E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(4): 969-973

www.orthopaper.com
Received: 21-08-2020
Accepted: 29-09-2020

Dr. Muralidharan R
Junior Resident in Orthopedics, Department of Orthopaedics, Sree Balaji Medical College and Hospital, No. 7, Works Road, New Colony, Chromepet, Chennai, Tamil Nadu, India

Dr. Vijay Narasimman Reddy
Professor in Orthopedics, Department of Orthopaedics, Sree Balaji Medical College and Hospital, No. 7, Works Road, New Colony, Chromepet, Chennai, Tamil Nadu, India

Corresponding Author:
Dr. Muralidharan R
Junior Resident in Orthopedics, Department of Orthopaedics, Sree Balaji Medical College and Hospital, No. 7, Works Road, New Colony, Chromepet, Chennai, Tamil Nadu, India

Distal tibial fractures treated by minimally invasive percutaneous plate osteosynthesis

Dr. Muralidharan R and Dr. Vijay Narasimman Reddy

DOI: https://doi.org/10.22271/ortho.2020.v6.i4n.2447

Abstract
Objective: To analyse the functional and radiological outcomes of treating distal tibia fractures with minimally invasive percutaneous plate osteosynthesis.
Methods: A prospective study was performed on Thirty adult patients who underwent locking compression plate using MIPPO technique for closed fracture of distal tibial in the Department of Orthopaedics from May 2017 to April 2018 and were followed for one year. The functional outcome was measured using AOFAS (American Orthopaedic Foot and Ankle Society score) and was then graded as excellent/ good/ fair and poor. Radiological outcomes assessed to look for cortical union by taking anteroposterior and lateral view x-ray of affected limb.
Results: Majority of the patient were male (60%) belonging to the age group of 36 to 40 years (26%). AOFAS score depicts excellent result in the majority of the patients (70%). Duration of cortical union is less than 16 weeks in almost 50% of patients. Complication resulted in 22% of patients.
Conclusion: minimally invasive percutaneous plate osteosynthesis technique for the treatment of distal tibia fracture provides good healing and excellent functional results in most of the patients with few complications.

Keywords: MIPPO, percutaneous plate osteosynthesis, LCP, distal tibia fracture

Introduction
The process of unplanned and rapid urbanization in developing country like India lead to increase in number motor vehicle. There is a massive increase in morbidity and mortality due to road traffic accidents in the past few years. Recently road traffic accident takes ninth place in disease burden and will occupy the third place by 2020 [1]. All over the world, around 1 million death and around 50 million injuries occur due to a road traffic accident [1]. In India, around eighty thousand death and around 1 million injuries occur due to a road traffic accident. Among these RTA, half of the population belong to the wage-earning group [2]. Tibia is the most common long bone fracture involved in RTA. Distal Tibia fracture is second most common among all Tibial fracture [3]. Delayed bone union, Non-Union, wound complications such as dehiscence and infection are the complication following post-traumatic tibia fracture due to the peculiar blood supply, superficial location of bone and use of certain treatment methods(4). Surgical treatment available for the distal tibia fracture includes ORIF with plating [5, 6], external fixator [6-10] and intramedullary nailing [11-13]. Recently minimally invasive percutaneous plate osteosynthesis is used in the treatment of complex bone fracture of the lower extremity [14-16]. The main aim of this procedure is to provide stable plate fixation and maintain fracture biology without extensive soft tissue damage. Vascular studies following MIPPO technique demonstrated preservation of blood supply when compared to open plating [17]. Open reduction and plating cause extensive soft tissue damage and periosteal injury associated with complications like infection, malunion and non-union [18-23]. Intramedullary nailing remains gold standard for the shaft of tibia fracture, and also used for distal tibia fracture but reaming of marrow leads to the destruction of bone marrow and make the bone brittle after implant removal [24]. External fixator also associated with complications like pin site infection, loosening of pin and non-union. In MIPPO technique, soft tissue attachment and hematoma surround fracture fragment are not disturbed. Hence it preserves the vascularity and osteogenic capacity of the fragment.

The fracture site is stabilized by fixing plate proximal and distal to the fragment by minimal soft tissue damage. Displaced and angular alignment are corrected by closed reduction technique. The advantage of MIPPO technique is.

- It preserves extra osseous blood supply.
- Fracture hematoma is not disturbed.
- Biologically friendly and stable fixation.
- Sub-cutaneous tunnelling of the plate avoids large incision.
- Iatrogenic injury to vessels and nerves are prevented.
- Provides both angular and axial stability.

Aim and objective

To analyse the functional and radiological outcomes of treating distal tibia fractures with minimally invasive percutaneous plate osteosynthesis.

Materials & methods

This prospective study was conducted at Sree Balaji Medical College and Hospital, Chrompet during the period from May 2017 to April 2018 in the Department of Orthopaedics. Thirty-two patients have been operated with MIPPO technique for the distal tibia fracture. Out of which one patient lost to follow up, and one died because of an unrelated cause, and they were excluded from the study. Thirty cases were followed for twelve months. Written consent from all the patients was taken to publish their clinical and radiological data. Necessary clearance was also sought from the institution's research and ethical committee for the conduct of this study.

Inclusion criteria

1. Patients 26-50 years old at the time of injury.
2. Both males and females.
3. Simple closed fractures of distal one third tibia.
4. Extra articular fracture.
5. Isolated tibia fracture.
6. All type of fracture distal tibia.

Exclusion criteria

1. Patients aged below 26 and above 50 years.
2. Pathological fractures.
3. All open fracture.
4. Patients with concomitant fractures in the Ipsilateral limb.
5. Intraradicular fracture.

Pre-operative planning

i. Examine for the signs of vascular damage, closed degloving injury, fracture blisters and compartment syndrome.
ii. Evaluate the soft tissue condition and accordingly plan for the timing of surgery.
iii. Classify fracture pattern and degree of commination.
iv. Evaluate the need for distraction to achieve reduction.
v. Patient factors like diabetes mellitus, immune compromised condition, chronic disease, peripheral vascular disease, alcoholism and smoking must be considered.
vi. Investigations – X-Ray leg Anteroposterior and Lateral views.
vii. All required preoperative investigation.

Procedure

When trauma patient arrives in casualty, the first thing we stabilize the general condition (airway, breathing and circulation) of the patient. Then we rule out morbid injuries like intracranial haemorrhage, Rib fracture, Pneumothorax and intraabdominal bleeding. After which a head to toe examination is done. Suspected fracture site from the examination is splinted. X-ray of the required portion is taken. In distal tibia fracture, the limb was immobilized temporarily with the above-knee slab. All routine pre-operative investigations done and associated comorbid condition like diabetes, hypertension is treated and brought under control. Anaesthetic fitness obtained and patient posted for LCP plating using MIPPO technique. LCP can be used in different ways:

- Conventional plating (compression and absolute stability) [25].
- MIPPO technique (relative stability).
- Combination of the above technique.

Stability is mainly due to friction between plate and bone. The main goal of conventional plating is to provide anatomical reduction. Now recently developed bridging plate osteosynthesis is used in multi fragment fracture of distal tibia. It has the advantage that it preserves vascularity of the bone, thus allowing the healing process of bone with callus formation. Damage to soft tissue is also less extensive, thus achieving the more rapid union of bone.

Patient in the supine position, with a tourniquet, applied. Regional anaesthesia is given. The indirect reduction was done using manual traction, Steinmann pin, Kirschner wire and reduction forceps. After reducing 3-4 cm incision in the vertical direction is made just proximal and distal to fracture site with care not to injure vessels and nerves. Using a special elevator, a subcutaneous tunnel was made. Locking compression plate was applied based on the fracture pattern. The locking sleeve is used as a handle for inserting the plate through a tunnel across the fracture site. The plate was centred across the fracture site. Initially, the cortical screw is inserted depending on the need for reduction of the proximal or distal fragment. Locking screw was inserted after reduction. There should be a minimum of 6 cortices on either side. Wound site was closed in layers, and a sterile dressing is done. The patient is temporarily immobilized with the above-knee slab.

Post-operative

Prophylactic antibiotic Cefotaxime was given to all patients 30 minutes before incision and was continued till postoperative day 3. In some compound fracture antibiotic is continued till suture removal. Adequate analgesics were given to relieve pain. Alternate suture removal is done on the 12th postop day. Complete suture removal is done on the 14th postop day.

The patient is made to sit and Non-weight bearing mobilized is started on the 1st post-op day. Muscle strengthening exercise and active range of movement exercise were started as tolerated by the patient. Passive range of motion apparatus is used for hip until the patient is discharged from the hospital. Full weight-bearing is advised generally after 18 weeks after confirming union by X-ray. Exercise is continued until the patient regains muscle strength and range of motion. The anteroposterior and lateral view was taken postoperatively to look for an adequate reduction.

Follow-up

The patient is asked to come for a follow-up two week

following discharge. Both functional and radiological evaluation of the patient is done during follow-up. Then after the patient is asked to come for follow up at six weeks, three months, six months, and one year and annually after that. Even though not all patients routinely came for follow-up. Sufficient amount of patients came. Attempts made to call patients those who missed follow-up through a phone call.

Outcome analysis

The functional outcome was measured by using AOFAS Scores.

The American Orthopaedic Foot and Ankle Society Score (AOFAS) introduced in 1994 consists of nine questions in three components.
Pain (1 Question - 40 points),
Function (7 Questions - 50 points)
Alignment (1 Question - 10 points)
Total score 100 points.
Points to Alignment and range of motion was based on clinical examination and radiograph.
Individual points are added to get an overall functional score, which is expressed as a percentage.
Radiological outcomes are evaluated by anteroposterior and lateral view X-ray to look for cortical union.

Results

Thirty patients with the distal tibia fracture who satisfy inclusion criteria are included. They were operated with MIPPO technique.
Majority of the patient were male (60%) belonging to the age group of 36 to 40 years (26%). AOFAS score depicts excellent result in the majority of the patients (70%). Duration of cortical union is less than 16 weeks in almost 50% of patients. Complication resulted in 22% of patients.

Table 1: Age and Sex distribution

Age	Number of patients			Percentage of patients
	Male	Female	Total	
26 to 30 Years	3	2	5	17
31 to 35 Years	3	3	6	20
36 to 40 Years	6	2	8	26
41 to 45 Years	2	3	5	17
46 to 50 Years	4	2	6	20
Total	18	12	30	100%

Table 2: AOFAS Score

Grading	Points	Number of patients	Percentage
Bad	0-30	0	0
Fair	31-60	0	0
Good	61-90	9	30
Excellent	>90	21	70
Total		30	100%

Table 3: Radiological outcome: duration of cortical union

Duration (weeks)	Number of patients	Percentage
<16 weeks	15	50
16-20 weeks	10	33
20-24 weeks	4	13
>24 weeks	1	4
Total	30	100%

Table 4: Complication

Complications	Number of patients	Percentage
Superficial Infection	3	10
Deep Infection	2	6
Malreduction	1	3
Delayed union	1	3
Total	7	22%

Case Illustration 1

Fig 1: X-ray ankle showing fracture of distal tibia

Fig 2: Clinical intra-operative picture of MIPPO technique

Fig 3: Post-operative X-ray after plate fixation

Case Illustration 2

Fig 4: X-ray ankle showing distal tibia fracture

Fig 5: Clinical intra-operative picture of MIPPO technique

Fig 6: Post-operative X-ray after plate fixation

Discussion

Many new innovative surgical techniques have been developed over the years with an improved understanding of biomechanics, which leads to a better functional outcome for patients. Managing a severely comminuted distal tibia fracture is challenging. Tibia is a long bone that transmits body weight to the ground. This study is done to access the effectiveness of minimally invasive MIPPO technique in the management of distal tibia fracture.

Previously more importance of fracture treatment is to achieve anatomical reduction and rigid fixation to achieve stability. This results in an increased incidence of delayed union and non-union due to disturbing soft tissue and hematoma covering fracture. This lead to the development of a minimally invasive technique to avoid damage to fracture hematoma and soft tissue covering fracture. This helps in the early union of the fracture. This type of fixation is a demanding technique and success depends on the technique used

MIPPO has been extensively used in distal tibia fracture. In our study, we have used MIPPO technique in all kind of distal tibia fracture. Tibia is one of second longest bone in our body which bears the entire weight of the body. Treating such bone fracture with minimally invasive technique is a challenging part. Presence of open injury associated with skeletal injury and skin condition all affected outcome. In our study we have taken only closed isolated tibia fracture.

In our study, we treated thirty patients with distal tibia fracture with MIPPO technique. Males are more commonly involved in distal tibia fracture than female. The reason might be due to males are more involved in our door activities than female. Most of the cases occur in the age group of 36 to 40 years. AOFAS score revealed excellent result in 70% of patients and good results in 30% of patients. There are no patients with a fair and bad score. Radiological outcome revealed almost 50% of patients achieved cortical union within 16 weeks, and most of the patients achieved cortical union within 24 weeks. Only one patient had a cortical union for more than 24 weeks. Complications were seen only in 22% of patients.

Inference from the above study

i. Minimally invasive percutaneous fixation following closed reduction is very effective in the management of distal tibia fracture.
ii. It decreases the duration of surgery, intraoperative blood loss and postoperative complication, which allow early rehabilitation.
iii. It decreases the duration of the union.
iv. AOFAS Score provide excellent results when distal tibia fracture treated by MIPPO technique.
v. It also decreases the postoperative incidence of infection as compared to the open technique.
vi. Perfect restoration of limb length, alignment and rotation.

Table 5: Comparison of previous studies

Publication	No of patients	Average age of patient (in yrs)	Average time for cortical union	Post-operative Infection (%)	Malreduction (%)	Delayed unions (%)	Mean AOFAS score at union (Max 100)
Borg *et al.*	21	-	5.44m	14.3%	28.5%	19%	-
Bahari *et al.*	42	35	22.4 wks	7.14%	-	-	-
Mafulli *et al.*	20	-	-	0	36.8%	5.3%	-
Redfern *et al.*	20	38.3	23 wks	5%	5%	0	-
Hasenbohler *et al.*	32	45	75% at 6m	3.4%	0	17.2%	-
Williams *et al.*	20	-	-	10.5%	-	31.5%	-
Lau *et al.*	48	-	18.7 wks	16.7%	-	10.4%	-
Gupta *et al.*	71	-	-	3.8%	2.5%	12.7%	-
Ronga *et al.*	21	-	-	42.3%	19%	4.8%	-

Sitnik *et al.*	80	43	87.5% by 6m	9%	6%	13%	-
Hazarika *et al.*	20	44.7	58.3%at 6m	5%	-	10%	-
J J Guo *et al.*	54	44.4	17.6 wks	14.6%	-	-	83.9
Collinge *et al.*	38	-	21 wks	-	2.63%	8%	85
Siddhartha VP *et al.*	50	36	21.4 wks	12%	2%	2%	95.06
Present study	30	37	16 wks	22%	3%	3%	96

Conclusion

From the above study, we prove that minimally invasive percutaneous plate osteosynthesis has given excellent and good functional outcome in most of the patient. Duration of union is less than 16 weeks in most patients. Complication resulted only in 22% of patients. Hence we conclude that minimally invasive percutaneous plate osteosynthesis can be considered treatment of choice for distal tibia fracture.

Reference

1. WHO. World report on road traffic injury prevention. Geneva: WHO, 2004. Geneva: WHO 2004, 3-29.
2. Ruikar M. National statistics of road traffic accidents in India, J Orthop Traumatol Rehabil 2013;6:1-6.
3. Court-Brown CM, Rimmer S, Prakash U, McQueen MM. The epidemiology of open long bone fractures Injury 1998;29(7):529–34.
4. Trueta J. Blood supply and the rate of healing of tibial fractures Clin Orthop 1974;(105):11–26.
5. Kellam JF, Waddell JP. Fractures of the distal tibial metaphysis with intraarticular extension: the distal tibial explosion fracture, J Trauma 1979;19:593.
6. Pugh KJ, Wolinsky PR, McAndrew MP *et al.* Tibial pilon fractures: a comparison of treatment methods, J Trauma 1999;47:937-941.
7. Bone L, Stegemann PM, McNamara K, et al. External fixation of severely comminuted and open tibial pilon fractures, Clin Orthop Relat Res 1993;292:101-107.
8. Court-Brown CM, Walker C, Garg A *et al.* Half-ring external fixation in the management of tibial plafond fractures, J Orthop Trauma 1999;13:200-206.
9. Marsh JL, Bonar S, Nepola JV *et al.* Use of an articulated external fixator for fractures of the tibial plafond, J Bone Joint Surg Am 1995;77:1498-1509.
10. Marsh JL, Weigel D, Dirschl D. Tibial plafond fractures. How do these function over time?, J Bone Joint Surg Am 2003;85:287-295.
11. Nork SE, Schwartz AK, Agel J *et al.* Intramedullary nailing of distal metaphyseal tibial fractures, J Bone Joint Surg Am 2005;87:1213-1221.
12. Mosheiff R, Safran O, Segal D, et al. The unreamed tibial nail in the treatment of distal metaphysical fractures, Injury 1999;30:83-90.
13. Robinson CM, McLauchlan GJ, McLean IP *et al.* Distal metaphyseal fractures of the tibia with minimal involvement of the ankle, J Bone Joint Surg Br 1995;77:781-787.
14. Collinge C, Sanders R. MIPO, J Am Acad Orthop Surg 2000;8:211-216.
15. Collinge C, Sanders R, DiPasquale T. Treatment of complex tibial per articular fractures using percutaneous techniques, Clin Orthop Relat Res 2000;375:69-77.
16. Helfet DL, Shonnard PY, Levine D *et al.* Minimally invasive plate osteosynthesis of distal fractures of the tibia Injury 1997;28(1):S-A42-S-A48.
17. Borrelli J Jr, Prickett W, Song E *et al.* Extraosseous blood supply of the tibia and the effects of different plating techniques: a human cadaveric study, J Orthop Trauma 2002;16:691-695.
18. Fisher WD, Hambledon DL. Problems and pitfalls of compression fixation of long bone fractures: A review of results and complications. Injury 1978;10:99-107.
19. McFerran MA, Smith SW, Boulas HJ, Schwartz HS. Complications encountered in the treatment of pilon fractures, J Orthop Trauma 1992;6:273-85.
20. Collinge C, Sanders R, DiPasquale T. Treatment of complex tibial periarticular fractures using percutaneous techniques, Clin Orthop Relat Res 2000;375:69-77.
21. Redfern DJ, Syed SU, Davies SJM. Fractures of the distal tibia: minimally invasive plate osteosynthesis Injury 2004;35:615-620.
22. Toms AD, McMurtie A, Maffulli N. MIPO of the distal tibia, J Foot Ankle Surg 2004;43:199-203.
23. Hazarika S, Chakravarthy J, Cooper J. Minimally invasive locking plate osteosynthesis for fractures of the distal tibia - results in 20 patients Injury 2006;37:877-887.
24. Oh CW, Kyung HS, Park IH *et al.* Distal tibia metaphyseal fractures treated by percutaneous plate osteosynthesis Clin Orthop Relat Res 2003;408:286-291.
25. Heather A, Vallier T, Toan le, Asheesh Bedi. Radiographic and clinical Comparisons of distal tibia shaft fractures (4-11 cms proximal to Plafond) versus intramedullary nailing, J Orthop Trauma 2008;22:307-311.