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Functional Evaluation Following Operative Management Of Extra Articular Distal Tibia Fractures With Precontoured Medial Distal Tibial Locking Compression Plate By MIPPO Technique.

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Abstract: *Extraarticular distal tibial fractures are among the most challenging fractures encountered by an orthopedician for treatment.The surgical treatment of fractures according to AO principles has seen a change in the past decade, from anatomical reduction and rigid fixation to the current concept of biological fixation. The LCP is a screw plate system that offers the possibility of inserting conventional and locking head screws into the specially designed combination holes. We aimed to study the nature of fracture union and the functional outcome of distal tibial fractures treated with LCP by MIPPO technique, and to analyse any complications arising out of this technique*

This is a prospective study of 23 cases of closed distal tibia fracture (19 patients had associated with fibula fracture) admitted jiangpin hospital, Zhenjiang, between November 2015 and November 2017. Cases were taken according to the inclusion and exclusion criteria. We treated all patients with medial distal tibial LCP by MIPPO technique.

We followed up all the patients for 6 months or till fracture union whichever is later. All fractures eventually united including 2 which had delayed union. We had totally 6 complications which included superficial infection (2), deep infection (1), complex regional pain syndrome (1), delayed union 2).

The patient sample approximately reflected the regular trauma patients encountered at our set up. Fractures treated with MIPPO, healed rapidly by secondary healing, hence achieving strong bony union across the fracture site. With the LCP system the biological fixation of the fractures was easier than the conventional plates. The anchorage of the locking head screws even in the osteoporotic bone was excellent. We also confirmed its proven efficacy in the treatment of difficult fracture situations; where in other implants have limited application.

Key Words: *Locking compression plate (LCP), internal fixator, Biological fixation, MIPPO, distal tibial fractures.*

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I. Introduction

In the recent years, road traffic accidents (RTA) have emerged as one of the leading causes of morbidity in the age group of 15-45 years. In patients sustaining high velocity trauma due to RTA, tibial fractures are most commonly encountered in which distal tibial fractures have second highest incidence after middle third tibial fractures. Extra articular distal tibial fractures are difficult to treat as they extend within approximately 4 cm of the tibial plafond i.e., involving metadiaphyseal and metaphyseal region which present with severe comminution and soft tissue injury.

Anatomic and physiologic features of distal tibia like subcutaneous location, precarious blood supply and high incidence of open fractures make management of distal tibial fractures difficult. Further, the presence of neighbouring hinge joint allows for little rotational malalignment after fracture union. Fracture pattern, soft tissue status, bone quality, age and activity level of patient affect the selection of treatment methods. The choice of treatment modality is hence controversial and not clear.

Various treatment options for treating extra articular distal tibial fractures are conservative with cast immobilization or by calcaneal pin traction, external fixation in case of open injuries, intramedullary nailing and open reduction and internal fixation with plate osteosynthesis by conventional method or through minimal soft tissue dissection.

Open reduction techniques with rigid fixation have resulted in poor operative outcomes ranging from wound infections to decreased fracture consolidation and non-union. Therefore better techniques of osseous fixation with minimal soft tissue handling have evolved, to produce the biological fracture fixation with minimally invasive techniques.

MIPPO (minimally invasive percutaneous plate osteosynthesis) is a method of fracture fixation which has gained wide popularity because of reduction of surgical trauma with excellent functional results. The advantages of MIPPO include limited soft tissue dissection; reduced wound related complications, preservation of osteogenic fracture hematoma and improved union rates.The subcutaneous anatomy of the distal tibia has led to the development of anatomically precontoured implants which preserve the biology of bone and provide good clinical results.

In this study, we have used 3.5 mm precontoured medial distal tibial locking compression plate (LCP) for fixation. Though enormous literature from global orthopaedic research on outcome of MIPPO in extra articular distal tibial fractures is available, evidence in china is still growing. This study was carried out to analyse the functional and radiological outcome and complications following medial distal tibia plating with precontoured LCP through MIPPO technique for extra articular fractures in our population.

II. Aims And Objectives

1) To evaluate the functional outcome among patients underwent MIPPO technique for extra articular distal tibial fractures with precontoured medial distal tibial LCP
2) To evaluate the complications following LCP fixation of extra articular distal tibial fractures.
3) To determine the time taken for radiological union following MIPPO with LCP in extra articular distal tibial fractures.

III. Material And Methods

Study Site

Jiangpin Hospital referral centre for various medical and surgical specialties. Study area includes patients from various regions of south region of china include zhenjiang,wuxi,taizhou,changzhou,xuzhou etc.

Study Population

All the patients who have been operated with locking compression plate for extra-articular fractures of distal tibia in Department of Orthopaedic Surgery in jiangpin hospital. All the patients operated during the period of 1st November 2015 to 31st March 2017 were followed up prospectively for a period of 6 months. A written informed consent has been signed by all the subjects. The study was approved by the ethical committee of the hospital.

Study Design

A prospective, longitudinal, observational study.

Sample Size with Justification

Total no of patients studied were 23 (15 male and 8 female) aged 24 to 70 years (mean age 49.4 years) with extra articular distal tibia fractures (19 patients with associated fracture of fibula). All of them were operated with precontoured medial distal tibia LCP. The sample size correlates with study conducted by **Borg et al**(2004) and **Kundu AK et al** (2016) who included 21 and 20 patients in their study respectively.

Considering the proportion of any outcome to be detected as 5%, with a relative precision of 10%, with an alpha error of 0.05, the sample size required for the study would be 23subjects.

The following formula was used to calculate the sample size

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where

N= required sample size

Z= Z statistic for the level of confidence (95%) - 1.96

P= prevalence (0.05)

d= level of precision (0.1)

So it was decided to include at least 23 subjects in the final study.

Time Frame to Address the Study

The study was carried out over a period of 25 months from 1st November 2015 to 31stNovember 2017. Patient enrolment started in November 2015 and ended in March 2017. Final follow up of the lastly enrolled patient ended in March 2017. All the patients included in the study were followed up for a period of 6 months or till fracture union whichever is later.

Inclusion Criteria

1) Patients in the age group of 18-70 years, who require surgical intervention for extra articular distal tibial fractures by MIPPO with LCP.
2) Patients willing for follow-up and participation in the study.

Exclusion Criteria

1) Patients aged less than 18years and above 70 years of age.
2) Patients with open fractures
3) Patients with intra articular fractures of distal tibia
4) Patients with pathological fractures
5) Revision cases

IV. Study Methods

1) All the patients who underwent open reduction and internal fixation with medial distal tibial locking compression plate for extra articular distal tibial fractures by MIPPO technique at zhenjiang Hospital and who satisfied the inclusion and exclusion criteria and who were willing to undergo follow up were included.
2) Surgical fixation performed by one of the three senior orthopaedic surgeons was considered for the study.
3) Subjects were granted full anonymity.
4) At the time of admission, demographic data collection was done, and details regarding age, gender, occupation, mode of injury and functional status of the patient were noted.
5) At the time of admission, clinical examination was done, and the following findings were noted- side of injury, overlying skin condition, respiratory status, associated injuries and neurovascular examination of the affected side.
6) Radiological analysis was done as below- Standard anteroposterior and lateral radiographs of the involved leg was done at the time of admission. The fracture displacement and comminution was noted based on these X-rays. Length of the plate to be used during surgery was assessed provisionally.
7) Functional outcome was assessed by Olerud and Molander scoring.

V. Data Collection Techniques:

A: Written informed consent collected .
B: Patient's data collected
C: Olerud and Molander functional scoring done.

VI. Statistical Analysis

Descriptive and analytical statistics were generated with IBM SPSS version 21.
All the cases were analysed as per the following criteria:

1. Age distribution
2. Gender distribution
3. Mode of injury
4. Fractured bone
5. Duration of union
6. Complications
7. Grading of results

VII. Surgical Method

Pre-operative Protocol:

At the time of admission general condition of the patient was assessed with regards to hypovolemia and associated systemic injuries, resuscitative measures were taken accordingly. All patients received analgesics and tetanus toxoid in the emergency room.

A thorough clinical examination was performed including detailed history taking related to age, sex, occupation, mode of injury, past and associated medical illness. All patients were evaluated clinically and radiologically to find out associated skeletal and systemic injuries. Importance was given for serious injuries like head injuries, chest injuries and abdominal injuries and were treated accordingly.

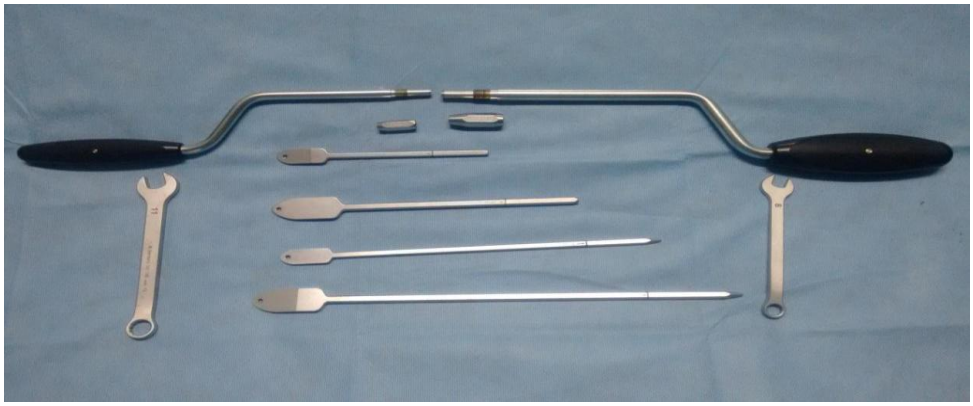
Routine investigations were done for all patients. Distal tibia radiographs were obtained in two planes (anteroposterior and lateral view) and fractures were classified according to AO classification system.The limb was immobilized with above knee plaster slab and limb elevation was given for all patients with a pillow.
Patients were operated once general condition of the patient was optimised and fit for anaesthesia. Adequate time was given for soft tissue healing and oedema to subside. Chest physiotherapy advised for all patients to improve the lung function. All patients were treated by fixation with Zimmer precontoured medial distal tibia locking compression plate and minimally invasive technique.
When Fibular fracture was noted,plan was decided accordingly. Type and likely length of the plated was calculated.
1. Plate and screw density ratio – we preferred a screw density ratio of 0.5, and inserted minimum 3 screws in each fragment. Thus we planned with a plate which had 6 holes proximal to the fracture line. Due to the small distal metaphyseal fragment, this plate-screw ratio of 0.5 had to be compromised in the distal fragment, although we followed the principle where we could.
2. Comminution- In comminuted fractures, the plate span ratio was kept to 3 and in case of fractures with a simple fracture configuration, a plate 8 to 10 times longer than the fracture was planned for.
3. LCP design - We used the medial distal tibial anatomical locked plate in distal fourth fractures with a small metaphyseal fragment since the metaphyseal flare of the plate allowed placement of the three minimum requisite screws.

Pre-operative Preparation:
- Injection xylocaine and injection cefazoline sensitivity test performed.
- Patients were kept nil per oral for 8 to 10 hours before surgery.
- IV fluids were given as per need.
- Adequate amount of compatible blood if needed was reserved.
- Written and informed consent was obtained after explaining the procedure.
- Proctolytic enema given one day before surgery.
- IV antibiotics were started one hour before skin incision
- Skin preparation with hair clipper was done in operating room.
- Instruments to be used were checked beforehand and sterilised.

Instruments:
1.Soft tissue retractors of various sizes.
2. Battery operated drill.
3. 2.5mm drill bit for cortical screws.
4. 2.7 mm drill bit for locking screws.
5. AO drill sleeve for cortical screws.
6. Hexagonal screw driver.
7. Drill sleeve for locking screws.
8. Zimmer 3.5 mm 6 to 14 holed distal tibial medial locking plate with zig.
9. 3.5 mm cortical screws.
10. 3.5 mm locking screws.
11. General instruments like retractor, reduction clamps, depth gauze and bone level.

Figure 1: MIPPO instruments and Zimmer 3.5mm medial distal tibial LCP

MIPPO instruments



Zimmer 3.5mm medial distal tibial plate and instruments used

Position:

1. Pneumatic tourniquet was used.
2. Patient in supine position on a radiolucent table with an image intensifier in operating room.

Surgical Technique:

1. Painting and draping of the part was done.
2. Skin marking was done using a sterile marker.
3. Locking compression plate was applied externally on the antero-medial surface. A locking compression plate of adequate length was selected so that 6-8 cortices are obtained on either side of the fracture was kept on the leg and visualised under C-arm.
4. The fracture was reduced by indirect means without opening the fractured area.

i. Gentle manual traction and external manipulation e.g. a bolster under the ankle to correct the posterior displacement and angulation were adequate to reduce AO43A1 fractures.

ii. Use of percutaneous pointed reduction forceps and fixation of preliminary reduction by K-wires was needed oblique fractures.

iii. Schanz pins inserted into the fracture fragments can be used to externally manipulate the fracture under radiographic control to achieve reduction.

iv. In severely comminuted fractures, a femoral distractor was used.

The reduction was assessed repeatedly using visual and fluoroscopic control. Angulation, length of tibia and fibula, rotation and integrity of the ankle mortise were considered. The mechanical axis and anatomical axis of the lower limb was checked with the cautery cord. If the associated fracture fibula required fixation, it, was fixed by rush nail or one third tubular plate LCP/DCP according to the fracture type, before fixation of the tibia.

After provisional reduction, a 3-4 cm vertical incision was given at the centre of the medial malleolus and a subcutaneous tunnel was opened with a soft tissue retractor. Then the selected locking compression plate with a locking sleeve screwed into its distal hole was held with a pen-like grip. The plate was tunnelled proximally subcutaneously across the fracture site, using the locking sleeve as the handle with a dagger hold. Smooth and gentle supination-pronation motions were used while inserting the plate. The thumb was kept anteriorly on the tibialcrest and was used to guide the proximal part of the plate onto the antero-medial surface of the tibia.

The plate was centred on the proximal fracture fragment in both antero-posterior and lateral views with the help of a locking sleeve inserted into the most proximal hole. Following confirmation, a drill bit or K-wire was used to fix the plate onto the tibia. Non locking screws were inserted first in either the proximal or distal fragment as required to aid in the reduction of the fracture so as to pull the bone to the plate.

The 3.5mm locking screws were inserted only and only when the fracture reduction was satisfactory. A similar sized LCP placed over the skin helped to localise the hole in the inserted plate (Mirror plate technique). Only in an overweight or obese patient, was C-arm assistance necessary to localise the locking hole. At least 6-8 cortices were held proximal and distal to fracture site

Figure 2: INTRA OPERATIVE PHOTOGRAPHS

Wound closure

Technique of inserting the Locking Screws:

Since the locking head of the screw has to get locked in the locking part of the combi-hole, the direction of the drilling has to be perfect. Hence for all LHS has to be done after fixing the screw –in drill sleeve(available with LCP set).

We actually determine the length of the screw so as not to miss the far cortex. We also make sure that whenever using the non-locking regular cortical screws in the fixation, they were inserted prior to the insertion of the locking screws.

For fractures of tibia with associated fibula fracture, fibula was fixedfirst by open reduction and internal fixation prior to MIPPO for tibia fracture.

5. After thorough irrigation adequate haemostasis was ensured.
6. Subcutaneous closure done with absorbable interrupted sutures followed by skin closure with non-absorbable sutures.

Post-operative Care:

1. Patients were kept nil per orally for 4 hours post-operatively.
2. Intravenous fluids were given as needed
3. Intravenous cefazoline 1 g was given twice on the day of surgery
4. Analgesics were given according to the needs of the patient.
5. Check X-ray was taken on the first post-operative day and reduction was confirmed.
6. The wound was inspected on 1st postoperative day and dressing was changed.
7. Thereafter dressing was done only if soakage of dressing was observed.
8. Suture/staple removal was done on 11th postoperative day.
9. Strict limb elevation over a bohler brawn splint till suture removal.

Mobilization:

Patient made to walk non weight bearing with walker on post-operative day 1 along with knee, ankle range of movements exercises for first 6 weeks. Partial weight bearing after 6 weeks was allowed, after confirming the beginning of healing process; by the haziness of the fracture site and minimal soft callus formation

Follow Up:

The first follow up was usually after 1st monthof surgery and later followed up at 3rd month, 6th month and further follow-up at every 3 months for cases of delayed union.

During follow up,

1. The course of fracture healing was documented radiologically(with minimum of 6weeks between successive radiographs). The moment of complete healingwas defined radiological complete bone regeneration at the fracture site.
2. Evaluation of any possible loss of reduction that might have occurred compared to immediate post-operative radiographs.
3. Assessment and analysis of any complications observed.
4. Follow up of our patients is for 6 months or till fracture union whichever is later. No patient was lost to follow up.
5. Functional outcome was assessed by Olerud and Molander score

Figure 3: CLINICAL AND RADIOLOGICAL PHOTOGRAPHS

CASE 1: 28 year old male with left distal tibia transverse # and medial malleolus #

PREOPERATIVE AP VIEW PRE OPERATIVE LATERAL VIEW

IMMEDIATE POST OP VIEW

IMMEDIATE POST OP LAT VIEW

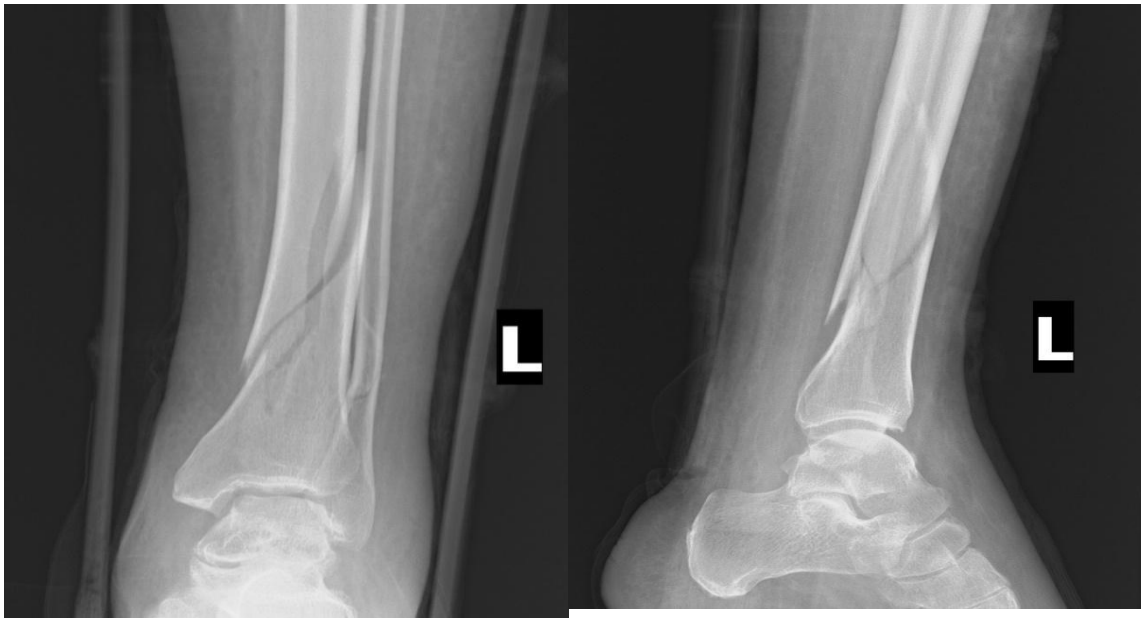
6 MONTHS POSTOP AP VIEW

6MONTHS POST OP LAT VIEW

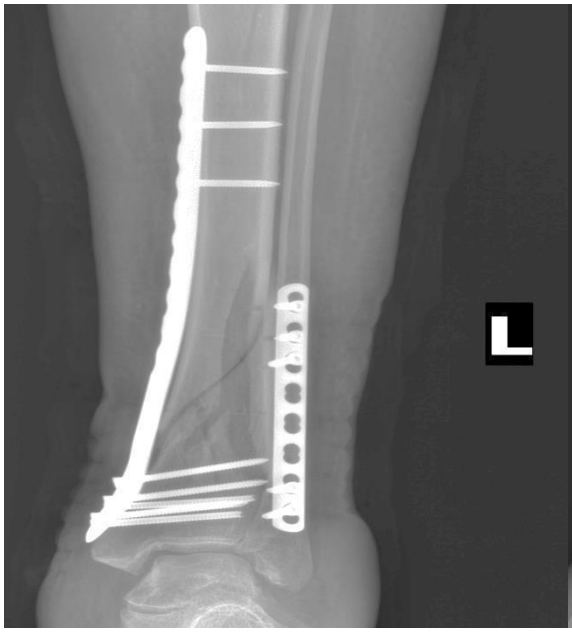
RANGE OF MOTION AT 6 MONTHS PLANTAR FLEXION

CASE 2:42 year female, with left distal tibia long spiral # & fibula shaft fracture

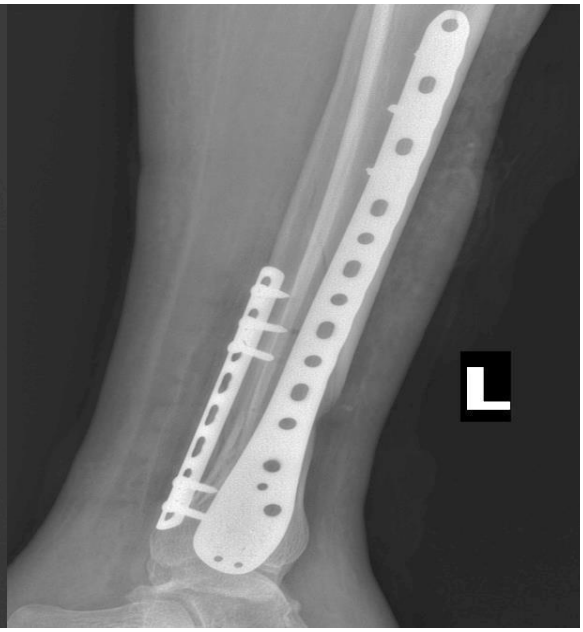
PRE OPERATIVE AP VIEW PREOPERATIVE LAT VIEW



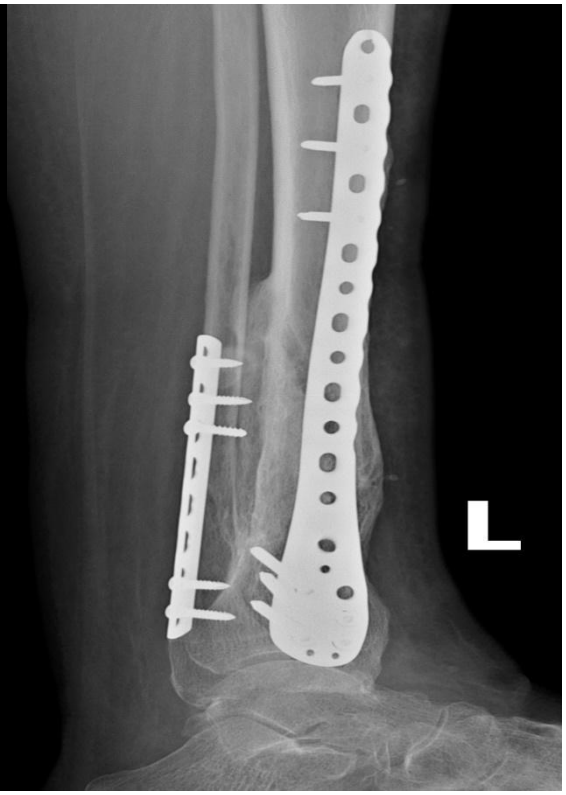
IMMEDIATE POSTOP VIEW IMMEDIATE LAT VIEW



6 MONTHS POST OP



6 MONTHS POST OP LAT VIEW



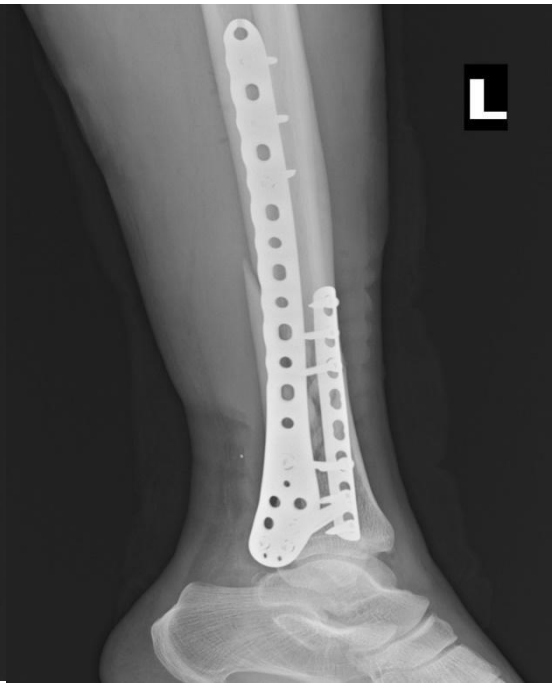
ROM at 6 months – plantar flexion Dorsi flexion

CASE 3: 38 year male, with left distal tibia spiral # & distal fibula #

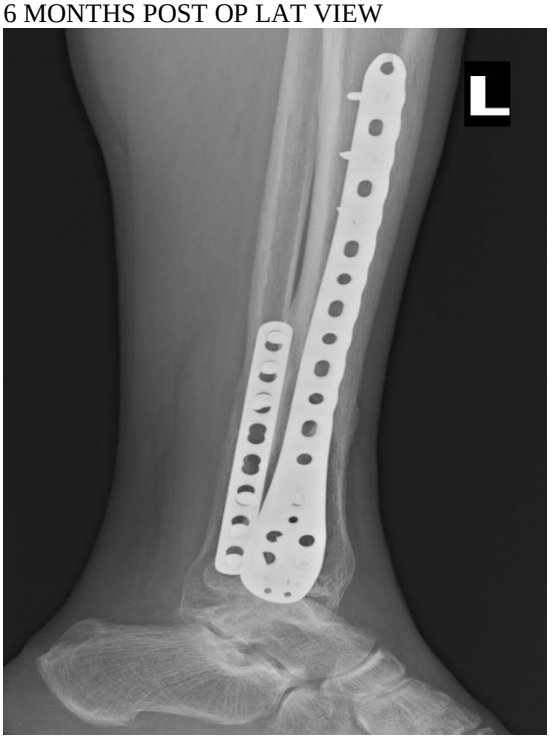
PREOPERATIVE AP VIEW PREOPERATIVE LAT VIEW

IMMEDIATE AP VIEW IMMEDIATE LAT VIEW

6 MONTHS POST OP LAT VIEW



6 MONTHS POST OP LAT VIEW



6 MON POSTOP – DORSIFLEXION PLANTAR FLEXION

VIII. Observation & Results

We studied factors like age, gender of the patient, mode of injury, initial type and classification of injury as primary explanatory variables. Primary outcome was assessed using Olerud and Molander functional score. Complications such as superficial infection, delayed union which occurred in the study group, including deep infection and complex regional pain syndrome were the other outcomes considered for analysis. Initial descriptive analysis of all the variables was done using frequencies and percentages for categorical variables and means and standard deviations for quantitative variables. The association between the explanatory and outcome variables was done by using the difference in proportions or means. Appropriate statistical test was used to assess the statistical significance of the association. IBM SPSS version 21 was used for data analysis.

We studied 23 patients with 23 tibia and 19 patients associated with fibula fractures, who treated with the precontouredlocking compression plate by MIPPO technique.Follow up was done for all cases for 6 months or till fracture union whichever is later. Results were assessed both clinically and radiologically. They wereevaluated by Olerud and Molander functional assessment at every follow up.

AGE DISTRIBUTION

Table 1: Age frequency

AGE GROUP(year)	No. of Patients	Percentage
21-30	3	13.0
31-40	4	17.3
41-50	4	17.3
51-60	5	21.7
>60	7	30.4
Total	23	100

The age group of the patients in our study ranged from 24 years to 70 years (mean 49.4 years). Most of the patients belonged to an elderly population (50% above the age of 50years) indicating the need to use LCP in these elderly people.

Graph1:Age group frequency

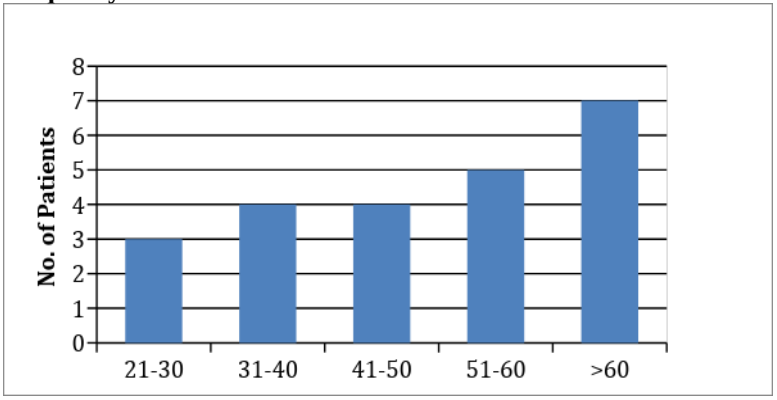
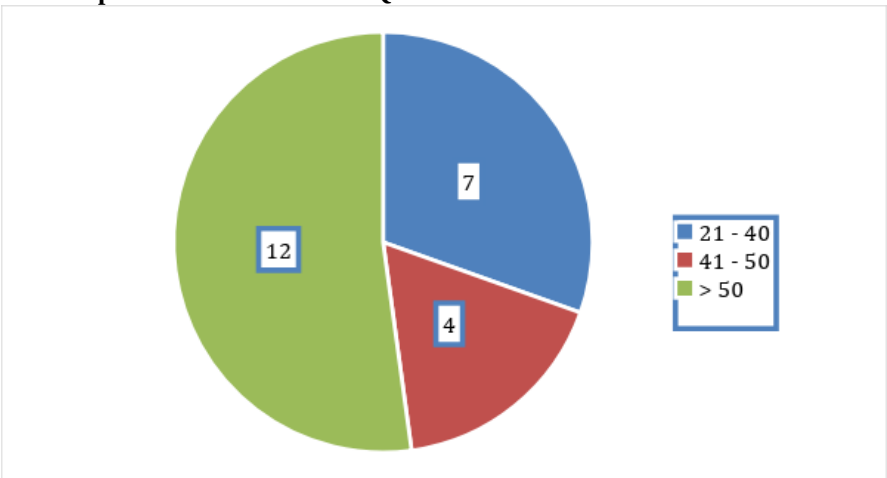


Table 2: fracture frequency in younger and old age groups:

AGE GROUP(YEARS)	FRACTURE FREQUENCY	PERCENTAGE
21 - 40	7	30.40%
41 - 50	4	17.40%
> 50	12	52.20%

We observed an increased incidence of fracture frequency in elderly age group with more than half of the cases, followed by younger age group i.e. age less than 40 years.

Graph 2: FRACTURE FREQUENCY IN VARIOUS AGE GROUPS



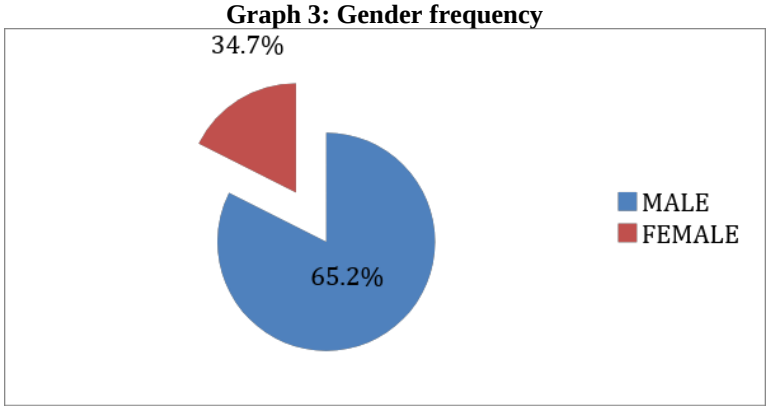
SEX DISTRIBUTION

Table 3: Gender frequency

	No. of patients	Percentage
Male	15	65.2%
Female	8	34.7%

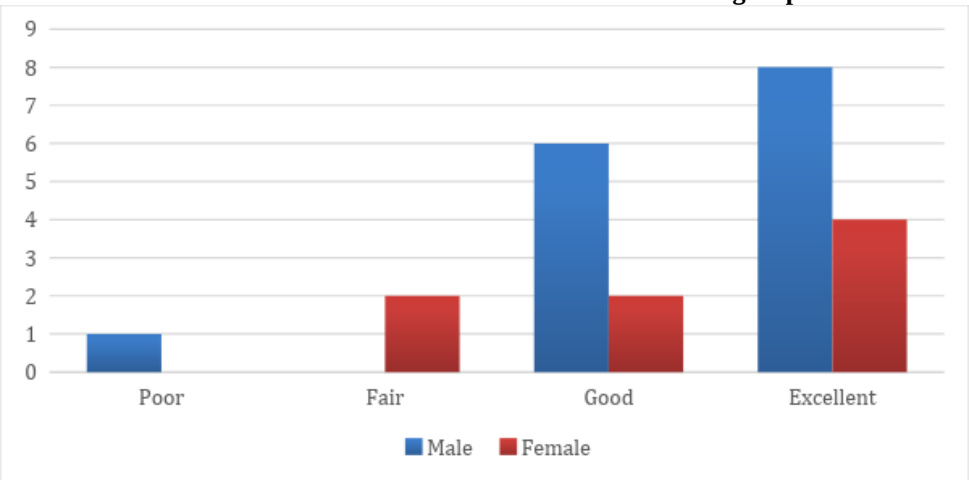
Most of our patients were males. It reflected the general population which visits our both outpatient as well as the emergency trauma section.

Graph 3: Gender frequency

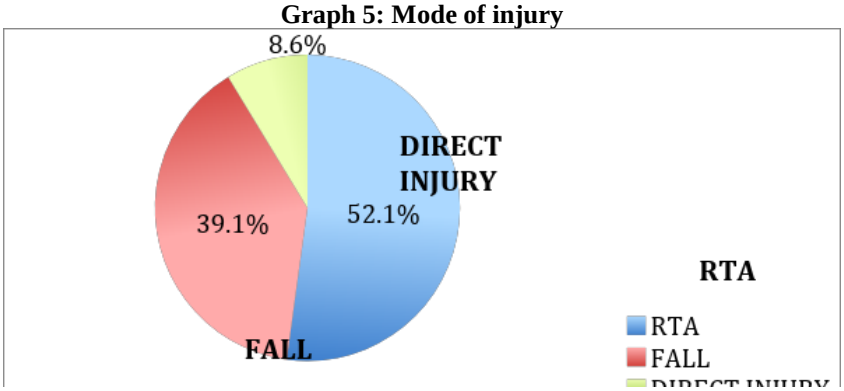


The proportion of patients with excellent outcome was 66.70% in males, whereas it was only 33.30% in females. 40% of males and 25% of males had good outcome. Only two females had fair outcome i.e. 25% of female patients. The association between gender and outcome was not statistically significant (p value 0.201) which was tested using chi- square test

GRAPH 4: functional outcome in male and female groups



Graph 5: Mode of injury



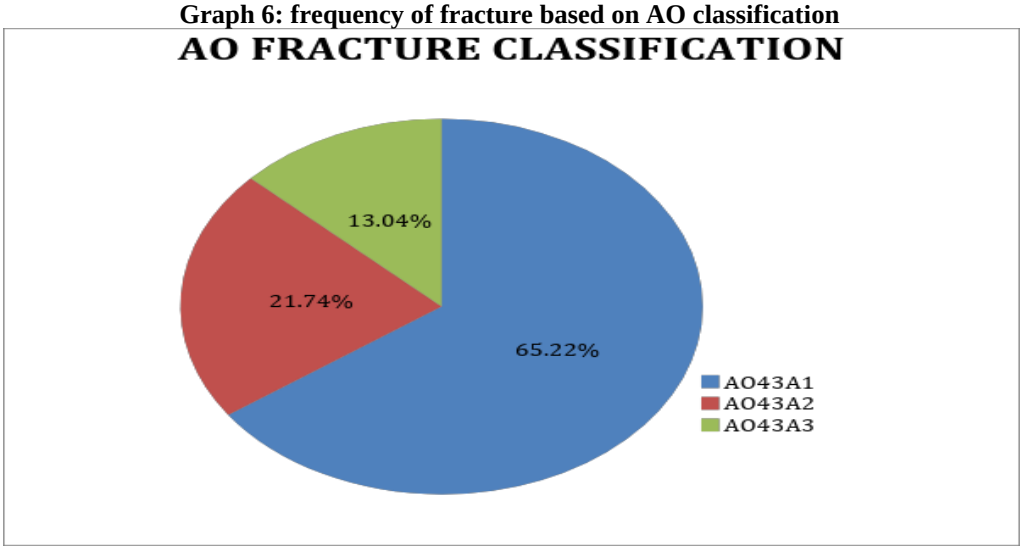
FRACTURE TYPE BASED ON AO CLASSIFICATION

Table 4: frequency of fracture based on AO classification

AO CLASSIFIACTION	No. of patients	%
43A1	15	65.22%
43A2	5	21.74%
43A3	3	13.04%

Based on AO classification, 15 cases belonged to 43A1, 5 cases belonged to 43A2 and 3 cases belonged to 43A3.

Graph 6: frequency of fracture based on AO classification



FRACTURED BONES

Table 5: frequency of fracture pattern:

Bone	No. of patients	Percentage
Isolated Tibia	4	17.3%
Tibia and fibula	19	82.6%
Total	23	100

In our series all patients had fracture of distal tibia; none of them were amenable to treatment by intramedullary nailing.

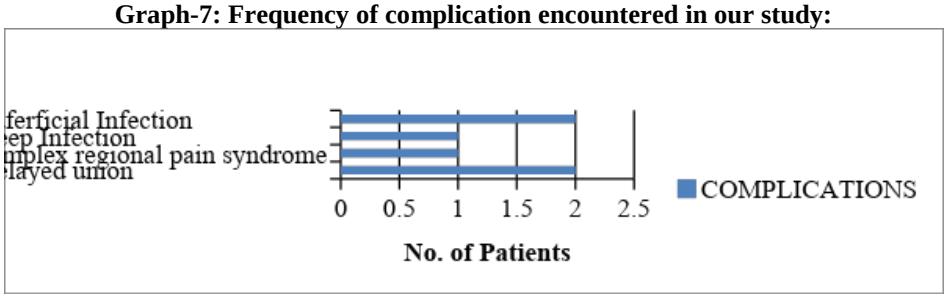
DURATION OF FRACTURE UNION

Table 6: Duration of fracture healing

Duration (weeks)	No. of patients	Percentage
12-16	10	43.7
17-20	8	34.7
21-24	3	13.0
>24	2	8.69
Total	23	100

We had about 80% of fractures united by 20 weeks, which was well in the expected time period. We had two cases of delayed union, of which one fracture united at28weeks and the other united at 38 weeks.

Graph-7: Frequency of complication encountered in our study:



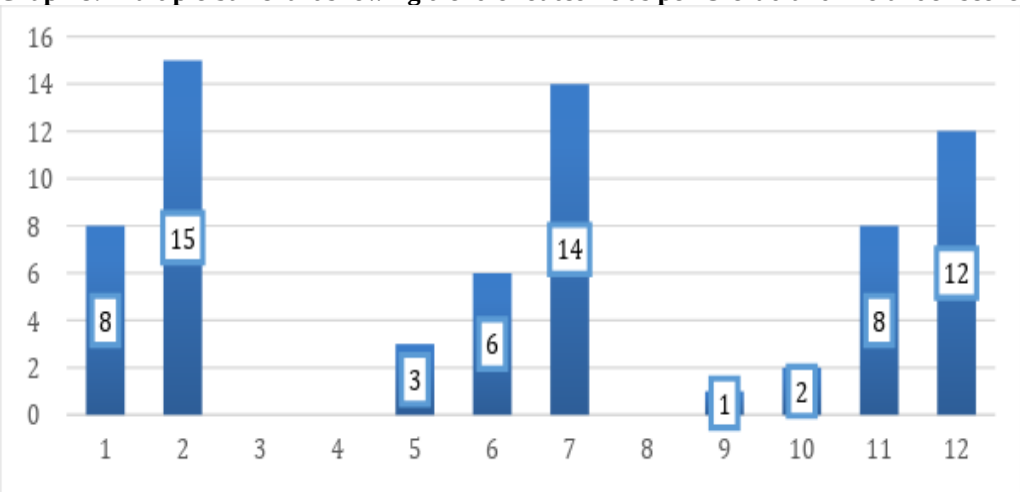
IX. Grading Of Results

Based on Olerud and Molander functional assessment, cases were graded as excellent, good, fair and poor after 6 months from surgery. There was no change in functional scoring after 6 months.

Table 7: Grading of our results according to Olerud and Molander scoring:

Grading	No. of cases	Percentage
Excellent	12	52.17%
Good	8	34.7%
Fair	2	8.69%
Poor	1	4.34%

Graph 8: Multiple bar chart showing trend of outcome as per Olerud and Molander score



X. Discussion

Periosteal blood supply diaphyseal- metaphyseal region of distal tibia is under high risk.MIPPO technique preserves the hematoma in the fractured area while at the same time it prevents iatrogenic soft tissue injury and retains the osseous vascular supply. This technique involves attaining axial alignment to maintain the mechanical axis without reduction of each intermediate fragment i.e.alignment of proximal and distal joint line. This method is indirect reduction and immobilization by internal fixator. That is; it uses plates and screws internally in a similar way to the principles of external fixator which has the advantage of minimal damage to the periosteum due to minimal contact to the bone.As per the current concepts, the fracture fixation aims to give sufficient stability for early functional treatment at the same time permitting instability for speeding up the healing process.

The main aims of MIPPO were to minimize biologic damage to soft tissue and to decrease the rates of infection and non-union. MIPPO requires only realignment of tibial mechanical axis and clear exposure of fracture is not necessary. For comminuted fractures, MIPPO is advantageous than ORIF. Based on literature, MIPPO claims earlier union process and lower risk of infection and non-union.

We aimed to analyse the results of distal tibial non articular fractures treated in line with these principles with MIPPO technique; on distal tibia to confirm whether it is true that there is early fracture healing with preserved function without loss of alignment and wound complications.

We studied 23 patients with fracture of distal tibia (19 patients had associated fracture of fibula). All patients were treated with MIPPO technique. For the fractures of associated tibia fibula fracture, we first checked under fluoroscopy for the reduction of distal tibia, if found satisfactory, proceeded with tibia fixation alone. Fibula fixation was first done by open reduction and internal fixation prior to MIPPO if closed reduction of tibia was not satisfactory.

We stuck to the recommendations and for all locking head screws drilling was done with the screw in drill sleeve to obtain exact centring and correct orientation of the screw. Hence we did not encounter any loosening of a locking head screw. Neither there was any screw breakage. We also made sure to leave a sufficient length of plate without inserting screws at the level of fracture in the bridging technique. Because of this, we did not have any plate failure as the span length in our study was adequately maintained.

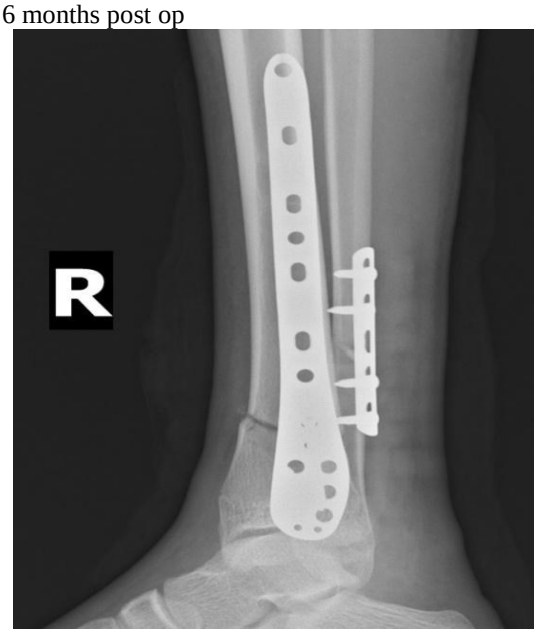
The fractures treated with MIPPO technique showed healing by callus formation leading to an early solid bony union; except in one case. We had a mean time to fracture union at 18.9 weeks for in our study.

Figure 4: Clinical pictures of complications encountered in our study

Delayed union and final healing in 58 year old male

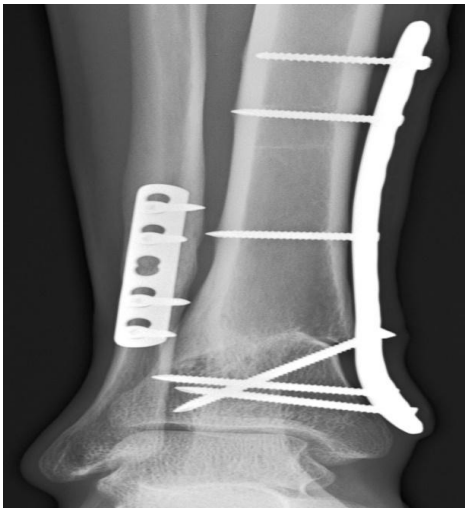
6months post op

6 months post op



9months post op

9 months post op



XI. Conclusion

- We conclude from our study that the functional outcome following precontoured locking compression plate fixation by MIPPO of extra articular distal tibial fractures in adults has produced excellent results in majority of cases with a few complications with no additional need for implant removal after union.
- Incidence of distal tibial fractures had a bimodal age distribution, in younger population due to road traffic accidents and in elderly age due to accidental falls.
- In our study of 23 patients, there were minimal wound complications, the reason being enough time for soft tissue healing between injury and surgical fracture fixation and minimal soft tissue injury by MIPPO techniques.
- We observed that it is important to select a strong plate with sufficient proximal and distal screw fixation to avoid stress concentration and achieve an elastic fixation which is very essential for secondary fracture union in these distal tibial fractures.
- Precise surgical timing, sterile precautions, accurate intraoperative fracture reduction and implant positioning and fixation, good and early postoperative rehabilitation were needed to achieve favourable results.

XII. Limitations

Statistical evaluation was limited due to the small sample size and heterogeneity of subgroups. Hence the conclusions drawn from this analysis cannot be extrapolated in a generalized manner.Similar studies using similar implants and with longer period are required to arrive at a consensus.

XIII. Recommendations

- We found that the locking screws had excellent hold even in the osteoporotic bones. Therefore we recommend using LCP in elderly population.
- We noticed excellent hold even with 2 bicortical screws when locking screws were used, which has its importance in fractures at the ends of long bones where other implants are of little value. So we suggest using this precontoured LCP which has got 6 distal LHS for sufficient hold in small distal fragment.
- Drilling the holes for the locking head screw should always be through a screw in drill sleeve since the locking head screws are to be inserted at predetermined angle to the plate.
- We noted a strong bony bridging callus across the fracture site even in non comminuted fractures which were fixed with elastic fixation using the MIPPO techniqueby preserving osteogenic fracture hematoma which drives us to suggest that MIPPO can be used even in transverse fractures of distal tibia besides its advantage in spiral, oblique and comminuted fractures.
- We suggest delaying surgery till soft tissue edema settles and biological fixation with minimal soft tissue handling through MIPPO technique for distal tibia extra articular fractures to avoid post-operative wound complications.

We also suggest that the proper understanding of the biomechanics of the LCP and the general principles guiding its application before actually venturing into its clinical use

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