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Outcome of minimally invasive plate osteosynthesis (MIPO) for distal tibial fractures

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Abstract

Background: Distal tibial fractures, also known as Pilon fractures constitute about 5 to 10 percent of the tibial fractures. These fractures are difficult to manage. MIPO (Minimal invasive plating osteosynthesis) technique is indicated for fractures with minimal articular comminution and the fractures where soft tissue envelope is minimally damaged. It works on Biological Fixation Principle, in which blood supply to the fracture fragments is maximally preserved.

Aim: The purpose of this retrospective study is to evaluate the outcome of MIPO for distal tibial fracture.

Design: This is a single center retrospective study conducted between 2016 and 2019 in a Tertiary Care Hospital (Medical College Hospital).

Method: 19 patients of distal tibial fracture operated with MIPO technique using pre-contoured metaphyseal LCP (locking compression plate) were analyzed retrospectively. Fractures were classified as per AO system and patients were followed and scored according to TEENY and WISS clinical scoring criteria.

Result: Among 19 patients operated, there were 14 males and 5 females with a mean age of 41.32 years (ranging from 26-66 yrs). 16 patients sustained extra-articular fractures (type A), 02 partial-articular fractures (type-B) and 01 total-articular fracture (type C). High energy trauma (road traffic accident) predominated causing 13 fractures. Average trauma surgery interval was 10 days (02-16 days). Patients were followed, minimum for 01 year (range 1-4 years). Surgical wound breakdown with implant exposure was seen in 01 case. Based on Teeny and Wises clinical rating system, all except one patient had an 'Excellent'/good outcome.

Conclusion: MIPO is an effective and safe technique for the management of distal tibial fractures without intra-articular comminution and minimum soft tissue damage. It preserves bone biology by maintaining balance between revascularization and mechanical perfection. Further studies with longer follow-up and large sample size are warranted.

Keywords: Distal tibia fracture, MIPO technique, Locking Compression Plates (LCP), Tibial Pilon

Introduction

Distal tibial fractures, also known as Pilon fractures or plafond fractures constitute about 5 to 10 percent of the tibial fractures caused by high energy trauma^[1]. These fractures are difficult to manage due to subcutaneous location, scarcity of blood supply and sometimes involvement of the ankle joint. Many classification systems are there for these fractures but AO-OTA alphanumeric classification is the most popular. Open reduction, internal fixation was popularized by Ruedi and Allgower^[2-4] but their impressive results were not paralleled by other authors and subsequent reports showed significant number of major complications which are mainly attributed to damage of soft tissues. This led to change in the philosophy of treating such injuries. Currently, two methods are gaining popularity. One method is wire fixators, which is useful in highly comminuted fractures with significant soft tissue damage^[5-7]. Other is MIPO (Minimal invasive plating osteosynthesis) technique, when there is minimal articular comminution and the soft tissue envelope is minimally damaged^[8-9]. It works on Biological Fixation Principle, in which blood supply to the fracture fragments is maximally preserved. Plate is inserted percutaneously to place on epi-periosteum and is fixed at a distance proximal and distal to the fracture site through minimal exposure. The purpose of this paper is to evaluate the outcome of MIPO for distal tibial fracture.

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Material and Method

A retrospective study was done for patients of distal tibial fracture treated by MIPO technique in our Institute after proper approval by the relevant ethical committee. A full informed consent was taken from all subjects to participate in this study. 19 patients (14 males and 5 female) of distal tibial fracture were studied retrospectively from April 2016 to March 2019. The cases were selected from medical record department of this institution by review of the case files during study period. AO Classification ^[10] used to classify Distal Tibial Fractures [Figure 1].

Inclusion Criteria

1. AO-OTA Types A, B & C1 confirmed by preoperative radiograph.
2. Closed/Open (Grade 1 of Gustilo Anderson Classification)

Exclusion Criteria

- i. AO-OTA Types C2, C3 fractures, confirmed by preoperative radiograph.
- ii. All Open fractures except Grade 1 of Gustilo Anderson Classification
- iii. All distal tibia fractures, associated with other major injuries e.g. head injury, Chest injury, Pelvic injury etc.

Surgical Technique: All cases were operated by standard MIPO technique using Distal Tibial Locking Plate (DTLCP) within an average of 10 days (2-16 days) of injuries. Steps of standard surgical procedure [Figure 2] were followed in all cases. Perioperative periods were uneventful.

Follow up: Follow up for a mean period of 25 months was done in all patients for clinical & radiological evaluation. The functional outcome was evaluated with the clinical rating system for the ankle by Teeny and Wiss criteria ^[11]. At every 6 months follow-up and graded as Excellent (>92 points), good (87-92points), fair (65-86points) and poor (<65 points).

Results

There were 19 patients of distal tibial fracture operated with MIPO technique among which 14 were males and 5 females with a mean age of 41.32 years (range of 26-66 yrs.).

As per AO classification, 16 patients sustained extra-articular fractures (type A) and 03 intra-articular fractures (2 cases of type B and 1 case of type C1). High energy trauma predominated in this study, causing 13 fractures. Average trauma surgery interval in this study was 10 days (02-16 days). Thirteen patients (70%) had an associated ipsilateral fibula fracture, which were fixed with plate / Titanium Elastic Nails (TENS) to maintain the length.

Bony union was achieved in less than 10 weeks in 13 patients, 10-12 weeks in 03 patients and 12 to 14 weeks in 02 patients. All except 01 fracture united in acceptable alignment [Figure 3 & 4] without any shortening and varus/valgus/rotational deformity. The mean range of motion at the ankle joint was 25 degree of dorsiflexion and 40 degree of plantar flexion. Based on Teeny and Wiss clinical rating system, all except one patient had an 'Excellent'/good outcome [Table 1].

Complications like wound infection was seen in 01 case [Figure 5] that had surgical wound breakdown with implant

exposure at 6 months follow-up. This was treated with removal of implant followed by antibiotics, formal debridement and regular dressings. Fortunately wound healed but fracture went on to delayed union at 14 months follow-up.

Discussion

Distal 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 tibia. Though intramedullary interlocking nailing (IMIL) is less invasive compared with traditional plating but achieving reduction and fixation can be difficult because of the shorter distal fragment ^[12-14]. Other potential complications of IMIL nailing are malunion (0-29%) and implant failure (5-39%) ^[15]. ORIF with conventional plate which needs stripping of periosteum is also not an ideal treatment option because of increased complications like non-union, delayed union and infection.

With the development of technique of MIPO with LCP which preserve extra osseous blood supply, respect osteogenic fracture hematoma, biologically friendly and stable fixation method is available for distal 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.

The average age incidence in our study is 41.32 years (range 26 - 66 years) and sex distribution shows 14 males (75%) and 5 females (25%). Higher prevalence in males are most probably because of the fact that the fracture is a common occurrence in vehicular accidents (72.5 percent) which are more common amongst the male population. This is showing similarity with other studies ^[16-18].

Average trauma surgery interval in this study was 10 days (range 02-16 days) which is similar to other studies ^[17-18]. Concomitant fibula fracture also play the role in success of reduction especially when fracture is at same level of tibia. In this study, 03 cases were treated with fibular plating and in one case by TENS to maintained length of fibula.

Radiologic union and full weight bearing was achieved in 13-16 weeks in 75% of cases while in 25% it was seen in 17-20 weeks showing similarity with other studies ^[16-20].

Complications like superficial wound infection in 02 cases and which healed with antibiotics and daily dressing. In one case surgical wound breakdown with implant exposure found in series which needed debridement and dressing. Fortunately fracture became sticky and then implant was removed. With regular dressing, the wound healed.

Based on Teeny and Wiss clinical rating system, all except one patient had an 'Excellent'/good outcome. One elderly patient with known diabetic of extra-articular fracture of distal tibia had poor result. Post operatively, he had wound infection and subsequently wound breakdown with exposure of implant which was removed in due course. Finally wound healed with repeated debridements and appropriate antibiotics but fracture went into delayed union in malposition. Over-all, the final outcome of MIPO for distal tibia in our series was found to be highly satisfactory with negligible complication which is comparable to study done by Helfet *et al.* who reported no complications ^[21].

Table 1: Results of our study based on Teeny and Wiss criteria

Results	Number of cases of various types of distal tibia fracture (AO Types)			
	Type A	Type B	Type C	Total
Excellent	12	01	00	13
Good	03	01	01	05
Fair	00	00	00	00
Poor	01	00	00	01
Grand Total	16	02	01	19

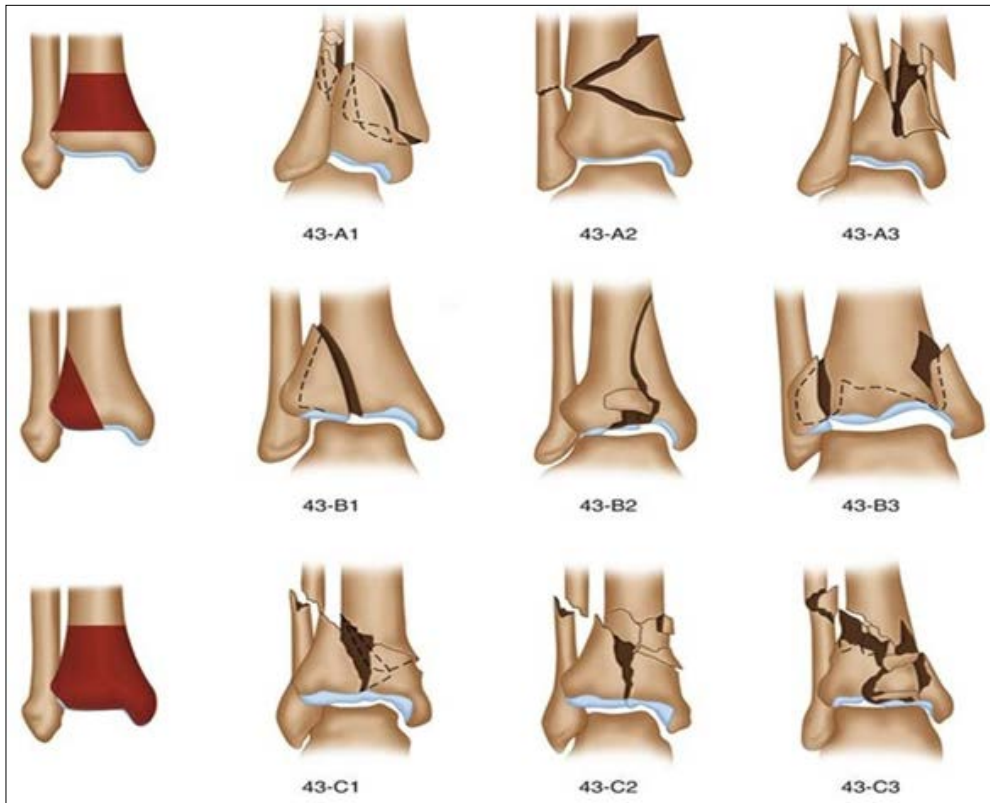


Fig 1: AO Classification of Distal Tibial Fractures



Fig 2: Steps of standard surgical procedure; Minimal skin incision of inserting point of plate (Fig. 2a), Percutaneous plate insertion (Fig. 2b), Plate placement on epi-periosteum (Fig. 2c), Plate fixed at a distance proximal and distal to the fracture site (Fig. 2d), Skin Closure (Fig. 2e)

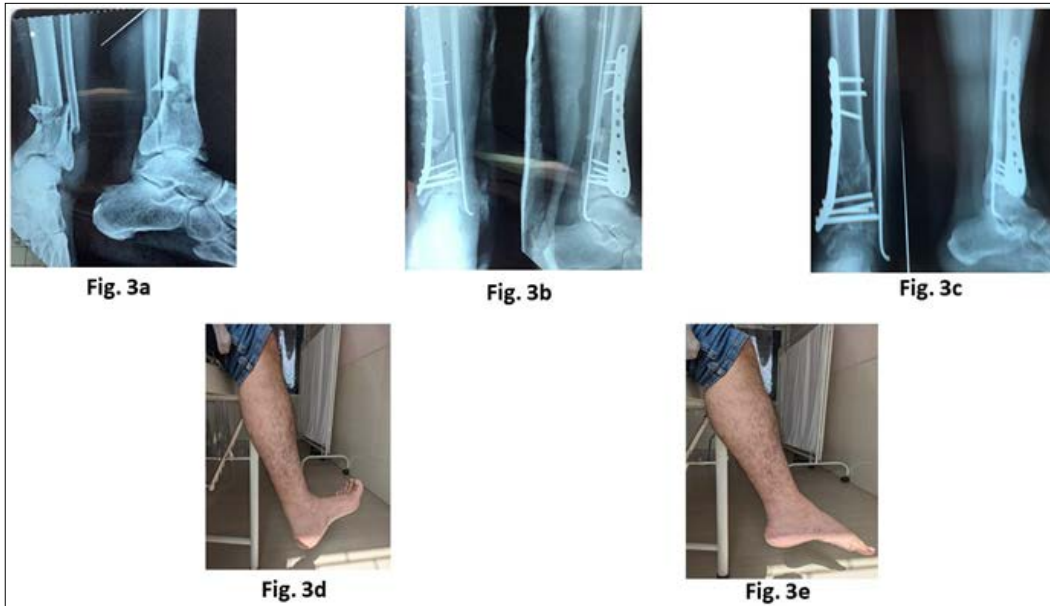


Fig 3: Preoperative radiograph (Fig. 3a) of a case of intra-articular fracture of distal tibio-fibula, fixed by MIPO and TENS respectively as evident in post-operative radiograph (Fig. 3b) which was united well in acceptable alignment (Fig. 3c) and showing excellent result with good range of motion of Ankle joint (Fig. 3d & 3e) at last follow-up

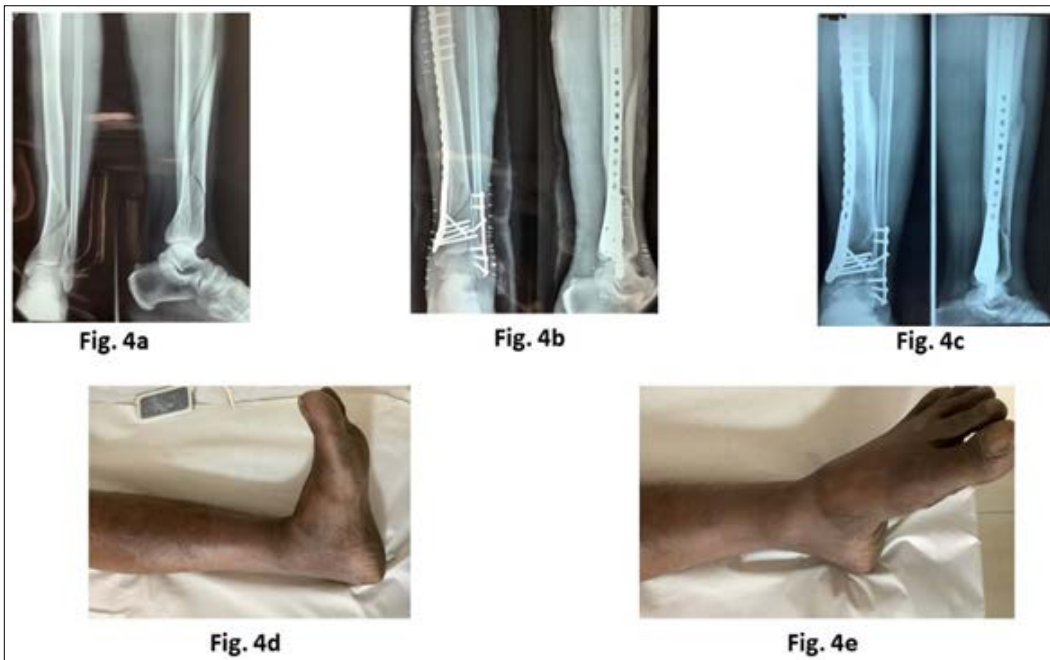


Fig 4: Preoperative radiograph (Fig. 4a) of a case of extra-articular fracture of distal tibio-fibula, fixed by MIPO and semi tubular plate respectively as evident in post-operative radiograph (Fig. 4b) which was united well in acceptable alignment (Fig. 4c) and showing excellent result with good range of motion of Ankle joint (Fig. 4d & 4e) at last follow-up



Fig 5: Wound dehiscence with poor result; Comminuted fracture distal tibia underwent MIPO (Fig. 5a) had wound dehiscence with exposed implant (Fig. 5b), wound healed (Fig. 5c) with regular dressing after implant removal (Fig. 5d).

Conclusion

MIPO is an effective and safe technique for the management of distal tibial fractures without intra-articular comminution and minimum soft tissue damage. It preserves bone biology by maintaining balance between devascularization and mechanical perfection. Further studies with longer follow-up and large sample size are warranted.

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