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## Functional outcome following fixation of distal tibial fracture (Extra articular) with locking compression plate (LCP) using the minimally invasive percutaneous osteosynthesis (MIPO) technique

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### Abstract

**Background:** Distal tibia is more superficial, with minimal soft tissue coverage and poor blood supply, hence operative treatment can lead to complications, making it a challenging surgery. The aim is to see the results of the distal tibial fracture fixation with LCP using MIPO technique.

**Methodology:** Twenty consecutive patients with type AO 43A distal tibia fractures were prospectively included into the study during the period of march 2018 to march 2019 with a follow-up of minimum one year. Fourteen male and six female patients with a mean age of 47 years were reviewed. Patients of Bidar institute of medical sciences with closed extra articular distal tibial fractures who fulfill the inclusion & exclusion criteria were taken in to study after obtaining informed written consent. History, Clinical examination and details of investigations were recorded in the study Performa. Minimally Invasive Percutaneous Plate Osteosynthesis was carried out depending on requirement for specific fracture pattern. These cases were reviewed periodically at 6, 12, 24 weeks and regularly both clinically and radiologically for bony union. Clinical outcome and Radiological criteria (RUST SCORE) regarding fracture union and complications was evaluated and documented. Functional outcome was measured by lower extremity functional score (LEFS).

**Results:** Mean time to union was 6.5 months (range 4–16 months). Sixteen fractures healed with good functional outcome. Two patient had delayed union. One patient had nonunion which was treated with iliac crest bone grafting that ultimately healed with good functional outcome. One patient developed superficial infection that was treated with appropriate antibiotics and the fracture united eventually.

**Discussion:** The MIPO technique for pilon A type fractures is proven to be more effective over the conventional methods. Early mobilization with no risk of secondary displacement helps to prevent stiffness of the ankle joint and good wound healing.

**Keywords:** Functional outcome, distal tibial, locking compression, minimally invasive, technique

### Introduction

First described by the French radiologist Destot in 1911, ankle fractures that involve the weight-bearing distal tibia are known as pilon fractures. The term “pilon” is from the French language and refers to pestle, specifically a club-shaped tool for mashing or grinding substances in a mortar, or a large bar moved vertically to stam or pound. Later, Bonin would refer to a similar fracture as “plafond” fracture. Plafond, meaning “ceiling” in French, liken the distal tibial articular weight-bearing surface to the ceiling of the ankle joint<sup>[1-2]</sup>.

Ruedi’s results were supported over the following decade, initially by the results of Heim and later by those of Ovdia and Beals. The authors of these manuscripts noted that their best results were obtained by open reduction and internal fixation (ORIF) according to the Arbeitsgemeinschaft für Osteosynthese (AO) technique utilized by Ruedi<sup>[3]</sup>.

Unstable fractures of the distal tibia with or without intra-articular fracture extension can present a management challenge. High rates of associated complications have been reported with conventional methods of fixation<sup>[4]</sup>. Intramedullary nailing is generally not considered suitable for distal periarticular tibial fractures. Conventional open reduction and internal fixation of such injuries results in extensive soft tissue dissection and periosteal injury, compromising the blood supply, and may be associated with high rates of infection,

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delayed union, and nonunion [5]. Similarly, external fixation of distal tibial fractures may also be associated with a high incidence of pin site infection and loosening in up to 50% of cases and malunion rates of up to 45% [6]. Minimally invasive plate osteosynthesis (MIPO) may offer biological advantages. Reduced soft tissue dissection and exposition results in low surgical trauma and thus preservation of the blood supply is one of the main advantages of MIPO. Biological fixation is achieved with lesser evacuation of osteogenic fracture hematoma. Locking compression plates provide a stable construct. They function as an internal-external fixator in a bridging fashion [7]. Minimally invasive plate osteosynthesis (MIPO) was recently introduced with many claimed benefits, and has now become more popular with the development of the distal tibial LCP [8]. This plate is side-specific and precontoured to match the shape of the medial aspect of the tibia, which helps to achieve indirect reduction of the fracture. The plate is tunneled subcutaneously, but extra periosteally, through a small skin incision (2 cm) and along the medial aspect of the tibia and then fixed with locking screws. The device allows the screws to lock to the plate, thus creating a stable fixed angle.

### Methodology

Patients of tertiary care centre attached to Bidar Institute of Medical Sciences with closed extra articular distal tibial fractures who fulfill the inclusion & exclusion criteria were followed up following fixation with LCP using the MIPO technique between march 2018 to march 2019 and were followed up for a minimum period of one year. History, Clinical examination and details of investigations were recorded in the Proforma ascribed. Minimally Invasive Percutaneous Plate Osteosynthesis was carried out depending on requirement for specific fracture pattern. These cases were reviewed periodically at 6, 12 weeks, 24 weeks and regularly both clinically and radiologically for bony union. (RUST SCORE) regarding fracture union and complications was

evaluated and documented. Functional outcome was measured by lower extremity functional score (LEFS). Since these are proven methods of fixation, no control groups are required.

A total of 20 patients (6 female, 14 male) with a mean age of 47 years (range 22–70 years) were included.

Fractures were classified according to the AO comprehensive classification system. Eighteen patients were involved in road traffic accidents and 2 had a fall from height. Patients were allowed to mobilize non weight bearing with crutches on the first postoperative day with active and passive foot and ankle exercises. The patients started partial weight-bearing at eight week post operatively which was then gradually be increased to full weight-bearing depending on the radiological and clinical assessment.

### Surgical technique

Under regional anesthesia, patient was positioned on a radiolucent table. Intravenous antibiotics were given at induction. The patient was positioned supine on table, with a thigh tourniquet.

A vertical or curvilinear incision was made with medial malleoli as reference and to take care not to injure the saphenous vein and nerve. Subcutaneous plane was made without stripping the periosteum and disturbing the fracture site. Fracture was reduced under c arm control and where reduction was difficult k-wires were used.

DTLCP was passed into the plane created and its position confirmed under c arm. Plate was initially fixed with help of K wires.

Provisional non locking screws used to bring plate near the bone. Interfragmentary screws used to achieve compression in simple fractures. With separate stab incisions locking screws were used on either side of fracture site under c arm guidance. In case of fractures with a simple fracture configuration, a plate 8-10 times longer than the fracture was planned. Reduction was confirmed under c arm and wound was closed.



Proximal and distal locking



Associated fibula fixation

**Fig 1:** Intra-op Images

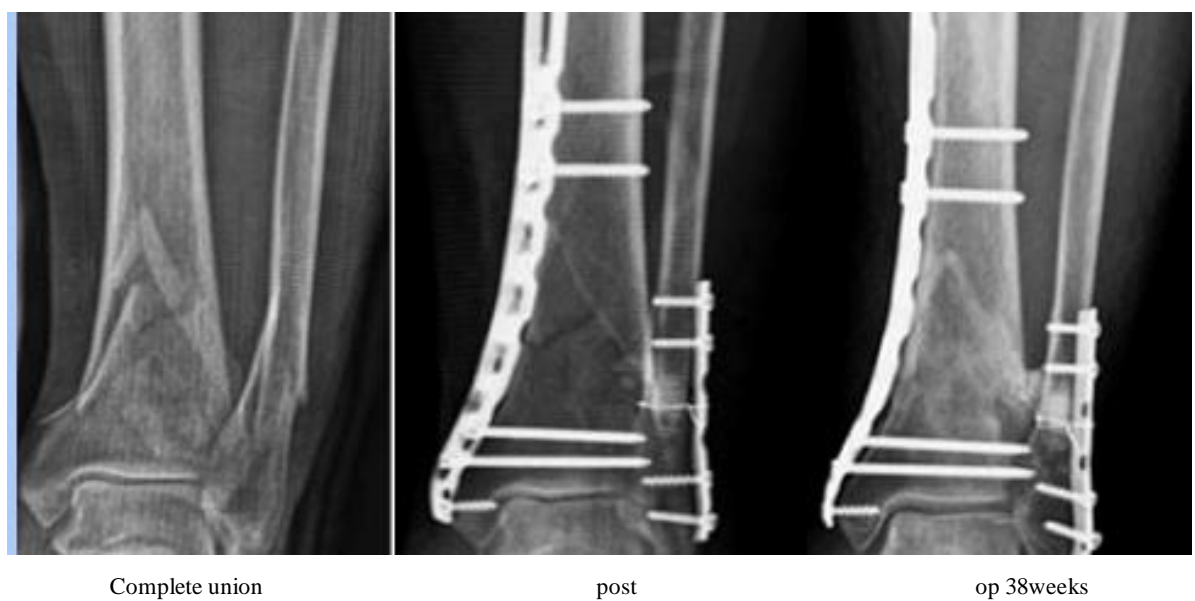
**Case 1**



**Case 2**



**Case 3**



Case 4

Table 2: Range of motion



Pre-op 12week

post op

Results

The median number of days between admission and definitive fracture fixation was three days (range 0– 14 days). The fibula was fixed in 10 cases. Minimum follow-up was 12 months. Fracture healing was defined accordingly with RUST (The radiographic union score for tibia) score [9].

RUST scoring system is a reliable and repeatable outcome measure for assessing tibial fracture healing. Further improvement in the reliability of the scoring system can be obtained if the radiographs are compared with the baseline postoperative radiographs [9].

Clinical assessment is done according to LEFS; Lower extremity functional scale is a questionnaire containing 20 questions about a persons ability to perform everyday tasks. The LEFS can be used by a clinician to evaluate the functional impairment of a patient having disorder with one or both lower extremities. The lower the score the greater the disability.

Mean time to union was 6.5 months (range 4–16 months). Sixteen fractures healed with good functional outcome. Two patient had delayed union. One patient had nonunion which was treated with iliac crest bone grafting that ultimately healed with good functional outcome. One patient developed superficial infection that was treated with appropriate antibiotics and the fracture united eventually.

One of the 2 patients who had delayed union was known to have hypothyroidism, the fracture eventually healed at 13 months and the other patient with delayed union was a known smoker with non compliant to medical advices.

Patient (who developed nonunion) was a 60-year old male with uncontrolled diabetes and revision surgery with exchange plating (LCP) and bone grafting was performed at eight month. The fracture subsequently healed after six months.

Table 1: Complications

	No of Cases	Percentage
Wound infection	1	5.00
Nonunion	1	5.00
Malunion	1	5.00
Delayed union	2	10.00

	No of Cases	Percentage
Plantar Flexion >30 Dorsiflexion >5	10	50
Plantar Flexion 20-30 Dorsiflexion 0-5	4	20
Plantar Flexion 15-20 Dorsiflexion 0-5	4	20
Plantar Flexion <15 Dorsiflexion < -5	2	10

Table 3: Lefs-lower extremity functional score

Lefs Score	No of Cases	Percentage
20-40	2	10
40-60	2	10
60-80	16	80

Discussion

Pilon fractures or distal tibia fractures are one of the complex injuries associated with significant soft tissue damage because of subcutaneous nature of bone and high velocity trauma associated with these injuries. Open reduction in the distal tibia causes an increased risk of disrupting the blood supply, as shown by Borelli *et al.* [10]. LCP plating using MIPO causes minimal soft tissue damage. Therefore, it has a biological advantage over ORIF in that it preserves the periosteal blood supply and as a result increases the chance of healing [11].

Collinge and Sanders [13] have described indirect fracture reduction and percutaneous plating techniques as evolutionary steps in biological plating. Redfern *et al.* [12] and Borg *et al.* [11] reported good results for MIPO using closed, indirect reduction and contoured dynamic compression plates for distal tibial fractures.

Open reduction and internal fixation has shown increased rates of deep infection and wound dehiscence are the major soft tissue complications. The rate of infection is drastically decreased with the use of minimally invasive percutaneous plate osteosynthesis (MIPPO) in comparison with ORIF which was reflected in our results with only one case of superficial wound infection which resolved with antibiotics.

AO distal tibial locking plate using MIPPO technique provide a stable and rigid fixation of fractures minimizes the angulations and malunion without wound complication as in ORIF. The distal tibia plate is precontoured to the anatomy of distal tibia and thus allows placement of plates without disruption of fracture fragments. The distal end of plate allows placement of locking screws that provide stability. The threaded holes lock to the locking screw head and minimize the plate bone interface and maintain the vascularity of the fracture site. The proximal combination holes allow placement of locking or cortical screws where relative or absolute stability can be achieved.

Acceptable degree of alignment is 5 degree of varus/valgus and 10 degree of recurvatum or procurvatum. All of our patients were found to have acceptable reduction and alignment post operatively and at union except one.

Redfern [12] *et al.* had 1 malunion in a series of 20 patients treated with MIPO with DTLCP in their study on Minimally Invasive Plate Osteosynthesis in distal tibial fractures.

Helfet *et al.* in their series of 20 patients of distal tibial fractures treated by MIPO reported 4 cases of malunion.

Recently, Borrelli *et al.* [10] demonstrated that the distal metaphyseal region of the tibia has a relatively rich extraosseous blood supply, provided primarily by branches of the anterior tibial and posterior tibial arteries.

The “internal fixator” design of locking plates has the advantage that screw insertion does not draw the bony fragments to the plate, and hence the precise contouring of the plate is less important for achieving accurate fracture reduction.

Although our study includes only a small number of cases, the clinical and radiological results are very encouraging. This technique allows for soft tissue recovery and has gained popularity, as complication rates with this strategy appear to be significantly improved.

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