



COMPARISON OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF DISTAL THIRD TIBIA FRACTURE MANAGED WITH IMILN vs. VA-LCP – A RETROSPECTIVE STUDY.

Orthopaedics

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ABSTRACT

Background: Distal tibia fractures are challenging injuries because of their inherent instability, scarcity of soft tissues, subcutaneous nature and poor vascularity of bone. Although, distal tibial fractures accounts for approximately 7% of all tibial fractures, the best treatment still remains controversial. The purpose of our study is to assess the radiological outcomes of distal third tibia fracture treated with surgical techniques i.e., intramedullary nailing using closed reduction internal fixation technique vs. locking compression plating using minimal invasive plate osteosynthesis technique. **Method And Materials:** This Retrospective, observational, hospital-based study was conducted at tertiary health care center KOLAR, involving patients with extra articular closed tibia fractures of distal 1/3 up to 43-A3 of AO classification, from DEC 2016 - DEC2019. Demographic data and clinic-radiological data were collected and evaluated during pre- and post-procedure. **Result:** Mean union time in intramedullary nailing using closed reduction internal fixation technique group was 17.25 ± 1.065 weeks and locking compression plating using minimal invasive plate osteosynthesis technique group was 20.19 ± 1.759 weeks, which was statistically significant with p value less than 0.05. **Conclusion:** The group receiving the intervention of Locking Compression plating took more time to unite distal third tibia fractures compared to the group receiving the tip locking nailing.

KEYWORDS

Intramedullary nailing, minimally invasive plate Osteosynthesis, distal tibia.

INTRODUCTION

Distal tibia fractures are challenging injuries because of their inherent instability, scarcity of soft tissues, subcutaneous nature and poor vascularity of the bone. Distal tibial fractures accounts for approximately 7% of all tibial fractures and less than 10% of all lower extremity fractures.^[1] Distal tibial fractures are a result of combined compressive and shear forces, which may result in the instability of the metaphysis, with or without articular depression, as well as injury to the soft tissue.

The various treatment modalities include open reduction and internal fixation (ORIF), external fixation with or without limited internal fixation, intramedullary (IM) nailing or, more recently, minimally invasive plate Osteosynthesis (MIPPO).^[2] However, the best treatment still remains controversial.

Furthermore, conservative management are indicated for stable fractures with minimal shortening. However, many of the complications that are being reported particularly with distal tibia fracture includes malunion, shortening, limited ROM and early osteoarthritis of ankle.^[3]

Intramedullary nailing can be considered as the "gold standard" for the treatment of tibial midshaft fractures, but there are concerns regarding biomechanical stability of fixation due to the risk of malunion or non-union in distal tibia fractures. Technical difficulties with distal nail fixation are attributed to the risk of nail propagation into the ankle joint, along with the miss-match between the diaphyseal and metaphyseal diameter of the intramedullary canal.^[4] Hence the goal is to correct axial and rotational alignment, as well as the secondary bone healing with callus formation.^[5]

The intramedullary nail spares the extra-osseous blood supply, which allows load sharing and avoids extensive soft tissue dissection.^[6] In addition, IM nailing is indicated in tibia shaft fracture allowing two or more distal locking bolts distal to fracture site. It is contraindicated where the fracture line is less than 5 cm proximal to the ankle joint.^[7]

Malalignment i.e., rotational and angular, is attributed to the resemblance of an hourglass shape of the distal tibia, which hinders anatomical reduction during intra-medullary interlocking nailing, therefore being technically more challenging. Fixed angular stability through the head of locking screw, which is independent of friction fit, are the properties attributed to superior holding power, in case of locking plates. Locking plates also have the biomechanical properties of internal and external fixators.

Minimally invasive plate osteosynthesis (MIPPO) as the name implies, is a minimal invasive technique that preserves vascularity of the soft tissue envelope and decreases the soft tissue complications. MIPPO technique aims to reduce iatrogenic soft tissue injury and damage to bone vascularity, as well as preserving osteogenic fracture hematoma. Hence, it is a better technique for the management of distal tibia fracture. In addition, a mechanically stable fracture-bridging Osteosynthesis is established using MIPPO technique with no significant dissection and surgical insult to the bone or surrounding soft tissues, thereby preventing complications such as wound dehiscence, sepsis, delayed or non-union.^[8,9]

The indications for minimally invasive plate Osteosynthesis of distal tibial fractures include displaced distal tibial fractures (43A, 43B and 43C), unstable metaphyseal fractures which are far too distal for safe stabilization with intramedullary nails, and fractures with intra-articular extensions.

Therefore, the purpose of this study is to assess the radiological outcomes of distal third tibia fracture treated with surgical techniques, which includes, the intramedullary nailing using closed reduction internal fixation technique vs. locking compression plating, using minimal invasive plate osteosynthesis technique.

MATERIALS & METHODS:

This was a retrospective, observational, and hospital-based study conducted in the tertiary health care center Kolar from DEC 2017-DEC 2019 for a period of 2 years. The sample size was estimated according to the mean difference in union time between two procedures in a study by Dr Yash Rabari et al. The study was approved by the institutional ethics committee, and confidentiality of the patient maintained. Patients of age group > 18 years diagnosed with distal third tibia fracture i.e., extra articular closed fractures of distal third up to 43-A3 of AO classification were included in the study. Patients with pathological fracture, treated conservatively or any other method for other medical reasons, compartment syndrome/ poor local skin conditions, associated neurovascular injury were excluded from the study.

METHOLOGY

In this retrospective study, 32 patients with distal third tibia fractures who were treated in our hospital were included. The patients were divided into two groups: group A included patients who underwent intramedullary nailing using closed reduction internal fixation technique (CRIF) and group B included patients who underwent locking compression plating using minimal invasive plate osteosynthesis technique (MIPPO). Outcomes were measured and

assessed at 1 month, 3 months, 6 months and 12 months interval radiologically, on the basis of bridging callus (at least in three cortices, seen in AP and lateral view).

After obtaining approval from the institutional ethical committee, 32 cases were followed up for a period of 12 months. Demographic data including age, sex and also information about the fracture, surgery, recovery and post recovery periods were obtained from the medical records of the patients. The information regarding presence of anterior knee pain was obtained from clinical notes.

Analysis & Statistical Methods:

The estimated sample size was 32 cases and the collected data were recorded in an Excel format which included all the quantitative measures, categorical variables like functional outcome, sex, age, fracture type was compared using percentages. Chi square test was used as the test of significance. P value <0.05 will be considered as statistically significant. Statistical analysis will be carried out using SPSS version 20.

Operative Procedure Of Lcp Fixation Using Mippo Technique:

On a standard radiolucent table, supine position, sand bag was given under ipsilateral buttock for good exposure. Tourniquet was used in all cases after extinguishing the extremity. The fibula fracture was addressed first in the case of distal 5-8 cm of fibula fracture so that the length could be restored indirectly. Generally, anteromedial plate was used but in the case of fracture comminution on lateral side, blister or compound punctured wound over medial side anterolateral plate was used.

Fracture reduced under c-arm due to the traction given and maintained that by using K-wire and/or reduction clamp. Under image intensifier, two mini-incisions were made, one at proximal end of anticipated plate position and another at distal end. Then, a tunnel was created between these two incisions at extra periosteal fashion, by advancing the periosteum or clamp from distal to proximal or vice versa. The plate was pulled through the subcutaneous tunnel under image intensifier. Finally, the fracture was fixed with locking and cortical screws.

Postoperative protocol: In all the cases, short leg posterior slab was applied immediately after surgery. Active knee exercises were commenced after 48 hours. Weight bearing was avoided till six weeks, depending on the comminution of fracture. Then, follow up radiological and clinical examination were done at 4, 6, 12, 24, 36, 48 weeks interval. However, partial weight bearing had been allowed once the radiological union was noted. Soon after fracture consolidation, full weight bearing was allowed.

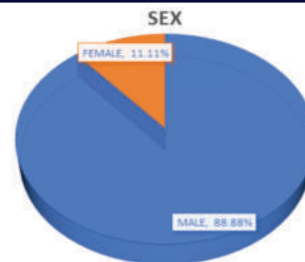
Operative Procedure Of Imil Nailing Using Crif Technique:

On standard operating table, in supine position, under adequate draping, along with at least 90-degree knee flexion was required for nailing using Midline patellar tendon splitting approach. Serial reaming was done up to 1 or 1.5 cm above the desired nail. The procedure was done by inserting the nail with proper jig and confirming the distal end of the nail position by means of C-arm. In addition, rotational alignment was evaluated by aligning anterior superior iliac spine, mid-patella and second ray of the foot. Then, two locking screws were applied in the proximal part with the help of the jig provided. By using free hand technique under the c-arm guidance, 2-3 locking screws were applied distally.

Postoperative protocol: On the first day, isometric quadriceps, knee and ankle exercise was advised. On the second day, partial weight bearing with the help of walker was allowed if fracture reduction was satisfactory. If the fibula was fixed with plate, non-weight bearing was advised for six weeks. Eventually later, weight bearing as tolerated by patient, was advocated for next six weeks. Patient follow-up was done on 6th week, 3rd month, 6th months, 9th month and 1 year.

RESULT:

All the patients were available for the follow-up and they were followed up until 12 months. Results were analyzed both clinically and radio-logically. Sixteen (16) cases of distal third tibial fractures in group A, who underwent intramedullary (Tip locking) nailing using closed reduction internal fixation technique (CRIF) and sixteen (16) patients in group B treated with locking compression plate using minimal invasive plate osteosynthesis technique (MIPPO) were studied and followed up at regular intervals.



The distribution of age reveals that majority of the cases lie between 20-40 years. The mean age estimated was 41 years in nailing group and 45 years in plating group.

Majority of the cases i.e., 13 cases (81.25%) in nailing group and 15 (93.75%) in plating group occurred as a result of road traffic accidents. 2 cases (12.5%) in nailing group and 1 case (6.3%) in plating group as a result of self-fall, 1 case (6.3%) in nailing group and no cases in plating group due to assault. In this study, there were a total of 9 cases (56.3%) that had right sided fracture, and 7 (43.7%) left sided fracture among nailing group and 7 cases (43.7%) had right sided fracture, and 9 (56.7%) left sided fracture in plating group.

In this study 13 (81.25%) out of 16 cases in nailing group had associated fibula fracture i.e., 10 (62.5%) patients had associated distal third fibula fracture respectively, 3 (18.8%) patients had associated proximal third fibula fracture, 3 (18.8%) patients had isolated distal third tibia fracture while 15 (%) out of 16 cases in plating group had associated fibula fracture i.e. 11 (68.8%) patients had associated distal third fibula fracture respectively, 2 (12.5%) patients had distal third fibula fracture, 2 (12.5%) patients had associated segmental fibula fracture, while 1 (6.3%) patients had isolated distal third tibia fracture. In plating group one patient had associated medial malleoli fracture, another one patient had associated proximal tibia fracture and one patient had bilateral distal fibula fracture.

With comparison of complications, surgical site infection was seen in 3 (18.8%) patients in nailing group and 2 (12.5%) patients had surgical site infection in plating group. 2 (12.5%) patients had malunion in nailing group and 1 (6.3%) patient in plating group. 2 (12.5%) patients had delayed union in nailing group and 1 (6.3%) in plating group. 1 (6.3%) patient had ankle stiffness in plating group and none in nailing group. No other complications were observed such as deformities, compartment syndrome, implant irritation/skin impingement or implant failure.

The mean union time noted in nailing group was 17.25 ± 1.065 weeks while the union time noted in plating group was 20.19 ± 1.759 weeks.

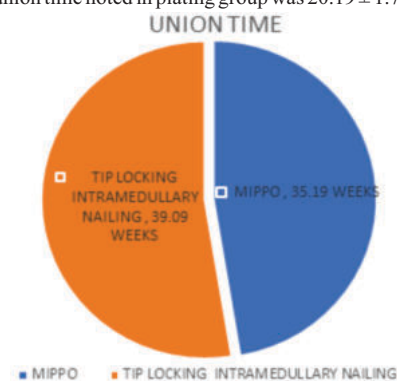


Table 1: Demographic Data

		GROUP I- Nailing group		GROUP II- plating group	
		Frequency	Percent	Frequency	Percent
Sex	Male	13	81.3	12	75.0
	Female	3	18.8	4	25.0
Side	Left	7	43.8	9	56.3
	Right	9	56.3	7	43.8
Associated Fibula Fracture	Distal Third	10	62.5	11	68.8
	Isolated	3	18.8	1	6.3
	Proximal Third	3	18.8	2	12.5
	Segmental	0	0	2	12.5

Treatment For Fibula and Other Associated Fracture	Rush Pin	3	18.8	5	31.3
	Semi tubular Plating	4	25.0	4	25.0
Union Time	No Treatment	6	37.5	6	37.5
	Others	3	18.8	1	6.3
Complication	16 Weeks	5	31.3	0	0
	17 Weeks	4	25.0	1	6.3
	18 Weeks	5	31.3	1	6.3
	19 Weeks	2	12.5	5	31.3
	20 Weeks	0	0	2	12.5
	21 Weeks	0	0	3	18.8
	22 Weeks	0	0	2	12.5
	23 Weeks	0	0	2	12.5
No Complication	No Complication	9	56.25	11	68.8
	Superficial infection	1	6.3	2	12.5
	Deep infection	2	12.5	0	0
	Delayed Union	2	6.3	1	6.3
	Malunion	2	12.5	1	6.3
Ankle Stiffness	Ankle Stiffness	0	0	1	6.3

Table 2: Comparison Of The Intervention In Two Group

	Intervention Type	Mean $\pm$ STD. Deviation	p value#
Union Time In Weeks	Tip Locking (Nailing group)	17.25 $\pm$ 1.065	0.001
	Plating group	20.19 $\pm$ 1.759	

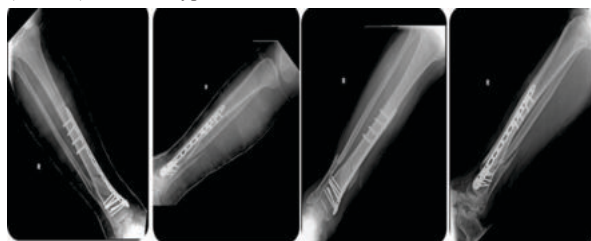
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DISCUSSION:

Distal tibial fractures remain one of the most substantial therapeutic challenges for an orthopaedic surgeons and optimal treatment still remains controversial. Treatment for distal tibia fractures is challenging, due to the very nature of its subcutaneous location, limited soft tissue coverage and poor vascularity. However, with the advancement of the intramedullary nail design i.e., nail with multiple locked multidirectional screws, have extended the spectrum of fractures fixation and is found to be superior to the conventional interlocking nail. Furthermore, with the recent advancement in plating technique which is called as the "Minimally Invasive Percutaneous plate osteosynthesis" (MIPPO), reduces the iatrogenic soft vascularity as well hematoma.

In the study conducted by Somashekar et al. [10] they described the mode of injury, duration of surgery associated with distal tibia fracture, in which 90% individual in the intramedullary interlocking nailing group occurred due to RTA while 10% of the individuals were caused due to self-fall. Similarly, 50% of individual in MIPPO group were due to RTA while 20 % individual suffered from fall from height and 10% had experienced sports injury. Furthermore, the mean duration of the surgery in both groups was 61 minutes 90 minutes respectively. On the other hand, in our study, 81.25% cases in nailing group and 93.75 % cases in plating group occurred as a result of road traffic accidents. 12.5 % cases in nailing group and 6.3 % cases in plating group occurred as a result of self-fall. Lastly, 6.3% cases in nailing group and no cases in plating group occurred due to assault.

Kawalkar et al. [11] in his study, classified the various distal tibia fracture encountered into AO classification and associated fibula fracture. 87% of participant in intramedullary nailing group and 56% of participants in MIPPO group had 43A1 type of fracture while 74% and 66% had associated fibula fracture respectively. Though our study had also taken into consideration the similar classification system, it was seen that 81.3% Participant in Nailing group and 68.8% In plating group (MIPPO) had 43A1 type fracture.



Postoperative and final follow-up radiographs of patient underwent LCP(MIPPO TECHNIQUE).



Postoperative final follow-up radiographs of patient underwent IMILN (CRIF TECHNIQUE).

Arup et al. [12] investigated 42 patients, out of which 21 underwent Nailing and 21 underwent plating with MIPPO technique. The average union time noted was 18.26 weeks in nailing group and 21.70 weeks in MIPPO technique plating group. In addition, partial weight bearing and full bearing average time noted was 4.95 weeks and 10.09 weeks with nailing group and 6.90 weeks and 13.38 weeks for MIPPO technique plating group respectively. However, the study conducted by Anil Takaesen et al. [13] showed that the average bony union time was 15 $\pm$ 12.7 weeks in MIPPO and 16 $\pm$ 11.3 weeks in nailing group. However, severe wound dehiscence was noted in two patients (7.4%) treated with MIPPO technique, hence secondary surgical intervention was advocated. While our study, it showed the mean union of 17.25 $\pm$ 1.065 weeks in IMILN group and 20.19 $\pm$ 1.759 weeks in plating group (MIPPO) respectively.

Ali et al. [14] recorded the post-operative complication associated with two surgical procedures. The most common complication was superficial infection observed in 6.67% of the participants from intramedullary nailing and 12.5% MIPPO group respectively. In our study, surgical site infection was seen in 3 (18.8%) patients in nailing group and 2 (12.5%) in plating group. 2 (12.5 %) Patients had malunion in nailing group and 1 (6.3%) in plating group. 2 (12.5 %) Patients had delayed union in nailing group and 1 (6.3%) in LCP group. 1 (6.3 %) Patients had ankle stiffness in nailing group and none in LCP group.

CONCLUSION:

Among these two treatment modalities i.e., ORIF and MIPPO techniques for extra articular fracture of distal 1/3rd tibia (AO type A), group receiving the intervention of Locking Compression plating took more time to unite distal third tibia fractures compared to the group receiving the tip locking nailing. This difference was statistically significant with p value less than 0.05.

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