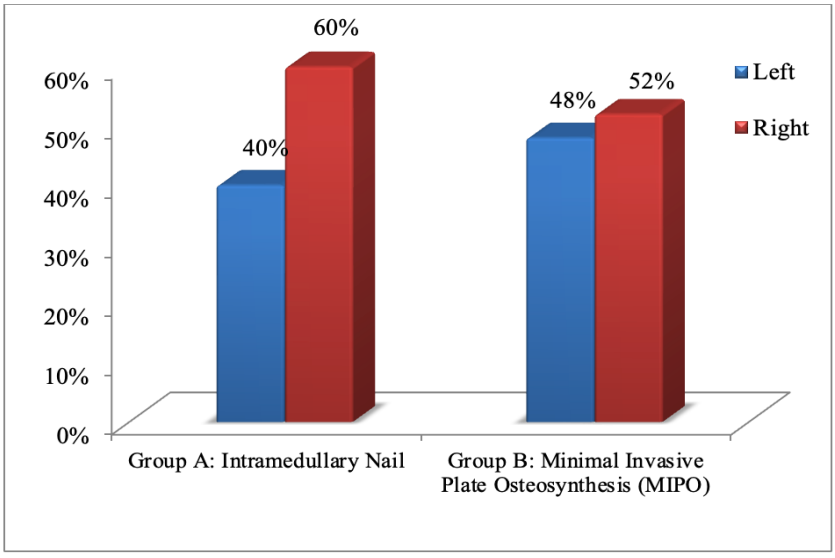


Graph 4: AO classification

A majority of the patients of both groups (60% in Group A and 52% in Group B) had right sided injury. Apart from left-sided injury in group A was 40% and Group B was 48%. Using chi-square test, this results was statistically not significant difference between both the groups in terms of side of injury (P>0.05; P=0.569).

Table 5: Side of Injury

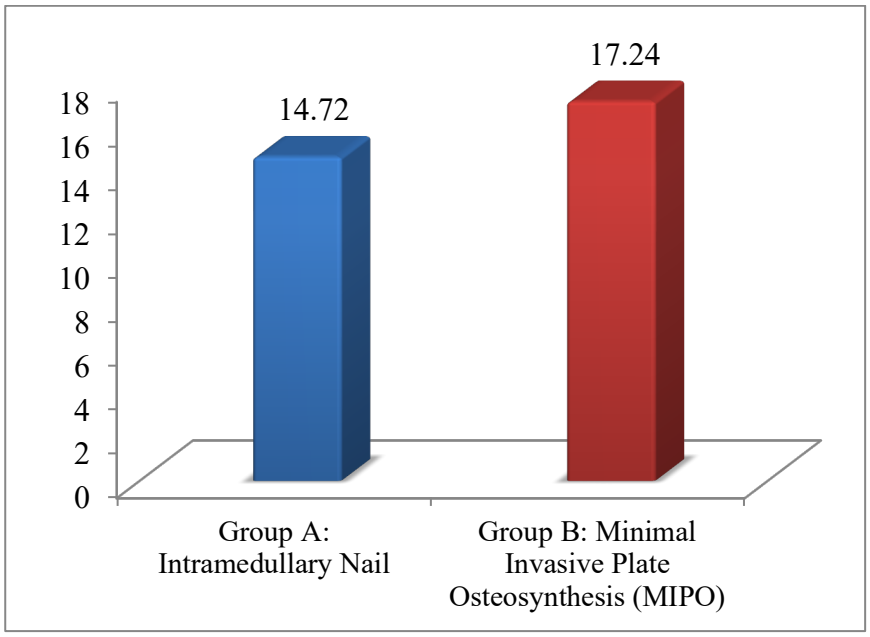
Side of Injury	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
Left	10	40%	12	48%	$\chi 2$=0.325 P=0.569 (NS)
Right	15	60%	13	52%	
Total	**25**	**100.0%**	**25**	**100.0%**	



Graph 5: Side of Injury

Table 6: Mean time to weight bears (weeks)

Groups	N	Mean	Std. Deviation	P value
Group A: Intramedullary Nail	25	14.72	1.745	0.000 (S)
Group B: Minimal Invasive Plate Osteosynthesis (MIPO)	25	17.24	1.052	

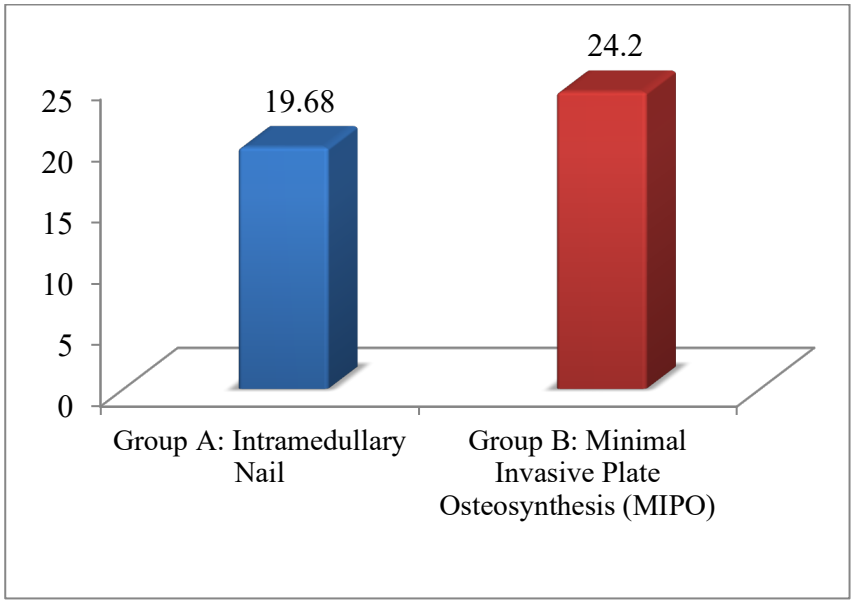


Graph 6: Mean time to weight bear

The mean time to weight bearing (weeks) for the Group A was 14.72±1.745 and Group B was 17.24±1.052. Using t-test, this results was statistically significant difference between both the groups (P<0.05; P=0.000).

Table 7: Mean time to union (weeks)

Groups	N	Mean	Std. Deviation	P value
Group A: Intramedullary Nail	25	19.68	1.773	0.000 (S)
Group B: Minimal Invasive Plate Osteosynthesis (MIPO)	25	24.20	2.415	



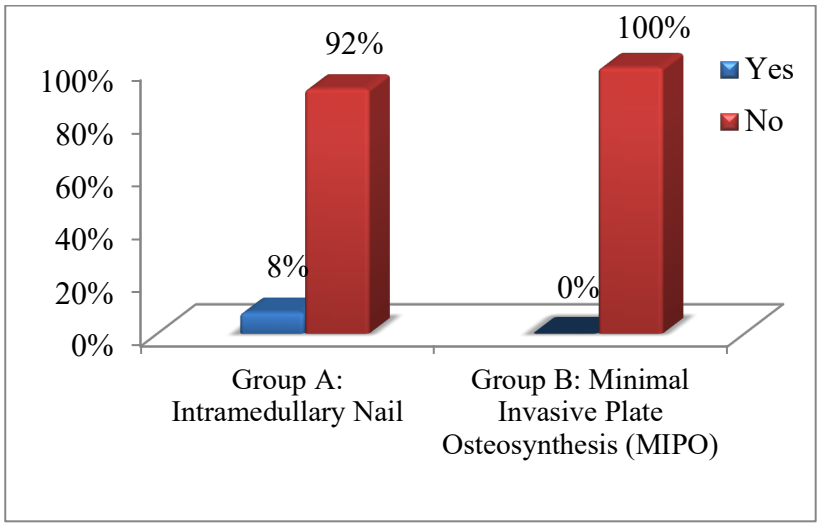
Graph 7: Mean time to union

The mean time to union (weeks) for the Group A was 19.68±1.773 and Group B was 24.20±2.415. Using t-test, this results was statistically significant difference between both the groups (P<0.05; P=0.000).

Table 8: Ankle ROM in Valgus Malalignment

Valgus Malalignment	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
Yes	2	8%	0	0.0%	$\chi 2=2.083$ P=0.149 (NS)
No	23	92%	25	100.0%	
Total	**25**	**100.0%**	**25**	**100.0%**	

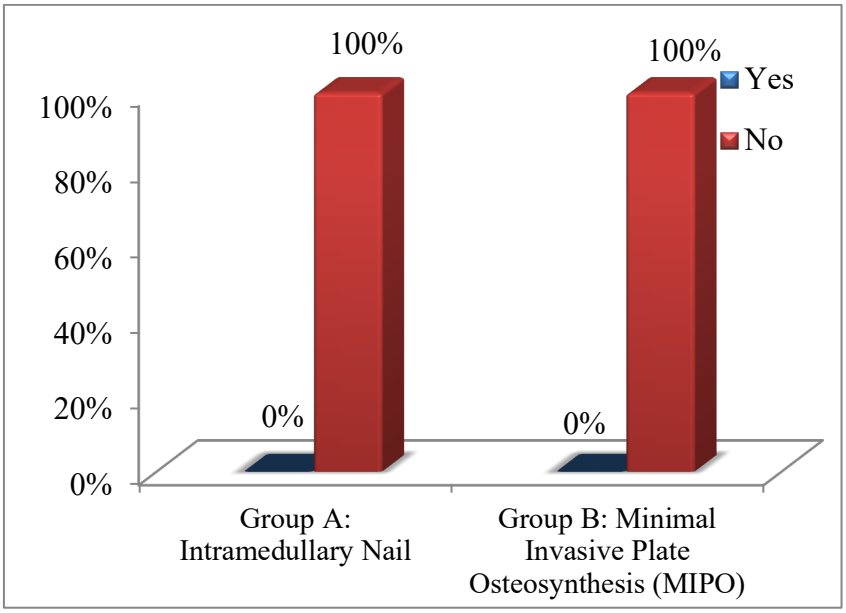
The ankle ROM in valgus malalignment was required only 8% patients in Group A. Using t-test, this results was statistically not significant difference between both the groups (P>0.05; P=0.149).



Graph 8: Ankle ROM in Valgus Malalignment

Table 9: Ankle ROM in Varus Malalignment

Varus Malalignment	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
Yes	0	0.0%	0	0.0%	-
No	25	100.0%	25	100.0%	
Total	**25**	**100.0%**	**25**	**100.0%**	

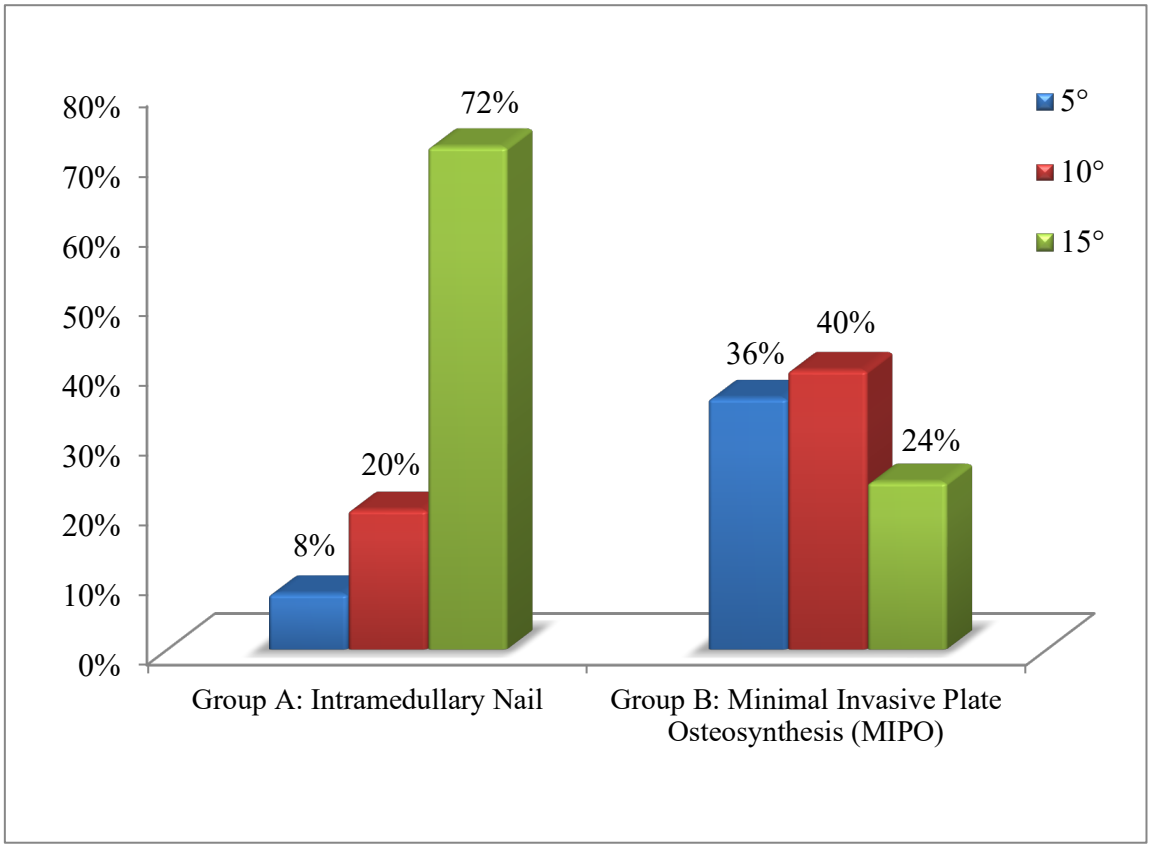


Graph 9: Ankle ROM in Varus Malalignment

Table 10: Ankle ROM Dorsiflexion (degree)

Dorsiflexion (degree)	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
5°	2	8%	9	36%	$\chi 2$=12.121 P=0.002 (S)
10°	5	20%	10	40%	
15°	18	72%	6	24%	
Total	**25**	**100.0%**	**25**	**100.0%**	

No ankle ROM in varus malalignment was required in both the groups. The 15 degree angle of dorsiflexion was more in Group A (72%) and 10 degree angle was more in Group B (40%), followed by 5 degree angle (36%). Using t-test, this results was statistically significant difference between both the groups (P<0.05; P=0.002).

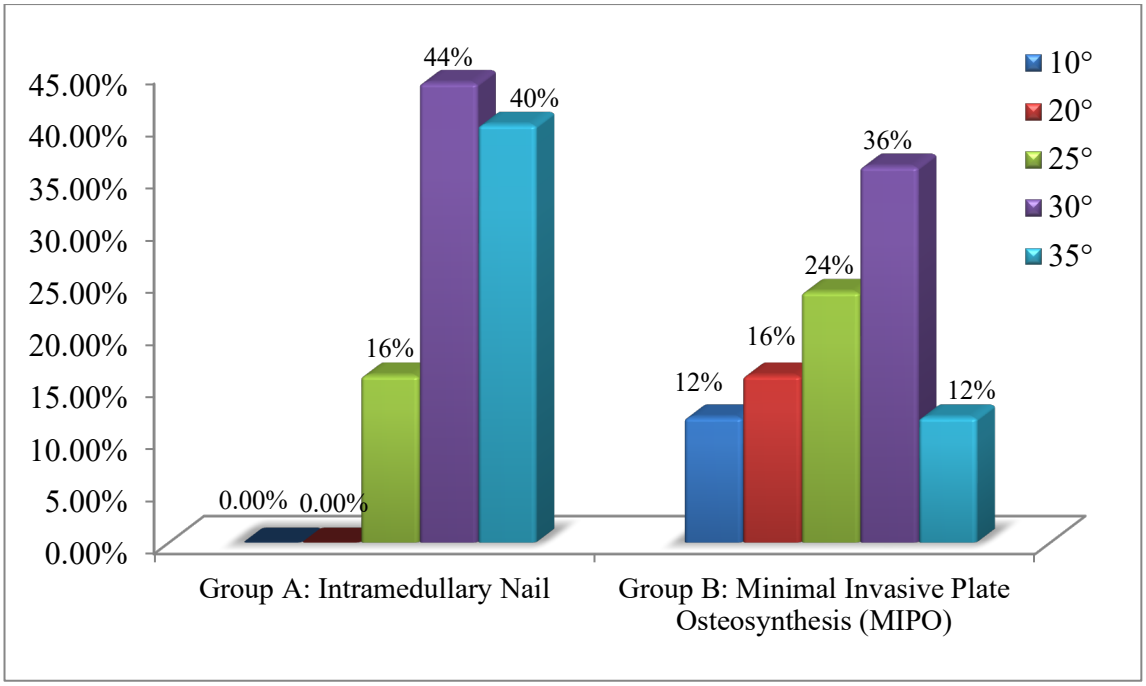


Graph 10: Ankle ROM Dorsiflexion (degree)

Table 11: Ankle ROM Plantar flexion (degree)

Plantar flexion (degree)	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
10°	0	0.0%	3	12%	$\chi 2$=11.369 P=0.023 (S)
20°	0	0.0%	4	16%	
25°	4	16%	6	24%	
30°	11	44%	9	36%	
35°	10	40%	3	12%	
Total	**25**	**100.0%**	**25**	**100.0%**	

The 30 degree angle of plantar flexion was more in Group A and Group B (44% & 36%) respectively. Using chi-square test, this results was statistically significant difference between both the groups (P<0.05; P=0.023).

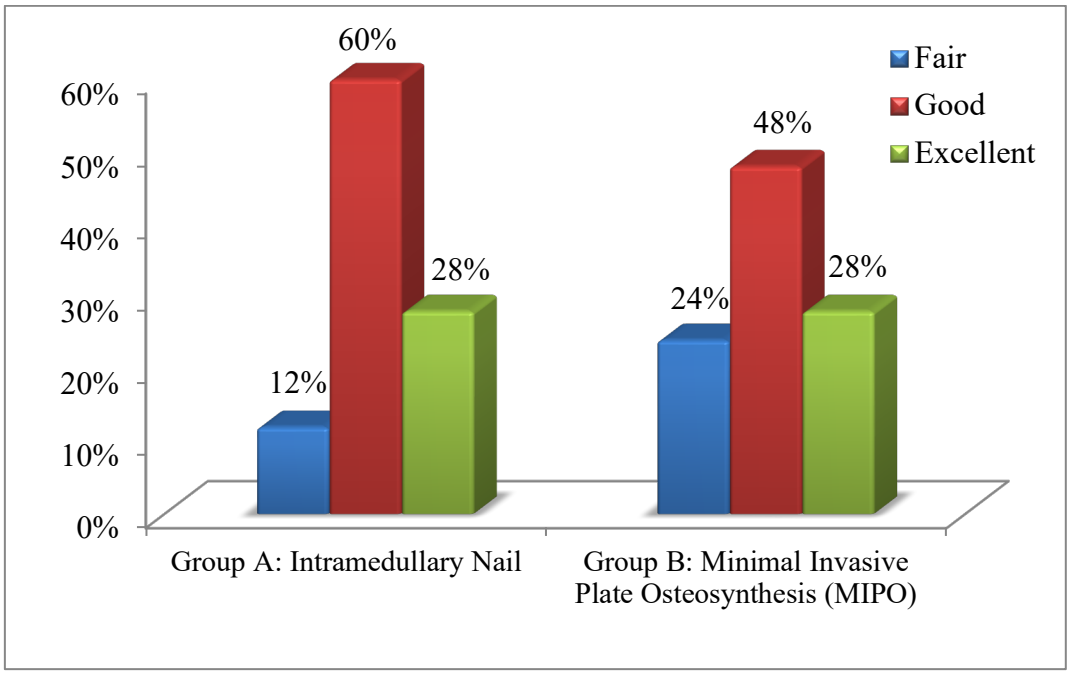


Graph 11: Ankle ROM Plantar flexion (degree) of both the groups

Table 12: Ankle Score of both the groups

Ankle Score	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
Fair	3	12%	6	24%	$\chi 2=1.333$ P=0.513 (NS)
Good	15	60%	12	48%	
Excellent	7	28%	7	28%	
Total	**25**	**100.0%**	**25**	**100.0%**	

The ankle score of both the groups was good followed by excellent. In the group A and B, the ankle score was good to excellent. Using chi-square test, this results was statistically not significant difference between both the groups (P>0.05; P=0.513).

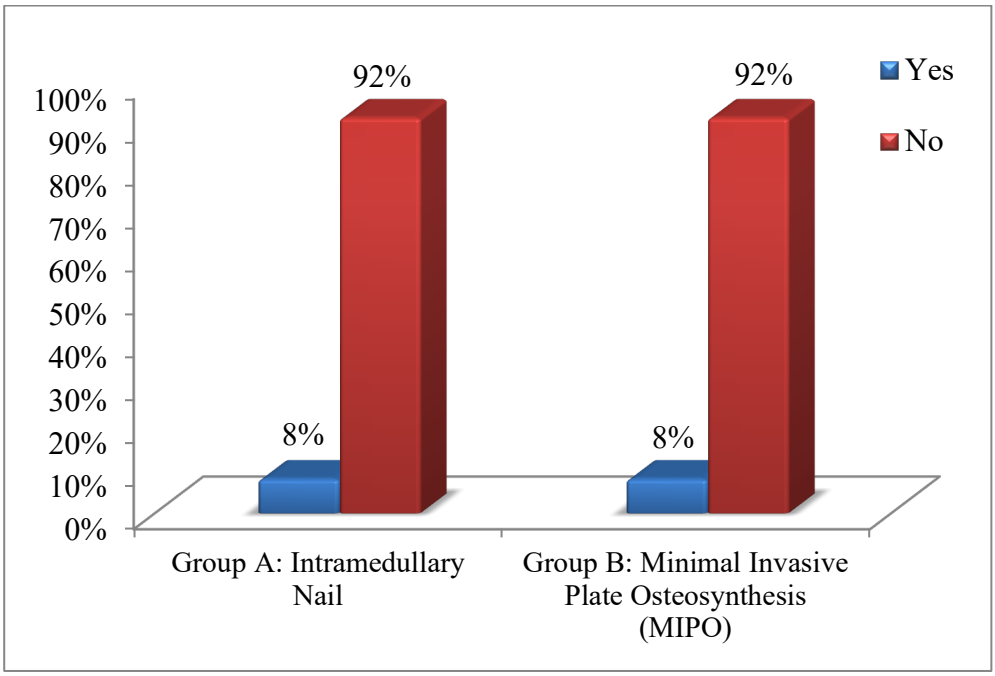


Graph 12: Ankle Score of both the groups

Table 13: Postoperative Infection of both the groups

Postoperative Infection	Group A: Intramedullary Nail		Group B: Minimal Invasive Plate Osteosynthesis (MIPO)		P value
	No.	%	No.	%	
Yes	2	8%	2	8%	$\chi 2$=0.000 P=1.000 (NS)
No	23	92%	23	92%	
Total	**25**	**100.0%**	**25**	**100.0%**	

The postoperative infection was found in equal in both the groups. Using chi-square test, this results was statistically not significant difference between both the groups (P>0.05; P=0.157).



Graph 13: Postoperative Infection of both the groups

Discussion

In our study the distal tibial fractures are treated with the intramedullary nailing and plating (MIPO/open). In the intramedullary nailing the length and the diameter varies according to the patient and for plating universally the 3.5 mm locking compression plate used for tibia fixation and one third tubular plate for fibular fracture fixation. Among 50 patients the 25 patients are treated with intramedullary nailing and plating (MIPO/open) each. In AO type classification distal tibia fractures of type 43 A1, 43 A2, 43 A3 were used in our study for internal fixation. The age for intramedullary nailing and minimal invasive plate osteosynthesis (MIPO) was above 18 years. The mean age of group A was 41.32±13.726 and group B was 44.16±13.588 (P>0.05). A majority of the patients in both the groups presented with male category which included 16 (64%) patients in Group A and 21 (84%) patients in Group B[3] Predominant involvement of male sex in both the groups can be explained, as males are more frequently exposed to outdoor activities and hence more involved in road side accidents, industrial misfortunes and assaults. Road traffic accident predominates as the major cause of death, disabilities and hospitalization in the world. In our study, majority of the 18 (72%) patients in Group A and 13 (52%) patients in Group B had road traffic accidents. A majority of the patients of both groups (60% in Group A and 52% in Group B) had right sided injury. The mean time to weight bearing (weeks) for the Group A was 14.72±1.745 and Group B was 17.24±1.052, In the study conducted by Tyllianakis M et al.[10] and Nork SE et al[11], the average time for union was about 4-5 months. In our study the average time for union for nailing was 4.92 months and for plating was 6.05 months. The amount of malalignment considered as malunion in the diagnostic criteria in this study is controversial. In the present study, the valgus malalignment was required only 8% patients in Group A. Kumar Y et al.[12] and Beytemur O et al.[13]showed that 9% patients and 10.8% patients respectively in the from nailing group had malalignment whereas one case in plating group had malunion. The malunion was not clinically significant and hence no additional surgery was done. In the literature, similar success has been reported in functional assessment comparison of MIPO and IMN which determined that angle of dorsiflexion and plantar flexion was

significantly higher in IMN group.[6] In our study, the 15 degree angle of dorsiflexion was more in nail group (72%). The ankle plantar flexion 30 degree angle was more in nail group.

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