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# Clinical outcomes of patients undergoing Minimally Invasive Plate Osteosynthesis (MIPO) for distal tibia fractures

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## Abstract

**Introduction:** Distal tibial fracture being subcutaneous poses a surgical challenge and can be complicated with delayed union, non-union, wound infection and wound dehiscence. Minimally Invasive Plate Osteosynthesis (MIPO) of distal fractures is indicted for displaced or unstable fractures due to its technical advantages and satisfactory clinical outcomes.

**Methodology:** We prospectively studied consecutive adult patients with closed distal tibia fracture treated with locking plates with MIPO technique. We included consecutive patients with Gustillo type 1 closed fracture with or without articular extension. Clinical outcome was assessed using Olerud and Molander Score (OAMS). Radiographic assessment was done to assess for radiological union.

**Results:** Among the 30 patients, right side was involved in 53% of the patients and the most common type of fracture was 43.A1 type (47%). OAMS done post-operatively found that 67% had excellent outcome, 27% had good outcome, 6% and fair and none of the patients had poor clinical outcome. Radiological union was achieved in 12 weeks in 20%, 12 to 16 weeks in 23%, 16 to 20 weeks in 50% and 20 to 24 weeks and 24 to 28 weeks in one patient each. Superficial wound infections was observed in five patients, ankle stiffness in four patients and delayed union in two patients.

**Conclusions:** Results of our study show that locking compression plate using MIPO technique does not compromise the periosteal blood supply and does not rely on the compression between the plate and the bone. Thus MIPO is an effective treatment for tibial diaphysis and distal tibia fractures.

**Keywords:** Distal tibial fractures, locking plate, Minimally invasive percutaneous plate osteosynthesis

## Introduction

The distal tibial fractures constitute about 10–13% of all tibial fractures and are often associated with soft tissue injury. The fractures of distal tibia pose a surgical challenge to the surgeon due to subcutaneous location, scarcity of blood supply and limited soft tissue coverage. This fracture can be further complicated if there is involvement of the ankle joint during high impact injuries. Delayed union, nonunion, wound infection, and wound dehiscence are the most commonly observed complications due to the physiological characteristics of distal tibia, poor blood supply and decreased muscular cover anteriorly. Therefore, the ideal treatment for treating distal tibial fractures in patients remained controversial. Minimally Invasive Plate Osteosynthesis (MIPO) of distal fractures is indicted for displaced or unstable fractures. Recently, minimally invasive percutaneous plate osteosynthesis (MIPPO) has been widely used owing to its technical advantages and satisfactory clinical outcomes. The present study describes the clinical outcomes of MIPO technique in patients with distal tibial fractures and its complications.

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## Methodology

### Study Design and Sample population

The present prospective study was conducted of consecutive adult patients with closed distal tibia fracture treated with locking plates with MIPO technique at the Department of Orthopedics, D.Y. Patil Medical College, Hospital and Research Centre, Navi Mumbai. During the study duration of 36 months, we included 30 patients in the present study. All consecutive patients with Gustillo type 1 closed fracture with

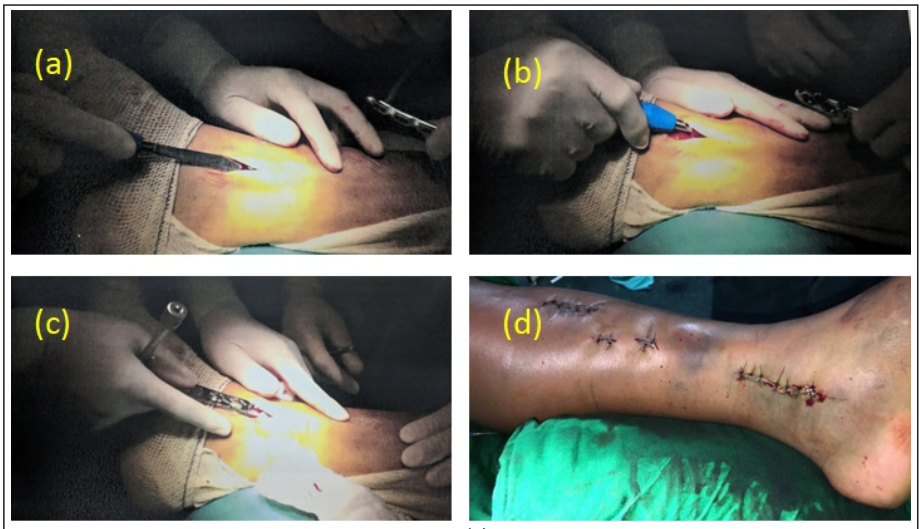


**Figure 1:** Operative steps in MIPO technique (a) Incision is made over the medial malleolus (b) Tunnel for the passage of locking plate (c) Insertion of plate (d) Post-operative sutures

or without articular extension were included. We excluded patients with tibial shaft fractures, elderly patient with co-morbid condition, non-weight wearing limb, pathological fractures and Gustillo type II & III open fracture. All patients were explained the purpose of the study and a written consent, separate from the one for surgery, was taken. The study was approved by the Institutional Ethics Committee.

**Table 1: Baseline characteristics of the patients included in the study**

| Variables | N | % |
|---|---|---|
| **Age groups** | | |
| 0 to 18 | 0 | 0% |
| 19 to 30 | 2 | 7% |
| 31 to 40 | 9 | 30% |
| 41 to 50 | 12 | 40% |
| 51 to 60 | 5 | 17% |
| 61 to 75 | 2 | 7% |
| **Gender** | | |
| Females | 8 | 27% |
| Males | 22 | 73% |
| **Occupation** | | |
| Agriculture | 12 | 40% |
| Business | 9 | 30% |
| Labour | 5 | 17% |
| Office work | 4 | 13% |
| **Mechanism of injury** | | |
| Road Traffic Acciden | 22 | 73% |
| Fall | 8 | 27% |
| **Side of Injury** | | |
| Left | 14 | 47% |
| Right | 16 | 53% |

## Operative Procedure and outcome analysis

All fractures were classified according to the Arbeitsge- meinschaft fur Osteosynthesefragen/-Orthopedic Trauma Association (AO/OTA) classification of long-bone fractures. Pnuematic tourniquet was applied and the patient was prepared and draped leaving the leg exposed as required for surgical incision and intra-operative evaluation of fracture. Once the patient ias prepared and draped, intra-operative antibiotics were administered before the inflation of the tourniquet. By traction and manipulation reduction was attempted. The provisional reduction was then confirmed by image guidance under C-ARM (IITV). After adequate reduction and alignment was achieved, plate size was selected under image guidance so as to provide adequate fixation and stabilization fracture.

In MIPPO technique, incision was made obliquely at the tip of medial malleous and extended proximally to create easy passage. The medial malleous was exposed. With care taken to protect the great saphenous vein, Percutaneous elevators was then inserted to create a submuscular, extraperiostal tunnel for the plate. The anterior and posterior borders of the medial tibia was then palpated and incision was extended longitudinally exposing the periosteum. Sub-muscular plane was developed in proximal incision and tunnel developed till fracture site and the plate was pushed by the surgeon's opposite hand. The plate was palpated in the proximal incision and confirmed to be well seated. The plate was then fixed on the tibial surface with a Kirschner wire inserted through a fixation bolt. Adequate positioning was then confirmed with anterposterior and lateral imaging. The proximal position of the plate was then checked to ensure central placement of the tibial shaft. This was then followed by the insertion of fixation screws following the standard procedure for non-locking cortical screws and locking screws. All the non locking screws were inserted first as decided pre-operatively and after attaining adequate reduction, locking screws were inserted. A minimum of four screws were used in each main fracture fragment. After the plate was inserted with the screws, the stabilization bolt was removed from the middle distal hole and screw was inserted in its place. The principles of fixation using LCP were adhered to at every stage of fixation. This was followed by irrigation of all incisions with normal saline and wound closure in layers (Figure 1).

Post-operative X-Ray was done to document proper fixation and reduction of fracture fragments. Ankle mobilization was started from 2nd or 3rd post-operative day according to the tolerance of patients or associated injuries. Follow-up visits were done at 1 week, 4 weeks, 2 months, 4 months, 6 months, 1 year and thereafter, during which thorough

**Table 2: Classification of fractures based on The AO Foundation/Orthopaedic Trauma Association (AO-OTA) types**

| AO-OTA type | N | % |
|---|---|---|
| 43.A1 | 14 | 47% |
| 43.A2 | 6 | 20% |
| 43. A3 | 7 | 23% |
| 43.B1 | 2 | 7% |
| 43.B2 | 1 | 3% |

clinical examination of the progress was done. Clinical outcome was assessed using Olerud and Molander Score (OAMS), which is a self administered patient questionnaire with a score of 0 (totally impaired) to 100 (completely impaired) and is based on nine different items: pain, stiffness, swelling, stair climbing, running, jumping, squatting, supports and work/activities of daily living. Radiographic assessment was done comparing the antero-posterior and lateral views of the affected and the normal leg with both the knee and ankle joints included to assess for radiological union.

### Data Collection and Data Analysis

All distal tibial fracture admitted during the study period were clinically assessed and those fulfilling the study criteria were included in the final analysis. Pre-operative clinical examination and laboratory investigations were performed as part of surgery preparation. Using a pre-designed semi-structured questionnaire, the data of the patients was noted. Outcomes of the patients with respect to OAMS and time taken for radiological union were noted for all patients. Any complications during the post-operative follow-up period was noted for all patients as well. The data were presented with descriptive analysis of demography, fracture classification and clinical outcomes.

## Results

The present study included 30 patients. The most common age group was 41 to 50 years (40%), followed by 31 to 40 years (30%). Our study population comprised of 73% males and 40% of the patients were agriculturists (Table 1). Most common mode of injury was road traffic accident (73%) and rest had a fall. Right side was involved in 53% of the patients and rest had injured their left side. Table 2 describes how the fractures were classified according to the AO/OTA system of classification. The most common type was 43.A1 type (47%). Other fracture types were 43.A2 (20%), 43.A3 (23%), 43.B1 (7%) and 43.B2 (3%). OAMS done post-operatively found that 67% had excellent outcome, 27% had good outcome, 6% and fair and none of the patients had poor clinical outcome. Radiological union was achieved in up to 12 weeks in 20% of the patients, 12 to 16 weeks in 23%, 16 to 20 weeks in 50% and 20 to 24 weeks and 24 to 28 weeks in one patient each. There were no complications in 63% of the patients. Superficial wound infections was observed in five patients, ankle stiffness in four patients and delayed union in two patients.

**Table 3: Distribution of patients according to their complications**

| Outcome assessment | N | % |
|---|---|---|
| **Clinical outcome (OAMS)** | | |
| Excellent | 20 | 67% |
| Good | 8 | 27% |
| Fair | 2 | 6% |
| Poor | 0 | 0% |
| **Radiological union (in weeks)** | | |
| Up to 12 | 6 | 20% |
| 12 to 16 | 7 | 23% |
| 16 to 20 | 15 | 50% |
| 20 to 24 | 1 | 3% |
| 24 to 28 | 1 | 3% |
| **Complications** | | |
| None | 19 | 63% |
| Superficial wound infection | 5 | 17% |
| Ankle stiffness | 4 | 13% |
| Delayed union | 2 | 7% |

## Discussion

Managing distal tibial fracture requires customized decision making. Where stable fractures can be managed conservatively, open reduction and internal fixation requires extensive soft tissue dissection and periosteal stripping. MIPO technique reduces the surgical trauma and maintains a biologically favorable environment for healing of the fracture. The present study was conducted to assess the functional outcome of patients with distal tibial fracture treated with locking plates with MIPO technique. It was observed that 70% of the patients were aged between 30 and 50 years and 73% were males. This age group is economically productive, which makes treating this fracture satisfactorily is all the more important. Also, road traffic accident was a more common cause of distal tibial fracture, an observation reported by many investigators previously.

In our study, clinical outcome post-operatively was assessed using OAMS. Patel et al described the MIPO technique and its usefulness in distal tibial fractures. They used the Teeny and Wiss criteria for assessing functional outcomes of the patients. It was observed that 15 patients (75%) had excellent outcome, 3 patients (15%) had good outcome and two cases (10%) with complications had fair outcome. Gupta et al evaluated the efficacy of MIPO technique in the management of closed proximal and distal fractures of the tibia and reported the functional outcome using SJLAM criteria , based on which the authors found that 60% had excellent results, 33% had good results and 7% had fair result. Kumar and Sahu compared low multidirectional locked nail and MIPO by locking compression plate in extra-articular distal tibial fractures with respect to their functional outcomes, the union rate and time, and the various complications associated with it. They used Kaikkonen ankle score and Lysholm knee scoring system. The authors found that 16 patients achieved full range of motion of ankle in nail group and 12 patients in plate group. Nail group

showed excellent ankle score and good to excellent in plate group. This shows that the ankle function was restored well in all the patients. Furthermore, the nail group showed early union compare to plate.

Patel et al reported complications like superficial wound infection in two cases, surgical wound breakdown with implant exposed in one case which healed with antibiotic and daily dressing and prominent hardware was seen in one case which was asymptomatic. Gupta et al observed that there was one superficial wound infection which resolved with daily dressings and one week of oral antibiotics. One patient had non-union for which autogenous bone grafting from illiac crest was done at 12 weeks and the fracture was united at 22 weeks. The investigators attributed non- union to early weight bearing, comminution and fracture pattern. Kumar and Sahu encountered more complications in plate group, like delayed union, nonunion, superficial infection, wound dehiscence and implant failure. Malunion rate was noted more in nail group.

Minimally invasive techniques do not allow direct visualisation of the fracture, and hence intraoperative fluoroscopy is required to confirm the reduction. This would mean more radiation exposure to the operating team as well. On the other hand, MIPO technique preserve extra osseous blood supply, respect osteogenic fracture haemotoma, biologically friendly and stable fixation method is available for distal tibia fracture.

There are a few limitations of the present study. The follow up period for this study was not long enough to know if any case had re-fracture, though plate induced osteoporosis is less frequently seen with locking compression plate which can cause re-fracture after plate removal is less common. Secondly, since this technique is experience dependent, the results of the present study might not be applicable to other surgical centers.

## Conclusion

Results of our study show that locking compression plate using MIPPO technique does not compromise the periosteal blood supply thereby causing less interference with the fracture haematoma and the fracture healing. There is rapid fracture consolidation and union time. In addition, locking compression plate does not rely on the compression between the plate and the bone so pre contouring of the plate is not required. This technique is also preferred by the patients as there was no need of any specialised instrumentation and the method is less time consuming. Thus we can conclude that MIPPO is an effective treatment for tibial diaphysis and distal tibia fractures. However, future studies are required from a larger multi-centric sample to arrive at robust conclusions.

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