

# Comparison between Intramedullary Nailing (IMN) and Minimally Invasive Plate Osteosynthesis (MIPO) Technique in Distal Tibia Fractures in Term of Union

MUHAMMAD IMRAN<sup>1</sup>, MOHAMMAD ISHAQ<sup>2</sup>, LAL MOHAMMAD KHAN KAKAR<sup>3</sup>

## ABSTRACT

**Aim:** To compare the outcome in terms of union between minimally invasive plate osteosynthesis (MIPO) and intramedullary nailing (IMN) technique in treating distal tibia fractures.

**Methods:** This randomized controlled trial was conducted at Department of Orthopedic, Ibne Sina Hospital, Multan from 1<sup>st</sup> September 2015 to 29<sup>th</sup> February 2016. Total 86 patients with AO Type A distal tibial fractures of <3 days duration either male or female with age range from 20-60 years selected for this study.

**Results:** Average age of patients in group A was 38.79±10.47 years and in group B was 39.63±11.73 years. Out of these 86 patients, 59(68.60%) were male and 27(31.40%) were females with ratio of 2.2:1. Rate of union in Group A (minimally invasive plate osteosynthesis) was 97.67% while in Group B (intramedullary nailing) was 79.07%.

**Conclusion:** This study concluded that union is higher with minimally invasive plate osteosynthesis technique compared to intramedullary nailing technique in treating distal tibia fractures.

**Key words:** Distal tibial, Intramedullary nailing, Fractures, Minimally invasive plate osteosynthesis

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## INTRODUCTION

The tibia is long bone which was located in the lower front portion of the human leg. Tibia is the strongest weight bearing bone of the human body<sup>1</sup>. Among the 10 to 15 cases of trauma, there is one fracture shaft tibia<sup>2</sup>. This fracture generally associated with the fracture of fibula, because the force is transmitted along the interosseous membrane to the fibula<sup>3</sup>. Tibia injury spectrum is so diverse because there is no single procedure applicable to all the tibia fractures<sup>4</sup>. The management of distal third tibial fractures is still controversial. This type of fractures differs from proximal third fractures due to the difference in anatomy and potential of healing<sup>5</sup>.

In routine practice, there were different methods such as closed reduction and intramedullary interlocking (IMIL) nailing or open reduction and internal fixation (ORIF) with plating or closed reduction and percutaneous plating or external fixators.<sup>6</sup> Recently, techniques of closed reduction and minimally invasive plate osteosynthesis (MIPO) with locking compression plate (LCP) has emerged as an alternative treatment option for distal diaphyseal tibia fracture<sup>6,7</sup>. IMIL may sometimes fail to stabilize fractures in the distal metaphysis due to mal-alignment. The purpose of MIPO is to assist

Correspondence to Dr. Muhammad Imran Email: imr\_770@yahoo.com

physiological process of bone healing wisely and optimally with minimal intervention<sup>8</sup>. The MIPO technique can preserve the periosteal blood supply and offers a clear biological advantage over conventional Plating, due to reduction of iatrogenic damage of surrounding soft tissues<sup>9</sup>.

As the distal tibial fractures have always been a problem in orthopaedics trauma and continuous effort and work was required to reach best option to treat such fractures, moreover, no local randomized trial had done before, so we had planned to conduct this study to compare the rate of union between MIPO and IMN technique in treating distal tibial fractures. On the basis of the results, the better technique with higher rate of union could be opted routinely in our general practice technique for treating these types of fractures in order to reduce the morbidity of the pts.

## MATERIALS AND METHODS

This randomized controlled trial was conducted at Department of Orthopaedic, Ibne Sina Hospital, Multan from 1<sup>st</sup> September 2015 to 29<sup>th</sup> February 2016. Total 86 patients with AO Type A distal tibial fractures of <3 days duration either male or female with age range from 20-60 years selected for this study. Patient with tibial fractures with intra-articular extensions, pathological fractures, open fractures, aseptic non-unions, significant medical co-morbidity like chronic liver disease, diabetes mellitus, chronic renal failure, chronic steroid use were excluded from

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<sup>1</sup>Asso. Prof of Orthopedics, Multan Medical & Dental College Multan,

<sup>2</sup>Assistant Professor of Orthopedics, Nowshera Medical College, Nowshera KPK,

<sup>3</sup>Associate Prof. of Orthopedics, Bolan Medical College Quetta

the study. Fracture is the breach in the continuity of bone and distal tibial fractures are those in which fracture occurs at the distal third part of the tibia. These fractures are named as 43 (4 for tibia; 3 for metaphysis) and subdivided into A, B and C. We included only 43 A fracture type in which there was one fracture line and cortical contact between fragments >90% after reduction (assessed on anteroposterior and lateral x-rays). An approval was taken from the institutional review committee and written informed consent was taken from every patient. Patients were divided into two equal groups (A & B) randomly. Base line investigations like complete blood count, random blood sugar, Complete Urine Examination, Renal functions tests and ECG (where needed) were done in every patient on admission for anesthesia purposes. Antero-posterior and lateral X-rays of the affected leg were done in all patients. In groups A patients, minimally invasive plate osteosynthesis (MIPO) was done for the fractures, while in group B, intramedullary nailing (IMN) was done. All patients were followed on regular intervals post-operatively and final outcome (union) was noted at the end of 3 months. Union was defined as the healing radiologically (anteroposterior and lateral x-ray) at 3 months after procedure by the presence of bridging of three of the four cortices in standard anteroposterior and lateral radiographs. All this information was collected through pre-designed Performa. The collected data was entered in SPSS version 20. Mean and standard deviation were calculated for age and duration of injury. Frequency and percentage was calculated for the gender and union (yes/no). Chi-square test was used to compare study variable i.e., union, in both groups and p-value  $\leq 0.05$  was taken as significant.

**RESULTS**

Total 86 patients with distal tibia fractures were selected for this study. Age range in this study was from 20 to 60 years with mean age of  $39.05 \pm 10.98$  years. The mean age of patients in group A was  $38.79 \pm 10.47$  years and in group B was  $39.63 \pm 11.73$  years. After 3 months of surgery union was assessed in both groups. In group A (MIPO), union was seen in 42(97.67%) patients while in group B (IMN) union rate was 34(79.07%). Statistically significant difference between the union rate of both groups was noted with p value 0.007. (Table 1) Patients of both group were divided into two age group i.e., age group 20-40 years and age group 41-60 years. Total 25 (58.14%) patients of group A and 26(60.47%) patients of group B belonged to age group 20-40 years. Union rate in study group A was 24(96.0%) and in group B union rate was 20(76.92%). Difference between the union rate was statistically significant with p value 0.048. Total 18(41.86%)

patients of group A and 17(39.53%) patients of group B belonged age group 41-60 years. The difference of union rate was statistically insignificant with p value 0.062 (Table 2).

Total 31(72.09%) patients of group A and 30 (96.77%) patients of group B were found with  $\leq 1$  day duration of fracture and fracture union was noted in 30(96.77%) patients of group A 30 (96.77%) patients of group B was noted. Statistically insignificant (P=0.078) difference of union rate between the both groups was seen. In group A, total 12 (27.91%) patients found with >1 day of duration of fracture and union rate was 100%. Total 13(30.23%) patients of group B found with >1 day of duration of fracture and fracture union rate was 9(69.23%). The difference of union rate between the both groups was statistically significant with p value 0.036 (Table 3).

Total 30(69.77%) of group A and 29(67.44%) patients of group B were male and fracture union was seen in all 30(100%) patients of group A and 24(82.76%) patients of group B. Fracture union rate was significantly high in male patients of group A as compared to male patients of group B (30 vs 24). Union rate was 12(92.31%) female patients of group A and 10(71.43%) in female patients of group and the difference was insignificant [P=0.163] (Table 4). Fracture union was achieved in all 17 (100%) obese patients of group A and 14(87.50%) obese patients of group B with statistically insignificant (P=0.133) difference of union rate. In non-obese patients of group union rate was 25(96.15%) and non-obese patients of group B union rate was 20(74.07%) with significant (P=0.025) difference of union rate (Table 5).

Table 1: Comparison of presence of union between both Groups

Group	Union				P value
	Yes	%	No	%	
A	42	97.67	1	2.33	0.007
B	34	79.07	9	20.93	

**DISCUSSION**

We have conducted this study to compare the union rate between MIPO and IMN technique in treating distal tibia fractures. Mean of the patients in our study was of  $39.05 \pm 10.98$  years. The average age of patients in group A was  $38.79 \pm 10.47$  years and in group B was  $39.63 \pm 11.73$  years. Majority of the patients 51 (59.30%) were between 20 to 40 years of age. Out of 86 patients, 59 (68.60%) were male and 27(31.40%) were females with ratio of 2.2:1. In our study, union was seen in 42 patients in group A (minimally invasive plate osteosynthesis) and 34 patients in group B (intramedullary nailing) with p-value of 0.007. So, rate of union in Group A

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Table 2: Stratification of union in both groups according to age of patients

Age (years)	Group A						Group B						P value
	Yes	%	No	%	Total	%	Yes	%	No	%	Total	%	
20-40	24	96.0	1	4.0	25	58.14	20	76.92	6	23.08	26	60.47	0.048
41-60	18	100.0	-	-	18	41.86	14	82.35	3	17.65	17	39.53	0.062

Table 3: Stratification of union in both groups according to duration of injury

Duration (days)	Group A						Group B						P value
	Yes	%	No	%	Total	%	Yes	%	No	%	Total	%	
≤ 1	30	96.77	1	3.23	31	72.09	25	83.33	5	16.67	30	96.77	0.078
> 1	12	100.0	-	-	12	27.91	9	69.23	4	30.77	13	30.23	0.036

Table 4: Stratification of union in both groups according to gender

Gender	Group A						Group B						P value
	Yes	%	No	%	Total	%	Yes	%	No	%	Total	%	
Male	30	100.0	-	-	30	69.77	24	82.76	5	17.24	29	67.44	0.017
Female	12	2.31	1	7.69	13	30.23	10	71.43	4	28.57	14	32.56	0.163

Table 5: Stratification of union in both groups according to BMI

BMI	Group A						Group B						P value
	Yes	%	No	%	Total	%	Yes	%	No	%	Total	%	
Obese	17	100.0	-	-	17	39.53	14	87.50	2	12.50	16	37.21	0.133
Nonobese	25	96.15	1	3.85	26	60.47	20	74.07	7	25.93	27	62.7	0.025

(minimally invasive plate osteosynthesis) was 97.67% while in Group B (intramedullary nailing) was 79.07%. Kumar D et al<sup>10</sup> in his study has shown the union rate after MIPO treatment as 100.0% and after intramedullary nailing (IMN) as 86.67% in distal tibial fractures.

In one comparative study, it was reported that mal-alignment rate was high in patients of tibia fracture managed with nailing technique as compared to patients managed with plating technique (50% vs 17%).<sup>11</sup> Sirbu et al<sup>12</sup> reported that by using MIPO technique for the management of distal tibial fracture, all the fractures were healed no nonunion was noted. Atiq G et al,<sup>9</sup> reported union rate as 94.44% in tibial fracture cases managed by MIPO technique. Higher non-union rate in cases of tibial fracture managed by IMN was reported by different studies.<sup>13-14</sup> In fractures with intra-articular involvement, nailing technique is contra-indicated.

Management of these complex fractures, popularity of locking plates has increased significantly because this procedure do not require large incision or soft tissue damage and minimizes the failure rate because of nonunion and infection. The efficacy of the MIPO technique in terms of fracture healing time and ROM is comparable with published literature.<sup>12,15</sup>

Secondary surgery rate is 0-20% in percutaneous plating while 42% in IMN which suggesting that plating is the most effective in timely union of fracture without secondary procedures.<sup>16</sup> In one case series, by using MIPO excellent results in term of union was achieved.<sup>17</sup>

## CONCLUSION

This study concluded that rate of union is higher with MIPO technique as compared to IMN technique in treating distal tibia fractures. So, we recommend that minimally invasive plate osteosynthesis (MIPO) technique should be used as a first line treatment for treating distal tibia fractures in order to reduce the morbidity of these patients.

## REFERENCES

1. Canale ST. *Campbell's Operative Orthopaedics*, 10<sup>th</sup> ed. St Louis, Mo: Mosby-Year Book; 2003.
2. Koval KJ, Zuckerman JD, eds. *Handbook of Fractures*. 2<sup>nd</sup> ed. Baltimore, Md: Lippincott, Williams & Wilkins; 2002.
3. Casstevens C, Le T, Archdeacon MT, Wyrick JD. Management of extra-articular fractures of the distal tibia: intramedullary nailing versus plate fixation. *J Am Acad Orthop Surg*. 2012; 20(11): 675-83.
4. Cheng W, Ying Li, Manyi W. Comparison study of two surgical options for distal tibia fracture-minimally invasive plate osteosynthesis vs. open reduction and internal fixation. *Int Orthop* 2011; 35(5): 737-42.
5. Pawar ED, Agrawal AR, Patil AW, Choudhary S, Asadi G. A comparative study of intramedullary interlocking nail and locking plate fixation in the management of extra-articular distal tibial fracture. *J Evolution Med Dental Sci* 2014; 3(24): 6812-26.
6. Shrestha D, Acharya BM, Shrestha PM, Minimally invasive plate osteosynthesis with locking compression plate for distal diaphyseal tibia fracture. *Kathmandu Uni Med J* 2011;34(2):62-8.

7. Ronga M, Longo UG, Maffulli N. Minimally invasive locked plating of distal tibia fractures is safe and effective. *Clin Orthop Relat Res* 2010; 468(4):975-82.
8. Ram GG, Kumar D, Phagal VV. Surgical dilemma's in treating distal third leg fractures. *Int Surg J* 2014;1(1):13-6.
9. Atiq G, Khan A, Ul Hassan M, Mahmood A. Functional and radiological outcome of minimal invasive plate osteosynthesis for fractures of tibia. *J Pak Orthop Assoc* 2014;26(2):20-3.
10. Kumar D, Ram GG, Vijayaraghavan PV. Invasive plate versus intramedullary interlocking nailing in distal third tibial fractures. *J Med Dental Sci* 2014; 13(3):15-7.
11. Court-Brown CM, McBirnie J, Wilson G. Adult ankle fractures--an increasing problem?. *Acta Orthop Scand* 1998; 69(1):43-7.
12. Sîrbu PD. Osteosinteza minim invazivăcu plăciînfracturilefemurului distal, Casa deeditura Venus, 2007.
13. Collinge C, Kuper DO, Protzman R. Minimally invasive plating of high energy Metaphyseal distal tibia fractures. *J Orthop Trauma* 2007; 21(6): 2007.
14. Egol KA, Weisz R, Hiebert R, Tejwani NC, Koval KJ, Sanders RW. Does fibular plating improve alignment after intramedullary nailing of distal tibia metaphyseal fractures. *J Ortho Trauma* 2006;20(2):94–103.
15. Im G-I, Tae S-K. Distal metaphyseal fractures of tibia: a prospective randomized trial of closed reduction and intramedullary nail versus open reduction and plate and screws fixation. *J Trauma*. 2005; 59(5):1219–23.
16. Zhang QL, He QL. Clinical analysis of the internal fixation treatment of 58 cases tibial fracture with interlocking intramedullary nails and with percutaneous plates. *Med Innovation China* 2012; 9(23):18–20.
17. Zhou B, Chen Z. Minimally invasive percutaneous plate fixation in treatment of tibial fracture. *Med J Chinese People's Health* 2012; 24(11):1327–9.