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Functional and Radiological Outcome of Distal Tibia Fracture Treated with Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO)-Prospective Study

[1]Mohamed Syed Moosa, [2]Zakir Hussain Mohamed, [3]Mathan Kumar, [4]K.C. Mathew and [5]Mohamed Sheriff

[1-5]Department of Orthopedics, Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu, India

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Corresponding Author
Zakir Hussain Mohamed,
Department of Orthopedics, Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu, India.
zh_mohammed14@yahoo.com

Author Designation
[1,2]Junior Resident
[3,5]Assistant Professor
[4]Professor and Head

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Abstract
Distal tibial fractures accounts for less than 7% of all tibial fractures and less than 10% of all lower extremity fractures. Distal tibial fractures are more commonly seen in males between the age group of 30-50 years, at present there are various techniques evolved to improve fixation of distal both bone fractures of leg including fibular plating (distal third fractures), different nail design with different proximal bends (proximal third fractures), blocking screws (poller screws) and Locking plates. All methods has some merits and demerits of its own, therefore Gold standard treatment option for distal 1/3r tibia fracture is still controversial. Hence in this study we assessed functional and radiological outcome of Minimally invasive percutaneous plate osteosynthesis (MIPPO) in the treatment of distal 1/3rd tibia fracture. To study the functional and radiological outcome of MIPPO in the treatment of distal 1/3rd tibia fracture. After getting institutional human ethical committee and research committee approval, This Prospective Study was conducted among 30 patients in Sree Mookambika Institute of Medical Sciences, Kulasekharam, who were diagnosed to have extra articular distal tibia fractures. Nonprobability sampling technique. We included patients with age >18 years , extra-articular distal tibia fractures, Closed fracture and Type 1 and 2 Gustilo and Anderson type fracture , AO Type 43 A1, A2 and A3 fractures Acute fractures (<2 weeks old) . We have excluded patients with age <18 years, Intra articular fractures (AO type B1-3, C1-3), Open fractures (Gustilo and Anderson Type 3 and 4), Pathological fractures, Fractures >2 weeks. All the patients involved in the study were explained in detail and informed consent forms were obtained. All required investigations were done including X-Ray, CT-Scan, blood investigations. All the 30 patients were managed with Minimally invasive percutaneous plate osteosynthesis The patients were regularly followed up for a period of 6 months in regular intervals at 4 , 8 , 12 and 24 weeks. Functional outcome was measured using Modified Klemn and Borner scoring system. Patients were evaluated for complications such as infection, mal-alignment and pain on weight bearing, muscle atrophy and ankle Range of motion. The data collected was subjected to double data entry in MS Excel. The data was analysed using SPSS Version 20.0 using Chi square test. The functional outcome of 30 patients in our study was evaluated using Modified Klemn and Borner score. Based on the score the patients were graded as Excellent, Good, Fair and Poor. According to this score, MIPPO has 13 (43%) excellent outcome, 13(43%) Good, 3(10%) fair outcome and only one patient (4%) had poor outcome. In our study MIPPO has 26 patients of Excellent to Good results (86.7%) Distal tibial fractures can be effectively treated by Minimally Invasive Percutaneous Plate Osteosynthesis providing good to excellent results. Very minimal complications were encountered in our study. No cases of non-union were found among MIPPO. In our present study we observed that MIPPO had 43.3% excellent outcome according to the scoring system used. Therefore, we recommend that Minimally Invasive Percutaneous Plate Osteosynthesis considered as a very effective modality of treatment in indicated distal third tibia fractures with good soft tissue condition.

INTRODUCTION

Distal tibial fractures accounts for less than 7%[1,2] of all tibial fractures and less than 10%[3,4] of all lower extremity fractures. Distal tibial fractures are more commonly seen in males between the age group[5] of 30-50 years. Tibial fractures have a bimodal distribution, low energy spiral patterns being commonly seen in patients over 50 years of age due to rotational forces[6] and high-energy transverse or comminuted fractures seen in patients under 30 years of age due to fall from height and Motor vehicle accidents[7]. Various other mechanisms of injury to distal tibia includes axial loading, compressive force as well as torsional force[8,9,10]. The distal tibial fractures are mainly due to road traffic accident, fall from height and twisting of ankle. The goal in expert care is good fracture reduction, limb length restoration and quick recovery of function[11]. Any slight mal-alignment in the distal third tibia grossly alters the mechanism of the ankle joint that greatly affects the function of the joint and also produces increased pain in later stages. Preoperative planning of distal third tibial fractures is of much importance since operative management is challenging in this injury. Fracture pattern, soft tissue injury and bone quality critically influence the selection of fixation technique. Numerous techniques have been developed for management of distal third tibial fractures which includes conservative management, hybrid external fixation, minimally invasive percutaneous plate osteosynthesis and intra medullary nailing. Most of the distal tibial fractures are usually associated with fracture fibula also. The need for fixation of fibula fractures in patients with distal tibia fracture is an inconclusive according to many literature. However fixation of fibula fracture provides improved reduction of fracture. The comorbid conditions like diabetes mellitus, peripheral vascular diseases, smoking and alcoholism complicates this delicate situation[7]. In the Minimally Invasive Percutaneous Plate Osteosynthesis technique (MIPPO), the rate of fracture union is high, ranging from 80 to 100%. In this procedure trauma to the soft tissue is reduced and it provides the apt environment for fracture healing. in MIPPO technique complication like implant failure, non-union, malunion has been reported and weight bearing is delayed in case of MIPPO whereas immediate weight bearing is possible in IMILN. Therefore various techniques have evolved to improve fixation of distal both bone fractures of leg including fibular plating (distal third fractures), different nail design with different proximal bends (proximal third fractures), blocking screws (poller screws) and Locking plates. All methods has some merits and demerits of its own, therefore Gold standard treatment option for distal 1/3r tibia fracture is still controversial. Hence in this study we assessed functional and radiological outcome of MIPPO in the treatment of distal 1/3rd tibia fracture.

MATERIALS AND METHODS

After getting institutional human ethical committee and research committee approval, This Prospective Study was conducted among 30 patients in Sree Mookambika Institute of Medical Sciences, Kulasekharam, who were diagnosed to have extra articular distal tibia fractures. Nonprobability sampling technique. We included patients with age >18 years, extra-articular distal tibia fractures, Closed fracture and Type 1 and 2 Gustilo and Anderson type fracture , AO Type 43 A1, A2 and A3 fractures Acute fractures (<2 weeks old) . We have excluded patients with age <18 years, Intra articular fractures (AO type B1-3, C1-3), Open fractures (Gustilo and Anderson Type 3 and 4), Pathological fractures, Fractures >2 weeks. All the patients involved in the study were explained in detail and informed consent forms were obtained. All required investigations were done including X-Ray, CT-Scan, blood investigations. All the 30 patients were managed with Minimally invasive percutaneous plate osteosynthesis The patients were regularly followed up for a period of 6 months in regular intervals at 4 , 8 , 12 and 24 weeks. Functional outcome was measured using Modified Klemn and Borner scoring system. Patients were evaluated for complications such as infection, mal-alignment, and pain on weight bearing, muscle atrophy and ankle Range of motion. The data collected was subjected to double data entry in MS Excel. The data was analysed using SPSS Version 20.0 using Chi square test.

RESULTS AND DISCUSSIONS

In our study most of the patients were of the age group 31-45 years with 18 patients in this age. However, 12 patients were of the age group of 46-60 years in the study population. In our study of 30 patients with distal tibia fractures, there were 16 males and 14 females with slight Male predominance owing to the more incidence of Road traffic accidents among males. In our study the most common mode of injury was found to be Road Traffic Accident (RTA) in about 16 patients (53%). Fall from height caused distal tibia fracture in 4 patients, fall of object lead to fracture in 4 patients and Self fall was the mode of injury in 6 patients.

A total of 30 patients were diagnosed to have extra articular distal tibial fracture. Out of 30 cases, 24 (80 %) cases were closed fractures and 6 (20 %) cases were Grade I open fractures according to Compound Gustilo Anderson classification.

The functional outcome of 30 patients in our study was evaluated using Modified Klemn and Borner score. Based on the score the patients were graded as

Excellent, Good, Fair and Poor. According to this score, MIPPO has 13 (43%) excellent outcome, 13(43%) Good, 3(10%) fair outcome and only one patient (4%) had poor outcome. In our study MIPPO has 26 patients of Excellent to Good results (86.7%) (Fig. 1).

In our study the range of movements of ankle joint was assessed at each follow up. There was no restriction of movements was seen in about 13 patients of MIPPO, minimal (<25%) restriction was observed in 13 patients Moderate restriction (>25%) was seen in 3 patients and Severe restriction was seen in only 1 patient. In MIPPO among 30 patients, 26 patients (86%) had full movements to minimal restriction only. (Fig. 2).

In our study on 30 patients, atrophy of calf muscle was observed 17 (56%) were treated with MIPPO. There was no muscle atrophy was 13 (44%) patients were treated by MIPPO.

In our study of 30 patients, all fractures had overall union time for MIPPO was 23.03 weeks.

In our study on 30 patients the fracture alignment was normal in 20 patients of which 13 (43%) patients had normal alignment, 13 (43%) patients had minimal angular deformity (<5), 3 (10%) patients had less than 10 of malalignment and only one patient (4%) had > 10 malalignment. (Fig. 3).

In our study the time for full weight bearing was ranging from 14-24 weeks In this study there were complications like Malunion, delayed union, non-union and superficial wound infection were seen. . In MIPPO there was 4 cases of malunion (13.3%) and 1 case (3.3%) of delayed union and 2 cases (6.6%) of superficial infection and no case of non-union were seen. (Fig. 4).

Minimally invasive percutaneous plate osteosynthesis(MIPPO) is a technique in which we can reduces the damage due to operative procedure and also it preserves the biological environment for fracture healing maintaining the osteogenic fracture hematoma[12]. Nevertheless even MIPPO techniques should be performed only after soft tissues heal. The main factor in treating these injuries is to estimate the degree of associated soft tissue injury. Since both open and closed fractures were included in our study, we used Gustilo-Anderson classification for open fractures and the Tscherne classification for closed fractures with soft tissue injury to assess and grade the severity of soft tissue injury. Definitive surgical fixation is desirable and posted for surgery only when there is soft tissue healing. This is indicated by the skin wrinkle sign, once limb oedema subsides.

In our study population the age group of patients sustained distal third tibia fracture ranges from 24-60 years. The majority of patients of patients were between the age group of 31-45 years The p valve is about 0.769 and it is statistically not significant. This is comparable to the study conducted by Heather A Vallier[13] in which the age group was between 16 years to 77 years with an average of 39.1 years.

In our study, there were male preponderance with 16 males and 14 female patients However, there was more male predominance in the study by Cory Collinge[14] with 77 males 23 females In this present study left side was most commonly fractured. There were 14 (46%) patients with right distal tibia fracture and 16 (54%) patients with left distal tibia fractures.

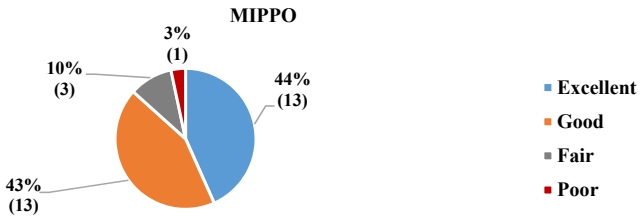

Fig. 1: Pie chart demonstrate the functional outcome based on Modified Klemn and Borner score

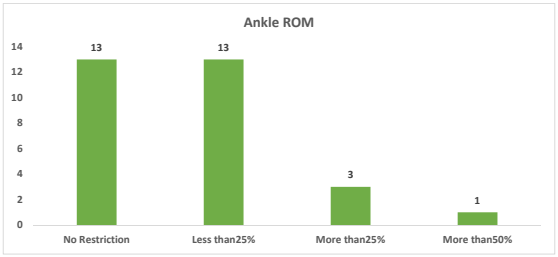

Fig. 2 Bar diagram demonstrate ankle Range of motion

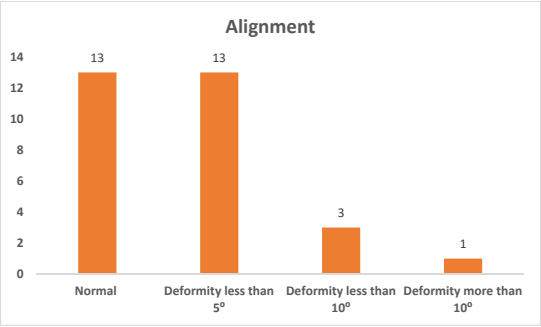

Figure 3: Bar diagram demonstrate fracture alignment

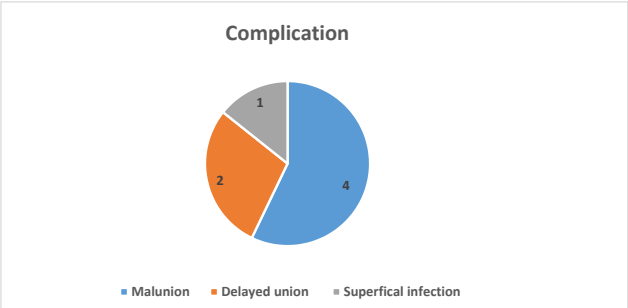

Fig. 4: Pie chart demonstrate the complication

Table 1: comparison of fracture union time with present study.

Study	MIPPO (weeks)
Present study	23.03
Fang *et al*[15]	21.8
Li Y *et al*[16]	23.1

Table 3: comparison of full weight bearing time with present study

Study	MIPPO (weeks)
Present study	16.06
Daolaguppu17	13.38

Table 3: comparison of functional outcome with present study.

Study	MIPPO (Excellent to Good %)
Present study	90
Y Li, Jiang *et al*[18]	86.6

In our study the most common mode of injury was found to be Road Traffic Accident (RTA) in about 16 patients (53%). Fall from height caused distal tibia fracture in 4 patients, fall of object lead to fracture in 4 patients and Self fall was the mode of injury in 6 patients. Similarly Heather A Vallier[13] also had 51% high and 49% low energy injury,

A total of 30 patients were diagnosed to have extra articular distal tibial fracture. Out of 30 cases, 24 (80 %) cases were closed fractures and 6 (20 %) cases were Grade I open fractures according to Compound Gustilo Anderson classification This was comparable to the other studies conducted by Heather A Vallier[13] who had 70% closed and 30% open fractures.

In our study of 30 patients, all fractures had overall union time for MIPPO was 23.03 weeks. Fang[15]. Done a study and in his study the mean union time was 21.8 weeks and similarly study done by Li[16] in their study also had average union time of 23.1 weeks in percutaneous plating group this is also similar to our study. (Table 1).

In this present study among 30 patients of distal third tibia fracture, patients were allowed for weight bearing as tolerated. Average time for full weight bearing was 16.06 weeks. And a study done by Daolaguppu[17] noted an average time for full weight bearing was 13.38 weeks. (Table 2).

The functional outcome of 30 patients in our study was evaluated using Modified Klemn and Borner score. Based on the score the patients were graded as Excellent, Good, Fair and Poor. According to this score, 13 (43.3%) excellent outcome, 13(43.3%) Good, 3(10%) fair outcome and only one patient (3.3%) had poor outcome. In average there was 86.6% of Excellent to Good results, the poor outcome in one patient is attributed to comminution of fracture, poor general health condition of the patient with comorbidity. Y Li, Jiang[18] in their study had 90% excellent to good result in MIPPO (Table 3)

In our study there were 4 cases of malunion among MIPPO which is 13% of the study population treatment and This is similar to the study conducted by Li Y[16] there was malunion in 1 case (4.3%) in minimally invasive percutaneous plating. Delayed union of fracture was seen in 1 patient (3.3%). Y Li, Jiang[18] in their study there was 1 case of non-union in both MIPPO, delayed union was seen in 4 cases (9.5%).

In our study there was superficial infection seen in 2 patients of MIPPO Similarly Li[16] in their study found 3 cases (13%) of superficial infection and there was no deep infection was observed in their study. All the patients who developed infections were diabetic. However, no deep surgical site infection was seen in our study.

CONCLUSION

Distal tibial fractures can be effectively treated by Minimally Invasive Percutaneous Plate Osteosynthesis providing good to excellent results. Very minimal complications were encountered in our study. No cases of non-union were found among MIPPO. In our present study we observed that MIPPO had 43.3% excellent outcome according to the scoring system used. Therefore, we recommend that Minimally Invasive Percutaneous Plate Osteosynthesis considered as a very effective modality of treatment in indicated distal third tibia fractures with good soft tissue condition.

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