



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2019; 5(4): 980-984
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www.orthopaper.com
Received: 12-08-2019
Accepted: 15-09-2019

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Functional outcome of distal tibia fracture treated with locking compression plate using minimally invasive percutaneous plate osteosynthesis technique (MIPPO): A prospective study

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DOI: <https://doi.org/10.22271/ortho.2019.v5.i4q.1805>

Abstract

Introduction: Treating distal tibia fracture is a greater challenge for surgeons to manage even today. The difficulty is due to its poor blood supply and limited soft tissue envelope. Various techniques are now available for the treatment of tibia fractures. The occurrence of implant failure, skin necrosis, infection and malunion are high in case of distal tibia fractures.

Aims/Objective: Our aimed was to analyze the functional outcome of distal tibia fractures treated by MIPPO Technique using the American Orthopedic Foot and Ankle Society Score.

Method: A total of 20 patients of a closed distal Tibia fracture were studied by us with a MIPO with LCP Technique in Department of Orthopedics at DYP Medical College and hospital Kolhapur during the period from June 2017 and June 2019 and were prospectively followed for average duration of 16 months (6-24 months).

Results: In our study the mean age of patients was 43 out of which 65% was male and 35% was female. Functional outcome was measured using the AOFAS score and mean AOFAS score was 84.45 at the end of 6 months. Under our study out of 20 patients 4 had excellent outcome, 14 had good result, 2 had acceptable result on basis of AOFAS score.

Conclusion: MIPPO is an effective method of treatment for distal tibia fractures because it offers a Biological advantage by preserving periosteal blood supply and combine with C-arm guidance helps in indirect reduction of distal tibia fracture in restoring length an alignment, thus reducing the chances of malunion and deformities. It helps in early mobilization of ankle movement and reduces the ankle stiffness thus improving clinical and functional outcome.

Keywords: Distal tibia fracture, LCP plate, MIPPO, AOFAS score

Introduction

Distal Tibia Fractures Constitute 5 to 10 % of all lower extremity Fractures. Treatment of these Fractures remains challenging due to their inherent instability, scarcity of soft tissues, subcutaneous nature and poor vascularity of bone [1]. Low energy fractures occur in elder age group due to twisting injury resulting in extra-articular fracture without much soft tissue injury. High energy fractures occur in young age group due to axial-loading resulting in intra-articular comminuted fracture with severe soft tissue injury, edema and skin blisters around the Ankle.

Several methods of treatment are applied including Non-operative Treatment, Intra-Medullary Nailing, external fixation and open reduction and internal fixation with plates and screws, however each of these treatments options are associated with certain challenges. Intramedullary nails often do not provide enough stability, whereas an external fixations which usually applied for primary stabilization until soft tissue edema get subsided but delayed in return to work [2].

Recently, the trend have been shifted towards use of a Locking compression plate for treatment of fractures of the distal tibia [3, 4]. Goal of this Technique is stable plate fixation, maintaining the fracture Biology and minimizing the soft Tissue problems. Locking plates can

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be implemented by means of open reduction and internal fixation or by minimally invasive percutaneous plate osteosynthesis is (MIPPO).

The principles of MIPPO Includes:

- Access of bone through soft Tissue Windows,
- Minimal Trauma to bone and soft tissue by indirect reduction
- Use the tools with small foot prints when direct reduction is needed.
- Stable fixation with locking plate.

MIPPO Technique serves better limb alignment with good clinical outcome in high energy metaphyseal fracture of distal tibia [5].

Methods

Source of data

The Prospective study of twenty patients of distal Tibia Fractures was conducted from June 2017 to June 2019 at Department of Orthopedics, DYP Medical College and Hospital Kolhapur after ethical committee approval.

Inclusion criteria

- Adults - >18 years (Male & Female both)
- Extra-articular distal tibia fractures (AO OTA A1, A2, A3), partial-articular (AO OTA B1, B2, B3), Intra-articular fractures (AO OTA C1)

Exclusion criteria

- Age- <18 years
- Intra-articular fractures (AO OTA C2, C3).
- Compound / open fractures
- Pathological fractures
- Old fractures with implant failure.
- Fracture with Neuro-vascular injuries or compartment syndrome

The fracture distribution is illustrated in table 1.

Table 1: Fracture Distribution

Age distribution	No. of patients	Total
18-30	3	20
30-40	6	
40-50	8	
50-60	2	
>60	1	
Sex		
Male	13	20
Female	07	
Side		
Right	8	20
Left	12	
Mode of Injury		
Road Accident	13	20
Fall From Height	3	
Self-fall	4	
AO/OTA Fracture type		
A1	3	20
A2	4	
A3	7	
B1	3	
B2	1	
B3	1	
C1	1	

Pre operative assessment

Clinical and Radiological Examination was carried out on all patients in orthopedic OPD/emergency trauma ward. Ankle AP Lateral and Mortise views were taken to identify the fractures. A 3D CTSCAN may be required to find out any Intra-articular fractures. The ankle was immobilized by below knee slab till definitive fixation done. All the cases were taken for early primarily fixation with locking compression plate. Five cases were delayed for 8 days due to swelling and those cases were operated after appearance of wrinkle sign.

Surgical technique

Medial approach is most commonly used for the MIPPO Technique. Surgery was performed under spinal anesthesia. Tourniquet was used. A vertical and curvilinear Incision was made at level of medial malleolus. Subcutaneous plane was made without disturbing the fracture hematoma. Reduction of fractures was done under C-arm guidance and fixed with LCP plate and screws. Tourniquet was removed and incision closed.



Incision picture and intra op images

Post operative period

Intra venous Anti-biotic was continue for 3 days after surgery. Suture or staple removal was done at 12th -14th post operative day. Active Quadriceps exercises are started on the 1st post operative day with active ankle and toe movement as far as the patient is comfortable and free of pain. The patients were made to ambulate from 4th post operative day without weight bearing on operated leg with walker.

Follow up

The patient were assess clinically, functionally using AOFAS (American orthopedic foot and ankle society) scoring system at follow up of 6 weeks, 3 months and 6 months. Partial and

full weight bearing were allowed based on radiological sign of fracture healing. The fracture were designated as united when there was periosteal bridging callus at a fracture site at least in 3 cortices in AP and Lateral views.

Case 1- 48yr old male patient, H/O RTA, closed distal tibia fracture treated with LCP using MIPPO technique.



Pre OP Xray Immediate Post OP Xray



24 weeks follow Up



Dorsiflexion Plantar Flexion

Case-2 32 yr old female patient, h/o fall at home, having distal tibia and fibula fracture treated with lcp using Mipppo technique.



Preop, postop and 24 weeks follow up xray

Result

Total number of patient included in our study was 20. The details of the patients, there background, mode of injuries and type of fracture are provided above in Table 1: Fracture Distribution.

Assessment of functional and radiological outcome

The American Orthopaedic Foot & Ankle Society (AOFAS) scale was used in our study to assess the functional outcome. This scale consists of subjective and objective variables classified into three major categories: pain (40 points), function (50 points), and alignment (10 points).

Table 2: AOFAS (American Orthopedic foot & Ankle Society) SCORE

AOFAS Scale (Functional outcome)	Outcome	No of cases
>89	Excellent	2
80-89	Good	14
70-79	Acceptable	4
<69	Bad	-

Table 3: Patient Data

Gender	Age(y)	MOI	AO Fracture type	AOFAS	
				3 Months	6 Months
Female	28	RTA	A3	87	88
Male	38	FALL	B2	85	87
Female	35	FALL	A1	86	86
Male	49	RTA	B3	76	80
Male	27	FALL	A2	88	90
Male	35	RTA	A3	84	86
Male	58	RTA	A2	74	76
Female	56	RTA	B1	76	78
Male	45	FALL	A2	84	86
Female	45	RTA	A1	88	90
Male	47	FALL	C1	76	78
Male	29	RTA	A3	86	86
Female	39	RTA	A3	84	86
Male	39	RTA	A1	88	88
Female	47	FALL	A2	84	86
Male	68	RTA	A3	78	78
Male	37	RTA	B1	82	84
Male	49	RTA	A3	84	86
Female	48	FALL	B1	84	84
Male	42	RTA	A3	86	86

Discussion

Distal tibia fracture is one of the most problematic injury to manage because of status of soft tissue and degree of comminution sustained at a time of injury, which affect the long term clinical result. The goal of operative treatment is to obtain anatomic realignment of joint surface while providing enough stability to allow early motion .This is achieved with minimal bony and soft tissue devascularisation in order to decrease the complications resulting from the treatment [6, 7, 8]. In our study 20 patients with distal tibia fracture were treated with LCP by MIPPO technique. This technique has been resulted as effective stabilization of these fractures. Its angular stability represents an improvement of the internal fixation of complex fractures. So its provides adequate stability allows early motion. Minimal invasive technique preserves the biological environment by decreasing soft tissue injury with better outcome in the terms of radiological union and functional outcome.

The present study was undertaken to evaluate the functional outcome of plate Osteosynthesis with LCP using the MIPPO.

Our evaluated result has been compared with other’s results using similar modalities of treatment. Our analysis was as follows:

➤ **Age distribution**

In our study mean age of patients was 43 whereas the mean ages of other’s study of similar fractures were as follows:

Table: Age distribution

Study	Average Age
C Mauffry <i>et al.</i> [11]	46
Bahari <i>et al.</i> [9]	35
Redfern <i>et al.</i> [12]	38.3
Hasenbohrer <i>et al.</i> [3]	46
JJ Guo <i>et al.</i> [10]	44.4
our study	43

➤ **Gender distribution**

In our study the ratio of male and female was almost similar to the other’s study as compared below:

Table: Gender distribution

Study	Male %	Female %
C Mauffry <i>et al.</i> [11]	66	34
JJ Guo <i>et al.</i> [10]	65	35
Our study	65	35

➤ Range of motion

On post op day 1 ankle movements were started. Non weight bearing mobilization was done for 6 weeks after surgery and then partial weight bearing was started. Depending on radiological union total weight bearing was started after 12-16 weeks. 16 patients (80%) got full range of motion by 24 weeks. 4 patients (20%) got full range of motion by 26-28 weeks after physiotherapy.

➤ Duration of time to radiological consolidation

The average time for fracture consolidation in our study was 22 weeks. Whereas the average time for fracture consolidation in various other studies conducted using similar methods was between 16-20 weeks.

Table: Duration of time to radiological consolidation

Study	Mean time to union (weeks)
Bahari <i>et al.</i> [9]	22.4
Redfern <i>et al.</i> [12]	23
JJ Guo <i>et al.</i> [10]	17.6
Collinge <i>et al.</i> [13]	21
Our study	22

➤ Functional outcome

In our study mean AOFAS score was 84.45. The comparative study with other studies for similar fractures was as follows:

Table: Functional outcome

Study	Mean AOFAS score
JJ Guo <i>et al.</i> [10]	83.9
Collinge <i>et al.</i> [13]	85
Our study	84.45

➤ Complications

In our study, 4 patients were suffering with ankle stiffness even at the end of 24 weeks of follow up. Stiffness gradually improved and functional range of ankle movements was achieved with the help of physiotherapy by 26-28 weeks. In our study 3 patients had superficial wound infection. The wound eventually healed with the help of antibiotics and regular dressings.

Table: Complications

Study	Infection rate (%)
Bahari <i>et al.</i> [9]	7.14
JJ Guo <i>et al.</i> [10]	14.6
Borg <i>et al.</i> [14]	14.3
Our study	15%

In our study, all fractures united. No deformities were observed.

Conclusion

MIPPO is an effective method of treatment for distal tibia fractures because it offers a Bio-logical advantage by preserving periosteal blood supply and combine with C-arm guidance helps in indirect reduction of distal tibia fracture in restoring length an alignment, thus reducing the chances of malunion and deformities. It helps in early mobilization of

ankle movement and reduces the ankle stiffness thus improving clinical and functional outcome.

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