

## Outcome of minimally invasive plate osteosynthesis in distal tibial fractures

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### Abstract

**Introduction:** Distal tibial fractures present as a major challenge for the orthopedic trauma surgeons. Most non-operative treatments result in non-union or malunion and needs prolonged immobilization of the knee and ankle joints, with resulting stiffness. Open reduction and internal fixation as well as external fixation has high rate of infection and non-union. Minimally Invasive Plate Osteosynthesis has been shown to have a better outcome and has been the procedure of choice in most distal tibial fractures since the introduction of the locking compression plate. The objective of the study is to review the outcome of Minimally Invasive Percutaneous Osteosynthesis (MIPO) in unstable distal tibial fractures.

**Methods:** Charts of patients who underwent MIPO from the year 2008 to 2013 for unstable distal tibial fractures over five years at Patan Hospital and Om Hospital were reviewed. All displaced closed fractures and Gustillo Anderson Type I and II fractures were included in the study. Plates consisted of the anatomically contoured 4.5 mm LCP and 3.5 mm LCP-Pilon form plate. A simple uniplanar external fixator was used to retain the reduction till the plate was inserted and secured with locking screws. The outcome of MIPO in distal tibial fractures were followed up and evaluated. Clinical and radiological assessments were performed at 6 weeks, and at 3, 6, 9, 12 and 24 months.

**Results:** Of the 75 patients (45 male, 30 female) age ranging from 19 to 70 years (mean 47 years), 5 patients were lost to follow-up. 28 patients at 3 months, 32 at 6 months, and 8 at 9 months met the criteria for a healed fracture. Two patients required autologous bone grafting at 9 months for non-union ultimately resulting in the fracture union at 16 months. There was one malunion attributable to the loss of reduction during plate fixation. There were no deep infections, no soft tissue complications and no failures of fixation. The cause of fracture were RTA (n=35), fall from height (n=9), twisting of ankle as a result of fall from standing height (n=22), and others (n=11). The mean time for surgery from the time of injury was 5 (range, 2 to 14) days; the mean hospital stay was 10 (range, 7 to 21) days.

**Conclusion:** MIPO is an effective treatment for closed, unstable fractures of the distal tibia, avoiding the complications associated with more traditional methods of internal fixation and/or external fixation.

**Keywords:** Fractures; MIPO; Osteosynthesis; Tibial.

**Introduction**

The distal tibial fractures have always presented as a challenge to the orthopaedic trauma surgeons especially because of the precarious blood supply and the limited implant choices. Non-operative treatment can be tricky and is associated with joint stiffness (up to 40%) as well as shortening, angulation and rotational malunion (>30%).<sup>1,2</sup> In case of open fractures with contamination or which is associated with extensive soft tissue damage, external fixation (linear, circular or hybrid) may be used. However it is cumbersome and is not well tolerated by the patient. Furthermore, it is associated with pin tract infection, malunion, and non-union.<sup>3,4</sup> Open reduction and internal fixation (ORIF) requires extensive soft tissue dissection and periosteal stripping, which further compromises blood supply and is associated with high rates of infection, delayed union, and non-union.<sup>5-8</sup> Nail osteosynthesis is the preferred treatment for shaft fractures, but it is not always practical for the distal tibia, as fractures in this region are often spiral or extend to the tibial pilon. With the introduction of Locking Compression Plates (LCP), Minimally Invasive Plate Osteosynthesis (MIPO) has become increasingly popular in the distal tibial fractures, with or without intra-articular extension. The plate acts as an internal fixator in a bridging manner, and preserves bone vascularity and haematoma, resulting in secondary bone healing.<sup>9,10</sup> Results of MIPO for unstable distal tibial fractures are promising.<sup>11,12</sup> Patients who underwent MIPO for distal tibial fractures were reviewed in this study.

Furthermore we have also discussed the application of the simple external fixator to hold the reduction temporarily before the plate is secured percutaneously.

**Methods**

All the patients who underwent MIPO from the year 2008 to 2013 for unstable distal tibial fractures over five years at Patan Hospital and Om Hospital were included in the study. This study was approved by the ethical committees of our hospitals. All displaced closed fractures and Gustillo Anderson Type I and II fractures were included in the study. Patients with a complex pilon fracture or Gustillo Anderson Grade III open fractures were excluded, as well as those with ORIF or external fixation.

The patients were admitted, preoperative investigations were sent, a plaster splint was applied, the injured limb was elevated and appropriate analgesics were given until definitive treatment. Surgery was delayed only if patients had soft tissue swelling, if open fracture mandated debridement and antibiotics or if they had medical co-morbid conditions which made them unfit for anaesthesia.

Patient was placed supine on a radiolucent table; painting and draping were done following the standard aseptic precautions. Pneumatic tourniquet was inflated after elevation for 3 to 5 minutes. One 5mm Schanz pin was inserted to the proximal tibia and one into the calcaneus, both from lateral to medial side. Closed reduction was performed and the reduction was held temporarily with the incorporation of the connecting tubular rod into the pins. Figure 1. A 5cm incision was made over the anteromedial aspect of the medial malleolus, the long saphenous vein and the saphenous nerve were identified and protected. The anatomically contoured 4.5 mm LCP and 3.5 mm LCP-Pilon form plate (Greens Surgical, New Delhi, India) was inserted extraperiostally under image intensifier guidance. The plate was fixed with at least 3 locking screws in the proximal and distal fragments (5.0-mm and 4.0-mm screws, respectively). Ordinary 4.5mm cortical screws were also used when demanded by proper reduction. In 15 patients with associated lateral malleolar fractures associated with severe comminution of the distal tibia, the fibula was also fixed with 3.5mm reconstruction plates and 3.5mm cortical screws for restoration of leg length Figure. 2.



**Figure 1: Application of external fixator prior to insertion of plate**



**Figure 2: Insertion of the plate with minimally invasive technique with the external fixator in situ**



Figure 3: Fracture of distal tibia and proximal fibula



Figure 5: Six weeks after surgery, alignment maintained



Figure 4: POD 1 Immediate post operative x-ray after MIPO



Figure 6: Twelve weeks after surgery, with bridging callus

Clinical and radiological assessments were performed at 6 weeks, and at 3, 6, 9, 12 and 24 months. Five patients were lost to follow-up.

Fracture healing was defined as callus bridging of three out of four cortices, seen on both lateral and antero-posterior X-ray, and full, painless weight bearing.<sup>11,12</sup>

Postoperatively, crepe bandage was applied or an above-knee plaster of Paris slab was applied for one to two weeks depending upon the severity of soft tissue injury. Sutures were removed at 14<sup>th</sup> post operative day. Early active and passive knee and ankle range of motion exercises were encouraged. Partial weight bearing with crutches was allowed for the first 6 weeks and then gradually progressed to full weight bearing. The patients were followed up and evaluated for a mean of 27 (20 to 36) months. Clinical and radiological assessments were performed at 6 weeks, and at 3, 6, 9, 12 and 24 months.

## Results

There were 75 unstable distal tibial fractures who underwent MIPO (right, n=50 and left, n=25). Five patients were lost to follow-up. 28 patients at 3 months, 32 at 6 months, and 8 at 9 months met the criteria for a healed fracture. Two patients required autologous bone grafting at 9 months for non-union ultimately resulting in the fracture union at 16 months. There was one malunion attributable to the loss of reduction during plate fixation. There were no deep infections, no soft tissue complications and no failures of fixation. The cause of fracture were RTA (n=35), fall from height (n=9), twisting of ankle as a result of fall from standing height (n=22), and others (n=11). The mean time for surgery from the time of injury was 5 (range, 2 to 14) days; the mean hospital stay was 10 (range, 7 to 21) days. (Table). The mean time to full weight bearing was 14 (range, 8–22) weeks. The mean time to bone union was 14 (range: 12–36) weeks.

The range of motion of the ankle joint in all patients was comparable to the contralateral side. Three patients had superficial infection, which was resolved with intravenous antibiotics and regular dressings. Three patients had their implants removed at 18 months because of hardware prominence, and 50 more had their implants removed for psychosocial reasons at 18 to 36 months (mean, 22 months). There were no significant discomfort but mild persistent pain was a common complain, especially until the implant was present.

## Discussion

Distal tibial fractures are notorious for their lack of muscle attachments and precarious blood supply. Subcutaneous location of the bone on the medial side make it vulnerable to direct contact with foreign objects.<sup>13</sup> The rotational component of the energy which results in most of the fractures at this level makes intramedullary nailing very difficult and often include nail or locking bolt failures, malunion, wound infection, and bone healing problems. The distal metaphyseal tibia has a rich extra-osseous blood supply provided by branches of the anterior and posterior tibial arteries; disruption of this extra- osseous blood supply is greater in open plating than MIPO.<sup>14</sup> ORIF results in further devascularization of already compromised supply because of extensive soft tissue dissection and periosteal stripping, which in turn results in infection, non-union, and implant failure.<sup>15,16</sup> MIPO with LCP, although technically demanding, has come up with a very valid and promising option in the treatment of distal tibial fractures. It is minimally invasive, preserves blood supply and fracture hematoma, is elastic but adequately strong to resist bending or torsional deforming forces.<sup>17</sup>

In our study, the delay in surgery was chiefly due to soft tissue swelling, medical co-morbid conditions, unavailability of the operating room, open fractures and/or financial reasons. Longer hospital stay was attributable to the long distance to the patients' homes and transportation problems. The time needed for clinico-radiological union and the time to full weight bearing were comparable to other studies.<sup>11,18,19</sup>

## Conclusion

MIPO is an effective treatment for unstable fractures of the distal tibia, avoiding the complications associated with more traditional methods of internal fixation and/or external fixation.

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