

# Comparative Study of Minimally Invasive Percutaneous Plate Osteosynthesis versus Reamed Intramedullary Nail Fixation for Extra Articular Distal Third Tibial Fractures

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## ABSTRACT

**Introduction:** Extraarticular distal third tibial fractures are highly controversial and difficult to treat despite of numerous methods of fixation. The most common methods of treating these fractures are minimally invasive percutaneous plate osteosynthesis (MIPPO) and reamed intramedullary nailing (RIMN). **Aims:** The aim of this study is to compare and assess its demographic status, preoperative status and functional outcomes of these two groups of patients with extraarticular distal third tibial fractures. **Methods:** This prospective hospital based observational study of 36 patients with extra articular distal third tibial fractures was carried out from January 2018 to January 2021 at Nepalgunj Medical College Teaching Hospital, Kohalpur. Thirty-six patients were included in the study and were divided into two groups of 18 each and were treated with MIPPO and RIMN methods and were followed up regularly. Clinical and functional outcome were evaluated at 12 months. **Results:** Out of 36 patients 20 were male and 16 were female. Mean age was 37.63 with SD  $\pm$  11.43 years. Twenty two were right sided and 14 were left sided. Mean duration of surgery in MIPPO group was 75.33 with SD  $\pm$  14.64 minutes and in RIMN group was 98.33 with SD  $\pm$  18.96 minutes. There were 24 cases of associated fibular fractures. Two cases of surgical site infection and two cases of K-wire impingement on fibular side were encountered in MIPPO group whereas three cases of postoperative blisters were seen in RIMN group. All fractures united. The mean average time for fracture healing in MIPPO group was 25.55 weeks and in RIMN group was 27.55 weeks. The clinical and functional outcome were evaluated using American Orthopedic Foot and Ankle Society (AOFAS) scoring system, the mean score in MIPPO group was 91.22 and in RIMN group was 90.77. **Conclusion:** There was a good outcome in MIPPO group than RIMN group for extra articular distal third tibial fractures.

**Keywords:** Extraarticular distal third tibial fracture, Minimally invasive percutaneous plate osteosynthesis, Reamed intramedullary nailing

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## INTRODUCTION

With the increasing use of motor bikes and active sportive and physical activities, the distal third tibial fractures are on rise. They are caused by high energy axial compression, direct bending or low energy rotational forces.<sup>1</sup> These fractures constitute about 10%-13% of all tibial fractures.<sup>2</sup> Various modalities of treating these fractures are conservative method with cast application, internal fixation with Intramedullary nails and plates, external fixators, Ilizarov's fixators, minimally invasive osteosynthesis.<sup>3,4,5</sup> However, MIPPO has been widely used because of its less invasive technique which preserves

vascularity of fracture fragments, fracture hematoma and minimal soft tissue damage.<sup>6,7</sup> Similar to MIPPO, RIMN also has been widely used because of its advantages like shorter operation time, very minimal soft tissue damage and postoperative weight bearing benefits. The requirement of this procedure is to have adequate bone stock distal to fracture site so as to engage and fix with the interlocking screws.<sup>8</sup> However, both the techniques have advantages and disadvantages with complications.<sup>9,10</sup> The distal third tibial fractures were classified according to Arbeitsgemeinschaft für Osteosynthesefragen (AO) Type 43 with subtype of type A fracture (extraarticular), type B (partial articular) and type C (total articular). These

fractures are controversial and difficult to treat to most of the orthopedic surgeons even today despite of numerous methods of fixation.

The aim of this study is to evaluate and compare the clinical and functional outcome of MIPPO and RIMN for the management of extra articular distal third tibial fractures (AO type 43 A).

## METHODS

A prospective hospital based observational study was conducted at Nepalgunj Medical College Teaching Hospital, Kohalpur from January 2018 to January 2021. A total of 36 patients were enrolled and selected into two groups consisting of 18 patients in each group by using convenient sampling technique. The study was approved by the Institutional Review Committee and written consent was taken from all the patients before surgical procedure and to include them in the study. All the patients with age 18 year or above with closed fractures of AO type 43 A, Gustilo Anderson type I open fractures of the extra articular distal third tibia were included whereas pathological fractures, bilateral distal third tibial fractures, fractures with syndesmotic injuries, patients who were not fit for surgery and patients not willing to participate in the study were excluded. Although there are different criteria to define the distal tibial fractures, we used the area which was extended within the two Müller squares of the ankle joint.<sup>11</sup> All the patients were examined and screened in Emergency department and in outpatient department. All the patients were admitted after thorough radiological assessment and adequate immobilization with plaster of Paris posterior splint. Preoperative investigations were sent and the limb was elevated in Bohler Braun splint so as to decrease the swelling.

**Surgical technique of MIPPO:** A single surgeon operated all patients with the patient in supine position on a radiolucent operating table under spinal anesthesia. Preoperative antibiotics were given intravenously. Tourniquet was used in all the cases on the upper thigh. Medial vertical incision was made at the center of medial malleolus preserving the great saphenous vein. Subcutaneous tunnel was made with curved periosteum elevator and the desired pre contoured locking plate was inserted through tunnel after provisional reduction of the fracture. The plate was placed centrally which was further confirmed on image intensifier and fixed with K wires for temporary hold. Non locking cortical screws were inserted first to bring the plate on the bone, and then followed by locking screws. After fixation all the K wires were removed. Wound was closed in layers and below knee slab was applied.

**Surgical technique of RIMN:** All the patients of RIMN group also were operated under spinal anesthesia on a radiolucent table but the table was bent at the level of knee and a thick bolster was kept beneath the knee joint so as to flex the knee while reaming and insertion of the nail. Tourniquet was used in all the cases. Transtendinous approach was used. Entry point was assured with the help of image intensifier by an all, gradual reaming was done after manual close reduction assessing length, axial and rotational alignment of fracture and

appropriate sized nail was inserted and interlocked with static locking bolts.

Associated fibular fractures were addressed with intramedullary single percutaneous K wire fixation through the tip of lateral malleolus, with one third tubular plates and screws and some cases were left unaddressed in both the groups despite of any level of the fibular fractures. All the patients were followed up at two weeks, six weeks, three months, six months, nine months and twelve months. Physiotherapy with early active and passive range of motion of knee and ankle joints and quadriceps strengthening exercises were started the very next day of surgery. First wound inspection was done on second postoperative day. Weight bearing was not allowed in either group for 4-6 weeks, which was followed by partial weight bearing as per tolerance of the patient and full weight bearing was allowed only after the clinical and radiological signs of union which was considered clinically as the absence of tenderness and formation of bridging callus on subsequent x-rays. Clinical and functional outcome were evaluated at twelve months by using American Orthopedic Foot and Ankle Society (AOFAS) scoring system.<sup>12</sup> The AOFAS scoring system evaluated using three parameters i.e. pain, function and alignment. 50 points have been allocated to function, 40 points to pain and 10 points to alignment. A score between 90-100 is excellent, 75-89 is good, 50-74 is fair and less than 50 is poor.<sup>13</sup>

Data management and statistical analysis was performed with Statistical Package for the Social Sciences (SPSS) version 20. Comparison of continuous distribution was shown by frequency, mean, standard deviation and discrete variables were tested by parametric independent t test. P values less than 0.05 were considered as statistically significant.

## RESULTS

There were 36 patients in the study, with 18 patients in either group. Average union time was 25.55± 6.17weeks (range 20-36 weeks) for MIPPO group and 27.55± 6.56 weeks (range 24-40 weeks) for RIMN group. AOFAS score of MIPPO group was 91.22±7.81 (range 80-100) and RIMN group was 90.77±3.29 (range 74-98). Though majority of outcome 15(83.3) had shown excellent result, there was no significant difference of mean in AOFAS scoring in between two groups (P = 0.19). (Table I and Table II)

Scoring outcome	Points	MIPPO group no. (%)	RIMN group no. (%)
Excellent	(90-100)	15 (83.3)	14 (77.7)
Good	(75-89)	2 (11.1)	3 (16.6)
Fair	(50-74)	1 (5.5)	1 (5.5)
Poor	(less than 50)	0 (0)	0 (0)

**Table I: Comparison of postoperative status between two groups**

according to AOFAS scoring system.

Variables	MIPPO		RIMN		P value
	Mean	± SD	Mean	± SD	
AOFAS	91.22	7.81	90.77	3.29	0.19

**Table II: Comparison of mean difference of AOFAS ratio in between two groups**

There were two superficial surgical site infections which resolved by minimal debridement and intravenous antibiotics and two cases had K-wire impingement on fibular side of MIPPO group where percutaneous intramedullary K-wire fixation was done through the tip of lateral malleolus. K-wires were removed early at 12 weeks. In RIMN group there were postoperative blister at the fracture site in three of the patients which was addressed immediately with cold packs, bed end raise and encouraging early active ankle and toe movements but there were no K-wire impingement in nailing group.

The mean age of the patients was 37.63 years (range 18-60 years). Twenty two (61.1%) patients had fractures on the right side and 14(38.8%) had on the left side. Twenty fractures (55.5%) were due to road traffic accident, 12(33.3%) fractures were due to fall and 4(11.1%) fractures were due to sports related injuries. All the extraarticular distal third fractures were reduced by closed technique. There were 24(66.6%) cases of associated fibular fractures. Out of 24 cases, 6(25%) were left unaddressed due to its proper alignment, 12(50%) were addressed by open reduction and internal fixation with one third tubular plates and rest 6(25%) were treated with single percutaneous intramedullary K wire under image intensifier. The mean duration of surgery was shorter for the MIPPO group; 75.33mins± SD 14.64(range 50-100 mins) as compared to RIMN group 98.33mins± SD 18.96(range 55-120 mins). (Table III and Table IV).

Variables	MIPPO	RIMN
	N%	N%
Mode of injury	9 (50)	11 (61.1)
	6 (33.3)	5 (27.7)
	3 (16.6)	2 (11.1)
Site of injury	11 (61.1)	11 (61.1)
	7 (38.8)	7(38.8)
Associated fibular fracture	14 (77.7)	10 (55.5)

**Table III: Comparison of preoperative status between two groups**

Variables	MIPPO		RIMN	
	Mean	± SD	Mean	± SD
Duration of surgery (minutes)	75.33	14.64	98.33	18.96
Time of fracture union (weeks)	25.55	6.17	27.55	6.56

**Table IV: Comparison of mean difference of post operative time duration between two groups**



**Figure 1: Pre and post operative x ray views of distal third tibial fracture treated with RIMN technique**



**Figure 2: Pre and post operative x ray views of distal third tibial fracture treated with MIPPO technique**

## DISCUSSION

Distal third tibial fractures are one of the difficult fractures to treat for the Orthopedic surgeons, due to its poor muscular attachment and poor blood supply. Although conservative management of these fractures are also recommended.<sup>14,15</sup> The main purpose of the surgical treatment is to obtain good alignment at the fracture site and to preserve the congruency of the joints, rigid and stable fixation and making patient out of bed, as per their tolerance, as early as possible.

In our study the mean age of 37.63 years was compatible with the studies of Bahari et al and Daolagupu AK et al.<sup>16,17</sup> The commonest cause of injury in our study was road traffic accident 20(55.5%) followed by fall injury 12(33.3%) and sports related injuries 4(11.1%) which was similar to the study done by Mohammed A et al in which the mean age was 42 years and the most common cause of injury was road traffic accident.<sup>18</sup>

Daolagupu et al had the mean operating time in the RIMN

group was 57.14 min (ranged from 45-70 min) and in the MIPPO group it was 66.67 min (ranged from 60-80 min)<sup>17</sup> whereas in our study the mean operating time in the RIMN group was 98.33 min (ranged from 55-120) and in the MIPPO group it was 75.33 min (ranged from 50-100 min) which was comparable with the study done by Paluvadi SV et al; 86.23 min (ranged from 70-123 min).<sup>19</sup> The prolong time taken for RIMN in our study was probably due to less trained man power to use image intensifier.

There were associated fractures of ipsilateral fibula in 24 cases. Our rate (66.6%) was smaller in comparison to the rates (80%) of associated fibular fractures found in the study of Nadeem A A et al.<sup>20</sup> Taylor et al reported the data of 98 patients who underwent RIMN of distal third tibia fractures with and without fibular fixation. They found no statistically significant differences between those two groups in operative time, malalignment, union time, delayed union rate and postoperative complications.<sup>21</sup>

Vallier HA et al have advocated RIMN for extra articular distal third tibial fractures due to its advantages of closed reduction with preservation of fracture hematoma and extra osseous blood supply.<sup>22</sup> Guo JJ et al advocated RIMN to be the better technique for distal third tibial fractures.<sup>23</sup> Their study reported AOFAS score of 86.9 in the RIMN group and 83.9 in the MIPPO group.

In a systemic review and Meta analysis done by Liu XK et al, there was no significant difference in union time between MIPPO and RIMN.<sup>24</sup> In our study the average mean for fracture union was 25.55 ±6.17 weeks in MIPPO group and 27.55 ±6.56 weeks in RIMN group which was comparable with the above study. Similarly, in our study AOFAS score of MIPPO group was 91.22±7.81 (range 80-100) and of RIMN group was 90.77±3.29 (range 74-98) which was comparable with the study conducted by Ahmad MA et al and Joveniaux P et al.<sup>25,26</sup>

## LIMITATIONS

The sample size of the study was small in number. We have used different modalities of fixation for associated fibular fractures which definitely had relative impact on functional outcome and postoperative complications. Randomized controlled trial studies may give better conclusion over the recommendations of distal tibial fracture management.

## CONCLUSION

Both modalities of treatment were effective and had good outcome, and this study could not establish one modality of treatment superior to another.

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