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ORIGINAL ARTICLE

RADIOLOGICAL AND FUNCTIONAL OUTCOME OF MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS (MIPO) IN CLOSED FRACTURES OF TIBIA

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ABSTRACT

Background: Operative treatment of the distal tibia fractures have higher rate of non-union and infection rates. Minimally Invasive Plate Osteosynthesis (MIPO) is one treatment option with added advantages of minimal soft tissue dissection. In this paper we explained the radiological and functional outcome of closed distal tibial fractures treated by MIPO. The objectives of this study were to determine the radiological and functional outcome of closed tibial fractures treated by Minimally Invasive Plate Osteosynthesis (MIPO).

Material and Methods: This descriptive study was conducted in Orthopaedic Division Lady Reading Hospital Peshawar from 30th July 2021 to 30th June 2023. In this study all patients of distal tibia fracture fulfilling the inclusion criteria were treated with MIPO. Post-operative radiological outcomes was determined using Radiologic Union Scale in Tibia(RUST) and functional outcome using Knee Society Clinical Rating and Olerud-Molander Ankle Score(OMAS) respectively. The data was analyzed with SPSS version 29.

Results: We treated 38 distal tibia fractures with MIPPO. Thirty-three patients were male and 5 females. The mean age was 31±3.2 years (ranged 20 to 60 years). At 9±5.3 months 35(92.1%) patients were radiologically healed with RUST score of 3. At one year 32 (91.42%) patients had excellent outcome and 3 (8.57%) had acceptable outcome using Knee Society Clinical Rating. The Olerude-Molander Ankle score was excellent in 30(85.71%) and good in 5(14.28%) patients.

Conclusion: Minimally Invasive Plate Osteosynthesis (MIPO) produced excellent radiological and functional results in majority of our patients. We therefore recommend MIPO as treatment of first choice for closed distal tibial fractures.

KEY WORDS: Minimal Invasive Plate Osteosynthesis; MIPO; Locking Plate; Radiographic Union Scale in Tibia; RUST.

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INTRODUCTION

Tibia is one of the most commonly encountered long bone fractures in Orthopaedic practice. The usual aetiology is high-energy trauma like car crashes and sports-related injuries. The subcutaneous position of the tibia increases the risk of soft tissue problems, making the management of these fractures more challenging.[1] Although traditional open reduction and internal fixation techniques are successful in attaining anatomical alignment. They are frequently linked to significant soft tissue dissection leading to increased risk of infection, delayed union, and nonunion.[2] Minimally Invasive Plate Osteosynthesis (MIPO) is a relatively newer, potentially effective treatment option that attempts to reduce soft tissue damage and other complications.[1-5] Intramedullary interlocking nail is yet another fixation implant for tibial fractures but it is suitable for diaphyseal fractures and is technically difficult for fixing distal tibia fracture specially with conventional tibial interlocking nails as distal nail locking is difficult to achieve because of short distal fracture fragment.[6] Minimally Invasive Plate Osteosynthesis (MIPO) entails the percutaneous insertion of locking plates with the least amount of soft tissue surrounding the fracture site being dissected.[7] With this treatment there is less chance

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of complications compared to traditional open techniques as biological healing is encouraged and the vascularity of the fracture fragments is preserved.[8] An increasing amount of research indicates that MIPO as opposed to traditional open reduction and internal fixation techniques provided better radiological and functional results in majority of patients.[9-12]

The purpose of this study was to assess the radiological and functional results of MIPO in the management of closed distal tibial fractures. The results of this study will add to the expanding body of knowledge on minimally invasive orthopedic procedures and would provide Orthopaedic surgeons important new perspectives on how to best treat distal tibial fractures. Our results will be used to formulate guidelines for treating closed distal tibial fractures in adults.

MATERIAL AND METHODS

We conducted this descriptive study in Orthopaedic Division Lady Reading Hospital Peshawar from 30th July 2021 to 30th June 2023.The study was approved by Institutional Review Board(IRB) Lady Reading Hospital Peshawar. Informed written consent was obtained from all participants for surgery and publication of results. All adults patients of both gender and all ages with closed distal tibial fractures(within 10 cm from ankle joint) presented within one week were included in this study. Patients with open tibial fractures, ipsilateral fibula fractures requiring surgical intervention, pathological fractures, with compartment syndrome and poly trauma patients requiring surgical interventions for other injuries were excluded from this study. Complete history and clinical examination of all the included patients were done. Radiographs of tibia in AP and lateral projections were taken and patients were prepared for surgery.

Surgical Technique

All surgeries were performed on radiolucent fracture table by the same surgical team under general or spinal anaesthesia and tourniquet control. Before incision tibia fractures were reduced using manipulation under image intensifier. For distal tibia fractures the plate was introduced through a small distal incision over the medial malleolus and slipped sub-muscularly over the periosteum. Only pre-contoured locking titanium plates were utilized. Plate was made central on tibia and checked under image intensifier. Temporary fixation was performed utilizing 1 mm K-wires through tiny holes in the implant to ensure the final plate location before inserting the first screw. Once perfect restoration of length, alignment, and rotation was achieved, the plate was temporarily stabilized with a single conventional cortical "positioning" screw. The screw was inserted into the non-locking hole through the plate. To achieve the ultimate reduction, the distal segment was dragged up against the plate and secured in place with the use of reduction clamps, push and pull devices, and image control. After passing a final positioning screw for a secure grip, additional proximal and distal screws were passed. The length of plate and number of screws were decided based upon fracture location and comminution.(Fig IA & IB) The wound was closed and slab applied. Intravenous antibiotics (Cefuroxime) was continued for 72 hours after surgery. Patients were allowed partial weight bearing at 6th week and full weight bearing at 10th week.

Post-operative follow up visits were scheduled at two weeks and 6th week initially and then monthly for one year. In follow up visits radiological outcome (x-ray AP and lateral view)was assessed with RUST score as 1(callus absent & fracture line visible),2(callus present & fracture line visible) and 3(callus present & fracture line not visible).[13] Functional outcome was assessed by Knee Society Clinical Rating Scores[14]with excellent(85-100), acceptable (70-84), fair (60-69), and bad (<60) outcome. For the ankle Olerud-Molander Ankle Score(OMAS)[15] scoring system was used with excellent(91-100 score), good(61-90), fair (31-60) and poor (0-30) outcome. At 9th months patients with RUST score of 1, Knee Society Clinical Rating Scores <60 and OMAS score <30 were declared non-union and offered revision surgery.

We analyzed our data with SPSS version 29. Frequencies and percentages calculated for qualitative variables like gender, aetiology of fracture and side of fracture. Mean and standard deviations were calculated for quantitative variables like age. Chi square test was used to calculate p value for statistical significance of categorical variables. Independent sample t test was used to calculate P value for the means of RUST score, Knee Society Clinical Rating Scores and Olerud-Molander Ankle Score(OMAS) scoring system.

RESULTS

In this study 38 patients with mean age 31±3.2 years (ranged 20 to 60 years) were treated with MIPO. The mean follow up period was 14.5±1 months. There were 33(86.84%) males and 5(13.15%) female patients. The aetiology of fracture was motorbike accidents in 17(44.73%), fall in 11(28.94%) and motor car accidents in 10(28.11%) patients. Right tibia was fractured in 21(55.26%) patients and left in 17(44.73%). The average union time was 4.6±3.2 months. At 9±5.3 months 35(92.1%) patients were radiologically healed with RUST score of 3. Only 3(7.89%) patients had RUST score 1, Knee Society Clinical rating score 44±4 and OMAS score 21.4±7 and were declared non-union and offered revision surgery. At one year 32 (91.42%) patients had excellent outcome and 3 (8.57%) had acceptable outcome using Knee Society Clinical Rating. The Olerude-Molander Ankle score was excellent in 30(85.71%) and good in 5(14.28%) patients. No significant difference was noted when functional and

radiological outcome was compared with gender, age and side of fracture (p=0.12). Superficial surgical infection was noted in 2 (5.26%) patients and was treated with antibiotics.

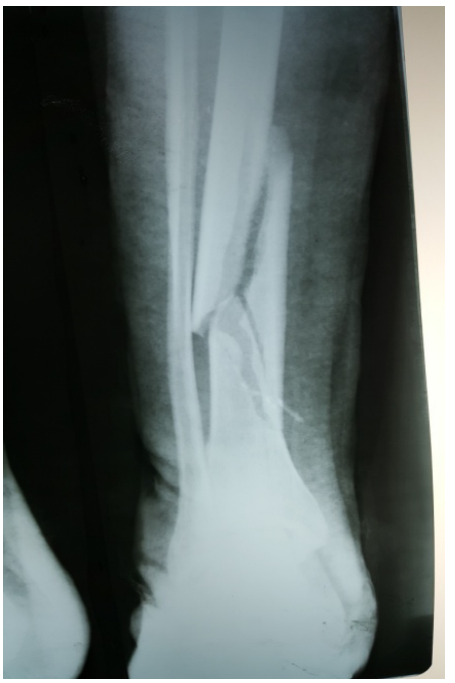

Fig IA: Pre-operative x-ray of distal tibia fracture

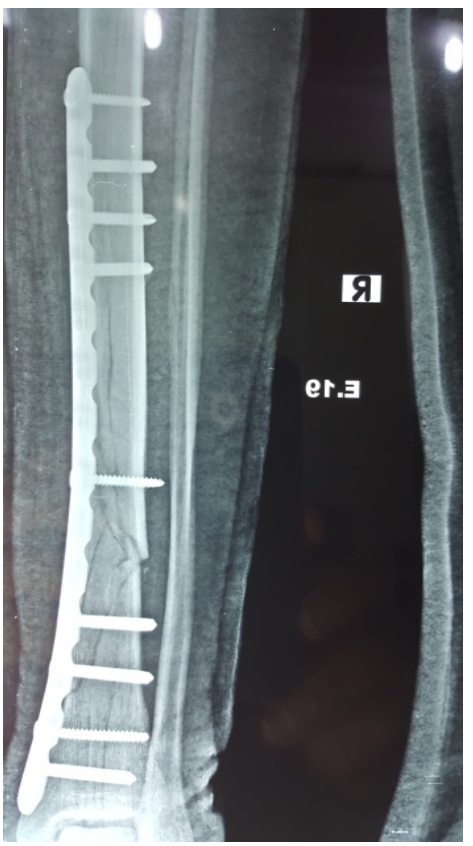

Fig IB: Post-operative x-ray of distal tibia fracture fixed with MIPO

DISCUSSION

We treated 38 distal tibia fractures with MIPO. We achieved union in 35(92.1%) patients. Non-union was observed in 3(7.89%) patients. Functional outcome at one year was excellent in 32 (91.42%) patients and acceptable in 3 (8.57%) patients using Knee Society Clinical Rating. The Olerude-Molander Ankle score was excellent in 30(85.71%) and good in 5(14.28%) patients. Our results are comparable to national and international studies. Vikranth[16] treated 30 distal tibia fractures with MIPO and reported excellent functional outcome in 16(54%), good in 9(30%), fair in 4(12%0 and poor in 1(4%) patients assessed with OMAS scoring system. Jeevo et al[17] treated 23 distal tibia fractures with MIPO and noted American Orthopaedic Foot and Ankle Score (AOFAS) of 92.43±5.6 at six months. They noted no case of non-union and mal union in their series. Singh and Ghani[18] treated 21 extra articular distal tibia fractures with MIPO and documented excellent results in 7(33.3%), good in 10(47.7%), fair in 2(9.5%0 and poor in 2(9.5%) patients as assessed with OMAS scoring system. The complications in this series were mal union in 2(9.5%), non-union in 1(4.8%), infection in 2(9.5%) and ankle stiffness in 1(4.8%) patient. Sharma and colleagues[19] treated 32 patients with MIPO and reported excellent functional outcome in 14(38.9%), good in 15(41.7%), fair in 5(13.9%) and poor in 2(5.6%) patients as per AOFAS scoring system. These authors documented mean radiological union time of 16.72 weeks in their study. Superficial surgical site infection was observed in 2(5.5%) patients in this series. Karmakar[20] treated 20 patients with MIPO and noted excellent outcome in 10(50%) cases, good in 4(20%), fair in 2(20%) and poor in 2(10%) cases assessed with AOFAS. Superficial infection was observed in 2(10%) cases. In one local study conducted in Shalamar Medical & Dental college Lahore[21] reported the outcome of 60 distal tibia fractures treated with MIPO as excellent outcome in 40(67%), good in 16(27%),fair in 3(5%) and poor in 1(1.6%) patient as assessed with Ovadia-Beals Scoring system. Superficial infection and non-union was reported in one case each in this series. In another local study conducted at Services Hospital Lahore Akhtar et al[22] reported excellent outcome in 48(82.6%) and good in 6(10.34%) patients when assessed with Tenny & Wiss criteria.Superficial infection was noted in 3(5.17%) patients.

Our study had few limitations. The design of our study was descriptive and our sample size was relatively small. We therefore recommend further studies to address these limitations and further verify our results.

CONCLUSION

Minimally Invasive Plate Osteosynthesis (MIPO) pro-

duced excellent radiological and functional results in majority of our patients. We therefore recommend MIPO as treatment of first choice for closed distal tibial fractures.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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None declared.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	NU, AAM
Acquisition, Analysis or Interpretation of Data:	NU, AAM, SIB, FAS
Manuscript Writing & Approval:	NU, AAM, SIB, FAS

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.