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Original Research Article

A Prospective Clinical Study of Surgical Management of Distal Tibia Fracture by Mippo Using Locking Compression Plate

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Abstract

Aim: Our aim of the study was to observe the outcome of the distal tibial fracture fixation (extra-articular and intra-articular) with locking compression plate (LCP) using MIPPO technique.

Materials and Methods: The study was conducted in Department of Orthopedics, Ballari Medical College and Research Centre, Ballari. In patients age above 18 years old, who were treated for distal tibia fracture (type A, B & C – AO classification) from the time period of 1st August 2022 to 31st January 2024. 30 patients were taken into the study; all were fixed with LCP by MIPPO.

Results: In our study out of 30 patients treated in that 12(40%) patients had excellent outcome, 12(33%) had good results, 5(17%) had fair outcome and 3(10%) had a poor result. Mean fracture healing was observed at 16.3 weeks. Total 17 Complications were seen. Most common complication was wound infection which was seen in 23.4%, Ankle stiffness and Occasional pain in 13.3% respectively, Malunion in 6.7%.

Conclusion: LCP with MIPPO technique is an effective method of fixation. While applied subcutaneously, it has many advantages like less soft tissue damage, does not endanger periosteal blood supply and will not disturb fracture hematoma and it results in fewer complications.

Keywords: Prospective, Distal tibia, Patients, Fracture, Osteosynthesis.

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Introduction

High speed motor vehicle accidents generally result in complex fractures and distal tibia fractures are one of the most common fractures. Surgical or conservative management of these tibia fractures is sometimes difficult due to minimal soft tissue around the bone and poor vascularity.

Surgical management with open reduction and internal fixation generally lead to extensive soft tissue dissection and periosteal stripping with high rates of complications like infections (range 9-25%), delayed union and non-union (range 9-23%).

To reduce complications MIPPO technique plays a pivotal role in reducing soft tissue injury and preserve fracture hematoma. [1]

Preserving soft tissue attachments and therefore the vascular supply to the tibia is of particular importance when plating tibia fractures. Modern plating techniques rely on more minimally invasive approaches, often using smaller skin incisions than those that were originally described and are associated with better outcomes. [2] Distal third of tibia is particularly prone for delayed and non-union because of its precarious blood supply. [3]

Low energy fractures occur in older age group due to rotation injury resulting in extra articular fracture without much soft tissue injury with fewer incidences of wound complications and infection. [4] Locking plates (LPs) have the biomechanical properties of internal and external fixators, with superior holding power because of fixed angular stability through the head of locking screws, independent of friction fit. The newer techniques include minimally invasive percutaneous plate osteosynthesis which aims at minimal periosteal dissection and disruption of hematoma, stable anatomical fixation and early mobilization, decreased post-operative complications and higher

rates of union. Minimally invasive percutaneous plating will restore limb alignment and yield successful clinical outcomes for high-energy fractures of the distal tibia. [5]

Aims and Objectives

1. To study and evaluate the clinical outcome of distal tibia fracture with MIPPO by using LCP.
2. To evaluate the incidence of complications in distal tibia fracture with MIPPO by using LCP.

Materials and Methods

The patients attending the department of orthopaedics, BMCRC and also patients referred from other departments BMCRC of Combined group of hospitals, BALLARI.

Source of data: All the patients attending orthopedics department and also patients referred from other departments of combined hospitals, BMCRC, BALLARI from August 2022 to January 202

Methods of collection of data:

Study design: A Prospective study

Study period: One year Six Months (From 1st August 2022 to 31st January 2024)

Place of study: Ballari Medical College and Research Centre, Ballari.

Sample size: 30

Inclusion Criteria:

1. Age Limit: Above 18 years
2. Patient fit for surgery
3. Extra and intra articular fractures

Exclusion Criteria:

1. Patients less than 18 years of age
2. Open fractures
3. Associated vascular injuries
4. Pathological fractures

Methodology: A written informed consent will be taken from all patients included in this study. A detailed history taking, thorough clinical examination and investigations is done for these patients. The data collected will be entered into a specially designed case record proforma.

Pre-Operative Regimen: The patients will be resuscitated in emergency room and a complete examination will be done for other associated injuries as well. Neurological and vascular assessment of the involved limbs will be done. Wound lavage, dressing and splintage will be done as per the initial assessment and injury to the patient. Analgesics, Antibiotics, I.V fluids will be administered as per protocol and tetanus prophylaxis as per requirement will be given and patients sent for radiological x rays.

Basic blood parameters will be evaluated. Gram positive and Gram negative antibiotic cover will be given for closed fractures. The patient will be taken for surgery after initial resuscitation stabilization of vital parameters and after getting pre anaesthetic check-up and clearance.

Investigations:

- Routine investigations for all cases like Haemoglobin %
- Total WBC count, Differential WBC count. Blood grouping and Rh typing.
- Bleeding time and Clotting time.
- Random Blood sugarBlood urea
- Serum creatinineHIV I&II
- HBsAgECG
- Plain x-ray AP and LATERAL views

Operative Procedure: All the patients will be operated in supine position on a radiolucent table. The unaffected limb will be kept in extended position. The patient will be prepared and draped leaving the leg exposed as required, for surgical incision and intraoperative evaluation of fracture alignment

Once the patient is prepared and draped, intraoperative antibiotics will be given before the inflation of tourniquet. By traction and manipulation reduction will be attempted. The provisional reduction will then be confirmed by image guidance under C-ARM. After adequate reduction and alignment isachieved, plate size will be selected under image guidance so as to provide adequate fixation and stabilization of fracture.

In all cases, fibula is fixed first in order to maintain the length of the affected limb and also to achieve indirect reduction of fracture by using rush nail or 1/3rd tubular plate through Postero-lateral approach.

In MIPPO technique, incision will be made obliquely at the tip of medial malleolus and extended proximally to create easy passage. The medial malleolus will be exposed, with care taken to protect the great saphenous vein. Percutaneous elevators will then be inserted to create a submuscular, extra periosteal tunnel for the plate. The passage of the plate till fracture site will be confirmed with C-ARM imaging. An incision will be made proximally at theestimated proximal edge of the plate. The anterior and posterior borders of the medial tibia will then be palpated, and incision will be extended longitudinally exposing the periosteum. Sub-muscular plane is developed in proximal incision and tunnel developed till fracture site and the plate will be pushed by the surgeon's opposite hand. The plate is palpated in the proximal

incision and confirmed to be well seated. The plate shall then be fixed on the tibial surface with a Kirschner wire inserted through a fixation bolt. Adequate positioning will then be confirmed with anteroposterior and lateral imaging. The proximal position of the plate will then be checked to ensure central placement of the tibial shaft (using the C-Arm).

This will then be followed by insertion of fixation screws following the standard procedure for non-locking cortical screws and locking screws. All the non-locking screws shall be inserted first as decided pre-operatively and after attaining adequate reduction, locking screws shall be inserted. A minimum of four screws should be used in each main fracture fragment. Osteopenic bone may require more screws.

After the plate is inserted with the screws, the stabilization bolt will be removed from the middle distal hole and screw will be inserted in its place. The principles of fixation using LCP shall be adhered to at every stage of fixation.

This will be followed by irrigation of all the incisions with normal saline and wound closure in layers. The technical problems/complications during the procedure (if any) will be recorded.

Post-Operative Regimen: Post-operative X-ray will be done to document proper reduction and fixation of fracture fragments. Ankle mobilization will be started from 2nd or 3rd postoperative day according to the tolerance of patients or associated injuries. Antibiotics (Intravenous /oral) will be continued till the wound condition necessitates. Progressive weight bearing will be allowed according to the callous formation as assessed in follow up X Rays. Secondary procedures if any shall be done.

Regular follow up of the patient in OPD with X-rays and functional outcome evaluated as per OLERUD AND MOLANDER SCORING SYSTEM (ANNEXURE-V) will be done. All long term complications like nonunion, malunion, angular deformity, implant breakage, shortening or infection will be recorded. Secondary surgical procedures which were done in the patients will also be analysed.

The patient shall be under follow up till the bony union of the fracture / upto 6 months, whichever is earlier. The final result shall be based on the functional and radiological outcome. The results shall be compiled and compared with literature.

The outcome of distal tibial fracture management with locking plates will beassessed in terms of: Time of bony union, Ankle range of movement, Infection, Malunion, Secondary procedures performed (if any)Implant failure.

Rush Nail for Fibula: Medial distal tibia LCP plate was used in 30 cases. In that 2 cases fibula fixed with plate and 22 cases with rush nail and other 6 cases only with LCP for tibia.

Sample Size of Estimation

Formula for sample size calculation: The below formula was used for sample size calculation [6]

n= (〖Z1〗 ^2 {P(1-P))/d^2

Variable considered for calculation of sample size:

76% wounds were healed at that time of plate removal is considered here for sample size Calculation [7].

Calculation.

P	Your guess of Population P (any value<1)	0.76
1-α	Confidence level set by you	0.23
Z	Z value associated with confidence	1.96
D	Absolute precision (Value less than P)	0.153
N	Minimum sample size	30

By using above formula and putting the values in it, minimum sample size came to 30. Statistical analysis and methods.

Data will be collected by using a structure proforma. Data entered in MS excel sheet and analysed by using SPSS 24.0 version IBM USA.

Qualitative data will be expressed in terms of proportions Quantitative data will be expressed in terms of Mean and Standard deviation Association between two qualitative variables will be seen by using Chi square/ Fischer'sexact test Comparison of mean and SD between two groups will be done by using unpaired t test to assess whether the mean difference between groups is significant or not.

Descriptive statistics of each variable will be presented in terms of Mean, standard deviation, standard error of mean.

A p value of <0.05 will be considered as statistically significant whereas a p value <0.001 willbe considered as highly significant.

Results

Table 1: The percentage distribution of cases according to age

Age in years	Number of Cases	Percentage
19-30	3	10
31-40	6	20
41-50	8	26.6
51-60	8	26.6
61-75	5	16.8
Total Cases	**30**	**100**

Mean and SD - 47.82 ± 13.03

The age distribution shows that the majority of injuries occur in the 41-50 and 51-60 age groups, each constituting 26.6% of the total cases. The least affected group is the 19-30 age group, with only 10% of the cases. This indicates that middle-aged and older adults are more frequently represented in this study.

Table 2: The distribution of cases according to gender

Sex	Number of Cases	Percentage
Male	17	56.7
Female	13	43.3
Total Cases	**30**	**100.0**

56.7% of the cases treated were males and 43.3 were females. The percentage of male cases is higher than females and this may be due to reason male tend to have a more active lifestyle when compared to females.

Table 3: The distribution of the cases according to their occupation

Occupation	Number Of Cases	Percentage
Business	3	10.0
Farmer	15	50.0
Labourer	12	40.0
Total Cases	**30**	**100**

The majority of participants are farmers, making up 50.0% of the study population. This suggests that a significant portion of the study's demographic is engaged in agriculture. 40.0% of the study population are laborers. This indicates a substantial representation of manual workers in the study. 10.0% of the study population are in business professionals.

Table 4: Mode of injury in the study.

Mode Of Injury	Number Of Case	Percentage
Direct Injury	4	13.3
Rta	17	56.7
Self-Fall	9	30.0
Total Cases	**30**	**100**

This table summarizes the distribution of different modes of injury within the study, with Road Traffic Accidents being the most common cause, It's around 56.7%. Followed by Self Falls 30% and Direct Injuries 13.3%.

Table 5: Distribution of cases according to AO classification.

AO Type	Number Of Cases	Percentage
43-A1	7	23.3
43-A2	13	43.3
43-A3	9	30.0
43-B1	1	3.3
Total Cases	**30**	**100**

The classification of injuries according to the AO system, with the majority being classified as AO Type 43-A2 i.e., 43.3%. Followed by A3 30%, A1 23.3% and B1 3.3%.

Table 6: Distribution of cases according to surgery procedure in the study.

Surgery Procedure	Number Of Cases	Percentage
Mippo With Lcp	6	20.0
Mippo With Lcp And Crif With Rush Nail	22	73.3
Mippo With Lcp And Orif With Fibula Plate	2	6.7
Total Cases	**30**	**100**

MIPPO with LCP and CRIF with RUSH NAIL procedure is the most commonly used, accounting for 73.3% of the cases.

This suggests that combining MIPPO (minimally invasive plate osteosynthesis) with LCP (locking compression plate) and CRIF (closed reduction internal fixation) with a rush nail is the preferred or most frequently performed approach in this study.

MIPPO with LCP procedure is used in 20.0% of the cases. MIPPO with LCP and ORIF with fibula plate is least common procedure, used in 6.7% of the cases.

Table 7: Post-operative complications in the study.

Post Op Complications	Number Of Cases	Percentage
Nil	13	43.3
Ankle Stiffness	4	13.3
Infection	7	23.4
Malunitted	2	6.7
Occasional Pain	4	13.3
Total Cases	**30**	**100**

In the present study 17 cases were seen with complications. Most common complication was wound infection which was seen in 23.4% of the affected cases. Occasional pain and Ankle stiffness was seen in 13.3% of the cases and Malunited was seen in 6.7% of the affected cases.

Table 8: Distribution of cases according to duration of fracture union

Union Time (Weeks)	No. Of Cases	Percentage (%)
Up To 12	4	13.3
12-16	9	30
16-20	12	40
20-24	3	10
24-28	2	6.7
Total	**30**	**100**

All the fractures united with an average duration of 16.3 weeks. There were two cases of delayed union with 24-28 weeks signs of radiological callus formation. Four cases fracture united in 12 weeks (13.3%), nine cases fracture united in 12-16 weeks (30%), twelve fractures united in 16-20 weeks (40%), three fracture united in 20-24 weeks (10%) and two cases of fractured united in 24-28 weeks (6.7%).

Table 9: Distribution of patients in the study based on their results

Clinical Results	Oams	Number Of Cases	Percentage
Excellent	>85	12	40
Good	70-80	10	33
Fair	55-65	5	17
Poor	<50	3	10
Total Cases		**30**	**100**

At the end of 18 months of the 30 patients treated, 12 (40%) patients had excellent outcome, 10 (33%) had good results, 05 (17%) had fair outcome and 03(10%) patient had a poor result.

Radiographs and Clinical Images

Figure 1: Pre-op X RAY

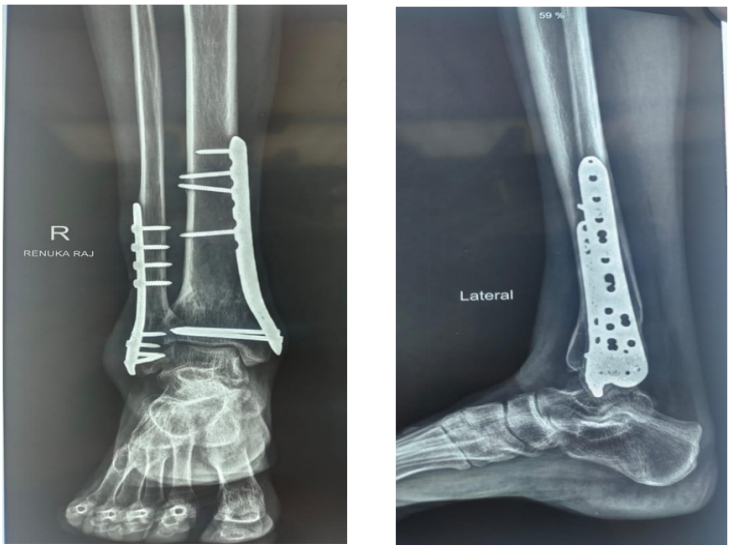

Figure 2: Post Op X Rays

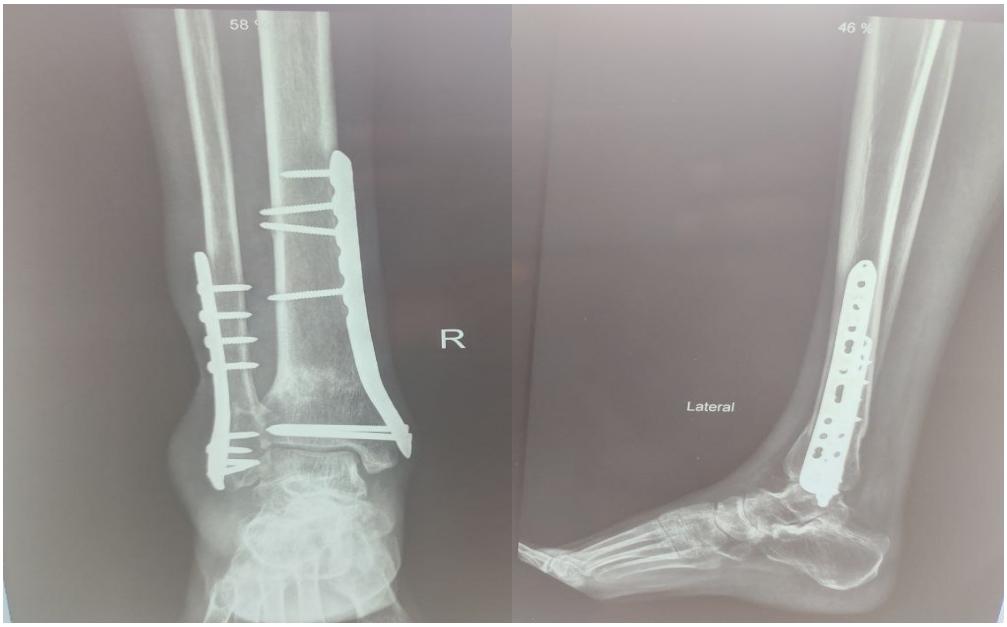

Figure 3: 3 Months Follow Up X Rays

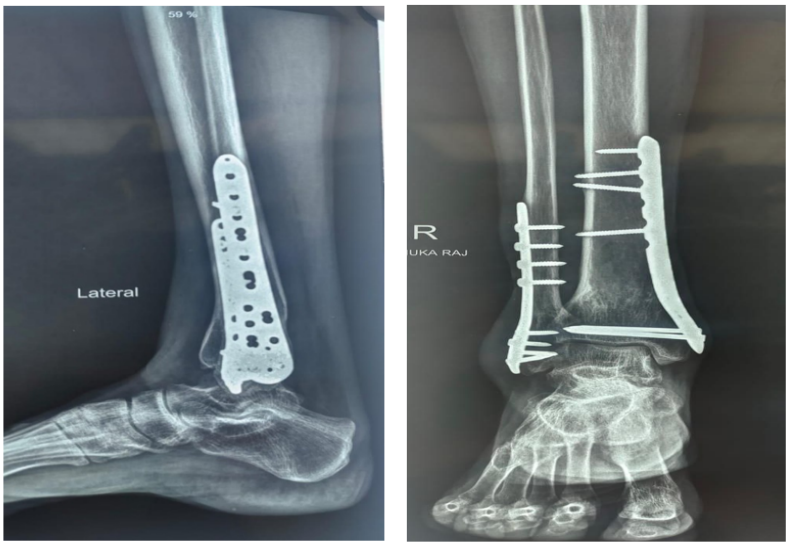

Figure 4: 12 Months Follow Up X Rays

Discussion

Fractures occurring in distal tibia are particularly challenging to treat with a high level of effectiveness. The long-term clinical outcomes are influenced by the condition of the soft tissues and the extent of comminution experienced at the time of injury. The objective of operative treatment is to achieve anatomical realignment of the joint surface while ensuring sufficient stability to enable early motion. The objective is to achieve this by employing methods that limit the reduction of blood supply to the bones and soft tissues, with the aim of decreasing the difficulties that arise from the treatment.

In the present study the age of the patients is above 18 years with the fracture being most common in the 5th and 6th decade and an average age of 47.8 years. It is comparable with other studies on similar fractures conducted by Heather A Vallier et al [8] and Collinger C et al [9], which shows average age of presentation is 43 years and 39.1 years respectively. In Bahari et al studies shows average age of presentation is 35 years.

In the present study, out of 30 patients, 17 (56.7%) patients were males and 13 (43.3%) patients were females showing male preponderance. It is comparable to the study by Collinger C et al, [9] which was 66% possibly due to the fact of male dominance over the female in travelling, occupational injuries etc., in India.

Also, the study by Heather A Vallier et al [8] was comparable in the fact that they had 67% male patients. 50% of cases in our study were agriculturists probably due to location of the hospital, to which people from nearby villages are brought for treatment. Majority of cases were due to road traffic accidents (RTA) i.e. 56.7%. Total 17 Complications were seen. Most common complication was wound infection which was seen in 23.4%, Ankle stiffness and Occasional pain in 13.3% respectively, Malunion in 6.7%. Ovadia and Beals [10] reported a 10% incidence of superficial wound infection and a 6% incidence of osteomyelitis in patients with closed fractures treated with ORIF. McFerran et al. reported that major complications occurred in 40% of fractures treated with ORIF. [11] Superficial wound infections were treated by anti-biotics for a period of 7-10 days and infection subsided subsequently. The deep wound infections were treated rigorously with I V antibiotics and wound became healthy after few weeks. Using minimal surgical intervention, in our patient series, the rate of both superficial and deep infection was significantly reduced compared with traditional ORIF, and there was no loss of reduction or implant failure with the use of LCPs.

At the end of the study of 30 patients treated 12(40%) patients had excellent outcome, 12(33%) had good results, 5(17%) had fair outcome and 3(10%) had a poor result.

Hazarika et al. studied a series of 20 patient of distal tibial fracture treated using locking compression plates through MIPPO technique. This provided 87.5% of good to excellent results. Fractures were classified according to the AO system. [12]

Im GI et a1, [13] in a study of 30 patients using anatomic plates and screws, open reduction and internal fixation was done with 88.2% excellent to good results according to Oleurd and Mollander functional ankle score and with a better alignment of fracture fragments.

Mean fracture healing was observed at 16.3 weeks. Our results were comparable to other studies using the MIPPO technique [14-17]. Comparing the

results with other methods of fixation, our results are better in comparison with ORIF and external fixation [8,13,15,18-22].

However, Hasenboehler et al. [23] reported prolonged healing times with MIPPO technique in simple fracture patterns [24].

Distal tibial plating by MIPPO technique gives rigid fixation, which obscures the routine use of plaster immobilization in postoperative period. This in turn allows early active ankle exercises. Our study also favors that ankle stiffness is not a problem in management of distal tibial fractures with MIPPO technique [25,14,15,17]

Conclusion:

In conclusion, MIPPO proves to be a highly efficient alternative treatment for fractures occurring in the tibial diaphysis and distal tibia. MIPPO or Minimally Invasive Plate Osteosynthesis, is a method of fixation that attempts to minimize surgical damage and preserve the blood vessels and osteogenic hematoma formation in the fractured bone. It is an effective alternative treatment for tibial diaphysis and distal tibia fractures with low rates of complications and high rates of bone healing.

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