



Management of Distal Tibia Metadiaphyseal Fracture-Minimal Invasive Percutaneous Plate Osteosynthesis (MIPPO) by Medial LCP Versus Expert Tibia Nailing (ETN) : A Comparative Study

KEYWORDS

DISTAL TIBIA FRACTURE, MIPPO, EXPERT TIBIA NAIL

Dr.NAVEEN RATHOR

Resident Doctor, Department of Orthopaedics R.N.T. Medical College, Udaipur

Dr.ANAMENDRA SHARMA

Professor, Department of Orthopaedics R.N.T. Medical College, Udaipur

Dr.UMA SHANKAR MEENA

Resident Doctor, Department of Orthopaedics R.N.T. Medical College, Udaipur

Dr.udaypal bishnoi

Resident Doctor, Department of Orthopaedics R.N.T. Medical College, Udaipur

Dr.Jitendra Rathore

Resident Doctor, Department of Orthopaedics R.N.T. Medical College, Udaipur

ABSTRACT

Introduction: distal tibia fracture is often more complex because its unique anatomical characteristic of subcutaneous location with precarious blood supply and proximity to ankle joint.

Due to lack of defined criteria of management and literature, the study is conducted to compare the complications and functional outcome of mippo and expert tibia nailing.

Material and Method: Adult patient with extraarticular distal tibia fracture admitted to trauma centre in R.N.T. Medical college, Udaipur were taken for this study. This is prospective study from January 2014 to December 2016.

Treatment method divided into two groups-

Group A (MIPPO by LCP)-25 patient

Group B (expert tibia nailing)-25 patient

Results :

-The mean time for fracture radiological union was 17.08 wks with MIPPO and 15.78 weeks with nailing.

-The average time for full weight bearing in MIPPO was 15.34 wks and 13.82 weeks in nailing.

-In MIPPO, 3 patients showed superficial skin infection, 1 patient shows deep infections, 2 patients had skin necrosis and 3 patients had ankle stiffness.

-In expert tibia nailing, 1 patient had superficial skin infection, 2 patients complain of anterior knee pain.

-None of the patients in both the groups had non union or implant failure.

Conclusion: both intramedullary nailing and locking plating can be safely used to treat OTA type-43A distal metadiaphyseal tibia fractures.

Closed nailing has the advantage of:-

-shortened operating time

-early weight bearing and early union

-decreased wound problems

We recommend fibular fixation whenever intramedullary nailing or locking plate fixation is used in distal tibiofibular fractures.

INTRODUCTION

Management of distal tibia fracture is often more complex than the treatment of diaphyseal fracture because of its unique anatomical characteristics of subcutaneous location with precarious blood supply and proximal to ankle joint. Various methods of management have been described with a reportedly variable rate of complications.

Treatment options includes:

- Close reduction and casting
- External fixation
- Open reduction and internal fixation with locking compression plate (LCP)
- Locking compression plate using minimal invasive percutaneous plate osteosynthesis (MIPPO)
- Intramedullary interlocking nail

More and more new insight in reduction techniques and fracture healing are leading to the development of a "minimal invasive percutaneous plate osteosynthesis" promoted by AO group and others. The emphasis now lies on indirect reduction, axial alignment and stable fixation without disturbing the fracture environment and thus preserving the most of the vascularization and fracture hematoma, containing all necessary growth factors for bony healing.

The expert tibia nail (ETN) is a new kind of low, multidirectional locked tibia intramedullary nail. Its interlocking system was developed to

attain increased angular stability and to enhance the axial & later stability attained by the nail fixation to proximal and distal tibia fracture.

Intramedullary nailing and plating are the two major options for the surgical management of distal tibia metadiaphyseal fracture. Both the techniques have been improved now with use of minimal invasive technique for plating and evolution of low multidirectional expert tibia nail for nailing.

MATERIAL AND METHOD**SOURCE OF DATA:**

Adult patients with fracture of distal tibia admitted to trauma centre in Maharana Bhupal Government hospital attached with R.N.T. Medical College, Udaipur were taken for this study after obtaining their informed, valid written consent. This is a prospective study from January 2014 to December 2016 (3 year).

Treatment methods divided into two groups:

First Group (group A) managed with minimal invasive percutaneous plate osteosynthesis (MIPPO) by medial LCP – 25 patients.

Second Group (group B) managed with closed intramedullary expert tibia nailing (ETN) – 25 patients.

Selection/Inclusion Criteria:

- Adults (age more than 18yr)
- All closed extra articular distal tibia fracture as per AO classification 43A1, 43A2, 43A3 with Tshere and Ostern grade 0 and grade 1.
- Distal tibia fractures extending into diaphysis.(fracture within 8cm from tibial plafond)
- Gustilo and Anderson type 1 fracture.

Exclusion Criteria:

- Age below 18 years and above 60 years
- Intra articular fracture as per AO classification 43B, 43C
- Gustilo and Anderson type 2 and type3 fracture
- All pathological fracture

Technique for minimal invasive percutaneous plate osteosynthesis (MIPPO) by medialLCP:

In this study we used low profile anatomical medial locking compression plate which provide angular stability and optimal screw orientation.



Medial LCP for Distal Tibia

A longitudinal skin incision was given distal to the medial malleolus and another incision was given proximal to fracture site

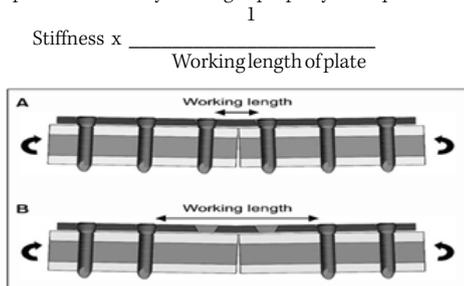
LCP was inserted subcutaneously but extraperiosteally.

After insertion of an internal fixation and single screw in the proximal and distal main fragment a persistent frontal plain malalignment is present. Insertion of standard screw in the middle of the plate reduce both fragments into a proper shaped plate. Osteosynthesis is completed with two additional locked screws.



Plate working length:

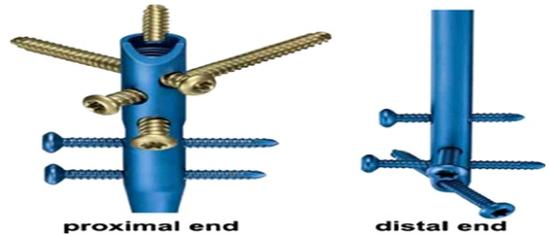
The distance between the proximal and distal screw in closest proximity to the fracture is defined as the "working length" of the plate. Plate working length has been shown to influence construct stiffness, plate strain and cyclic fatigue property of the plate.



Working length of the plate should be 2-3 times the length of the communitated segment that it is spanning.

Technique of expert tibia nailing:

Tibia nail used in this study has a modification in proximal and distal end. The two distal interlocking holes in distal end are at right angle to each other. The most distal interlocking hole is 5mm proximal to distal end of the nail and is anteroposterior direction and proximal distal interlocking hole is in mediolateral direction i.e., at right angle to distal interlocking hole at 15mm from the tip of the nail.



Begin the entry portal by making a 3cm incision via midline approach to patellar tendon extending from inferior pole of patella to tibia tuberosity.

The safe zone for entry portal is just medial to the lateral tibial spine on the anteroposterior view and immediately adjacent and anterior to the articular surface on the lateral view.

fibula was fixed in cases where it was deemed necessary to restore the stability and normal anatomy of the ankle joint, or where it was considered helpful to have a template for length. Image intensifier was used intraoperatively for assessment of fracture reduction and fixation.

OBSERVATIONS & RESULTS

GROUP A is designated for patients those are operated with MIPPO by Medial LCP.

GROUP B is designated for patients those are operated with Expert tibia nail.

Minimum 1 year follow up done for each patient.

Following are the observations of the study:

In This study in group A (19) 76% male patients and (06) 24% female patients and in group B (21) 84% males and (04) 16% females participate.

Mean age for Group A was years 40.28 years and for Group B was 38.48 years. probably because this age group is involved in outdoor activity.

TABLE 1. AO CLASSIFICATION OF FRACTURES INVOLVED IN STUDY

AO Classification	Group A		Group B	
	No. of Patients	%age	No. of Patients	%age
43A1	13	52	14	56
43A2	5	20	7	28
43A3	7	28	4	16
Total	100	100	25	100

Incidence of 43A1 type fracture was twice than 43A2 type fracture.

TABLE 2. DURATION OF SURGERY

Duration (in mins.)	Group A		Group B	
	No. of Patients	Percentage	No. of Patients	Percentage
31-40	4	16%	18	72%
41-50	13	36%	7	28%
51-60	7	24%	0	0
>60	1	08%	0	0
TOTAL	25	100%	25	100%

P VALUE : 0.001

The mean duration required for surgery was 47.28 min in Medial LCP

group and it was 37.68 min in Expert tibia nail group.

TABLE 3. TIME TAKEN FOR APPEARANCE OF CALLUS ON X RAYS

Time	Group A		Group B	
	No. of Patients	%age	No. of Patients	%age
6-10 weeks	8	32%	17	68%
11-15 weeks	14	56%	8	32%
16-20 weeks	3	12%	0	0
Total	25	100%	25	100%
Average mean time		12.0 weeks		9.6 weeks

P value = 0.009

On taking X-rays during follow up of included patients starting of radiological union was observed carefully by looking for bridging callus, haziness of fracture line. Appearance of callus took mean time of around 12 weeks in MIPPO groups and 9.60 weeks in Expert tibia nailing.

TABLE 04. TIME TAKEN FOR FULL WEIGHT BEARING

Time taken for full weight bearing	Group A		Group B	
	No. of Patients	%age	No. of Patients	%age
10-15 weeks	13	52%	19	76%
16-20 weeks	11	44%	6	24%
21-25 weeks	1	4%	0	0
Total	25	100%	25	100%
Average mean time		15.34 weeks		13.82 weeks

P VALUE : 0.877

Average time taken by patients for full weight bearing in group A was 15.34 weeks as compared to 13.82 weeks in group B. All patients were able to bear weight prior to complete union of fracture. By the process of weight bearing we believed that it would promote secondary bone healing.

TABLE 05. TIME TAKEN TO RADIOLOGICAL UNION

Time to fracture union	Group A		Group B	
	No. of Patients	%age	No. of Patients	%age
10-15 weeks	6	24%	11	44%
16-20 weeks	17	68%	13	52%
21-25 weeks	2	8%	1	4%
Total		100%	25	100%
Average mean time		17.08 weeks		15.78 weeks

P value: 0.786

Average time taken for union of fracture in our study groups was 17.08 weeks in Group A and 15.78 weeks in Group B. Union was defined clinically as the ability to walk without aid or pain and radiologically as a solid callus bridging of the fragments.

TABLE 06. MAXIMUM ANGULATION IN ANY PLANE AT FINAL FOLLOWUP

Angulation in any plane (in degrees)	Group A		Group B	
	No. of Patients	%age	No. of Patients	%age
0-5 Degree	24	96%	23	92%
6- 10 Degree	1	4%	2	8%
> 10 Degree	0	-	0	-
Total	25	100%	25	100%

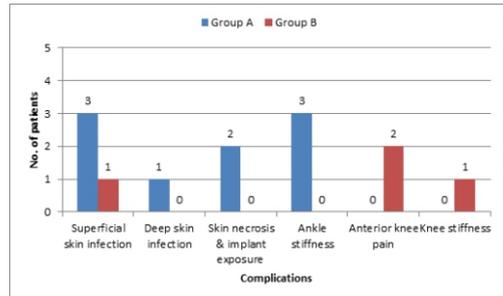
P VALUE : 0.852

Most of cases of the study maintained initial reduction and showed minimal angulation in any plane (0-5 degree) in both group.

TABLE 07. COMPLICATIONS

Duration (in mins.)	Group A		Group B	
	No. of Patients	Percentage	No. of Patients	Percentage
0-5 Degree	24	96%	23	92%
6- 10 Degree	1	4%	2	8%
> 10 Degree	0	-	0	-
Total	25	100%	25	100%

P value : 0.153



heera lal 48 yr male patient operated by medial LCP showing skin necrosis with implant exposure

TABLE 08. COMPARISON OF OLERUD AND MOLANDER SCORE AT FINAL FOLLOWUP

Olerud molander score	Group A		Group B	
	No. of Patients	%age	No. of Patients	%age
91-100 (excellent)	10	40%	14	56%
61-90 (good)	15	60%	11	44%
31-60 (fair)	0	-	0	-
MEAN SCORE		83		86.2

P VALUE : 0.298

OMAS score at the final follow up showed that excellent results were achieved in 40% cases in Group A and 56% cases in Group B. Good results were obtained in 60% cases in Group A and 44% cases in Group B. Mean OMAS score at final follow up for Group A was 83.00 and Group B was 86.20.

DISCUSSION

Fractures of distal tibia are among the most difficult fractures to treat effectively. The status of the soft tissues, the degree of comminution sustained at the time of injury affect the long term clinical results. The goal of operative treatment is to obtain anatomic realignment of the joint surface while providing enough stability to allow early motion.

We evaluated our results and compared them with those obtained by various other studies utilizing different modalities of treatment, our analysis is as follows:

Duration of Surgery:

The average duration of surgery in our study was 47.0 min in Group A as compared to 37.80 Min in group B.

The length of the operating time reflects a learning curve. The first few locking compression plates and expert tibia nailing in both the group required 50-60 min which decreased to 30-40 min over a period of time.

	Mean operating time (in minutes)	
	Group A (MIPPO)	Group B (Nailing)
Yong Li et al	90.4	76.10
Eknath D Panwar et al	70.36	57.20
Our study	47	37.80

Time Taken for radiological Union :

In our study the average time taken by the patient for fracture union was 17.08 weeks in Group A and 15.78 weeks in Group B. The results of our study were comparable with other studies.

	Mean time for radiological union (weeks)	
	Group A	Group B
Yong Li et al	23.1	21.30
Eknath D Panwar et al	21.40	17.43
Our study	17.08	15.78

Full weight bearing:

The average time taken for full weight in various studies conducted using different techniques was around 09-28 weeks. In our study the average time taken by the patient for full weight bearing was 15.34 weeks in Group A and 13.80 weeks in Group B. The results of our study were comparable with other studies.

	Full weight bearing(weeks)	
	Group A	Group B
Yong Li et al	11.7	9.0
Eknath D Panwar et al	13.06	9.50
Our study	15.34	13.80

OMAS SCORE:

OMAS score at the final follow up showed that excellent results were achieved in 40% cases in Group A and 56% cases in Group B. Good results were obtained in 60% cases in Group A and 44% cases in Group B. poor results not seen in any patient. Mean OMAS score at final follow up for Group A was 83 and Group B was 86.2. Statistically calculated P value for the OMAS score is 0.569 which is statistically insignificant indicating that the function outcome was similar in both the groups. This is comparable to some other studies conducted by other authors.

Yong Li et al in their study found significant difference (p value-0.478) in the function outcome of medial plating by MIPPO and expert tibia nailing of distal tibia. In their study OMAS score at the final follow up showed that excellent results were achieved in 73% cases in Group A and 65% cases in Group B. Good results were obtained in 26% cases in Group A and 34% cases in Group B. Mean OMAS score at final follow up for Group A was 89.0 and Group B was 87.6. Statistically calculated P value for the OMAS score is 0.478 which is statistically significant indicating that the function outcome was variable in both the groups.

Complications:

In our study superficial skin infection was more common in Medial Plating group accounting for 12% infection rate. It was only 4% in nailing group. Skin necrosis with subsequent exposure of the implant was much more common in Medial LCP group i.e. 08% cases , skin necrosis not seen in nailing group . 3 patients in Medial LCP group had ankle stiffness, ankle stiffness not seen in nailing group. It was probably due to the in compliance of the patient to the advised physiotherapy regimen. Ankle stiffness ranged from restriction of ankle movement by 20-40degrees. P value by Statistical calculation was 0.552 which is not significant. The above results are comparable to some other similar studies conducted by other authors.

SUMMARY & CONCLUSION

- We included total 50 patients in this prospective study who sustained extraarticular distal tibia fracture. Half of the patients

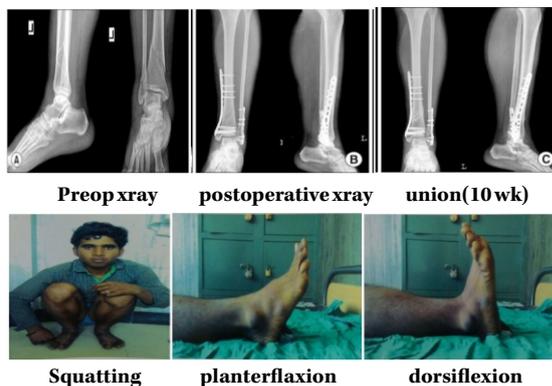
were treated with MIPPO by medial LCP and half were treated with Expert tibia nailing.

- Mean operative duration MIPPO = 47.28 min, ETN = 37.68 min.
- All patients achieved union at the end of study. The mean time for fracture radiological union was 17.08 weeks with MIPPO by medial LCP group and 15.78 weeks with Expert tibia nailing group.
- The average time for appearance of callus formation on X-ray was comparable in both the groups. In MIPPO by medial LCP group, Callus appeared at an average of 12.0 weeks and in Expert tibia nailing group, callus appeared at 9.6 weeks.
- The average time for full weight bearing was comparable in both the groups. In MIPPO by medial LCP group it was 15.34 weeks and in Expert tibia nailing group, average time for full weight bearing was 13.82 weeks.
- Out of 25 patients in MIPPO by medial LCP group, 3 patients showed superficial skin infection, 1 patient shows deep infections, 2 patients had skin necrosis with subsequent exposure of implant and 3 patients had ankle stiffness.
- Out of 25 patients with expert tibia nailing group, 1 patient had superficial skin infection, 2 patient complain of anterior knee pain and 1 patient complained of knee stiffness.
- None of the patients in both the groups had non union or implant failure.
- Out of 25 patients in MIPPO by medial LCP group, 10 patients had excellent OMAS score and 15 had good OMAS score at final follow up. Out of 25 patients in Expert tibia nailing group, 14 patients had excellent OMAS Score and 11 patients had Good OMAS Score. The average OMAS score for Group A was 83 and for Group B, it was 86.2.
- Our results have shown that both closed intramedullary nailing and locking plating can be used safely to treat OTA type-43A distal metadiaphyseal fractures of the tibia.
- Closed nailing has the advantage of:-
 - shortened operating time
 - early weight bearing and early union
 - decreased wound problems
 - decreased implant related problems and overall reduce morbidity.

We recommend fibular fixation whenever intramedullary nailing or locking plate fixation is used in distal tibiofibular fractures.

Illustrations

Jagdish 27yr male patient operated by MIPPO by medial LCP



Ganesh 48 yr male operated by MIPPO by medial LCP



Arjun 25 yr old male patient operated by expert tibia nailing



Preoperative xray postoperative xray union(10 wk)



Patient with full range of flexion and extension at knee joint

Patient durga bai 50 yr old female operated by expert tibia nail



Preoperative xray postoperative xray union(14 wk)

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