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Original Research Article

Outcomes of patients treated with minimally invasive plate osteosynthesis in the management of distal tibial fractures

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ABSTRACT

Background: Distal tibial fractures are a common injury, often caused by high-energy trauma, and can result in significant morbidity. Traditional surgical management with open reduction internal fixation (ORIF) is associated with complications including infection and soft tissue injury. Minimally invasive plate osteosynthesis (MIPO) has emerged as a potential alternative, with advantages including less soft tissue injury and a faster return to function. The study aimed to evaluate the outcomes of MIPO for distal tibial fractures.
Method: Sample size of 38 patients between 18-80 years of age with distal tibial fractures treated with MIPO was included. Patient demographics, fracture characteristics, surgical details and postop outcomes collected.
Results: A total of 38 patients with distal tibia fractures with a mean age of 44.36 years were included in the study. The mean duration of hospital stay was 12.71 days, and the time required for a union was 18.61 weeks. The AOFAS score improved significantly from 3 to 6 months after surgery. However, 15 patients (34.88%) reported complications, with deep infection and skin necrosis being the most common. Out of 43 patients, 11 underwent culture and sensitivity testing, with no growth in 5 cases, and the remaining cases showed various bacterial infections. Seven patients underwent implant removal due to complications.
Conclusions: The study provides valuable information about the use of MIPO in treating distal tibia fractures, as well as the risk of complications associated with this approach.

Keywords: Distal tibial fractures, MIPO, AOFAS score

INTRODUCTION

Distal tibial fractures are a common injury, representing approximately 7% of all fractures, and can result in significant morbidity and disability. These fractures are most often caused by high-energy trauma such as falls, motor vehicle accidents, and sports injuries.

Treatment for distal tibial fractures include non-operative management with casting or bracing and operative management with external fixators, closed reduction and nailing and ORIF using plates and screws. ORIF is the most common surgical technique which involves making an incision over the fracture site, reducing the fracture, and fixing it with plates and screws but requires extensive soft tissue dissection, which can result in complications such as wound healing problems and infection.[3-5]

The management of tibial fractures is influenced greatly by associated soft tissue injury. The tibia is more often involved in open fractures than many other bones because of its subcutaneous nature. Historically, wound complications have been documented to be as high as 36% after ORIF of the distal tibia and pilon fractures, with infections reported as high as 37% to 55%.[4,6]

MIPO involves using a limited incision to place a plate on the bone and then passing screws through the plate to stabilize the fracture (Figure 1). This technique had several advantages over traditional ORIF, including less soft tissue

injury, less blood loss, faster return to function and lower risk of infection.[7]

Figure 1: Incision in MIPO plating.

The goal of the MIPO technique is to apply stable plate fixation, maintain the fracture biology, and respect the soft tissues. Vascular injection studies have demonstrated the preservation of blood supply to the bone after MIPO of the distal tibia when compared with open techniques.[8] Studies have shown that the extra osseous blood supply is better preserved when the plate is applied in this fashion, and it facilitate fracture union, decrease problems with infection, and minimize the need for bone grafting.[8]

Aim of study to experience with MIPO for distal tibial fractures, including patient outcomes and complications. We hypothesize that MIPO will result in good patient outcomes and a low rate of complications.

METHODS

The present retro-prospective observational study was conducted at the department of orthopaedics, Bharati hospital and research centre, Pune, India. The study was approved by institutional ethics committee meeting held on 7th December 2020 with reference ID BVDUMC/IEC/128. The study population included patients attending the inpatient and outpatient departments of the Orthopaedics department of Bharati hospital with distal tibial fractures of which prospective cases were taken from September 2020 to April 2022. Retrospective cases were taken from May 2017 to September 2020.

The sample size was estimated to be 37 patients, between the age group 18 to 80 years, who were diagnosed with distal tibia fractures and treated with MIPO. Patients with compound fractures were excluded from study.

The surgical technique used was MIPO, and data collection included patient demographics, fracture characteristics, surgical details, and postoperative outcomes at 6 weeks, 3 months, and 6 months after surgery. Functional assessment was performed using the American foot and ankle score. Radiological assessment was performed by x-ray for union, deformity, implant failure, and loss of fixation. Any implant-related problems were also assessed.

Statistical analysis was performed using SPSS version 26.0 software. The means were compared using the student 't' test and a p value less than 0.05 was considered statistically significant.

RESULTS

A total of 43 patients with distal tibia fractures were included, of which follow-up of 5 patients was lost. So, a total of 38 patients were included in the present study with a mean age of 44.36±15.22 years, ranging from 18 to 77 years. Distribution of patients according to gender is shown in Table 1. Associated fibula fractures were noted in 34 patients.

Table 1: Gender distribution.

Variables	N	Percentage (%)
Female	12	31.58
Male	26	68.42
Total	43	100.0

The distribution of patients according to comorbidities is shown in Table 2. The mode of injury is depicted in table 3 respectively. Fractures were reported by means of duration of hospital stay, AOFAS scoring at 6 weeks, 3 and 6 months, and time of union in weeks, shown in Table 4. The mean duration of hospital stay was 12.71±4.83 days, ranging between 6 to 23 days. The AOFAS score at 3 and 6 months was 54.71±6.37 and 68.87±8.24, respectively. The difference in the AOFAS between 3 and 6 months was significant ($p<0.0001$). The time required for union in weeks was 18.61±4.26 weeks.

Table 2: Comorbidities.

Variables	N	Percentage (%)
Diabetes	9	23.7
Hypertension	9	23.7
Hypothyroidism	4	10.5

Table 3: Mode of injury.

Variables	N	Percentage (%)
Road traffic accident	20	52.6
Domestic fall	8	21.1
Twisting injury	8	21.1
Assault	1	2.6
Fall of heavy object	1	2.6
Total	38	100.0

Table 4: Outcomes.

Variables	Mean	Std. deviation	P value
Duration of hospital stay	12.71	4.83	<0.0001
AOFAS at 3 months	54.71	6.37	
AOFAS at 6 months	68.87	8.24	
Time of union (weeks)	18.61	4.26	

The complications reported in the study are depicted in Table 5. There were a total of 15 (34.88%) patients who reported having one or more complications of which commonest complication was deep infection (Figure 2) noted in 6 (15.8%) of patients, followed by skin necrosis in 5 (13.2%), delayed union in 4 (10.5%), and ankle stiffness in 3 (7.9%) patients. Out of the total of 15 patients who reported having complications, in 7 (46.67%) patients, the implants were removed, while in 8 were not.

Table 5: Complications.

Variables	N	Percentage (%)
Ankle stiffness	3	7.9
Deep infection	6	15.8
Delayed union	4	10.5
Skin necrosis	5	13.2

Figure 2: Surgical site wound with exposed implant.

The culture and sensitivity were done in 11 (25.58%) patients out of 43. Total 5 patients (55.6%) show no growth in culture. There was 1 (11.1%) case each of coagulase-negative *Staphylococcus aureus*, MRSA, MSSA, and MSSA with *E. coli.*

DISCUSSION

Distal tibia fractures are difficult to manage due to poor muscle cover, compromised vascularity, and proximity to the ankle, resulting in complications such as non-union, mal-union, and infection.[9] Surgical management remains the primary treatment for these fractures, as it provides a better outcome and faster return to full function.[10] Different osteosynthesis techniques can be used, such as ORIF, external fixation, intramedullary nailing, or MIPO, each with its advantages and disadvantages.[11] Despite surgical advancements, complications still affect a significant number of patients, with rates ranging from 20-50%.[4,12,13]

MIPO is a successful technique for treating distal tibia fractures. It uses an indirect reduction technique and smaller incisions, reducing the risk of complications such as infections and wound dehiscence. Studies have shown that MIPO can reduce the risk of non-union and superficial infections.[14]

Road traffic accidents were the most common cause of injury in the present study, similar to the findings of Shobha et al and Lakhotia et al.[15,19]

We reported a mean hospital stay of 12.71±4.83 days and required an average of 18.61±4.26 weeks for the union to occur. The findings suggest that patients with this condition can expect to have a relatively long hospital stay and recovery period, but can ultimately experience significant improvements in foot and ankle function over time.

The AOFAS score is a commonly used scoring system to evaluate the functional outcome of foot and ankle surgery, and in this study, we found a significant improvement in AOFAS scores between the 3- and 6-month follow-up points. The mean AOFAS score at 3 months was 54.71±6.37, which improved to 68.87±8.24 at 6 months, the improvement was significant, indicating a high level of confidence in the result. This suggests that patients undergoing MIPO can expect to experience a significant improvement in foot and ankle function over the first six months following surgery. However, it is important to note that individual results may vary.

In the world of orthopedics, complications are a frequent visitor, much to the chagrin of surgeons and patients alike. In this study, 15 out of 43 patients (34.88%) reported experiencing one or more complications following surgery. The most common complication was a deep infection, which was reported by 6 patients (15.8%). Skin necrosis was the second most common complication, reported by 5 patients (13.2%). Delayed union and ankle stiffness were also reported, by 4 patients (10.5%) and 3 patients (7.9%) respectively. These findings suggest that while surgical treatment can be effective for this condition, there is a significant risk of complications.

Interestingly, the study also found that in nearly half of the patients who reported complications, the implants were removed (7 out of 15 patients, or 46.67%). However, further research is needed to determine the most effective strategies for managing complications following surgery for this condition. Overall, these findings highlight the importance of carefully considering the risks and benefits

of surgical treatment for this condition, and of closely monitoring patients for potential complications.

The culture and sensitivity testing was performed in 11 out of 43 patients (25.58%). 5 patients (55.6%) had no growth on culture. The remaining 4 patients had identified bacterial infections, with one case (11.1%) each of coagulase-negative *Staphylococcus aureus*, Methicillin-resistant *Staphylococcus aureus* (MRSA), Methicillin-sensitive *Staphylococcus aureus* (MSSA), and MSSA with *E. coli*. These findings suggest that bacterial infections can occur in a significant proportion of patients undergoing MIPO and that multiple types of bacteria may be responsible.

MIPO for distal tibia fractures has been associated with complications such as infections, malalignment, and non-union. Incidence rates of complications vary across studies, with infections ranging from 6% to 15%. While MIPO has benefits such as smaller incisions, studies have not shown statistically significant advantages over open techniques.

Kariya et al shed light on the unfortunate occurrence of infections in the MIPO group, with implant removal being the only recourse for a significant number of patients.[9] Shobha et al reported on the struggles of patients plagued by varus malalignment, ankle stiffness, and limb length discrepancy, with superficial skin infections.[15] Singh et al also reported complications, with malunion and implant-related hardware symptoms leading to the necessity of a second surgery.[16] Meanwhile, Vidović et al reported an overall complication rate of 23.8%, with metalwork-related complications, delayed union, and wound breakdown causing significant distress to their patients.[18] As if the challenges of fracture healing weren't enough, these complications add insult to injury and test the mettle of both patient and surgeon.

Joveniaux et al uncovered surgical complications in 30 patients, with 35% of comminuted fractures resulting in nonunion. Lau et al found that 15% of patients in their study experienced late infections, leading to implant removal in over half of the cases.[11,22] On the other hand, Borg et al reported that titanium L.C.P. showed high success rates, with 17 out of 21 patients experiencing fracture healing within 6 months, although non-union and delayed union were observed in four cases.[23] Finally, Cheng et al paired comparison of MIPPO and open technique with LCP showed that there was no statistically significant difference in union time, recovery time, and functional results between the two techniques.[14] These findings remind us of both the triumphs and setbacks in the treatment of distal tibia fractures and underscore importance of continued research and innovation in field.

CONCLUSION

In conclusion, this study provides valuable insights into the use of MIPO in treating distal tibia fractures. However, as the study was retro-prospective and 3 patients underwent implant removal at another tertiary centre were some of the limitations of the study but we were still able to gather sufficient data through regular follow ups. While the results indicate that patients can experience significant improvements in foot and ankle function following surgery, study also highlights risk of complications. Finding that nearly half of patients who reported complications had their implants removed suggests that further research is needed to determine best approach.

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