

## Original Article

# MIPO Technique for Management of Distal Tibia Fractures Using LCP-Precontoured (3.5mm & 4.5mm) - A study Done in 250 Bedded General Hospital, Tangail

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### Abstract:

Fractures of the distal tibia are unique in that the bone is subcutaneous with poor muscular coverage. The consequence of its decreased vascularity leads to complications like delayed bone union, wound complications such as dehiscence and infection. These fractures can be managed with various techniques. Open reduction and internal fixation by plating, have been used with varying results. In current orthopedic practice, minimally invasive percutaneous plating osteosynthesis (MIPO) and interlocking nailing are the preferred techniques for fractures of the distal third tibia. In our study, twenty adult patients with closed fractures of distal tibia were treated with LCP using MIPO technique & were followed for a period of one year (January 2014 to December 2014). Average age of patients studied was 40.5 years (18-55) with majority being high energy trauma (65% vs. 35%). Mean duration for surgery from day of identification to go for surgery was 4-7 days. Results were evaluated clinically and radiologically. In 18 cases (90%) fractures united & 2 cases (10%) had delayed union. All fractures were united by 20 weeks. Superficial skin infection was found in 2 cases, Valgus mal-alignment in 2 cases & 1 case had ankle stiffness. Finally results showed: 10 cases (50%) had excellent outcome, 4 cases (20%) had good outcome, 4 cases (20%) had fair outcome, and 2 cases (10%) had poor outcome.

**Key words:** MIPO (Minimally invasive percutaneous plating osteosynthesis); LCP (Locking Compression Plate); Distal third tibia fracture.

### Introduction:

Treatment of fractures of distal tibia is a challenging problem due to lack of blood supply. Various methods of internal fixation for fractures of distal tibia are on practice. Minimally invasive percutaneous plating osteosynthesis (MIPO) and interlocking nailing are the

preferred techniques for fractures of the distal third tibia<sup>1</sup>. The intramedullary nail spares the extra osseous blood supply, allows load sharing and avoids extensive soft tissue dissection. However, proximal and distal shaft fractures can be difficult to control with an intramedullary device, increasing the frequency of mal-alignment.

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Concerns regarding difficulties with reduction or loss of reduction, inappropriate fixation in fractures with articular extension, anterior knee pain and hardware failure has slowed the acceptance of intramedullary nailing as a treatment of fractures of the distal tibia<sup>2</sup>. The recent innovation of nails with tip locking is a testimony that earlier nails were insufficient fixation tools for distal tibia; however tip locking is technically difficult and fractures that require it are essentially difficult to fix with nails.

Minimally invasive sub muscular and subcutaneous plate fixation (MIPO) can address several of the issues associated with intramedullary nailing, while amalgamating all biological benefits of closed reduction and fixation. This study was done to evaluate the functional outcome, duration of union, advantages and complications using this technique.

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## Materials & Methods:

This prospective study was done in the Department of Orthopaedics and Traumatology in 250 Bedded General Hospital, Tangail from January 2014 to December 2014. Our institutional ethics committee approved the study. Twenty patients were included in this study. Patients both males and females aged from 18 to 60 years, simple, closed fracture unfavorable for interlocking nailing and complex fractures of the lower third of tibia were included. Patients aged below 18 years, those with severe renal, cardiopulmonary, hepatic and central nervous system disorders, with pathological fractures and type 3b and type 3c compound fractures of distal tibia (Gustillo Anderson) were excluded from this study.

After stabilizing the traumatized patient, routine pre-operative evaluation was done including x-rays of the involved leg.

The leg was temporarily immobilized by long leg back slab until the skin condition was favorable for surgery as evidenced by appearance of wrinkle sign. Patients with precarious skin condition were managed with limb elevation, regular dressing care & prophylactic i. v. antibiotics. Fractures were fixed by MIPO technique with distal tibial precontoured anatomical LCP (3.5mm & 4.5mm).

## Operative Procedure:

Surgery was performed under regional anesthesia with a tourniquet in supine position. The plate was applied on the anteromedial surface & fixed to tibia using cortical & locking screws under c-arm guidance. Manual traction, k-wires, Steinmann pin, reduction forceps were the tools used for indirect reduction of fracture.

After provisional reduction, a 3-4 cm vertical incision was made over the medial malleolus towards proximally with care not to injure the saphenous nerve and vein. A subcutaneous tunnel was made using a specialized elevator; the selected locking plate was applied based on the fracture pattern and body habitus of the individual as shown in Fig 1. The plate was tunneled proximally across the fracture site using the locking sleeve as a handle for insertion of the plate.

The plate was centered on the tibia, confirmed on AP & lateral views; cortical screws were inserted first depending on the need for reduction in proximal or distal fragment. After the reduction was confirmed, locking screws were inserted with aim of achieving a minimum of 6 cortices on either side of the fracture. Fig. 1 & 3 shows pre-operative and post-operative x ray

of the patient. For articular fractures pointed reduction forceps were used. Lag screws were inserted first across the fracture site followed by metaphyseal & diaphyseal fixation. The incision was closed in layers & immobilized in long leg back slab till suture removal.



Fig. 1: Radiography before operation



Fig. 2: Photograph of operation



Fig. 3: Radiograph after operation

Post-operative regimen was to immobilize the fracture in below knee walking cast for a period of 4 to 6 weeks with restricted weight bearing until there was radiological evidence of fracture healing. Full weight bearing was ensued after callus was seen in at least three cortices on AP & lateral views.

### Results:

In this study, twenty cases with twenty fractures of lower one- third of tibia in adults were surgically managed by closed reduction and internal fixation using minimally invasive percutaneous plate osteosynthesis (MIPO) with LCP from January 2014 to December 2014 in 250 Bedded General Hospital, Tangail. All patients were evaluated clinically and radiologically before and following surgery. Average period of follow up was 6 months. The age of the patient in this study, ranged from 18 years to 55 years average being 40.5 years. There were 15 male patients as compared to 5 female patients in this study. 6 patients had fracture of left lower one third of tibia and 14 patients had fracture of right tibia. All 20 fractures were closed fractures. 15 cases sustained fracture following road traffic accident (high energy trauma) and 5 cases sustained fractures following self-fall (low energy trauma). The mean duration to surgery from the day of presentation and injury was 4-7 days for soft tissue swelling around the fracture to subside as evidenced by appearance of wrinkles on the skin as shown in table I & II.

**Table I:** Showing age of the injury at presentation.

Age of injury	No. Of patients	Total
<24 hours	17	17
24 – 48 hours	3	3
>48 hours	0	0

**Table II:** Showing time between arrival and surgery

Time duration	No. Of patients	Total
Within the golden hour	0	0
1-5 days	10	10
>5 days	10	10

The fractures united in 18(90%) patients with 2(10%) cases of delayed union, which took 20 weeks of time period for the radiological signs of callus formation as shown in table III.

**Table III:** Showing duration of fracture union

Duration (In Weeks)	No. Of patients	Percentage
14	7	35
16	7	35
18	4	20
20	2	10
Total	20	100

The fracture was additionally supported by an above knee plaster of Paris slab postoperatively for 10 days and later converted to complete below knee walking cast and patient was made to walk with restricted weight bearing over operated limb. Post operatively after 4 to 6 weeks depending on the check x ray patients were allowed full weight bearing. Post-operatively, 1 patient developed superficial skin infection and 2 patients developed ankle stiffness due to loss of postoperative protocol as shown in table IV. Good amount range of mobility of ankle joint was present in almost all patients. In our present study of 20 cases, 10(50%) patients had excellent outcome, 4 (20%) had good outcome, 4(20%) had fair outcome and 2 (10%) had poor outcome.

**Table IV:** Showing complications

Complications	No. of Patients	Percentage
Superficial skin infection	2	10
Ankle stiffness		
1. >75%	0	0
2. 50 -75%	0	0
3. 25 -50%	1	5
4. <25%	1	5
Varusmal-alignment	2	10

### Discussion:

Distal diaphyseal tibia fracture with or without intra articular extension is one of the difficult fractures to manage. None of the treatment options available

perfectly fulfill requirements of fracture characteristics of distal diaphyseal tibia. Distal tibia has got circular cross sectional area with thinner cortex as compare to triangular diaphysis with thicker cortex. So, intramedullary nail, which is designed for tight interference fit at diaphysis, cannot provide same stability at distal fracture. Other potential complications of IMIL nailing are malunion (0-29%) and implant failure (5-39%)<sup>3</sup>.

ORIF with conventional plate, which needs stripping of periosteum, is also not an ideal treatment option because tibia is subcutaneous bone and periosteum provides 2/3<sup>rd</sup> of blood supply. Non-union, delayed union and infection are reported with the range of 8.3-35% and 8.3-25% respectively with ORIF with plating<sup>4</sup>.

Similarly external fixators as a definitive method of treatment for distal diaphyseal tibia fracture are also reported with higher rate of infection, implant failure and malunion or non-union and hence recommended only for temporary method of stabilization in open fracture with severe soft tissue injury.

With the development of technique of MIPO with LCP, which preserves extra osseous blood supply, respect osteogenic fracture hematoma, biologically friendly and stable fixation method is available for distal diaphyseal tibia fracture. Indirect reduction method and sub-cutaneous tunneling of the plate and application of locking screws with small skin incisions in MIPO technique prevents iatrogenic injury to vascular supply of the bone. Unlike conventional plates, LCP is a friction independent self-stable construct, which provides both angular and axial stability and minimizes risk of secondary loss of reduction through a threaded interface between the screw heads and the plate body.

MIPO with LCP for distal diaphyseal tibia fracture has been found to be an effective treatment option. But unlike the present study, most of the previous studies have included both open and closed fractures and are retrospective study. Comparative studies with IMIL or conventional open techniques have found conflicting results with MIPO with LCP for distal diaphyseal tibia fracture. Vallieret al<sup>5</sup> reported significantly more angular malalignment in distal diaphyseal tibia fracture, treated with IMIL in comparison to those treated with plating (22 patients vs. 2 patients, p=0.003)<sup>5</sup>; whereas Guo et al in a comparative study of extra articular distal diaphyseal tibia fracture reported that patients treated with IMIL nailing had

better function, alignment and American Orthopedic Foot Ankle score, though none of them were statistically significant whereas operative time (81.33 vs. 97.9 minutes, p< 0.001) and radiation exposure (2.12 vs. 3 minutes, p< 0.001) was significantly more in LCP group and higher mean pain score was found in IMIL group<sup>3</sup>. Cheng et al in a small sampled paired comparison (15 in each group) of MIPO and open technique with LCP found former is not statistically better in terms of union time (16.8 vs., 19.2 wks. p=0.737), recovery time to return to work (21.1 vs. 27.7 weeks, p=0.35) and functional results. Kao et al. found no statistically significant advantages of LCP over conventional plate group.

In spite of use of MIPO with LCP as internal external fixators, anatomical reduction of the fracture by using indirect reduction maneuvers before applying the plate is very important surgical step<sup>6</sup>.

Mal-reduction and suboptimal pre contouring of the plate can result delayed union, non-union, prominent hardware, malleolar skin irritation and pain. Low profile metaphyseal LCP has been designed to reduce hardware prominence related complications but plates specifically designed according to measurement of adult distal tibia of western population may not perfectly match to other communities and often need change in pre contouring to avoid mismatch which in turn, can change the direction.

Indirect method of reduction of fracture under C- arm can be difficult on a few occasions. No calcaneal pins or mechanical distractors were used in our present series. 3mm k wires and reduction forceps were used to facilitate proper reduction in difficult cases.

No cases of injury to the saphenous nerve or long saphenous vein or the posterior tibial tendon were observed. Atraumatic placement of the drill sleeve and careful attention towards skin incision, tunneling prevents these complications. No plates and screws were removed in this series and hence the difficulty encountered in the removal was not studied.

### Conclusion:

It is an effective method in extra articular fractures occurring within 5cm of the joint because Intramedullary nails often do not provide enough stability and external fixators usually applied for primary stabilization until soft tissue edema get subsided delays the return to work with fixators. It is a simple, has a rapid and straight forward application and has a reduced surgical time in more extra articular fractures and intra articular fractures due to newer anatomically contoured locking compression plates for the distal end tibia fractures.

Although, a larger sample of patients and longer follow up are required to fully evaluate this method of treatment, we recommend fixation of simple distal third tibia fractures (AO A1, A2, A3) with LCP using MIPO technique. Since majority of the fractures encountered in our study were simple fractures, further studies encompassing a larger group of patients with more varied fracture patterns are required to know the efficacy of LCP using MIPO to treat such fractures. Prospective randomized controlled trial specially comparing newly available intramedullary nails which has various distal locking options is necessary to establish superiority of the technique.

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