

Functional Outcome of Open Reduction Internal Fixation (ORIF) versus Minimally Invasive Plate Osteosynthesis (MIPO) in Distal Third Tibia Fractures

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Abstract

Introduction: Distal Tibia fractures are considered as a surgeon's nightmare as it is difficult to treat due to less muscle cover, precarious blood supply and its proximity to ankle joint. Here we compare two surgical procedures Open Reduction Internal Fixation (ORIF) and Minimally Invasive Plate Osteosynthesis (MIPO) methods. **Aims and Objectives:** Study was done to compare results between surgical approaches ORIF vs. MIPO in treatment of lower third tibia fractures. **Methodology:** The study included 64 patients out of which 32 were treated by ORIF and remaining 32 by MIPO. Outcome was evaluated on the basis of length of incision, duration of surgery, blood loss, duration of stay, mobilization with partial and full weight bearing, AOFAS grading. **Results:** Length of incision, blood loss, mobilization at full weight bearing was significantly higher in ORIF group as compared to MIPO and was statistically significant. **Results and Conclusion:** MIPO offers biological advantages over conventional plating techniques in terms of low surgical trauma, preservation of the blood supply, lesser evacuation of osteogenic fracture hematoma and stable construct.

Keywords: Fracture, Distal Tibia, Internal Fixation, Plate Osteosynthesis

1. Introduction

Distal tibia fractures are unique and different in the sense that the bone is subcutaneous with minimal or no muscle coverage on the anteromedial aspect with less blood supply to tibia and its proximity to the ankle joint. All these factors make it a challenge for surgeons to treat them^{1,2}. Fractures treatment of distal tibia also remains

a controversial subject in spite of recent advances in both non-operative and operative care and reduction by means of cast and splints but rates of non union, delayed union and malunion were high^{3,4}. As time passed surgical techniques like intramedullary nailing, external fixators, plating's were developed⁵. Last decade saw the emergence of a newer technique MIPO aimed to minimize soft tissue dissection and periosteal stripping. Fracture hematoma

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is preserved and reduction is achieved percutaneously all favourable environment for fracture healing by allowing micromotion at fracture site and maintenance of soft tissue vascularity⁶. MIPO gained more popularity with precontoured locking plates⁷.

2. Aims and Objectives

Our objective was to study the functional outcome of ORIF and MIPO plating in distal third tibia fractures by clinical and radiological parameters.

3. Materials and Methodology

It was a comparative interventional type of study. Study was performed from August 2017 to December 2019. Patients having distal third tibia fractures were taken into account.

3.1 Inclusion Criteria

- Patients >18 years with distal tibia fractures.
- Closed fractures or Type I and Type II open fractures as per Gustillo Anderson classification of open fractures.
- Simple and locking plates.

3.2 Exclusion Criteria

- Patients having neurovascular compromise.
- Distal tibia fractures extending into ankle joint.

Sixty four patients enlisting in the casualty or as inpatient in the Department of Orthopedics of Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Nashik, Maharashtra. Only those patients satisfying the inclusion and exclusion criteria were included in the study. All the patients were explained about the surgical procedure, the purpose of the study and informed consent and approval from the IEC was taken. Patients were evaluated on the basis of history, clinical examination and radiological work up, follow up for wound check, suture removal. 6 weeks immobilisation, 6 weeks - 3 months active ankle extension, >3 months: partial weight bearing. Patients were evaluated on the basis of history, clinical examination and radiological work up.

3.3 Surgical Technique

3.3.1 Open Reduction Internal Fixation (ORIF)

ORIF conventional anteromedial incision taken starting from medial malleolus to proximal to it. Skin incision done, subcutaneous tissue dissected, reduction was achieved by manipulation under vision and checked under c-arm fluoroscopic guidance. Precontoured locking plate was placed over medial surface of distal tibia and reduction was secured with at least 4 proximal screws and 4 distal screws. In case of oblique and spiral fracture if needed one or two lag screws were used. Haemostasis was achieved after tourniquet deflation. Wound was washed and wound closed in layers.

3.3.2 Minimally Invasive Plate Osteosynthesis (MIPO)

Fracture was manipulated before taking an incision. Reduction was achieved closed under C-arm fluoroscopic guidance. Small straight incision taken longitudinally over centre of medial malleolus precontoured locking plate is slid proximally and subcutaneously without damaging the periosteum on medial surface. Plate was temporarily fixed by 1 proximal and 1 distal K wire. Fixation is secured by 4 proximal and 4 distal screws to traction line.

Need for associated fibula fixation was assessed intraoperatively, on the basis of stability of inferior tibiofibular syndesmosis. If needed fibula was fixed by intramedullary nail or plate.

3.4 Post Operative Management

Wound inspection done on 2nd day. Ankle and Knee ROM started on 2nd day. Suture removal done on 12th post operative day. Patient advised non weight bearing until radiological evidence of union. Radiological examination is done in once every 6 weeks. Once radiological union started partial to full weight bearing was started. All cases was assessed using the American Ankle and Foot Grading System⁸ as follows: Score of >90 was labelled as excellent, 80-89 as good, 70-79 as fair and <70 as poor.

3.5 Post Operative Assessment

Every case was followed for at least 6 months or more. At every follow up anteroposterior and lateral view X-ray of

distal tibia was taken. Fracture union was defined radiologically when 3 or 4 cortices shows bridging callus in both X-ray views and clinically when pain and tenderness at fracture site diminished. At end of follow up AOFAS score was used to assess the clinical outcome. Score of >90 was labelled as excellent, 80-89 as good, 70-79 as fair and <70 as poor.

Both the groups were compared on the basis of length of incision, duration of surgery, blood loss, duration of stay, mobilization with partial and full weight bearing, AOFAS grading.

4. Result

As seen in the table 1, most of the study in both group (ORIF)

Table 1. Age group amongst study population

AGE GROUP	ORIF	MIPO	TOTAL
25-50 years	8 (25.00%)	5 (15.63%)	13 (20.31%)
51-60 years	10 (31.25%)	11 (34.37%)	21 (32.81%)
61-70 years	5 (15.62%)	6 (18.75%)	11 (17.19%)
71-80 years	9 (28.13%)	10 (31.25%)	19 (29.69%)
Total	32 (100%)	32 (100%)	64 (100%)

Chi square test, P value: 0.08

Table 2. Distribution of patients according to gender

Sex	ORIF	MIPO	TOTAL
Male	21 (65.63%)	19 (59.38%)	40 (62.50%)
Female	11 (34.37%)	13 (40.62%)	24 (37.50%)
Total	32 (100%)	32 (100%)	64 (100%)

Chi square test, P value: 0.781

and MIPO) belongs to the age group of 51 to 60 years (31.25% vs. 34.37%) followed by 71 to 80 years (28.13% vs. 31.25%) and 25 to 50 years (21.87% vs. 18.75%) and the difference was statistically insignificant.

As seen most of the study in both group (ORIF and MIPO) were males (65.63% vs. 59.38%) as compared to female (34.37% vs. 40.62%) and the difference was statistically insignificant.

As seen from the table most of the patients in both groups (ORIF and MIPO) had Right side involvement (66%. 69%) as compared to Left side (34% vs. 31%) with a P value of 0.910 and the difference was statistically insignificant (Table 3).

Both ORIF and MIPO groups had more unstable fractures (81% and 75% respectively) as compared to

Table 3. Distribution of patients according to side involvement

Side	ORIF	MIPO	TOTAL
Left	11 (34%)	10 (31%)	21 (33%)
Right	21 (66%)	22 (69%)	43 (67%)
Total	32 (100%)	32 (100%)	64 (100%)

Chi square test, P value: 0.910

Table 4. Distribution of patients according to comorbidities

Comorbidities	ORIF	MIPO	TOTAL
Asthma	1 (3%)	1 (3%)	2 (3%)
CKD	0 (0%)	1 (3%)	1 (2%)
Diabetes Mellitus	9 (29%)	4 (12%)	13 (21%)
Hypertension	11 (35%)	5 (16%)	16 (25%)
Nil	11 (35%)	21 (66%)	32 (50%)
Total	32 (100%)	32 (100%)	64 (100%)

Chi square test, P value: 0.321

stable fracture (19% and 25% respectively) with p value 0.561 and the difference was statistically not significant.

As seen in the table 4, Hypertension (35%) was the most common comorbidities in ORIF group followed by diabetes (29%) and Hypertension (16%) was the most common comorbidities in MIPO group followed by diabetes (12%) with a P value 0.321 and the difference was statistically insignificant.

As seen in the table 5, Length of Incision (cm) and Blood Loss (ml) was significantly higher in ORIF group as compared to MIPO group with a P value of 0.0001 and 0.002 respectively. Therefore statistically significant while duration of surgery was higher in ORIF group as

compared to MIPO group with a P value of 0.38 though statistically insignificant.

As seen in the above table 6, Mobilization full weight bearing (weeks) was significantly higher in ORIF group as compared to MIPO group with a P value of 0.0001 and also statistically significant while Duration of Stay (days) and Mobilization Partial weight Bearing (weeks) was higher in ORIF group as compared to MIPO group with a P value of 0.127 and 0.42 respectively though statistically insignificant.

As seen in the above table 7, most of the study population in MIPO had excellent outcome (69%) followed good (25%) and fair outcome (6%) while in

Table 5. Intraoperative findings

Introperative Findings	ORIF	MIPO	P VALUE
Length of Incision (cm)	12.54 ± 1.39	7.95 ± 0.75	0.0001
Duration of Surgery (mins)	75.86 ± 16.76	71.06 ± 13.19	0.38
Blood Loss (ml)	117.14 ± 18.05	78.75 ± 19.87	0.002

Table 6. Postoperative findings

Postoperative	ORIF	MIPPO	P VALUE
Duration of Stays (days)	5.29 ± 1.1	4.69 ± 0.956	0.127
Mobilisation Partial Weight Bearing (weeks)	6.86 ± 1.23	5.75 ± 1.57	0.42
Mobilisation Full Weight Bearing (weeks)	16.86 ± 3.4	11.69 ± 1.07	0.0001

Table 7. Final outcome

Score	ORIF	MIPO	TOTAL
Excellent (>90)	18 (56%)	22 (69%)	40 (63%)
Good (80-89)	13 (41%)	8 (25%)	21 (33%)
Fair (70-79)	1 (3%)	2 (6%)	3 (5%)
Poor (<70)	0 (0%)	0 (0%)	0 (0%)
Total	32 (100%)	32 (100%)	64 (100%)

Chi square test, P value: 0.001

ORIF group, most of the study population had excellent outcome (56%) followed good (41%) and fair outcome

(3%) and with a P value of 0.001 and the difference was statistically significant.

5. Discussion

Distal end tibia fractures are one of the most common cases encountered in the emergency department. The management options available include non-operative, external fixation, intramedullary nail, conventional open plating and MIPO⁹. Each of these modalities is associated with their own limitations. And the best line of management is controversial. Being subcutaneous in nature the distal tibia has minimal soft tissue coverage and precarious vascularity. Impaired blood supply due to damaged periosteum further delays fracture healing and increases the chances of nonunion¹⁰.

The principle of preservation of fracture hematoma and minimal soft tissue destruction is utilized for biological osteosynthesis in MIPO technique¹¹. This technique has shown

successful results when clinical and radiological outcomes were compared. Conventional open plating is based on rigid internal fixation and stability achieved by maximum contact at fracture site¹².

Complications associated with treatment of distal tibia such as delayed union and non-union are important comorbidities encountered. In studies conducted by Li et al and Guo using MIPPO technique, they reported no incidence of delayed or non-union which was in accordance with results of our study in the MIPO group^{13,14}.

As per recent reports, malunion has been described as a common complication (2%-35%) in management of distal tibia fracture. In 88 distal tibia fracture treated with conventional open plating¹⁵, Lee et al have noted only 3 (3.4%) cases of malunion. In study by Zou et al, no malunion was reported using conventional open surgery^{13,16}. They have also reported that malunion have been seen in 9.6% of their patients treated with MIPO technique. In a similar study conducted by Borg et al the rate of malunion was reported to be 9.5%. We encountered one case of malunion in MIPPO group¹⁷. Restoring perfect anatomical alignment in distal tibia fracture with MIPPO technique is challenging as reduction is achieved by indirect closed manipulation under fluoroscopic guidance that suggests reduction we get is acceptable.

ORIF is expected to have comparatively more blood loss because of extensive exposure. Wound complications

and infection rate is expected to be higher. But we did not have any case of superficial or deep infection in case treated by ORIF. Accurate anatomical reduction and rigid fixation is possible with ORIF. Length of Incision (cm) and Blood loss (ml) was significantly higher in ORIF group as compared to MIPO group while Duration of surgery (Mins) was higher in ORIF group as compared to MIPO group though statistically insignificant. This finding was in agreement with the study conducted by J Jguo et al.¹⁸ and Satish R Gawati et al.¹⁹ in which the mean duration of surgery was 81.23 minutes and 89 minutes respectively. Mobilization full weight bearing (weeks) was significantly higher in ORIF group as compared to MIPO group and it was statistically significant whereas mobilization partial weight bearing (weeks) was higher in ORIF group as compared to MIPO though statistically insignificant.

6. Conclusion

Thus to conclude, MIPO offers a better option for fixation of these fractures due to less soft tissue dissection, more biological fixation, early full weight bearing and better functional outcome.

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