

Treatment of Fracture Distal Tibia by Distal Tibial Locking Plate Verses Interlocking Nail: A Prospective Comparative Study

Sudesh Chander Sharma¹, Sonali Sharma², Shashi Sudan^{3*}

¹Professor, Department of Orthopaedics, Government Medical College, Jammu, J & K, India.

²Senior Resident, Department of Radiology, Government Medical College, Jammu, J & K, India.

^{3*}Professor and Head, Department of Microbiology, Government Medical College, Jammu, J & K, India.

ABSTRACT

Introduction: Fractures of distal third of tibia pose greater challenge to the treating surgeon, in view of its relative lack of vascularity, as it is devoid of muscular envelope and is covered only by skin and tendons. Its proximity to the ankle joint makes it further complex than any diaphyseal fracture. A variety of treatment modalities are available including non operative, external fixation, IM nailing and plating. Whereas, closed reduction and casting is known for redisplacement with resultant malunion and joint stiffness because of prolonged immobilisation, external fixators are of utility only for compound fractures of mid third and are known for pin track infections.

Material and Methods: A Comparative prospective study of two procedures, for displaced fractures of distal third tibia in adults was conducted in Govt. Medical College (GMC), Jammu. 30 patients (Group A) were treated by Closed Reduction and fixation with IMIL Nailing and another 30 (Group B) were treated by closed reduction and fixation using Distal Tibial Locking Plate with MIPPO Technique. The patients were followed for a minimum of one year wherein the clinical parameters, radiological progress and final functional results were evaluated as per American Orthopaedic Foot and Ankle Society Score (AOFAS).

Results: There was no significant difference in fracture healing time or ambulation time. Good to Excellent results of 60% were found in Group A and 73.3% in Group B. There were 13.3% of poor results in Group A as compared to 6.7% of Group B. Overall complication rate was higher in Group A. IMIL Nailing had to be abandoned in 2 cases (6.7%) and switched on to DTLCP, due to per operative finding of medullary canal being narrower than 8 mm in one and curved in another. IMIL Group A, also had 2 cases (6.7%) bent nail, 2 cases (6.7%) broken

nail and another 3 cases (10%) of bent/broken locking bolts. No such implant related complications were observed in Group B.

Conclusion: IMIL Nailing is a technically demanding procedure, requiring a thorough pre-operative work up and a skilled experienced surgeon with all sizes of nails, reamers and alternative options available before contemplating it. However, DTLCP by MIPPO technique is easier to learn, is equally biological, based on sound AO principles of indirect reduction and stabilization by extra periosteal fixed angle construct. The procedure has fewer per operative and postoperative complications and gives comparable or better results than IMIL Nailing. The choice of the procedure should be guided by the site and geometry of fracture and individual experience of the treating surgeon.

Keywords: Fixation Distal Tibia, IMIL Nail and DTLCP MIPPO.

*Correspondence to:

Dr Shashi Sudan,
Professor and Head,
Department of Microbiology,
Government Medical College, Jammu, J & K, India.

Article History:

Received: 02-12-2018, Revised: 28-12-2018, Accepted: 17-01-2019

Access this article online

Website: www.ijmrp.com	Quick Response code 
DOI: 10.21276/ijmrp.2019.5.1.014	

INTRODUCTION

The incidence of fractures is on the rise due to increase in road traffic accidents (RTA). The fracture of leg bones is commonest amongst the long bone fractures and Tibia is the most commonly fractured bone amongst all long bones of the body due to its location and lack of soft tissue protection. Fractures of distal third of tibia pose greater challenge to the treating surgeon, in view of its relative lack of vascularity, as it is devoid of muscular envelope and is covered only by skin and tendons. Its proximity to the ankle

joint makes it further complex than any diaphyseal fracture.¹ A variety of treatment modalities are available including non-operative, external fixation, IM nailing and plating.²

Whereas, closed reduction and casting is known for redisplacement with resultant malunion and joint stiffness because of prolonged immobilisation, external fixators are of utility only for compound fractures of mid third and are known for pin track infections. Fracture distal third of leg pose a special challenge to

the orthopaedic surgeon, as the patients are invariably high demand and demand complete restoration of anatomy as well as function at the earliest. Intramedullary nail although considered to be the Gold Standard for middle third fractures, face the chances of ankle penetration in fractures close to ankle mortise and technical difficulty of distal tibial fixation due to diaphyseo-metaphyseal diameter discrepancy.³

The treatment has been evolving and newer modifications are continuously occurring, adding better implants and concepts to address the patient demand.

Commonest and most accepted mode of treatment, over the decades has been closed reduction and fixation with intramedullary interlocking nailing. However, recently the interest is shifting towards Distal Tibial Locking Plate by Minimum Invasive Percutaneous Plating Osteosynthesis (MIPPO)⁴ technique, especially in fractures that may be too distal or comminution extending to locking bolt site. Open reduction and rigid fixation with plates has almost been abandoned due to extensive soft tissue stripping of the bone ends leading to a vascularity and wound infections.³⁻⁵ These difficulties lead to development of expert distal locking nails and distal locking plates by MIPPO technique.² There is no consensus on to the best treatment and hence this study was conducted to compare the outcome of the two methods in our set up.

MATERIALS AND METHODS

The study included 60 prospective patients of fracture distal third of tibia, atleast 2.5cm short of ankle mortise, attending orthopedic emergency or out- patient department of GMC, Jammu, from May 2016 to Dec.2017. The patients were randomly divided in Group A and Group B of 30 cases each, undergoing Intramedullary Interlocking nailing and Distal Tibial Locking Plating by MIPPO technique respectively. The inclusion and exclusion criteria's were as under

Inclusion Criteria

Age more than 18 years, No sex discrimination, closed 43 A.1, 43A.2, 43A.3 A, extra articular distal 3rd tibial fractures, fresh fractures, gave consent for surgery and publication.

Exclusion Criteria

Age less than 18 years, open Fractures, Pathological fractures, patients with distal neuro vascular deficit, smokers, Intra-articular fractures, associated polytrauma, did not give consent for surgery or publication.

The patients were admitted, and detailed history, general physical and local examination and distal neuro vascular status recorded. All routine investigations for anesthesia fitness were done and X-rays of injured leg including knee and ankle AP and Lateral views(Fig.1a, Fig.2a) was done and above knee POP slab given. Preoperative planning done and patient posted for nailing or plating. Prophylactic antibiotic (cefuroxime 1.5 gm) was given half an hour before surgery. Surgery was performed in supine posture under spinal, epidural or GA as per the choice of anaesthetist. Standard ante grade reamed nailing was done through midline patellar splitting approach , fracture reduced under C arm image intensifier and distal locking done by free hand technique (Fig.1b). In case of plating, closed reduction obtained under C arm, an appropriate length of plate negotiated through a small 1 – 2 inches longitudinal incision just on and above the medial malleolus, passed subcutaneously upwards across the fracture to sit on medial surface of middle or upper third tibia (Fig.2c) and fix it using 3 - 4 locking 5 mm screws in proximal fragment and 4 – 5 locking (3.5 mm) screws in distal fragment (Fig.2 b).

There were 12 cases with concomitant fibular fractures, 7 in Group A and 5 in Group B. Fibular fractures upto 15 cm. from tip of lateral malleolus were fixed with 3.5 mm plates in both groups. POST operative period, limb is slightly elevated on a pillow for 3 – 5 days. ROM exercises of ankle and knee started within 24 hours as per patient tolerance. Wound was inspected on 3rd and 5th day and stitches removed after 10 to 14 days. Patient was made ambulatory by two weeks on crutches or walker with toe touching and partial weight bearing 3 weeks onwards , and gradually progressing to full weight bearing as guided by radiological healing. X- rays AP, LATERAL VIEW (Fig.1b, Fig 2b) were done at every follow up at 3, 6, 9 and 12 weeks followed by 3 monthly check-ups. The final functional results were assessed as per the American Orthopaedic Foot And Ankle Society Score (AOFAS).

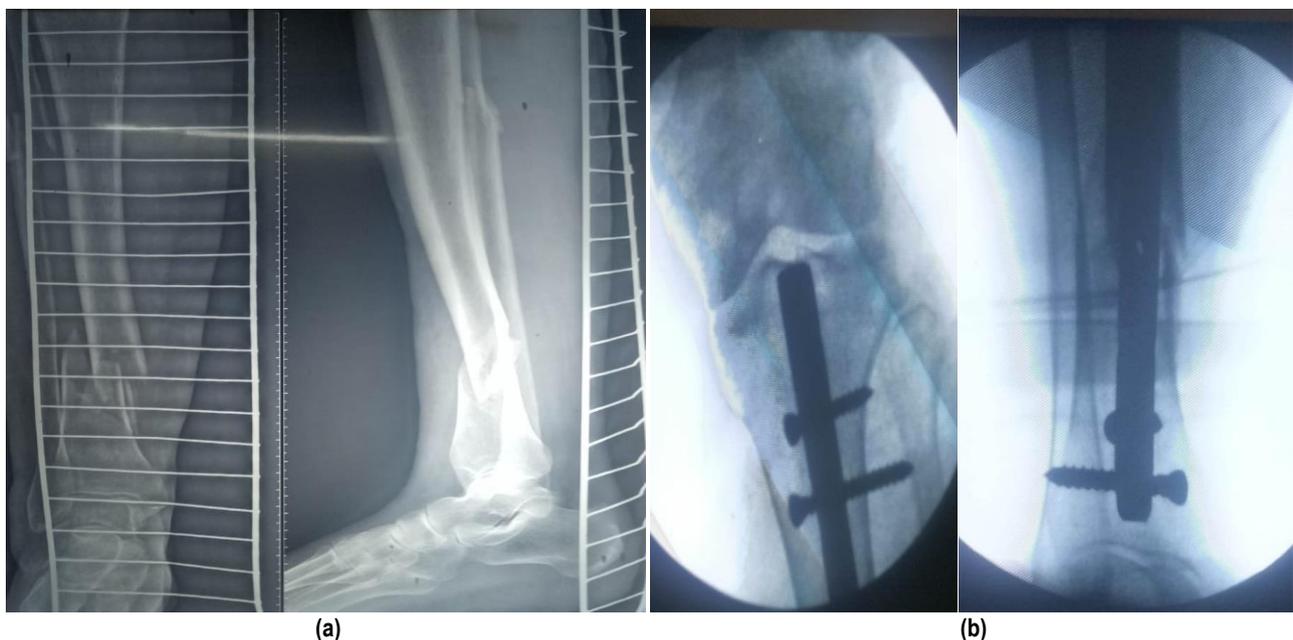


Fig 1: PRE op. (a) and post op. PICS (b) of nailing

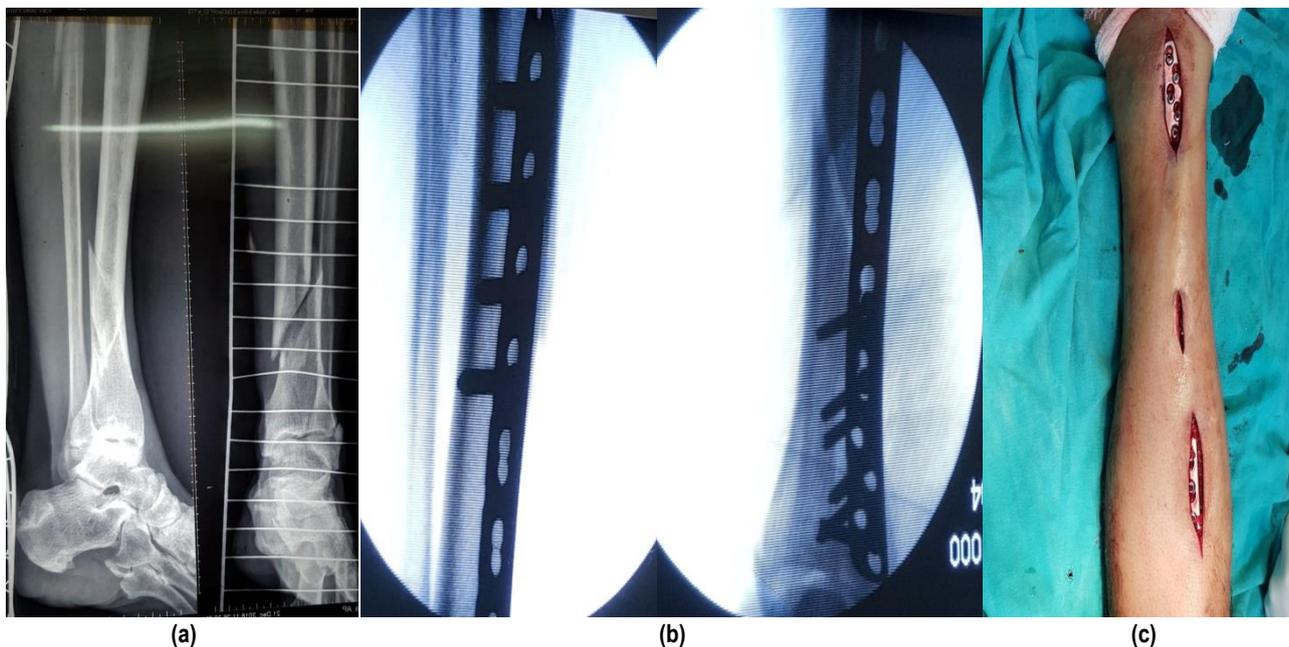


Fig II: Pre op. (a), Post op.(b), and Per op.(c) Pics of DTLCP.

RESULTS

Thirty patients of group A underwent closed reduction and intramedullary interlocking nailing and another thirty underwent closed reduction and distal tibial locking plate by MIPPO technique. The mean age in group A was 32 years (18 – 62) and 34 years in group B (22 – 64) (Table 1). Sex distribution was not significant, although males dominated both groups (63.3%) (Table 2). Commonest mode of trauma was Road Traffic Accident (63.3% Gp.A; 46.6% Gp B), followed by fall from height (46.6%) (Table 3). Commonest AO Type fracture was 43 A.2 (43.3%), followed by 43 A.1 & 43 A.3 (30% & 26.6%) (Table 4). Average surgical time in nail group was 72.3 minutes while in plating group was 63.3 minutes (Table 5). The mean radiological union time in Group A was 14.27 weeks and 15.0 weeks in Group B (Table 6). Evaluation of final functional results as per AOFAS scoring revealed 40% excellent results in plating group as compared to

33.3% of nailing group and 73.3% good to excellent results of plating group as compared to 60% of nailing group (Table 7). Post-operative complication rate was very high in nailing group 28 cases as compared to 12 of distal tibial locking plate (MIPPO) group. There were 2 cases (6.66%) each of nail bending, breakage, bone splintering and 3 cases (10%) of bending/breakage of distal locking bolts in Group A. In 2 cases of Group A (6.7%), reamer could not cross the isthmus because, one medullary canal was narrower than 8 mm and curved in the other. There were two cases (6.7%) of non-union in Group A and one in Group B, fractures united after bone grafting. Seven cases (23.33%) in Group A had anterior knee pain. Two cases (6.7%) of Group A and one case (3.33%) of Group B had mal union with angulation of < 15 degree. Superficial infection was seen in 2 (6.7) cases of Group A and 3 cases (10%) of Group B (Table 8).

Table 1: Age distribution

S.No	AGE IN YEARS	NUMBER OF PATIENTS		PERCENTAGE	
		GROUP A	GROUP B	GROUP A (%)	GROUP B (%)
1	20-40	18	15	60	15
2	40-60	8	10	26.7	33.3
3	60-80	4	5	13.3	16.7

Table 2: Sex distribution

S.No	SEX	NUMBER OF PATIENTS		PERCENTAGE	
		GROUP A	GROUP B	GROUP A (%)	GROUP B (%)
1	MALE	18	20	60	66.7
2	FEMALE	12	10	40	33.3

Table 3: Mode of Trauma

S. No	Trauma	NUMBER OF PATIENTS		PERCENTAGE	
		GROUP A	GROUP B	GROUP A (%)	GROUP B (%)
1	RTA	19	14	63.3	
2	Fall from height	6	8	20	26.7
3	Sports injury & others	5	8	16.7	26.7

Table 4: Type of Fracture AO / ATO

S.No	A.O TYPE	NUMBER OF PATIENTS		PERCENTAGE	
		GROUP A	GROUP B	GROUP A (%)	GROUP B (%)
1	43 A.1	8	10	26.7	33.3
2	43 A.2	14	12	46.6	40.0
3	43 A.3	8	8	26.7	26.7

Table 5: Duration of Surgery

S.No	DURATION IN MINUTES	NUMBER OF CASES		PERCENTAGE	
		GROUP A	GROUP B	GROUP A (%)	GROUP B (%)
1	30-60	6	8	20	26.7
2	60-90	14	18	46.7	60.0
3	90-120	10	4	33.3	13.3

Table 6: Radiological Union Time

S.No	DURATION IN WEEKS	NUMBER OF CASES		PERCENTAGE	
		GROUP A	GROUP B	GROUP A (%)	GROUP B (%)
1	6-9	2	2	6.7	6.7
2	9-12	7	6	23.3	20
3	12-15	13	14	43.3	43.6
4	15-18	5	6	16.7	20.0
5	>18	3	2	10.0	6.7

Table 7: Final Functional Results (AOFAS)

S.No	GRADE	NUMBER OF CASES		PERCENTAGE	
		GROUP A	GROUP B	GROUP A (%)	GROUP B (%)
1	Excellent	10	12	33.3	40.0
2	Good	8	10	26.7	33.3
3	Fair	8	6	26.7	20.0
4	Poor	4	2	13.3	6.7

Table 8: Complication rate

SNo	COMPLICATIONS	NUMBER OF CASES		PERCENTAGE (%)	
		GROUP A	GROUP B	GROUP A	GROUP B
1	INFECTION				
	SUPERFICIAL	2	3	6.7	10
	DEEP	-	-	-	-
2	STIFFNESS				
	KNEE	2	0	6.7	-
	ANKLE	-	2	-	6.7
3	PAIN				
	KNEE ANT.	7	-	23.3	-
	ANKLE	-	4	-	6.7
4	ANGULATION<15°	2	1	6.7	3.3
5	DELAYED UNION	2	1	6.7	3.3
6	NON UNION	2	1	6.7	3.3
7.	IMPLANT FAILURE				
	NAIL BROKEN	2	-	6.7	-
	LOCKING BELT BROKEN	2	-	6.7	0
	LOCKING BOLT BENT	1	-	3.3	-
8	BONE SPLINTERING	2	-	6.7	-
9	CHANGE OF PROCEDURE	2	-	6.7	-
	TOTAL	28	12	93.3	40.0

DISCUSSION

The fractures of distal third of tibia continue to be a decision making dilemma and predicting most of the fractures is a great challenge. The injury is commonly high energy axial and rotational trauma. The bone is poorly nourished, being devoid of muscular envelope and lies directly under the skin, and is prone to compounding. The fractures of distal third tibia are known for nonunion or delayed union.² Various classifications given by different authors from time to time, described it as Direct or Indirect, based on mode of trauma, based on the site, as upper, middle or distal third and as per type of fracture, as transverse, oblique, spiral or comminuted fractures, as per injury, as tortional or bending. But for the sake of international uniformity and better understanding, most accepted and commonly used classification is the one described by AO / OTA Group.

The present study included 60 cases of 43 A1, 43A.2, and 43A3 type fractures as per A O / OTA classification and were divided in two groups, labelled as Group A (30 cases, treated by closed reduction & internal fixation with intramedullary interlocking nail) and second group as Group B (30 patients treated with Distal Tibial Locking Plate by MIPPO Technique).

There are so many methods of treating fracture distal third of tibia. Conventionally, it used to be treated by closed reduction and POP casting by immobilizing a joint above and a joint below.⁶ It was discarded because of its association with osteopenia, joint stiffness, osteo dystrophy and frequent loss of reduction resulting in malunion. It is still useful in undisplaced, well reduced fractures immobilized by well moulded POP cast / PTB cast / or Functional cast.⁷

Surgical option used to be Intra-medullary V- Nail till late 80s, it could stabilise middle third fractures but failed to control rotation of distal fragment in distal third fractures.⁸ Then came Heavy duty compression and later AO Dynamic compression plate (DCP) & LCDCP. Whereas, plates provided good rigid fixation, compression and early primary union, but they were associated with disadvantages of open reduction like soft tissue stripping, de vitalization of bone ends and stress shielding of compression plates, resulting in many complications^{4,5} and hence search for biological options started.

Distal tibial locking plate is one such biological solution, especially utilising Minimum Invasive Percutaneous Plate osteosynthesis (MIPPO)² technique. Similarly, intramedullary interlocking nails are also done by closed reduction, closed nailing through minimum invasive technique of entering medullary canal through a hole made in tibial metaphysic close to tibial tuberosity and controlling the rotation by passing locking bolts through holes at the ends of nail. Out of DTLCP BY MIPPO and IMIL Nailing, which one is better is not clear and hence this comparative study was undertaken.

There are numerous studies comparing the two but no consensus on to which procedure should be the first choice². Comparing our study variables with other studies, in a study done by Gonsalves JJW¹¹(2018), average age in ILN group was 40 years while in MIPO group it was 43, ours was younger age patients with mean age of 32 and 34. Their study included a small sample of 15 patients in each group, exactly half than ours. Commonest mode of trauma in their patients was RTA (60%) similar to our series. The average duration of surgery in their ILN group was 57.33 min and plating group it was 70.36 min, where as in our study ILN took

longer time (72.3 min) and plating took average 63.30 min. The average time of total weight bearing in their ILN group was 9.53 weeks , and 13.29 weeks in plating, in our study, radiological union was considered to be total weight bearing criteria , hence it was 14.2 weeks in ILN and 15.0 in plating, a difference of 0.8 weeks was not significant. In their Group A of ILN, they have reported 133.33% ankle stiffness, 33.33% anterior knee pain and varus /valgus angulation of > 5 degree, 6.7% of non- union and implant failure and 3.3% knee stiffness, as compared to their plating group B. These observations were similar to our series as we also had lot number of complications in ILN group as compared to plating.

We, also compared our results with a similar study conducted by Rabari et al¹², (2017), on 73 patients, treated 30 with IMIL Nail and 43 with Distal tibial plate by ORIF. Fracture types were similar to our series, 43A1 to 43A3 of A O classification. Final functional results were assessed as per AOFAS like our study. Their mean age was 39.98 years for plating and 41.2 for ILN group. Mean radiological union time was 14.30 weeks in plating and 13.43 weeks, similar to our results, the difference in two groups was not significant like in ours. Their overall results as per AOFAS score, were better in open reduction and plate fixation than closed reduction and ILN, this was similar to our observations too. In their plating group there were only 4 complications as compared to 12 of nailing group, a difference statistically significant.

Our results match well with study done by Sunil et al., (2018)¹³ they reported operating time to be 44.21 in nailing as compared to 40.14 of plating, like our study 72.3 and 63.3 minutes. They also reported more number of complications with nailing than plating, like ours. They concluded distal locking plate by MIPPO to be superior to IMIL Nailing, as there is better anatomical reduction/alignment, quicker radiological union and better functional outcome as per AOFAS. Vallier et al., (2007)¹⁴ reviewed 111 patients treated with ILN or plating, delayed union mal union and secondary procedures were more common after nailing, as in our series.

Our series also had a high percentage of patients in IMIL Nailing group with complications; we had 28 complications in nailing as compared to 12 of plating a statistically significant difference. There were 7 (23.3%) patients of ILN group with anterior knee pain and none in plating, angulation < 15 ° in 2 (6.7%) in nailing and in 1(3.3%) of plating, non- union was 2:1, implant failure (nail bend, break, bolt bend, break) was in 7 (23.3%) of nailing. Change of surgical procedure had to be done twice (6.7%) due to narrow medullary canal, ILN group also had two cases with bone splintering. Non unions were treated by bone grafting. Commonest complication of plating group was implant prominence in 4 cases (13.3%) and required only counselling. There were 4 (13.3%) cases of superficial infection in plating as compared to two (6.7%) of IMIL Nailing, they healed with regular dressings and appropriate antibiotics after culture sensitivity tests. Stiffness of knee and ankle was not significant in both the groups in our series.

CONCLUSIONS

Distal tibial extra articular fractures are challenging due to their location, high energy trauma, close proximity to ankle and a number of complications of various surgical and conservative modes of treatment. The study proved that IMIL nailing is less invasive, more demanding than plating, technically more

challenging to achieve and maintain reduction because of anatomic configuration of distal tibia. Therefore, it is mandatory to do a thorough pre-operative work up, availability of all types and sizes of nails, reamers and alternative options with experienced surgeon to deal with any situation.

However, DTLCP gives a good anatomical reduction with a rigid construct, that is biomechanically superior to IMIL nailing, the harmful effects of soft tissue stripping by plating is taken care by minimum invasive percutaneous placement of plate, preserving periosteal blood supply without compromising intramedullary circulation too. DTLCP by MIPPO technique is associated with less number of complications, is more definitive and more biological alternative to IMIL nailing for extra articular, diaphyseal-metaphyseal fractures of distal third of tibia.

ACKNOWLEDGEMENTS

Our sincere thanks to the patients for their consent for surgery and publication of their data. We are also thankful to the ethical committee of the institution for their concurrence.

REFERENCES

1. Pan RH, Chang NT, Chu D, Hsu KF, Hsu YN, Hsu JC, Tseng LY, and Yang NP. Epidemiology of Orthopedic Fractures and Other Injuries among Inpatients Admitted due to Traffic Accidents: A 10-Year Nationwide Survey in Taiwan. *Scientific World Journal* Volume 2014; Article ID 637872
2. Shrestha D, Acharya B, Shrestha P. Minimally invasive plate osteo synthesis with locking compression plate for distal diametaphyseal tibia fracture. *Kathmandu University Medical Journal*.2011;34(2):62-68.
3. Im GI, Suk-Kee. Distal metaphyseal fractures of tibia: A prospective randomized Trial of closed reduction and intramedullary nail verses open reduction and plate and screw fixation. *Journal of Trauma-injury Infection & critical care*. 2005; 59(5)1219-1223.
4. Jansen KW, Biert J, Kampen AV. Treatment of distal tibia fractures: plate verses nail, A retrospective outcome analysis of matched pair of patients. *International Orthopaedics (SICOT)*.2007;31:709-714.
5. Kawalkar AC, Badole CM. Distal Tibia metaphyseal fractures; which is better, im nailing or minimally invasive plate osteosynthesis? *Journal of orthopaedics, trauma and rehabilitation*. 2018-24.
6. Charnley SJ. *Book of Closed Treatment of Common Fractures*. [https:// doi. Org/10.1017/CBO97805116665120.019](https://doi.org/10.1017/CBO97805116665120.019). The Golden Jubilee Edition 1999.
7. Sarmiento A, Sharpe FE, Ebranzadeh E, Nomad P. et al Factors Influencing outcome of closed tibial fractures treated by functional bracing. *Clin Orthop Relat Res*.1995;315:8-24.
8. Bong MR, Koval KJ and Egol KA. The history of intramedullary nailing *Bulleitin of the NYU Hospital for Joint Diseases*. Vol.64, Number3&4 ,2006.

9. Gupta A, Anjum R, Singh N, Hackla S. Outcome of Distal Both Bone Leg Fractures Fixed by Intramedullary Nail for Fibula & MIPPO in Tibia. *Arch Bone Jt Surg*. 2015;3(2):119-123
10. Newmen SD, Mauffey C, Krikler S. Distal tibial fractures. *Injury*. 2011; 42:975-84.
11. Gonsalves, Joe J, Wiibar. A Comparative study of locking plate by Mipo verses closed intramedullary Interlocking nail in extraarticular distal tibia fractures. *Internatinal journal of orthopaedic Science*2018;4(3):145-49.
12. Rabri Y, Somani A, Saji MA, Prasad DV, Gupta R and Sharif N. Treatment of distal 1/3rd tibia fractures: plating verses intramedullary nailing- A prospective comparative study. *International Journal Of Orthopaedics Sciences* 2017;3(2)720-22.
13. Sunil K, Shreyas A, Neelama GP et al. Outcome of distal tibia fractures treated with tibial IL Nail and minimum invasive plating. *International Journal of Orthopaedic Sciences*,2018;4(1):802-805.
14. Vallier HA, et al. *Int Orthop Treatment of distal tibial fractures: plate verses nail: a retrospective analysis of matched pair of patients*, 2007;31:709-714.
15. Khanna V, Sambandam SN, Ashraf M, Mounasam V. Extra-articular deformities in arthritic knees-a grueling challenge for arthroplasty surgeons: An evidence-based update. *Orthopedic Reviews* 2017; 9:7374
16. Zelle BA and Boni G. Safe surgical technique: intramedullary nail fixation of tibial shaft fractures. *Patient safety in surgery*. (2015) 9:40
17. Filardi V. The healing stages of an intramedullary implanted tibia: A stress strain comparative analysis of the calcification process. *Journal of orthopaedics* 12 (2015); S51 eS61.
18. Patel YC, Jangid AK and Patel CB. Outcome of minimally invasive plate osteosynthesis (MIPO) technique in distal tibial fracture. *International Journal of Orthopaedics Sciences* 2017; 3(3): 10-14
19. Vishwanath C and Mummigatti SB. Surgical management of compound fracture tibia using an unreamed interlocking nail. *International Journal of Orthopaedics Sciences* 2017; 3(4):787-79.

Source of Support: Nil. **Conflict of Interest:** None Declared.

Copyright: © the author(s) and publisher. IJMRP is an official publication of Ibn Sina Academy of Medieval Medicine & Sciences, registered in 2001 under Indian Trusts Act, 1882. This is an open access article distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Cite this article as: Sudesh Chander Sharma, Sonali Sharma, Shashi Sudan. Treatment of Fracture Distal Tibia by Distal Tibial Locking Plate Verses Interlocking Nail: A Prospective Comparative Study. *Int J Med Res Prof*. 2019 Jan; 5(1):71-76. DOI:10.21276/ijmrp.2019.5.1.014