Original Research Paper

Volume - 13 | Issue - 07 | July - 2023 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Orthopaedics

A COMPARATIVE STUDY OF INTRAMEDULLARY INTERLOCKING NAILING VERSUS LOCKING PLATE OSTEOSYNTHESIS (MIPO) IN THE MANAGEMENT OF EXTRAARTICULAR DISTAL TIBIAL FRACTURES

Dr Swapna Pran Saikia	Assistant Professor, Orthopaedics, JMCH
Dr Kartikey Mishra	Assistant Professor, Orthopaedics, JMCH
Dr Th Pouziivei	Post Graduate Trainee, Orthopaedics, JMCH
Dr Hrishikesh Goswami	Post Graduate Trainee, Orthopaedics, JMCH

ABSTRACT **Background:** The tibia is the major weight-bearing bone of the leg and is the most commonly fractured1 long bone in the body. Distal tibia fractures have the second highest incidence of all tibia fractures after the midshaft fracture of the tibia2. It is unique in that the bone is subcutaneous with decreased muscular cover; consequently, decreased vascularity leads to complications like delayed union and wound complications such as dehiscence and infection3. Currently, both intramedullary nail and plate fixation are the most commonly used treatment methods for distal extra-articular tibial fractures with their advantages and disadvantages4. So, this study is conducted to compare the treatment results of intramedullary nailing and locking plate technique in terms of rate of healing functional outcome and complications. **Methods:** This was a hospital-based prospective observational study for a period of one year with a total of 40 patients presented with closed distal tibial fractures Patients undergoing surgery were divided into two groups; Group (MIPO) (n-20): Treated by MIPO plating, Group (IM Nail) (n-20): Treated by CRIF with IM/IL nail. **Results:** The average surgical time was 74.50±8.09 minutes in the MIPO group and 69.25 ± 13.70 in the IM nail group. The mean time to partial weight bearing for patients in the MIPO group was 6.56 ± 2.38 weeks and 5.18 ± 2.21 weeks in the IM nailing group. The average fracture union in the MIPO group was 19.78±6.65 weeks and the average union time in IM Nail was 17.89±7.33 weeks. **Conclusions:** We concluded that the intramedullary interlocking nailing group was associated with a lesser duration of surgery, earlier weight bearing, faster union, lesser duration of hospitalization and earlier return to the pre-injury active life. However, locking plate fixation by the MIPO technique has the advantage of less chance of varus malalignment and anterior knee pain.

KEYWORDS : Extra-articular distal tibia fracture, Intramedullary Interlocking nailing, MIPO

INTRODUCTION

The tibia is the major weight-bearing bone of the leg. It is the most commonly fractured long bone in the body with an annual incidence of 2/1000 individuals[1]. Distal tibia fractures have the second highest incidence of all tibia fractures after the mid-shaft fracture of tibia[2]. Fractures of the distal tibia are unique in that the bone is subcutaneous with decreased cover, the consequently decreased vascularity leads to complications like delayed union, and wound complications such as dehiscence and infection[3]. Distal extra-articular fractures of the tibia can be managed with various techniques like intramedullary interlocking nailing, external fixators, and open reduction and plating with varying results[4]. Currently, both intramedullary interlocking nail and plate fixation are the most commonly used treatment methods for distal extra-articular tibial fractures[4]. Open reduction and plate fixation often require extensive soft tissue dissection and devitalization, creating an environment that is less favourable for fracture healing and more prone to infection and postoperative ankle stiffness[5]. The use of intramedullary nails obviates the need for extensive surgical dissection, spares the extraosseous blood supply, and allows the device to function in a load-sharing manner[6]. However, intramedullary management has its complications, including malalignment, hardware failure, and the risk of fracture propagation into the ankle joint[6]. Locking plate has the advantage of fracture management in osteoporotic bone and periarticular fracture patterns, making them a feasible treatment option for distal tibia metaphyseal fractures[7]. This study is conducted to compare the treatment results of intramedullary nailing and locking plate technique in terms of rate of healing, functional outcome and complications.

METHODS

Study Type: Hospital-based prospective observational study

Study Population: All the patients admitted with extra-articular distal tibial fractures in the Department of Orthopaedics in Jorhat Medical College & Hospital in Jorhat, who meets the inclusion criteria.

Duration Of Study: One year

Ethical Clearance: Permission was obtained from the Institutional Ethics Committee (Human) of Jorhat Medical College before starting the research.

Inclusion Criteria

1. Acute extra-articular distal tibial fractures (AO type 43 A1, A2, A3) presenting within 2 weeks of injury.
2. Age 18 years of both sexes.
3. Patient who gives consent to participate in the study & procedure.

Exclusion Criteria

1. Intra-articular fracture
2. Pathological fracture.
3. Preexisting skin lesions locally
4. Open fractures
5. Syndesmotic injury
6. Presence of coexisting systemic disease or co-morbid condition which might affect bone union

Procedure Methodology

All the patients with distal tibia extra-articular closed fracture cases were taken up for the study that fulfilled our inclusion criteria. All the patients were operated on on an elective basis after overcoming the avoidable anaesthetic risks. Patients undergoing surgery were divided into 2 groups, group A and group B. Group A was treated with a locking plate by MIPO, and Group B with intramedullary nailing. The operation was done on a radiolucent table in the supine position. In both groups, the operation was done under IITV control, under spinal anaesthesia.

Locking plate by MIPO: A small incision was made on the medial malleolus along the posteromedial border of the distal tibia sparing the saphenous vein and nerve. Extraperiosteally a tunnel was made by blunt dissection in the right orientation. An anatomical distal tibia locking plate was passed through this tunnel by retrograde technique. Plate size was determined by the plate span ratio and the number of screws was determined by plate screw density. Fracture reduction was achieved under an image intensifier by assessing the length, axial and rotational alignment. The plate was held temporarily by K wires whenever required. The first screw was inserted at the distal end of the plate close to the joint line and the second screw was inserted percutaneously at the proximal end of the plate. Fracture reduction was confirmed and a cortical screw was inserted into the proximal diaphyseal fragment which helped to contact the plate surface. The remaining screws were inserted by stab incisions. The wound was irrigated with saline and closure was done in layers. Sterile dressing

was done.

Preparation Of The Skin

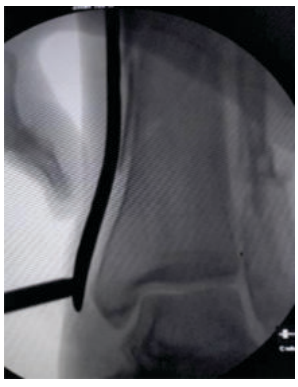
Minimal Skin Incision

Plate Placement

Distal Screw Fixation

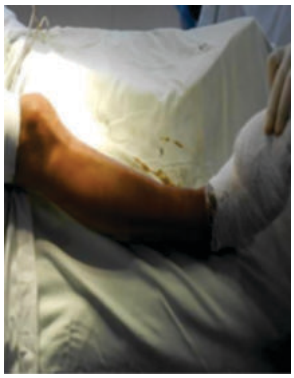
Proximal Screw Fixation

Complete Skin Closure



Intraoperative IITV Images

Intramedullary Nailing: The patient was operated on a fracture table with his knee flexed to 90 degrees on a bolster. In our case, we used the patellar ligament splitting approach. A 3-4 cm long longitudinal incision over the patellar ligament at the level of the knee joint was made. The patellar ligament was split longitudinally and retracted. Entry portal was made after selecting the ideal point of insertion at just medial to the lateral tibial spine which we had determined from a true AP view radiograph taken in C-arm. A curved awl was used to open the medullary canal and pushed as far as possible into the medullary canal. 3.2 mm guide wire with a ball tip was pushed into the canal, past the fracture site into the malleolar region (0.5 to 1cm proximal to ankle joint) assisted by reduction manually. The next step was to ream the medullary canal starting from 8 mm and increasing by increments of 0.5 mm. The medullary canal was reamed 1 mm more than the diameter measured at the isthmus in a ray lateral view. The nail with the proximal insertion handle and jig was passed over the guide wire and was inserted as far as possible, measured hammering was done to drive the tip of the nail to the distal metaphysis and proximal end and flush with the surface of the cortex at the point of insertion. The nail was centralized as far as possible. The guide wire was removed. For distal locking by C-arm and freehand technique, the C-arm was placed to show the locking holes of the nail as perfect circles on the monitor. The position was marked with a scalpel and an incision is done on the skin over the marked locking holes. Steinmann pin was centred on a locking hole under C-arm and a mark was made on the bone with a gentle tap of a mallet. The drill bit was inserted through the skin incision down to the bone near the locking holes and drilled under C-arm with the axis of the drill centred on the locking bole with a 4.0 mm drill bit. Drilling hole was done through both cortices, across locking holes. The length was determined with a depth gauge and confirmed with the C-arm as proximal locking was done with a proximal jig and insertion handle. The C-arm was used to confirm the locking bolt and nail position and fracture alignment.



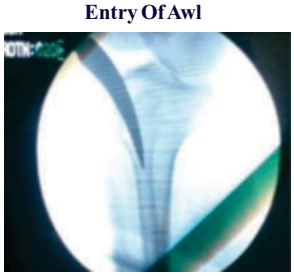
Preparation Of Limb

Incision

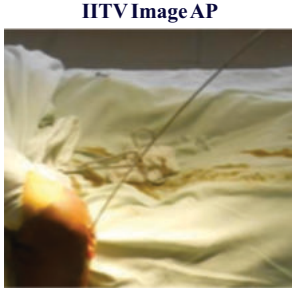
Exposure Of Entry Point

Entry Of Awl

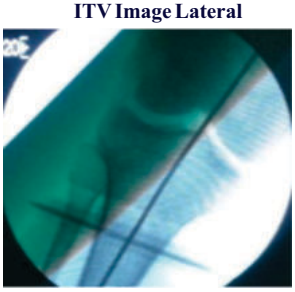
IITV Image AP



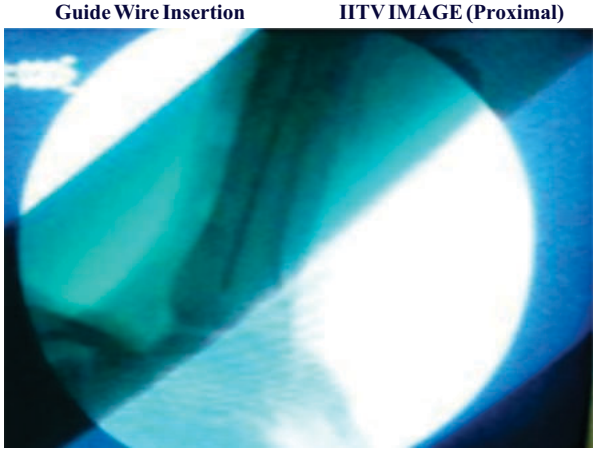
ITV Image Lateral



Guide Wire Insertion



IITV IMAGE (Proximal)



IITV Image (Distal)

In both groups A and B, the following intraoperative parameters were measured:

a. Operative time (in minutes)
b. Intraoperative blood loss by mopping method
c. Any intraoperative complication(s)

All patients were followed up at an interval of 1 month, 3 months & 6 months. At every visit, patients were assessed clinically regarding ankle range of motion, walking ability, fracture union, deformity and shortening. American Orthopaedic Foot and Ankle Society (AOFAS) score was used for evaluation. The degree of ankle dorsiflexion and plantar flexion of the injured limb was compared with the uninjured one. X-ray of the involved leg with ankle was done to assess fracture union and implant bone interaction.

Statistical Analysis

The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) And Microsoft Excel 2010. Results on continuous measurements are presented as mean+ standard deviation and are compared using the student's t-test. Discrete data are expressed as numbers (%) and are analyzed using the Chi-square test and Fischer's exact test (where the cell counts <0.05)

RESULTS

Gender Distribution

Sex Distribution	MIPO (N)	MIPO (%)	IM NAIL (N)	IM Nail (%)	p-value
Male	14	70	15	75	0.7148
Female	6	30	5	25	
Total	20	100	20	100	

Mode Of Injury

MOI	MIPO (N)	MIPO (%)	IM NAIL (N)	IM Nail (%)	p-value
RTA	16	70	17	85	0.6801
FALL	4	20	3	15	
TOTAL	20	100	20	100	

Ao Fracture Classification

Fracture pattern	MIPO (N)	MIPO (%)	IM NAIL (N)	IM Nail (%)	p-value
43A1	13	65	12	60	0.9131
43A2	4	20	4	20	
43A3	3	15	4	20	
Total	20	100	20	100	

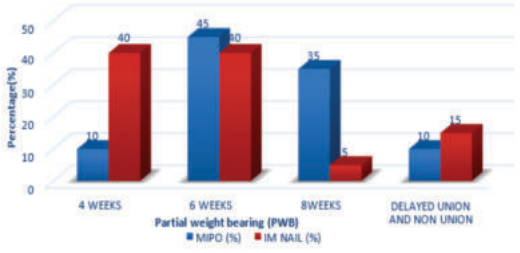
Duration Of Operation

Duration of operation (min)	MIPO	IM NAIL	P-Value
	74.50 ± 8.09	69.20 ± 13.70	0.1482

Intraoperative Blood Loss

Intraoperative blood loss (ml)	MIPO	IM NAIL	P-Value
	97.75 ± 19.63	93.00 ± 17.23	0.4208

Commencement Of Partial Weight Bearing



Partial weight bearing (PWB)	MIPO (N)	MIPO (%)	IM NAIL (N)	IM Nail (%)	p- value
4 weeks	2	10.00	8	40.00	0.0391
6 weeks	9	45.00	8	40.00	
8 weeks	7	35.00	1	5.00	
Delayed and non-union	2	10.00	3	15.00	

Union Time

Group	Union time (Weeks)	p- value
MIPO	19.78 ± 6.65	0.1768
IM Nail	17.89 ± 7.33	

Complications

Complications	MIPO (N)	MIPO (%)	IM NAIL (N)	IM Nail (%)	p-value
Anterior knee pain	0	0.00	1	5.00	0.3102
Stiffness	1	5.00	1	5.00	0.4666
Delayed union	2	10.00	2	10.0	0.5967
Non-union	0	0.00	1	5.00	0.3102
Infection	3	15.00	1	5.00	0.2921
Varus malalignment	0	0.00	1	5.00	0.3102

Aofas Score

AOFAS Score	MIPO (N)	MIPO (%)	IM NAIL (N)	IM Nail (%)	p-value
Excellent	14	70.00	13	65.00	0.4753
Good	1	5.00	4	20.00	
Fair	4	20.00	2	10.00	
Poor	1	5.00	1	5.00	

DISCUSSION

The status of soft tissue, degree of comminution and precarious blood supply make the management plan difficult in extra-articular distal tibial fractures. Results of surgical management are dependent on the severity of the initial injury, quality and stability of initial injury and stability of reduction. Mechanism of injury, the status of soft tissues, degree of comminution and articular damage affect the long-term clinical outcome of the patients.

There is a variety of treatment options available but regarding the best treatment modality still, there is no consensus[4]. Various options including external fixation, intramedullary nailing and plate fixation are available for surgical management. The operative intervention aims to attain anatomical reduction along with enough stability to provide an early weight bearing. This should be accomplished using techniques that minimize osseous and soft tissue devascularization and reduce various complications following treatment[8].

The following variables in each group were analyzed: age, sex, fracture type and pattern, mode of injury, duration of operation, average blood loss in ml, follow-up in months, complications and outcomes. During the subsequent follow-up, the following variables were recorded: range of motion of the ankle, complications like deformities, infection, and signs of the union. The statistical analysis consisted of percentages, range, and mean wherever it is applicable.

In the present study, the patients were 18 to 60 years old. The age group of 31-40 years comprised the highest number of patients in both groups with the mean being 35 ± 11.06years in MIPO and 34.70 ± 9.97 years in IM Nail. The lower mean age in our series was probably because of more exposure of the younger generation to road traffic accidents due to more outdoor activities. There were 14 male (70%) and 6 female (30%) patients in the MIPO group and 15(75%) males and 5(25%) females in the IM Nail group. Similar male preponderance was seen by other authors; Ravindran et al.[9] reported 25 males to 5 females (M: F 5:1).

Road traffic accidents (RTA) accounted for the majority of fractures (80%) in MIPO and 85% in IM Nail. Domestic falls accounted for 20% and 15% respectively. Similar findings were seen by Rahul Vishwanath Patil et al.[10] road traffic accident was the most common mode of injury (87.5%). 43A1 type fracture accounted for 65%, 43A2 for 20%, and43A3 for 15% in the MIPO group and IM Nail group, 43A1 type accounted for 60%, 43A2 for 20% and 43A3 for 20%. This finding was comparable to a study conducted by Daolagupuet al.[11] in which also most common type was 43A1 (50%).

The average surgical time in the MIPO group was 74.50 ± 8.09 minutes and 69.25 ± 13.70 in the IM Nail group. Other studies conducted by Gonsalves J et al.[12] reported asthe average duration of surgery in the interlocking group was 57.33 min and in the MIPO group was 70.36

min. The average intraoperative blood loss in group MIPO was 97.12 ±75ml and in the group, IM Nail reported an average blood loss of 93.23 ± 8.19ml. This is almost similar to the study conducted by Polat et al[13] who reported it as 84 ml. In the MIPO group, the mean duration of hospital stay in our study was 9.70±2.03 days and IM Nail group, the mean duration of hospital stay was 8.95 days. Studies conducted by 13 Polat et al.[13] reported 10.67 days.

In our study, the mean time for partial weight bearing to patients in the MIPO group was 6.56 ± 2.38 weeks and 5.18 ± 2.21 weeks in the IM nailing group. These findings are similar to the study by Daolagupu et al.[11] who reported the meantime for starting partial weight bearing at 6.90 ± 1.33 weeks in the MIPO group as compared to in the IM Nail groupwas 4.95 ± 1.07 weeks. In our study, the average fracture union in the MIPO group was 19.78 ± 6.65 weeks and the average union time in IM Nail was 17.89 ± 7.33 weeks. These findings are similar to the studies conducted by Gonsalves J et al[12] who reported a union time of 21.40 weeks in MIPO plating and 19.43 weeks in the patients with IM Nail surgery.

Based on the assessment parameters of AOFAS score[14] used in this study, in the MIPO group 14 patients (70%) had excellent, 1 patient (5%) had good, 4 patients (20%) had fair and 1 patient (5%) had poor outcome. Whereas in the IM Nail group, 13 patients (65%) had excellent, 4 patients (20%) had good, 2 patients (10%) had fair and 1 patient (5%) had poor outcomes. This is similar to the studies conducted by Patil RV et al.[10] who reported excellent to good outcomes in 90% of cases of nailing as compared to 85% of cases of plating. Poor outcome was reported in 15% of cases in plating as compared to 10% in the nailing group. The difference was statistically non-significant. Soni et al.[15] observed that in patients of the nailing group, 73.33% had excellent results, 13.33% had good, and 13.33% had poor results as per AOFAS scoring while in patients of the plating group, 60% had excellent results, 20% had good, and 20% had fair results.

There were not many intraoperative difficulties faced during the operation in both groups except for the little extra time needed for alignment in comminuted cases.

In the MIPO group, major complications were encountered in the form of superficial infections in 2 cases (10%) and one deep infection (5%) ankle stiffness in 1 case (5%), and delayed union in 2 cases (10%). These superficial infections were treated with appropriate antibiotics (culture and sensitivity proved) and all of them healed uneventfully. One case of deep infection was treated with implant removal, wound debridement and musculocutaneous flap. In the IM Nail group, we found 1 case (5%) of superficial surgical site infection, 2 cases (10%) of delayed union, 1 case (5%) of non-union, 1 case (5%) of ankle stiffness, 1 case (5%) of varus misalignment and 1 case (5%) of anterior knee pain. These superficial infections were treated conservatively and responded well to antibiotics and the non-union case was treated with Ilizarov external fixator. These findings are similar to the studies by Daolagupu et al.[11] who observed that the complication rate was comparable among the two groups in regards to delayed union, malalignment, knee, and ankle stiffness. However, a higher rate of infection (n-4 vs. n-2) was found in MIPO plating patients

CONCLUSION

In this study, the IM Nail group was associated with lesser duration of surgery, earlier weight bearing and union rate, lesser duration of hospitalization and earlier return to the pre-injury active life. However, locking plate fixation by the MIPO technique has the advantage of less chance of varus malalignment and anterior knee pain. Moreover, compression plating plays a pivotal role in the treatment of distal tibia extra-articular fractures especially when the fracture is comminuted, osteoporotic bone and with good soft tissue status. We conclude that both types of treatment are viable options in the management of distal tibial extraarticular fractures.

We also acknowledge our study limitations due to the smaller sample size & shorter follow-up of 6 months. Therefore, we recommend an RCT, possibly triple-blinded or at least double-blinded in nature, involving a large number of patients with long-term follow-up to demonstrate the superiority of one technique over the other.

REFERENCES

1. Bucholz RW, Heckman JD, Court-Brown CM, editors. Rockwood and Green's Fractures in Adults. 6th ed. United States: Lippincott Williams and Wilkins, 2006.
2. McBimie J. The epidemiology of tibial fractures. The Journal of Bone and Joint surgery. British Volume, 1995 May 1.77(3):417-21
3. Shrestha, D., Acharya, B. M., & Shrestha, P. M. (2011). Minimally invasive plate osteosynthesis with locking compression plate for distal diametaphyseal tibia fracture. Kathmandu University Medical Journal, 9(2), 62-68.
4. Sarmiento, A., & Latta, L. L. (2004). 450 closed fractures of the distal third of the tibia treated with a functional brace. Clinical Orthopaedics and Related Research (1976-2007), 428, 261-271.
5. Im, G. I., & Tae, S. K. (2005). Distal metaphyseal fractures of tibia: a prospective randomized trial of closed reduction and intramedullary nail versus open reduction and plate and screws fixation. Journal of Trauma and Acute Care Surgery, 59(5), 1219-1223.
6. Nork, S. E., Schwartz, A. K., Agel, J., Holt, S. K., Schrick, J. L., & Winquist, R. A. (2005). Intramedullary nailing of distal metaphyseal tibial fractures. JBJS, 87(6), 1213-1221.
7. Collinge, C., & Protzman, R. (2010). Outcomes of minimally invasive plate osteosynthesis for metaphyseal distal tibia fractures. Journal of orthopaedic trauma, 24(1), 24-29.
8. Gupta, R. K., Rohilla, R. K., Sangwan, K., Singh, V., & Walia, S. (2010). Locking plate fixation in distal metaphyseal tibial fractures: series of 79 patients. International orthopaedics, 34, 1285-1290.
9. Ravindran S, Arif KS. Prospective study of management of distal tibia fracture with Locking Compression Plate Using Minimally Invasive Percutaneous Plate Osteosynthesis Technique 10SR Journal of Dental and Medical Sciences (IOSR-JDMS): 2016 April:159(4): 63-87.
10. Patil, D. R., Kamath, P. S., & Borkar, S. (2020). Comparative Study of Interlocking Intramedullary Nailing and Plating in Distal Third Tibial Fracture (Doctoral dissertation).
11. Daolagupu, A. K., Mudgal, A., Agarwala, V., & Dutta, K. K. (2017). A comparative study of intramedullary interlocking nailing and minimally invasive plate osteosynthesis in extra articular distal tibial fractures. Indian journal of orthopaedics, 51, 292-298.
12. Gonsalves, J. (2018). A comparative study of locking plate by MIPO versus closed interlocking intramedullary nail in extra-articular distal tibia fractures. Int J Orthopaedics Sci, 3, 145-149.
13. Polat, A., Kose, O., Canbora, K., Yanık, S., & Guler, F. (2015). Intramedullary nailing versus minimally invasive plate osteosynthesis for distal extra-articular tibial fractures: a prospective randomized clinical trial. Journal of Orthopaedic Science, 20(4), 695-701.
14. Kitaoka, H. B., Alexander, I. J., Adelaar, R. S., Nunley, J. A., Myerson, M. S., & Sanders, M. (1994). Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. Foot & ankle international, 15(7), 349-353.
15. Soni, K., & Patel, J. (2018). Comparative Study of Distal Tibia Fractures managed by nailing vs plating. National Journal of Clinical Orthopaedics, 2(3), 106-12.