

ORIGINAL RESEARCH

Comparative study between the outcomes of Intramedullary Interlocking Nail and Minimal Invasive Percutaneous Plate Osteosynthesis (MIPO) in Extraarticular Distal Tibia Fractures**Jangde Pravin Kumar¹, Rawate Subhash², Kumar Dushyant³, Patel Ajay⁴, Noor Sofia⁵**

¹Associate Professor, Department of Orthopedics, LSLAM Government Medical College, Raigarh, Chhattisgarh, India.

²Associate Professor, Department of Orthopedics, BRLSABVM Medical College, Rajnandgaon, Chhattisgarh, India.

³Senior Resident, Department of Orthopedics, LSLAM Government Medical College, Raigarh, Chhattisgarh, India.

⁴Senior Resident, Department of Orthopedics, LSLAM Government Medical College, Raigarh, Chhattisgarh, India.

⁵Professor, Department of Community Medicine, LSLAM Government Medical College, Raigarh, Chhattisgarh, India.

ABSTRACT

Background: Distal tibia has its unique anatomical peculiarities like subcutaneous location, poor blood supply, paucity of muscular coverage. These peculiarities make treatment of distal tibia fractures challenging. Multiple treatment modalities available for the treatment of Extra articular distal tibia fractures including open reduction and MIPO, IMN and External fixation. With the development of the mini-invasive technique MIPO became an excellent method. Currently both MIPO and IMN are most commonly used but controversy still exists. Some authors are in the favor of IMN & some authors are in the favor of MIPO. Therefore, our purpose of study is to compare the outcomes of Extraarticular distal tibia fractures managed with IMN and MIPO techniques. Aims: Our aim to compare the outcomes of Extraarticular distal tibia fractures managed with Intramedullary Nailing and Minimal invasive plate osteosynthesis (MIPO). **Materials & Methods:** We have done a prospective comparative study in department of orthopedics at GMC, Raigarh from 2020-2022 between two groups of Extraarticular distal tibia fractures. Statistical analysis performed using the SPSS software quantitative data documented as mean +/- SD. **Results:** We have 54 patients divided in two groups, 27 in each group. All patients have extraarticular distal tibia fractures. Average fracture union time for MIPO is 26.27+/- 5.36 weeks and 25.26+/- 5.19 weeks for IMN patients (p value- 0.854). Functional outcome compared with AOFAS score at the 6 month follow up. AOFAS score for patients managed with MIPO is 81.14 +/- 7.98 whereas 80.83+/- 7.91 for patients managed with IMN (p value-0.855). Complications like malunion in MIPO group 5+/- 1.41 degree as compare to 10.22+/- 2.04 in IMN group (p value- 0.001). statically significant. **Conclusion:** In our study, IMN group was associated with less duration of surgery, earlier weight bearing and lesser incidence of infection while with MIPO technique lesser the risk of infection, knee pain, malunion and nonunion. We think more time needed for proper assessment of final, clinical and functional outcome.

Keywords: minimal invasive percutaneous plating osteosynthesis, Intramedullary Nailing, Extraarticular distal tibia fractures.

Corresponding Author: Dr Pravin Kumar Jangde, Associate Professor, Department of Orthopedics, LSLAM Government Medical College, Raigarh, Chhattisgarh, India.

INTRODUCTION

Distal tibia classically includes 4cm to 12cm¹ from tibial plafond. Distal tibia fracture results when force directed from the foot towards leg in high energy injury like RTA, sports injury and falling down.

Distal tibia has its unique anatomical peculiarities like subcutaneous location, poor blood supply, paucity of muscular coverage. These peculiarities make treatment of distal tibia fractures challenging. Distal tibia fracture if not treated properly then develop complications like non-union, delayed union, wound infection, wound dehiscence and implant failure.²

Multiple treatment modalities available for the treatment of Extra articular distal tibia fractures including open reduction and minimal invasive percutaneous plating osteosynthesis (MIPO), Intramedullary Nailing and External fixation¹. The optimal mode of surgical treatment in these fractures are still debatable in the of available modalities. ORIF gives anatomical reduction but increases the risk of soft tissue injury, Intramedullary Nailing is minimally invasive dynamic fixation, avoid soft tissue injury and helps in biological osteosynthesis. However, incidence of malunion and anterior knee pain has common complains with anterograde tibial nailing⁸. External fixation is useful tool for temporary fixation but for the definitive fixation it may result in malunion nonunion, Pin tract infection and ankle stiffness. With the development of the mini-invasive technique MIPO became an excellent method. It decreases the soft tissue injury, adequate implant coverage & lesser risk of wound complication.⁸

Currently both MIPO and IMN are most commonly used but controversy still exists. Some authors are in the favor of IMN & some authors are in the favor of MIPO. Therefore, our purpose of study is to compare the outcomes of Extraarticular distal tibia fractures managed with IMN and MIPO techniques. This is a prospective study of patients in the dept of Orthopedics at Lt. Shri Lakhiram Agrawal Memorial Govt Medical college Raigarh. Evaluate them with proper follow up in 3 & 6 months and compare their outcomes between two different treatment modalities.

Aims & Objectives

Our aim to compare the outcomes of Extraarticular distal tibia fractures managed with Intramedullary Nailing and Minimal invasive plate osteosynthesis (MIPO).

Objectives

1. Determine the effectiveness of treatment modalities on the basis of AOFAS (American Orthopedic Foot and Ankle society) score, fracture union time, surgical time, hospital stay and time to partial weight bearing.
2. Compare the results in between two groups by AOFAS (American Orthopedic Foot and Ankle society) score, fracture union time, surgical time, hospital stay and time to partial weight bearing.
3. Determine the complications and compare them.
4. Compare our study with other authors results

Inclusion & Exclusion Criteria

Inclusion Criteria

1. All patients age between 20 – 70 yrs.
2. Present trauma with in < 2 weeks.
3. Close extra-articular distal tibia fracture with intact neurological & vascular status.

Exclusion Criteria

1. Age <20 & >70.
2. Old trauma
3. Pt with neuromuscular disorder and paresis or plegia of lower limbs.
4. Open distal tibia fracture associated with vascular injury.
5. Intra articular fracture
6. Poly trauma pt with head injury and pathological fracture.

MATERIALS & METHODS

There is various scoring system available to calculate outcomes in distal tibia fractures like AOFAS (American Orthopedic Foot and Ankle society) 1, JLETS (Jeju lower extremity trauma score)⁴, Johner-Weuth functional score⁷, Jadad Score⁷etc. Preop & post op scores gives detailed history about functional outcomes after surgical procedures.

In our study we have done a prospective comparative study in department of orthopedics at Lt. Shri Lakhiram Agrawal Memorial Govt Medical college Raigarh from 2020-2022 between two groups of Extraarticular distal tibia fractures. One group managed with Minimal invasive percutaneous plate osteosynthesis (MIPO) and another group managed with IMN. In follow up radiograph of fracture limb knee with leg with ankle taken in two orthogonal planes (AP & Lateral). For distal tibia plate we wait for wrinkle sign for at least 1 week. Patient followed in 2 weeks, 1 month, 3 month and 6 months. AOFAS score (American orthopedic foot and ankle score) calculated at 6 month and compared with each group.

Methods**MIPPO Technique**

1. Leg prepared from mid-thigh to toe.
2. 3-4 cm medial incision given at metaphyseal region taking care of saphenous nerve and vein.
3. Epiphyseal tunnel made with blunt retractor.
4. Precontoured distal tibial plate glide over distal tibia after appropriate fracture reduction under traction.
5. Acceptable criteria for reduction is <5o varus valgus angulation, <10o anteroposterior angulation and shortening <10mm.
6. After insertion of plate and acceptable reduction plate temporary fixed with k wire and proximal fragment locked with one locking screw for good plate contact. Plate fixed with locking and non-locking screws. If there is syndesmotoc injury then fibula fixed with syndesmotoc screws.



Pre Op image Anteroposterior and lateral view



Post Op image

Intramedullary Interlocking Nail technique

1. Anterior midline incision given from distal tip of patella to proximal part of tibial tuberosity.
2. Entry made with Awl extraarticular in bare area of tibia under image guidance.
3. Guidewire inserted up to distal subcortical part of tibia at center of distal tibia confirmed under image in two orthogonal planes ap and lateral.
4. Serial reaming done than appropriate size nail inserted after appropriate reduction and fixed with two distal and two proximal locking screws.



Post Op image

Pre Op image

Post Operative Management

1. Post operatively each group was supported by below knee posterior slab for 4 weeks, radiographs taken in two orthogonal planes after surgery.
2. Quadriceps strengthening exercises started post op day one.
3. Post op iv antibiotics given for 5 days and wound review done on day2, day5 and look for wound condition, soakage and discharge.
4. Patient discharged on day 5or 6.

Follow up

1. Suture removal done on day 10 after procedure.
2. Slab removed after 4 weeks of surgery.
3. Knee and ankle ROM and quadriceps strengthening exercise started after slab removal.
4. Patient keep in follow up at 1 month ,3-month, 6 months.
5. After 1 ½ half month started partial weight bearing after 3 months started full weight bearing walk.
6. Post op radiograph taken in every follow up.
7. If union not progressed as expectation than dynamization done after 3 months of surgery.
8. At 6 months of follow up when bony union occurs American orthopedic foot and ankle society score obtained and compared.

Statics

Statistical analysis performed using the SPSS software quantitative data documented as mean +- SD. These variables assessed by independent students t test. quantitative data between two groups assessed by either chi square test or fisher exact test. P value <0.05 was considered statistically significant.

RESULTS

Variables	MIPO	IMN	P value
Age (Years)	48.81+/-18.8 (20-60)	53.30+/-14.3 (22-65)	
Fracture union time (weeks)	26.27+/-5.36 (19-50)	25.60+/-5.19 (18-46)	0.854
Surgical time (min)	60.31+/-10.1 (50-90)	50.42+/-9.32 (40-70)	
Hospital stay (days)	7.8+/-2.90 (5-10)	6.23+/-2.80 (5-9)	0.092
Time to partial weight bearing (weeks)	7.2+/- 1.64 (5-15)	6.02+/_ 1.50 (3-10)	0.824
AOFAS score	81.14+/-7.90 (62-92)	80.83+/-7.91 (59-92)	0.855
Malunion (degree)	5+/-1.41 (3-7)	10.22+/-2.04 (8-14)	0.001*

We have 54 patients divided in two groups, 27 in each group. In first group out of 27 patient 15 males and 12 females operated with MIPO technique. In second group out of 27, 17 males and 10 females treated with IM. All patients have extraarticular distal tibia fractures. Average time of procedure (Table 1) for tibia plating is 60.32+/-10.1 (Range 50-90) mins and for IMN 50.42+/-9.32 mins. Hospital stay in MIPO group is 7.8+/- 2.90 days and for IMN group 6.23+/-2.80 days (p value 0.092). Time to partial weight bearing in MIPO cohort is 7.2+/- 1.64 weeks whereas 6.02+/- 1.50 weeks for IMN cohort (p value 0.824). Average fracture union time for MIPO is 26.27+/- 5.36 weeks and 25.26+/- 5.19 weeks for IMN patients (p value- 0.854).

Functional outcome compared with AOFAS score at the 6 month follow up. AOFAS score for patients managed with MIPO is 81.14 +/- 7.98 whereas 80.83+/-7.91 for patients managed with IMN (p value-0.855).

Variables	MIPO (N=27)	IMN (N=27)	P value
Delayed union	3 (11.11%)	4 (14.8%)	0.769
Nonunion	1 (3.7%)	2 (7.4%)	0.04
Superficial infection	2 (7.4%)	1 (3.7%)	0.04
Deep infection	1 (3.7%)	1 (3.7%)	0.1
Knee pain	1 (3.7%)	3 (11.11%)	0.024

Complications like malunion in MIPO group 5+/- 1.41 degree as compare to 10.22+/- 2.04 in IMN group (p value- 0.001). statically significant. Other complication (Table-2) also evaluated like delayed union 11.11% , non union in 3.7%, superficial (7.4%) and deep infection (3.7%) and knee pain in 3.7% in MIPO group however 14.8% delayed union, 7.4% non union, 3.7% superficial infection, 3.7 % deep infection and 11.11% anterior knee pain noted in IMN group.

DISCUSSION

Extraarticular distal tibia fracture have large significant challenge to orthopedic surgeon because lack of soft tissue coverage, peculiar anatomy of distal tibia, significant bony comminution itself, decreased blood supply. Goal of Operative Treatment is to restore the anatomical alignment of distal tibia to allow early mobilization and minimizing the soft tissue injury and bone devascularization.

IMIL Nailing has been used for management of the fracture because that is minimal invasive, less soft tissue injury, less bleeding, early weight bearing, decrease infection rate, decreased periosteal stripping, and faster healing of fracture but bone maceow in distal Tibia is wide so cannot provide sufficient stability in distal region.

In MIPPO technique, it provides axial and angular stability at screw plate interface rather than plate bone interface and assume to preserve Periosteal blood supply so it seems logical to perform the comparative study between these two techniques.

Outcomes compared on the basis of surgical time, hospital stay, time to partial weight bearing, union time, AOFAS score and complications like non-union and delayed union, superficial infection, deep infection, malunion, knee pain.

In our study Surgical time in MIPPO Group 60.32 \pm 10.1 (Range 50-90) min whereas in case of IMN mean 50.42 \pm 9.32 (Range 40-70) min. In study by Arup k Daolagupa et al.² found surgical time in MIPPO mean 66.67 \pm 15.55 (60-80 min) mins whereas in IMN mean 57.14 \pm 8-3 (45-70) mins. Xiao- kai Liu MD et al⁴ found no significant difference in operating time in both techniques in his meta-analysis. Yongchuan Li et al³ found mean time for IMIL nail is 87.5 (70-190 min) and for MIPPO 114.4 min (65-186 min).

In our study mean time for hospital stay in IMN 6.23 \pm 2.80 (avg5-9) days as compared to 7.80 \pm 2.90 (5-10) days in MIPO technique (p value 0.092). Hyunseong Kang et al⁵ found no significant difference in hospital stay in both groups 21 days for IMN and 22 days for MIPO.

In our study mean time for starting partial weight bearing in IMN group was 6.02 \pm 1.50 (3-10) weeks Whereas in MIPO group 7.20 \pm 1.64 (5-15) weeks (p value 0.824). In study by Arup k Daolagupa et al.² found mean time for partial weight bearing in IMN group was 4.95 \pm 1.07 weeks as compared to 6.90 \pm 1.33 weeks in MIPO group (p value < 0.001).

In our study fracture union time for IMN 25.60 \pm 5.19 (18-46) weeks and for MIPO 26.27 \pm 5.36 (19-50) weeks. Statically not significant (p value 0.854). Arup k Daolagupa et al.² Average union time for IMN was 18.26 \pm 2.49 weeks (15-24 weeks) and in MIPO 21.70 \pm 2.67 weeks (16-24weeks) statically significant (p<0.001). Xiao- kai Liu MD et al⁴ found mean time for union was 15 weeks (13–34 weeks) for IMN and 15.6 weeks (13-29 weeks) in MIPO group.

In our study complications like Malunion is avg 5^o \pm 1.41 (3-7^o) in MIPO as compare to 10.22 \pm 2.04 (8-14) (p value 0.001). Xiao- kai Liu MD et al⁴ found in his study that more incidence of malunion was shown in the IMN as compared to MIPO Group. (p value 0.004)

Non-union and delayed union is more with IMN group (7.4 %) as compare to MIPO (3.7%) which is statistically not significant. (p<0.04). Delayed union in IMN 14.8% and MIPO 11.11%. Delayed union is reported more with IMN. Yongchuan Li et al³ found delayed union in 9.5% patients with MIPO and 12.5% patients with IMN which was not statistically significant (p<0.05). Hyunseong Kang et al⁵ also found no statistically significant comparable number between these two groups for the non-union and delayed union.

Anterior knee pain found in 11.11% with IMN patients and 3.7% with MIPPO group which is statistically significant (p<0.001) Hyunseong Kang et al⁵ found anterior knee pain in I MN

is 23.80% patients (p value 0.0478). Yongchuan Li et al³ found incidence of anterior knee pain is higher in IMN group as compare to MIPO group.

In our study superficial infection found in 3.7% patients with IMN and 7.4% with MIPO which is statistically insignificant (P value 0.04). Deep infection is 3.7% in both groups which is not statistically significant. Yongchuan Li et al³ found higher soft tissue infection rate with MIPO. Xiao- kai Liu MD et al⁴ found surgical wound complication is lower with IMN.

Functional Assessment

In our study there is no significant difference in AOFAS Score 81.14+/-7.90 (Range 62-92) vs 80.83+/- 7.91 (Range 59-92) for MIPPO & IMN respectively.

AOFAS Score (p value 0.855) no statistically significant

CONCLUSION

Both procedures have shown reliable method of fixation for Extraarticular distal tibia fractures, preserving the osseous vascularity, fracture hematoma, which provides biological repair.

In our study, IMN group was associated with less duration of surgery, earlier weight bearing and lesser incidence of infection while with MIPO technique lesser the risk of infection, knee pain, malunion and nonunion. Other parameters like hospital stay, union time, surgery time, time to weight bearing and AOFAS Score were within comparable range. Considering the results of the study we have slightly more preference for the MIPO technique.

We observed in our study that number of patient, duration and follow-up of our study was shorter due to limited time period. We think more time needed for proper assessment of final, clinical and functional outcome. A long-term follow-up needed to bring difference between these two techniques.

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Conflicts of Interests – there is no conflicts of interest.

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