



# Distal Tibia Fracture in Adult Age Group in Lumbini Province of Nepal: Outcome with Minimally Invasive Percutaneous Plate Osteosynthesis

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

**Introduction:** Management of distal tibia fracture is challenging for many orthopaedic surgeons. The definitive treatment remains controversial. Various treatment options are used for the management of distal tibia fractures. MIPPO for distal tibia fractures are widely accepted by various surgeons as these methods of treatment have advantages like less soft tissue dissection, fracture biology is preserved and provides stable bony construct.

**Methods:** This was a prospective interventional study done from February 2019 to January 2021 at Rapti Academy of Health Sciences, Ghorahi, Dang with displaced distal tibia fracture with or without articular involvement which was treated with MIPPO and assessed for one year. Ethical approval and informed written consent were taken from all patients. The outcome was assessed by American Orthopaedic Foot and Ankle surgery (AOFAS) scoring system.

**Results:** The mean time of fracture union was 21.23±9.066 weeks. At the final follow-up, the mean AOFAS score was 92.59± 5.297. Two patients developed superficial wound infection which

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resolved with oral antibiotics and regular dressing. One patient had delayed union of the fibula with posterior angulation of the tibia less than 5° which was managed with percutaneous bone marrow injection. Two patients developed ankle stiffness which after extensive physiotherapy regained movement at final follow-up.

**Conclusion:** MIPPO with locking compression plate for distal tibia fracture not only preserve the endosteal blood supply but also preserves the periosteal blood supply which results in early fracture union with excellent to good functional outcome compared to other methods of fixation.

*Keywords: Distal tibia fractures; endosteal; locking compression plate; mippo.*

## 1. INTRODUCTION

Fractures of the distal tibia account for 15% of all the fractures and less than 7% of all tibia fractures [1-3]. Distal tibial fractures account for less than 10% of all lower limb injuries [4]. These types of fractures occur due to axial compressive force of talus in high-velocity injury and due to rotational forces in low energy injuries [5-7].

In distal tibia fracture, soft tissue injuries are common as the tibia is located subcutaneously resulting in an open fracture in most cases [6] Closed distal tibia fractures usually present with massive swelling, blisters and contusion [6]. In high energy distal tibia fracture there is associated distal fibula fracture in 80% of injuries [8]. Associated fibula fractures are more severe than isolated distal tibia fracture [9].

Management of distal tibia fracture is challenging for many orthopaedic surgeons. The definitive treatment remains controversial. Various treatment options are used for the management of distal tibia fractures which includes closed reduction and long leg cast application, pins and plaster, external fixator, intramedullary interlocking nailing, open reduction and plate fixation and minimally invasive percutaneous plate osteosynthesis(MIPPO) [10,11-16] Conservative management like closed reduction cast application often results in malunion. External fixator and closed intramedullary nailing is less invasive and requires less soft tissue dissection but external fixator may result in pin-tract infection and closed intramedullary nailing often results in eccentric reaming of distal fragment leading to posterior angulation and valgus deformity [17,10,18-21] Open reduction and plate osteosynthesis requires extensive soft tissue dissection in both the anterolateral and medial border of the distal tibia resulting in wound complication [22].

Recently, MIPPO for distal tibia fractures is widely accepted by various surgeons as this

method of treatment have advantages like less soft tissue dissection, fracture biology is preserved and provides stable bony construct. However, these techniques often have complications like soft tissue infection, chronic deep tissue infection, implant exposure and implant failure [16,19,20].

Our study aims are to evaluate the functional outcome of distal tibia fractures managed with MIPPO (Single-stage surgery) which was then compared with other similar studies.

## 2. MATERIALS AND METHODS

A prospective study was conducted at Rapti Academy of Health Sciences, Ghorahi, Dang from February 2019 to January 2021. Ethical approval was taken from IRB and informed written consent was taken from all patients. Twenty-five closed distal tibia fractures with AO classification type 43A, B and C1 were included in our study. Polytrauma patient, pathological fractures, compound fractures, AO type 43C2 and 43C3 and the patient who lost follow-up were excluded from our study. The patient presenting to emergency and out-patient department were kept in a long leg back slab and the affected limb was elevated till the swelling subsided. All surgeries were performed under spinal anaesthesia block. Pre-operatively 1 gm of injection Ceftriaxone was given intravenously in the operating room. The involved limb was disinfected with 10% povidone-iodine solution and draped. If there was an associated distal fibula fracture, it was fixed first with a 3.5 mm dynamic compression plate or distal fibular locking plate via a lateral approach. A longitudinal incision was made at the medial malleolus level. Longitudinal traction was applied and the plate was slid proximally from the distal incision at medial malleolus level. The fracture was reduced by indirect method with the help of an image intensifier and the reduction clamp was used to hold the reduction. The plate was secured in position with K-wire provisionally.

Non-locking 3.5 mm cortical screw was used to make the contact of the plate to bone and with separate stab incision, locking screws were placed. The acceptable reduction criteria were varus/valgus angulation less than 5 °, anteroposterior angulation less than 10 ° and shortening of less than 15 mm. The skin was closed with sutures and the limb was protected in a long leg back slab. The wound was inspected on the second post-operative day. Knee range of motion and non-weight bearing crutch walk was started on the second post-operative day. Suture and slab were removed two weeks after surgery and ankle mobilization was carried out. Partial weight-bearing was started at six weeks and increased gradually to full weight-bearing after a clinical and radiological sign of union. The fracture was considered united if there was visible callus in at least three cortices in both view and no pain on bearing weight. The outcome was assessed by American Orthopaedic Foot and Ankle surgery (AOFAS) scoring system [23]. All data were entered and analyzed using SPSS 21.

### 3. RESULTS

There was a total of 25 patients. Three patients lost to follow-up and a total of 22 patients were included in our study. The age ranges from 18 to 63 years with the mean age of 37.41± 13.34 years (Table 1). 22.7 % of patient fall between 41 to 50 years of age (Fig. 1). The mean time of fracture union was 21.23± 9.066 weeks. 63.34% of injury occurs due to fall followed by RTA in 36.36%. According to AO classification, 11 (50%) of fracture were 43A type, 6 (27.27%) of fracture were 43B type and 5 (22.73%) of fracture were 43C1 type (Fig. 2). The average duration of injury to surgery interval was 8.41± 2.82 days. At the final follow-up, the mean AOFAS score was 92.59± 5.297 (Table 1). In 8 patients (36.36%) there was associated fibula fracture which was managed with open reduction and internal fixation with 3.5 mm DCP or distal fibular locking plate depending upon the fracture location. Two patients developed superficial wound infection which resolved with oral antibiotics and wound care. One patient had delayed union of the fibula with posterior angulation of tibia less than 5° which was accepted and delayed union of the fibula was managed with percutaneous bone marrow injection and two patients developed ankle stiffness after extensive physiotherapy regained movement at final follow-up. None of the patients had non-union, malunion, implant exposure and implant failure.

**Table 1. Demography of study participants (n=22)**

Characteristics (n=22)	Finding n (%)
<b>Age (Years)</b>	37.41±13.34 (range 18-63)
<b>Sex</b>	
Male	15(68.18%)
Female	7(31.82%)
<b>Side</b>	
Right	14 (63.64%)
Left	8 (36.36%)
<b>Mechanism of Injury</b>	
Fall	14 (63.34%)
Road Traffic Accident	8 (36.36%)
<b>AOFAS score</b>	
Pain Score	37.73±5.284
Function score	46.82±2.363
Alignment Score	9.77±1.066
Total	92.59±5.297
<b>Mean time of fracture union</b>	21.23±9.066 weeks

### 4. DISCUSSION

For management of distal tibia fracture, open reduction and internal fixation require extensive soft tissue dissection leading to a higher chance of infection as well as nonunion owing to loss of vascular supply. MIPPO has gained popularity along with the development of a locking compression plate, the plate can be placed extraperiosteally through a small incision on the medial aspect of the tibia [24,25,26] Intramedullary nailing for distal tibia fracture is also one of the minimally invasive technique that preserves extraosseous blood supply and the nail itself is a load sharing device but has the complications like malunion and implant failure [18-21]. External fixator devices are also used for the management of distal tibia fracture and it has a high rate of complications like pin-tract infection, malunion, nonunion and implant failure have been noted. So these fixation techniques are reserved for open fracture and severely comminuted fracture [10].

Locking compression plate when inserted extraperiosteally with minimally invasive technique preserves the intraosseous as well as an extraosseous blood supply. The fracture biology is preserved which enhances early fracture healing [27]. Locking compression plate provides a stable construct and has less chance of loss of reduction as the screw head is locked over the threaded hole [28].

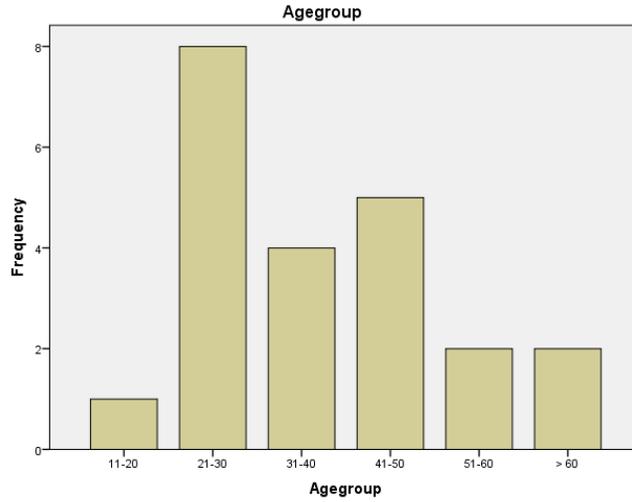


Fig. 1. Age-wise distribution of the participant

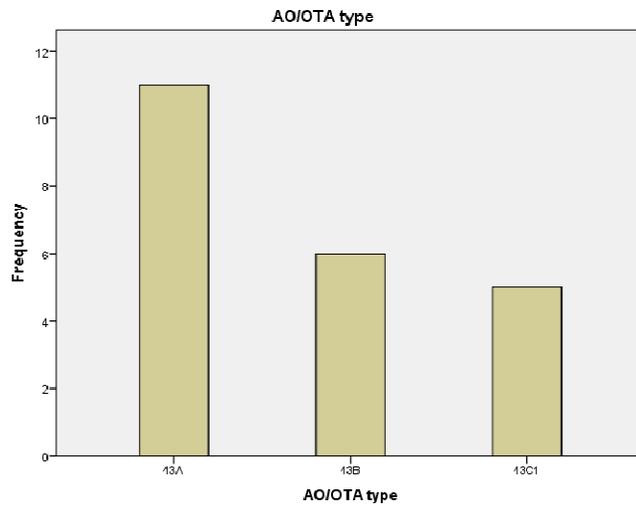


Fig. 2. Distribution of the participant according to AO OTA classification



Fig. 3. (A) Pre-operative radiograph (B) Immediate postoperative radiograph (C) Incision for fixation of Tibia (D) Final follow-up x-ray showing the delayed union of the fibula and posterior angulation of fewer than 5 degrees (E) Distal tibia lock plate to fix distal tibia fractures

**Table 2. Comparison of the current study with previous studies**

<b>Author</b>	<b>Study Design</b>	<b>No. of patients</b>	<b>Fixation methods</b>	<b>Outcome</b>	<b>Complications</b>
Ahmad MA et al. [33]	Retrospective	Eighteen	MIPPO	The mean time of fracture union was 21.2 weeks	Delayed union – Three patients Superficial wound infection – One patient Chronic wound infection – One patient Implant failure – One patient
Ronga M et al. [11]	Retrospective	Nineteen	MIPPO	The mean time of fracture union was 22.3 weeks	Nonunion – One patient Deep wound infection – Three patients
Hazarika S et al. [34]	Retrospective	Thirty-two patients with eight open fractures	MIPPO	The mean time of fracture union was 28.5 weeks	Nonunion – Two patients Delayed wound breakdown – Two patients Deep wound infection – One patient Implant failure – One patient
Shrestha D et al. [16]	Prospective	20	MIPPO	The mean time of fracture union was 18.5 weeks	Delayed union – One patient Superficial wound infection – One patient Deep wound infection – One patient Secondary procedure requirement – One patient
Our study	Prospective	22	MIPPO	The mean time of fracture union was 21.23weeks	Delayed union of fibula – One patient Ankle stiffness – Two patients Superficial wound infection – Two patients

Eight patients had ipsilateral fibula fracture and were treated with open reduction and plate fixation in all eight patients. The role of fibula fixation is to maintain and restore the tibial length and to prevent rotational instability. We had a small number of cases that had associated fibular fracture which was comparable to other literature [29-30].

The injury to surgery interval was 8.41 days, which was more compared to a study done by Shrestha D et al of 4.45 days [16]. This happens due to illiteracy and poor socioeconomic status resulting in delayed presentation to the hospital. There was 68.18% male patient which was comparable to a study done by Shrestha D et al. [16].

Pandey BK et al evaluated distal third tibial fractures managed with anterolateral plating by open method and found that mean time of fracture union was within nine months [31]. In our study, the mean time of fracture union was 21.23 weeks approximately six months. As discussed earlier open reduction results in extensive soft tissue damage that may hinder union time.

We compared our studies with other several studies, many of which include both compound and simple fractures and most of the studies are retrospective studies (Table 2). In the study done by Vallier et al, they reported greater angular malalignment in distal tibia fracture which was treated with the interlocking nail [18]. Guo et al did a comparative study between the interlocking nail and locking compression plate and concluded that interlocking nail had a better outcome according to AOFAS score [22]. Cheng et al did a comparative study between MIPPO and open reduction and internal fixation with locking compression plate and there was no statistical insignificance between these two groups [32].

Various newer design locking plates have been introduced for the management of distal tibia fractures [Fig. 3(E)]. These newer design plates are well contoured for the distal tibia. Hence, we didn't encounter major complications like plate exposure and implant failure.

Out of twenty-two fractures, eight had associated fibula fracture. As it involves the syndesmosis we routinely fixed all fibula fracture before fixation of tibia fracture to achieve good tibial alignment and to prevent valgus angulation. Collinge et al, concluded that there is an increased incidence of

secondary procedure like bone graft technique for the delayed union [35]. One patient develop delayed union of fibula while observing at the final follow-up period and later managed with percutaneous iliac crest bone graft injection.

The mean AOFAS score was  $92.59 \pm 5.297$ . Guo et al did a comparative study for distal tibia fracture managed with closed nailing and minimally invasive plate fixation. AOFAS score was 86.9 in the closed nailing group and 83.9 in the minimally invasive group however in their study they excluded intra-articular fracture [22].

Distal tibia fracture, owing to its subcutaneous location has a higher chance of swelling and fracture blisters. Waiting until the appearance of wrinkles sign results in a good functional outcome. Many authors suggest two-stage surgery [18]. Our country has the majority of the population belonging to low socio-economic status and hence two staged surgery won't be affordable to most of the patients. So initially, we kept the affected limb on a long leg back slab and once the swelling subsided we proceed for the surgery.

Many cadaveric studies show that there is a chance of long saphenous vein and saphenous nerve injury while treating distal tibia fracture [36]. We didn't encounter any such complications.

## 5. CONCLUSION

Management of distal tibia fractures is challenging even for experienced orthopaedic surgeons. MIPPO with locking compression plate for distal tibia fracture not only preserve the endosteal blood supply but also preserves the periosteal blood supply which results in early fracture union with excellent to good functional outcome compared to other methods of fixation.

## CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

## LIMITATIONS OF STUDY

We have small sample size and more sample size can be done by analyzing multi-center study

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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