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Outcome of Distal Tibia Fractures Managed with Locking Compression Plate Using MiPPO Technique

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ABSTRACT

Injuries to the distal tibia represent a significant source of physical impairment and disease burden, particularly among young adults and old age, predominantly due to the rising occurrences of vehicular accidents and the prevalence of osteoporosis, respectively. The complexity of fractures in this area is exacerbated by the tibia's tenuous vascular supply the inadequate coverage provided by surrounding soft tissues and the minimal margin for alignment error. This study prospectively evaluated 18 patients with distal tibia fractures, treated using Minimally Invasive Percutaneous Plate Osteosynthesis (MiPPO). Their functional and radiological outcomes were assessed at a 6-month follow-up. Fractures were categorized as per the AO/OTA classification, and surgical intervention involved the medial placement of an LCP plate using the MiPPO technique. Radiological outcomes were determined using X-ray imaging, while clinical outcomes were measured with the Kaikkonen Ankle Scoring System. Fracture united in all 18 patients, with average fracture union time being 18 weeks, average ankle dorsiflexion in patients was 20 degrees with 54% excellent, 29% good and 17% fair results in patients. The MiPPO technique for distal tibia fractures is a proficient fixation method that minimizes soft tissue trauma and maintains the body's natural biological processes.

INTRODUCTION

The current era, marked by a high frequency of Road Traffic Accidents, is a major contributor to human mortality and morbidity, with distal tibia fractures presenting notable treatment challenges. Concurrently, the surge in life expectancy has led to an increased elderly population, thereby elevating the occurrence of these fractures in osteoporotic bones and contributing further to morbidity. Statistically, these fractures constitute 1% of all lower extremity fractures 3-10% of tibial fractures, with a bilateral occurrence in 0-8% of cases. Compartment syndrome is observed in 0-5% of these cases. The primary injury mechanism involves axial loading, where the talus forcefully impacts the lower end of the tibia, determining the extent of articular surface damage, metaphyseal comminution, joint impaction, and associated soft tissue injuries^[1].

Several therapeutic approaches for distal tibia fractures encompass intramedullary nailing for metaphyseal fractures, conservative treatment using a well-moulded cast for non-displaced extra-articular fractures, minimally invasive percutaneous plate osteosynthesis, open reduction with internal fixation, and the application of primary external fixators in the case of compound fractures^[2,3]. This study focuses on examining the treatment strategies for distal tibia fractures, assessing the biomechanical and biological benefits of locking compression plates and evaluating the clinical, functional and radiological outcomes following minimally invasive plate osteosynthesis utilizing distal tibial locking compression plates.

MATERIALS AND METHODS

In this research, 18 individuals with distal tibial metaphyseal-diaphyseal fractures, some accompanied by fibula fractures, underwent treatment using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO). The prospective study occurred in the Department of Orthopaedics at a tertiary care centre in Ahmedabad from March 2022 to May 2023. The patients received follow-up every four weeks for approximately six months and underwent clinical, functional and radiological assessments. The Kaikkonen Ankle Scoring System was employed for functional evaluation^[4].

Before surgery, diagnostic procedures involved X-ray imaging of the ankle in anteroposterior and lateral views and C.T. scanning of the ankle featuring 3-Dimensional reconstruction. The assessment of patients included checking for indications of vascular injury, closed degloving, fracture blisters and

compartment syndrome. The condition of the soft tissues was evaluated the fracture pattern was examined and the extent of bone fragmentation was considered.

All surgical procedures were performed with patients in a supine position under spinal anaesthesia. A slightly curved incision was made on the distal tibia, extending up to the medial malleolus as its upper boundary. The subcutaneous tissue was dissected, the periosteum was elevated, and a locking compression plate was inserted from the distal to the proximal end. In cases involving an associated fibula fracture the fibula was initially stabilized either through open reduction and internal fixation or by using an intramedullary nailing system. The adequacy of fracture reduction and the size and placement of the plate screws were verified using radiographic imaging^[5,6].

Following surgery, patients were immobilized using a below-knee slab for a duration of four weeks. Intravenous antibiotics were administered for five days post-operatively, followed by oral antibiotics until suture removal, which occurred 15 days after the operation. For those with stable fracture reductions, mobilization of the knee and ankle commenced on the second postoperative day. All patients were advised to avoid weight-bearing until radiological evidence of bone union was observed^[7].

RESULTS

The study encompassed 18 participants, comprising 17 males and one female. Eligibility criteria included individuals aged 20 years or older, presenting with closed, unstable distal tibia fractures, Grade I and II compound distal tibia fractures, or fractures amenable to acceptable closed reduction. The average age among the subjects was 36.5 years, from 21-51 years. Approximately half of the surgeries addressed intra-articular fractures, while the other half dealt with extra-articular fractures. Closed fractures constituted 56% of the cases, with the remaining 44% being compound fractures classified as Grade 1 and 2 according to the Gustilo Anderson Classification. The average wait time before definitive fixation was approximately one week (Table 1).

In the study, complete fracture union was attained on average by 18 weeks, ranging from 14-30 weeks. Among the 18 patients, one patient passed away during the late postoperative period due to co-morbid medical conditions. The remaining patients were assessed for functional outcomes, with 16 experiencing normal bone union and 1 with delayed union (Table 2).



Fig. 1: Functional outcome according to Kaikonen Ankle Score



Fig. 2: Pre-op and Post-op X-rays of a patient operated with distal tibia LCP

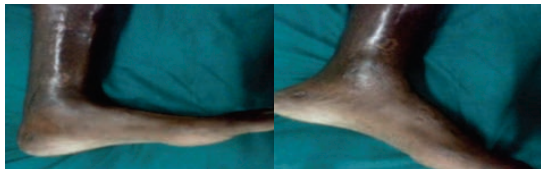


Fig. 3: Range of Motion of the same patient at 10 weeks

The overall outcomes for managing distal tibia fractures using the MIPPO technique indicated excellent results in 54% of cases, good in 29% and fair in 17% (Fig. 1). In this research, the complications observed included delayed union in 5.5% of cases, joint stiffness in 11%, valgus angulation in 5.5% and marginal skin necrosis affecting 11% of patients (Table 3). There were no instances of limb shortening or deep infections. The average recorded dorsiflexion of the ankle was 20 degrees (Fig. 3).

DISCUSSIONS

Ruedi and Allgower initially advocated open reduction and internal fixation (ORIF) in treating pilon

fractures^[8]. Their approach to managing these fractures with internal fixation yielded considerable success, albeit primarily in low-velocity injuries. Effective treatment of these fractures necessitates precise fracture reduction and alignment, careful soft tissue dissection without flap elevation, strategically planned skin incisions, minimal skin retraction and attention to overall swelling. Previously employed treatment methods, including conservative management, open reduction internal fixation and intramedullary nailing, were limited due to complications such as deformity, stiffness, skin necrosis, impingement and malalignment^[9].

The introduction of Minimally Invasive Percutaneous Plate Osteosynthesis (MiPPO) plating has been instrumental in mitigating many of these complications. This technique provides the benefit of securing the fracture while preserving the integrity of the soft tissue cover, thus reducing the risk of infection and allowing for earlier patient mobilization. Utilizing a pre-contoured locking compression plate diminishes the likelihood of varus collapse and impingement while enhancing stability (Fig. 2).

Our study's outcomes align with other research findings, further substantiating the effectiveness of Minimally Invasive Percutaneous Plate Osteosynthesis (MiPPO) in managing distal tibia fractures. Key advantages of MiPPO plating, such as improved fracture reduction, expedited surgical duration and early initiation of ankle mobilization, distinguish it from other treatment approaches^[2-11].

Employing a longer plate that extends across the fracture site, combined with a lower screw-to-hole ratio in the proximal fragment, facilitates micro-movements at the fracture site, thereby enhancing the process of indirect healing^[12]. Moreover, the application of locking screws forms a fixed-angle, stable construct that not only prevents angular deformity but also preserves the length of the bone. Nonetheless, the challenge of implant impingement in this subcutaneous bone remains a concern, necessitating the timely removal of the implant following bone union^[13].

Therefore, minimally invasive plate osteosynthesis utilizing locking compression plates (LCP) is an effective technique in managing distal tibial fractures that lack intra-articular comminution. This approach promotes efficient fracture healing, facilitates quick functional recovery and minimizes the risk of significant skin complications. It can be effectively used for treating all types of distal tibia fractures, either as a standalone method or in combination with other treatment strategies.

Table 1: Patient demographics and characteristics

Parameter	Details
Total participants	18 (17 Males, 1 Female)
Age range	21 to 51 years
Type of fractures	50% Intra-articular, 50% Extra-articular
Fracture classification	56% Closed fractures, 44% Compound fractures (Grade 1 and 2)
Average time to fixation	Approximately 1 week

Table 2: Clinical outcomes and complications

Outcome Metrics	Details
Fracture Union Time	Average 18 weeks (Range: 14 - 30 weeks)
Functional Outcomes	54% Excellent, 29% Good, 17% Fair
Complications	Delayed union (5.5%), Joint stiffness (11%), Valgus angulation (5.5%), Marginal skin necrosis (11%)
Average Dorsiflexion	20 degrees

Table 3: Table depicting complications and its incidence

Complications	Patients (%)
Delayed Union	5.5
Joint Stiffness	11.0
Valgus Angulation	5.5
Marginal Skin Necrosis	11.0
Deep Infection	0
Shortening	0

CONCLUSION

The study emphasizes the efficacy of Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) using distal tibial locking compression plates in treating distal tibia fractures. This technique offers a compelling balance of biomechanical stability and minimal soft tissue disruption, leading to effective fracture healing, reduced complications and expedited functional recovery. The successful outcomes observed in the majority of cases highlight MIPPO's viability as a preferred treatment modality for various types of distal tibia fractures, especially in the context of modern orthopedic care.

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