Minimal invasive percutaneous plate osteosynthesis (MIPPO) in treatment of distal tibial fractures: A prospective study of 50 cases

Dr. Subeg Singh, Dr. Kapil Bansal, Dr. Anshul Dahuja, Dr. Radhe Shyam Garg, Dr. Yugpreet Singh and Dr. Rohit Kumar

DOI: https://doi.org/10.33545/orthor.2021.v5.i3c.307

Abstract

Background: The limited soft tissue, subcutaneous location of large portion of tibia and precarious blood supply renders the treatment of distal tibial fracture very challenging. The main treatment of this type of fracture is reinstatement of the normal alignment and articular congruity. Conventional osteosynthesis is not suitable because distal tibia is subcutaneous bone with poor vascularity. Closed Reduction and MIPO with locking compression plate (LCP) has emerged as an alternative treatment option because it respects biology of distal tibia, maintains fracture haematoma and provides biomechanically stable construct, early mobilization, less complications and relatively higher rates of union. The aim of this study was to evaluate the functional and clinical outcomes of distal tibia fracture of patients, treated by internal fixation by minimally invasive plating osteosynthesis (MIPO) technique with locking compression plate (LCP).

Methods: 50 patients with distal tibia fracture with or without intra articular extension were treated in our department at Guru Gobind singh Medical College and Hospital, Faridkot by MIPO with LCP and were prospectively followed for average duration of 6 months. The outcome was evaluated using American Orthopadic Foot and Ankle Society (AOFAS) score.

Results: There were 50 patients in the study including 36 males and 14 female of mean age 38.4 years. The mean follow up period of our patients was 6 months. All fractures united at an average of 19.13 weeks (range 16-24 to weeks) except two cases of non-union. There were 12 superficial wound infections which were treated with oral antibiotics and progressed to union and there were no failures of implants. According to AOFAS score at 6 months, 6 cases had score of 31 to 70 and 44 cases had score of 71 to 100.

Conclusions: Minimally invasive plating osteosynthesis (MIPO) is an effective method of treatment for distal tibial fractures. The use of indirect reduction techniques and small incision is technically demanding as it is effective, minimally invasive, optimises the operation time, promotes early healing and reduces the incidence of infections.

Keywords: Distal tibia fracture, LCP, MIPPO

Introduction

Distal tibial fractures are a big challenge to an orthopaedic surgeon as far as management of these injuries are concerned. Various problems associated with these fractures are:- subcutaneous location of the bone with associated soft tissue trauma, high incidence of compound fractures combined with poor vascularity which many a times lead to delayed union or non-union. Achieving and maintaining anatomical axial and rotational alignment of limb and getting a good functional outcome with minimal soft tissue damage are the main factors that make the management of these fractures all the more difficult.

As far as classification of distal tibial fractures are concerned two classifications system are mainly in use

- Reudi and Allgower's classification \(^\text{[1]}\),
- AO/OTA classification \(^\text{[2]}\) – more comprehensive and complete classification
Main aim of management of these fractures are to achieve and maintain proper axial and rotational alignment of limb till union, minimal soft tissue damage, accurate restoration of articular surface whenever required and a sound functional outcome. Different management methods for these fractures are - close reduction and POP cast application, use of external fixator or distractors, nailing and open reduction and internal fixation (ORIF) with plating. Each method has its own advantages and disadvantages. However there is a general consensus that operative treatment is the treatment of choice for such fractures to achieve almost a perfect bony union and excellent functional outcome. External fixators are quite useful in compound injuries especially with severe soft tissue trauma. However pin related problems, joint contractures and stiffness, delayed union and poor patient compliance are the main issue associated with it. Intramedullary nailing is quite effective as it preserve the fracture biology and allow early joint motion. However, as the fracture tends to be more distal including intra-articular, it is difficult to get a mechanically stable construct with nail. ORIF with traditional plating system requires extensive soft tissue stripping with associated soft tissue and bony problems leading to more devascularisation lead to higher incidences of delayed union and non-union with poor functional outcome. All these factors have led to development of concept of biological osteosynthesis using locking plates. These locking screws provide angular and axial stability thereby decreasing the chances of loosening and the whole construct act as an internal splint. This technique is very useful especially for distal tibial, comminuted fractures where-in an indirect reduction is done and the locking plates are mainly used by minimal invasive percutaneous plate osteosynthesis (MIPPO), technique bridging the comminuted segment minimizing soft tissue dissection and devascularisation of bony fragments without much compromise on stability. The present study was also carried out mainly to assess the clinical outcome of minimal invasive percutaneous plate osteosynthesis in management of distal tibial fractures.3

**Material and Methods**

This was prospective study of 50 cases of either sex of distal tibial fractures treated in a tertiary care centre (Guru Gobind Singh Medical College and Hospital, Faridkot). All closed/open type 1 and 2 (as per Gustillo and Anderson classification) without or with (non-comminuted) joint involvement were included in the study. However type 3 compound fracture and fracture’s (AO B3 and C3) with grossly comminuted articular involvement and those with evidence of infection were excluded from the study. After initial resusitation in the emergency department and thorough examination to rule out associated injuries, patient was then subjected to surgery after thorough investigation and pre-anesthetic clearance. Informed consent was taken of every patient. Under spinal/ epidural anaesthesia patient operated in supine position on radiolucent table under all aseptic conditions. Indirect reduction was done with the help of manual traction-counter traction or femoral distractor. In case of intra-articular fracture minimal open reduction of fracture was done. Reduction was verified under C-ARM and when found accepted, stabilised using minimally invasive technique. In this technique an oblique incision was made at the tip of medial malleolus and extended proximally to creat easy passage. The proximal position of the plate was checked to ensure central placement on the tibial shaft using the C-ARM. Minimum of 3-4 screws were used in each main fragment. Immediate post-operative and then regular radiograph was taken at monthly interval to assess the union and functional outcome according to AOFAS (American Orthopaedics foot and ankle society). AOFAS score based on 3 categories, pain (40 points), function (50 points) and alignment (10 points).

**Observations and Results**

| Table 1: Pre-operative parameters |
|----------------------------------|
| Sr. No | Parameters | Number | Percentage |
|-------|------------|--------|------------|
| 1     | Age (years) | 18-20  | 8         | 16%        |
|       |            | 20-40  | 28        | 56%        |
|       |            | 40-60  | 12        | 24%        |
|       |            | >60    | 2         | 4%         |
| 2     | Sex        | Male   | 36        | 72%        |
|       |            | Female | 14        | 28%        |
| 3     | Mode of injury | RTA | 50 | 60% |
|       |            | Fall from height | 14 | 28% |
|       |            | Direct assault | 6 | 12% |
| 4     | AO Classification | Type A | 34 | 68% |
|       |            | Type B | 10 | 20% |
|       |            | Type C | 6 | 12% |
| 5     | Type of fracture | Open | 14 | 28% |
|       |            | Close | 36 | 72% |

| Table 2: Post-operative parameter |
|----------------------------------|
| Sr. No | Parameters | Number | Percentage |
|-------|------------|--------|------------|
| 1     | Complications | Fever | 6 | 12% |
|       |            | Skin necrosis | 2 | 4% |
|       |            | Superficial Infection | 12 | 24% |
|       |            | Malunion | 4 | 8% |
|       |            | Non-union | 2 | 4% |
|       |            | Deep infection | 2 | 4% |
| 2     | Time of Union | 16 Weeks | 16 | 32% |
|       |            | 20 Weeks | 24 | 48% |
|       |            | 24 Weeks | 7 | 14% |
|       |            | Non-union | 3 | 6% |
| 3     | AOFAS Pain score | No pain – mild | 46 | 92% |
|       |            | Moderate - severe | 4 | 8% |
| 4     | AOFAS Function score | 10-30 | 8 | 16% |
|       |            | 30-50 | 42 | 84% |
| 5     | AOFAS Alignment score | Poor | 6 | 12% |
|       |            | Fair to good | 44 | 88% |
| 6     | AOFAS Total score | 0-30 | 0 | 0% |
|       |            | 30-70 | 7 | 14% |
|       |            | 70-100 | 43 | 86% |
Discussion

Treatment of distal tibial fracture have always posed a challenge because of associated soft tissue injury and comminution. The main aim of managing these fracture is to achieve bony union in proper alignment and good functional outcome. Present study enrolled 50 patients with fracture of distal end tibia using locking plate by MIPO technique.

In our study it was found that distal tibial fractures were common in middle age group (20-40) with mean age 38.4 years. As this is the age group which indulge in more outdoor activities, so they were prone to accident with vehicular accident. Male predominance (72%) was seen. Similar results were reported by Hazarika et al. [4] and Mushtaq et al. [5] in their studies.

Most common mode of injury was road traffic accident (60%), fall from height (28%) and assault (12%). Hence distal tibia fracture most commonly occure after high energy trauma especially RSA so soft tissue insult is also quite high, here lies importance of appropriate management of such fracture. Similar observations were made in studies conducted by Gupta et al. [6] and Leung et al. [7].

We used AO/ATO classification system. Most common fracture type was Type-A (68%) Type-B (20%) and Type-C (12%). Studies conducted by Leung et al. [7] and Ronga et al. [8] has similar pattern of fractures.

Out of 50 distal tibial fracture 47 fracture (94%) united primarily after fixation; of these 16 (32%) united by 16 week, 24 (48%) by
20 weeks and 7(14%) fractures healed by 24 weeks. Average time of union was 19.13 weeks. Fracture non-union was observed in three patient (6%) at 6 months. In two patient implant removal was done before union, due to development of deep infection. Similar union rate and time was also reported by Mushtaq et al. [5], Ronga et al. [8], Bahari et al. [9], Zha et al. [10]. We have 12 (24%) superficial infections in our study using MIPO, all of them heal with oral medications. 2 (4%) case had early scar breakdown which was managed by debridement and dressings till the granulation tissue was formed and later wound closure was done. Gupta et al. [6], Hazarika et al. [4] and Mushtaq [5] et al. also have similar share of complications in there series. Malunion was observed in 4 (08%) patients. Valgus mal alignment was observed on immediate post-operative radiographs of this patient which healed with no change in alignment. The other patient had varus malunion at 6 month follow up. Such observations are comparable to the study conducted by Protzman et al. [11].

In present study, AOFAS score was used to analyse the functional outcome of the cases. It was observed that final average AOFAS score at 6 month was 84.2. Similar results were reported by Bahari et al. [9], Jha et al. [10] and Collinge et al. [12].

Conflict of interest: Nil

Conclusion
MIPO with LCP is a reliable and effective method of treatment for the distal tibial fractures with or without intra articular extension, preserving most of the osseous vascularity and fracture haematoma and thus providing for a more biological repair. The use of indirect reduction technique and small incision is technically demanding as it is effective, minimally invasive, safe, optimises the operation time, reduces the incidence of infection, allows restoration of limb alignment and provides good clinical and radiological results with low complications and high union rates.

References
1. Ruedi T, Algower M. Fractures of the lower end of tibia into the ankle joint. Injury 1969;1:92-9.
2. Orthopaedic Trauma Associated Committee for Coding and Classification. Fracture and Dislocation compendium. J Orthop Trauma 1996;10(1):1.
3. Smith WR, Ziran BH, Anglen JO, Stahel PF. Locking plates: tips and tricks. J Bone Joint Surg Am. 2007;89(10):2298-307.
4. Hazarika S, Chakravarthy J, Cooper J. Minimaly invasive locking plate osteosynthesis for fractures of distal tibia-results in 20 patients. Injury 2006;37(9):877-87.
5. Mushtaq A, Shahid R, Asif M. distaltibial fracture fixation with locking compression plate (LCP) using minimally invasive percutaneous plate osteosynthesis (MIPPO) technique. Eur J Trauma Emerg Surg 2009;35:159-64.
6. Gupta RK, Rohilla RK, Sangwan K, Singh V, Walia S. Locking plate fixation in distal metaphyseal tibial fractures: series of 79 patients. Int Orthop 2009;33:120-3.
7. Leung FK, Law TW. Application of minimally invasive locking compression plate in treatment of distal tibial fractures. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2009;23:1323-5.
8. Ronga M, Longo UG, Maffulli N. Minimally invasive locked plating of distal tibia fractures is safe and effective. Clin Orthop Relat Res 2009;468:110-4.
9. Bahari S, Lenehan B, Khan H, McElwain JP. Minimally invasive percutaneous plate fixation of distal tibia fractures. Acta Orthop Belg 2007;73:635-40.
10. Zha G, Chen Z, Qi X. Minimally invasive percutaneous locking compression plate internal fixation in the treatment of tibial fractures. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2008;22:1448-50.
11. Protzman R, Collinge C. Outcomes of Minimally Invasive Plate Osteosynthesis for Metaphyseal Distal Tibia Fractures. J Orthop Trauma 2010;24:24-9.
12. Collinge C, Kuper M, Protzman R. Minimally invasive plating of high-energy metaphyseal distal tibia fractures. J Orthop Trauma 2007;21(6):355-61.