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Original Research Article

Minimally invasive percutaneous plate osteo-synthesis in type 2 and type 3 AO distal tibia fractures

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Abstract: Intra-articular fractures are known to develop delayed arthritis in weight bearing joints. Distal tibia is a high velocity injury which needs fixation with low profile plates which can be applied with minimal dissection respecting the poor skin coverage. We conducted a prospective study with sample size of 30 patients to evaluate the outcome of type 2 and 3 AO distal tibia fractures treated with MIPPO technique and the short and long term complications related to it. Delayed union was found in 37 % beyond 20 weeks although none needed bone grafting. The AO type C fractures are prone to develop arthritis in lesser proportion with maximum type C fractures having good Olerud Molander scores, whereas AO type B has consistently shown good results with MIPPO technique.
Keywords: MIPPO, Plafond tibial fractures

INTRODUCTION:

Minimally invasive percutaneous plate osteosynthesis (MIPPO) was popularized by Krettek *et al.;* [1] in 1990 using conventional implants placed through small incision and sub muscular (subcutaneous) tunnels. Pai V [2] in 2003 had performed minimal invasive fixation in 18 patients for complex transition fractures of the tibia with excellent-good results. The treatment for difficult intra-articular fractures with a minimal invasive fixation is a useful management option. Peri-articular plate is easy to insert and gives better results with respect to alignment correction. Cadaveric studies by Borelli *et al.;* [9] and Farouk *et al.;* [18] demonstrated better preservation of periosteal vasculature with this minimally invasive method than with standard open exposure for internal fixation. Various studies are indicating well to fair results with MIPPO in distal tibia fractures.

We focused our study specifically on type 2 and 3 AO fractures as the results of partial or completely Intra-articular fractures have been not very satisfactory. Jeon, In Ho MD [24], in 2004 suggested that Intra-articular fractures (AO type B, C) showed less favorable range of motion and clinical scores than extra-articular fractures (AO Type A).

Aim:

1. To study the clinical and radiological outcome of MIPPO in type 2 and type 3 tibial plafond fractures.
2. Complications of MIPPO in Type 2 and 3 distal tibia fractures.

MATERIALS AND METHODS:

Type of study:
Prospective: The enrollment was done with prior intimation of the patient and their relatives. Ethical committee approval was taken prior to the study protocol application.
Sample size: 30 patients.

Inclusion criteria:

1. All the patients having Type 2 and 3 AO distal tibial fractures presenting at our casualty/ institute.
2. Age > 18 years was enrolled in the study.
3. Closed fractures or Gustillo Anderson type 1 open fractures.

Exclusion Criteria:

1. Distal extra-articular fracture tibia AO type A.
2. Pathological fractures.
3. Patients with compound fractures needing external fixation and reconstructive procedures including flaps or skin grafting
4. Old untreated fractures of distal 1/3rd Tibia.
5. Proximal or middle shaft fractures or segmental fractures.
6. Patients with open physis.
7. Ankle fracture dislocations.

8. Patient lost to follow up.

In our study there were total 30 patients with age ranging from 18 years to 60 years. All patients had acute, type 2and type3 AO distal end tibia fracture with sufficient medial and lateral soft tissue coverage to allow medial or antero-medial plating.

At the time of presentation in casualty all patients were examined thoroughly for vital signs, head injury, thoraco-abdominal injury and other associated injuries. The distal circulation was checked and the limb was examined for any neurological deficit. The compartment syndrome signs were monitored stringently. All wounds (if any) were covered by sterile dressing after cleansing with normal saline and associated injuries were taken care off.

Standard antero-posterior and lateral views of affected leg were obtained for diagnosis, extent of comminution and to measure likely length of implant. All surgeries were performed under regional anesthesia except in cases with head injury in which general anesthesia was given. All surgeries were performed under tourniquet.

Attempt was made to keep incision minimum at the distal site, straight or slightly curved skin incision on the medial aspect of the distal tibia was taken. Length of the incision varied from 3-5 cm, depending on the type of the planned plate. The incision was taken distally till the tip of the medial malleolus, long enough to negotiate the plate. Epi-periosteal plane was made over distal tibia using Cobb's elevator of appropriate length as per implant size and length, preserving periosteum. 4.5 mm distal tibia locking plate was then inserted through the tunnel. Plate position was confirmed under image intensifier.

Small stab incision was made over the tip of the plate proximally, through which plate was held. Proximally small incisions over the holes were taken directly either by clinical palpation or after confirmation under image intensifier or a single incision to expose and hold the plate.

After confirming the plate position, by indirect method, reduction was achieved and 2 guide pins were inserted, one on each end of plate to fix it. Position of the plate is rechecked under image intensifier. Distally 4.5 mm low profile locking cancellous screws were inserted over guide sleeve and their position was confirmed under image intensifier. Proximally 3 to 4, 4.5 mm locking cortical screws were inserted through stab incision over each hole of plate. Guide pins were removed. Entire construct was checked under image intensifier.

Post operatively the patients were given compressive crepe bandage dressing, foot end elevation and injectable antibiotics and analgesics. The injectable antibiotics were continued for 3 days to one week according to wound condition and other systemic disease like diabetes.

Static and dynamic quadriceps exercises and ankle mobilization was started as soon as patient's general condition and pain permitted, usually from second postoperative day. Non weight bearing walking was permitted except when there was no other contraindication like head injury, bilateral lower limb injury, or associated upper limb injury. Suture removal was done on post operative day fourteen.

1st Follow up was on 14th post operative day if patient was discharged before suture removal otherwise follow up was conducted regularly at an interval of 4-6 weeks in the outdoor department. At the time of follow up, a thorough clinical evaluation was done for progress of union and for joint range of motion. Once the fracture showed signs of union then partial weight bearing walking, followed by full weight bearing walking was started.

At follow up, assessment criteria was
CLINICAL

- Pain
- Status of wound
- Ankle range of motion
- Deformity

FUNCTIONAL:

- Sitting cross legged
- Squatting
- Walking
- Non weight bearing
- Partial weight bearing
- Full weight bearing

RADIOLOGICAL STATUS:

- Union status
- Position of implant

ASSESSMENT CRITERIA:

All patients were reviewed in a dedicated clinic and radiographs were obtained immediately post operatively and then at monthly intervals until three months, 6 months, 12 months and further if they still had symptoms. From 6 weeks onwards symptoms and functions were assessed using the scoring system of Olerud and Molander [4].

	PARAMETER	**DEGREE**	**SCORE(maximum)**
1.	PAIN	None While walking on uneven surface While walking on even surface outdoors While walking indoors Constant and severe	25 20 10 5 0
2.	STIFFNESS	None Stiffness	10 0
3.	SWELLING	None Only in Evening Constant	10 5 0
4.	STAIR CLIMBING	No problems Impaired Impossible	10 5 0
5.	RUNNING	Possible Impossible	5 0
6.	JUMPING	Possible Impossible	5 0
7.	SQUATTING	No Problems Impossible	5 0
8.	SUPPORTS	None Taping, Wrapping Stick or Crutch Walking	10 5 0
9.	WORK, ACTIVITIES OF DAILY LIFE	Same as before injury Loss of tempo Change to simpler job Severely Impaired work capacity	20 15 15 0

Excellent – If Score More Than 75 Points
Good – Between 50-75
Fair- Between 30 -50
Poor- Below 30

The data was analyzed using frequency, percentage, mean and graphs, charts were derived. Further statistical analysis was performed using Z-test for significance of proportion; the level of significance was set at 5%. All p-values less than 0.05 were treated as significant.

RESULTS OF THE PRESENT STUDY:

1) **Age Distribution Of Patients**
   - In this study, patients were of age group between 19-60 years.
   - Average age was 36.26 years.
   - There was increased incidence of fracture in the age group of 31-40 years (34%) noted in this study.

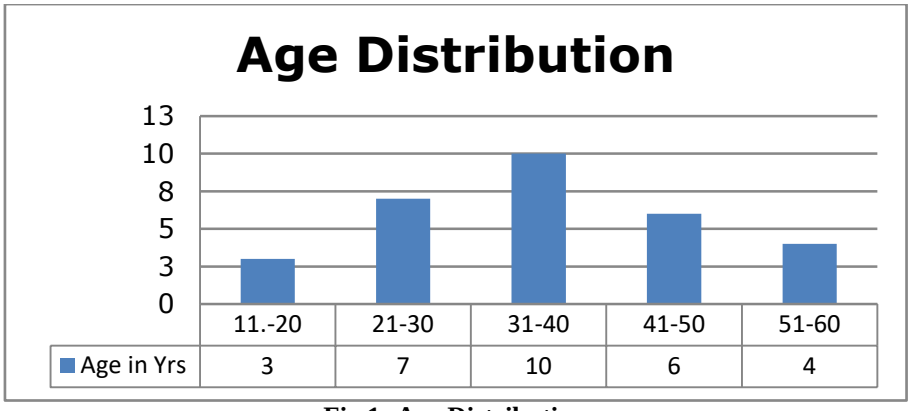

Fig 1: Age Distribution

2) Sex Distribution

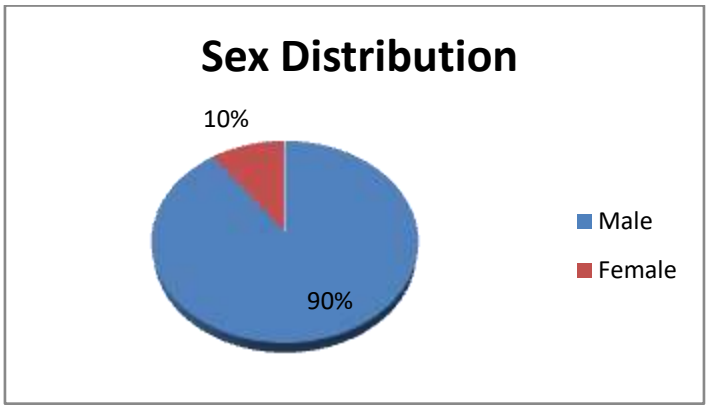

Fig 2: Sex Distribution.

- The ratio between male is to female was 9:1 in this study.
- There was definite male preponderance (90 %)

3) Mode Of Injury

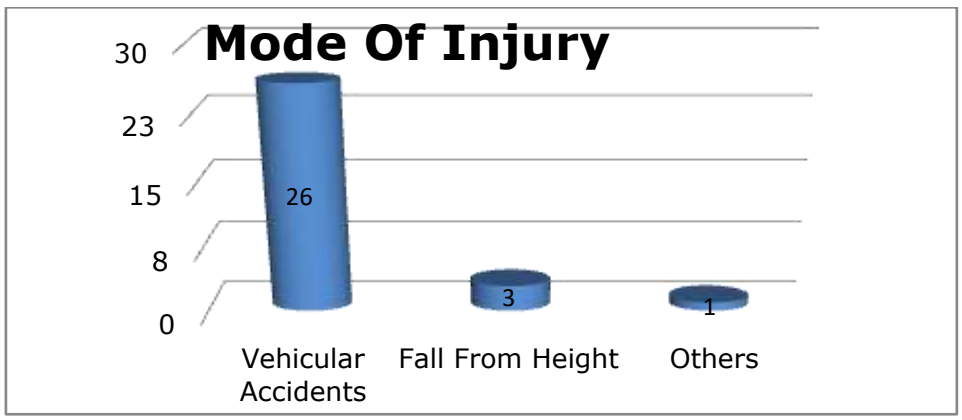

Fig 3: Mode of injury

- Vehicular accident was the main cause to produce lower end tibia fractures (86.7%) in our study.
- Other cause is fall from height or fall of heavy object (13.3%).

4) **Associated Injuries:**

Table 2

INJURIES			NO. OF PATIENTS	PERCENTAGE (%)
Head Injuries			01	3
Abdominal Injuries			01	3
Others			02	7
Other bony injuries	Ipsi-lateral	UL	02	7
		LL	06	20
	Contra-lateral	UL	02	7
		LL	01	3
Total patients			15	50

- In our study 50% of patients had associated injuries.
- The major associated injury was ipsilateral appendicular system (27%)
- Other bony injuries were of contralateral appendicular skeleton system (10%)
- One case had head injury, one had abdominal injury and others had associated spine and chest trauma.

5) Side Involved

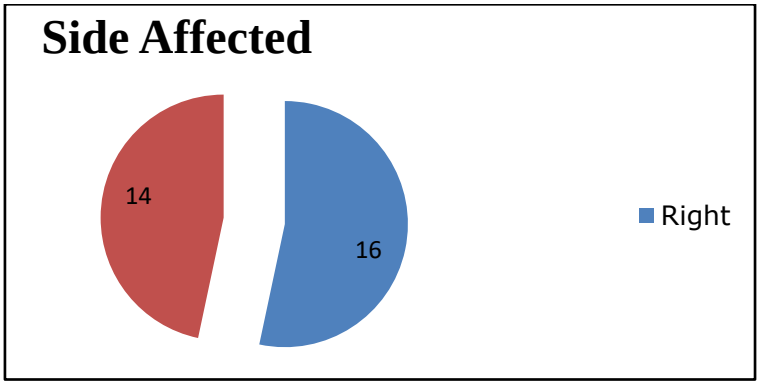

Fig 4: Side of involvement

- The right side was involved slightly more than left.

6) AO subtypes

Table 3: Type of AO subtypes

No.	AO Fracture Subtype	No. of cases	Percentages
1	B1	5	16.70
2	B2	7	23.33
3	B3	11	36.67
4	C1	4	13.33
5	C2	2	6.67
6	C3	1	3,33

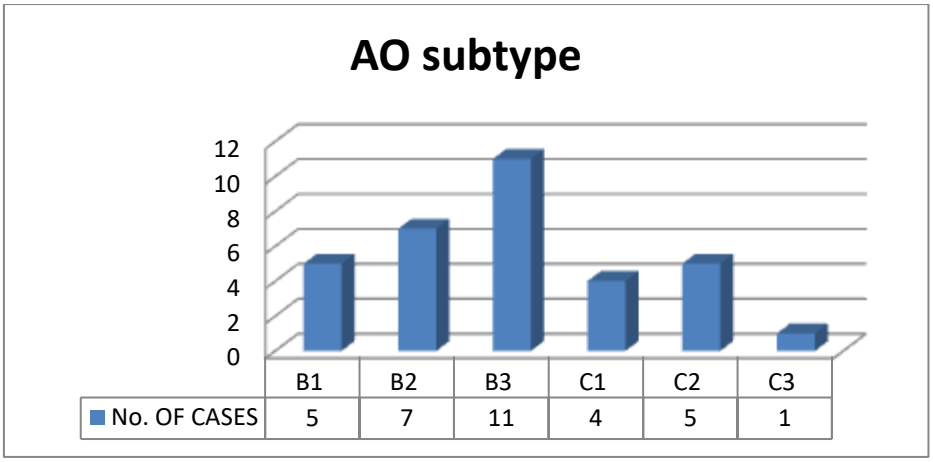

Fig 5: AO fracture Subtype

- Majority of the fractures were Type B 3. (36.67 %)

7) Injury Operation Interval

Table 4

TIME	NO. OF PATIENTS	PERCENTAGE (%)
Within 24 hours	06	20
24-72 hours	07	23
3-5 days	07	23
>5 days	10	34
Total	30	100

Majority of the patients were operated before 5 days of admission (66%). Remaining (34%) patients were operated after 5 days and the factors responsible for delayed surgery were:

- ➢ open injury
- ➢ systemic illness
- ➢ Presence of swelling over ankle, blisters and associated injuries.
- ▪ Six patients were operated within 24 hours of admission.

8) Hospitalization Period in Weeks

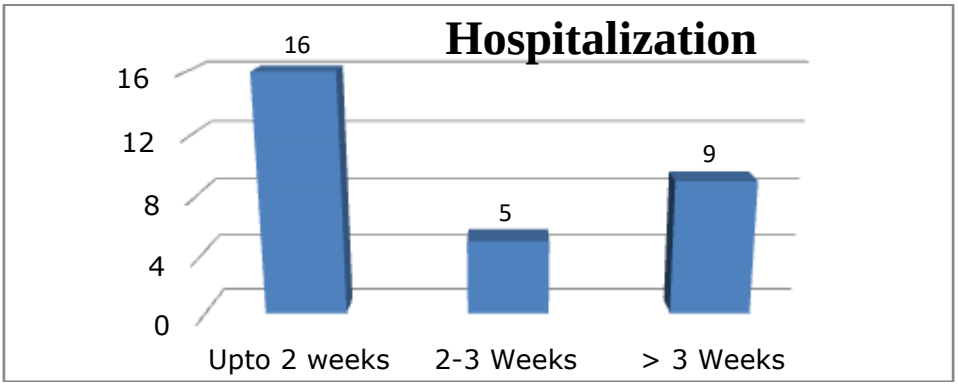

Fig 6: Hospital stay

- Average time for the hospitalization was 14.28 days.
- Longer hospital stay (>3 weeks) was due to associated other bony and systemic injuries, those requiring other operative procedures.
- All patients were discharged either after suture removal or with satisfactory dressing.

9) TYPE OF FRACTURE

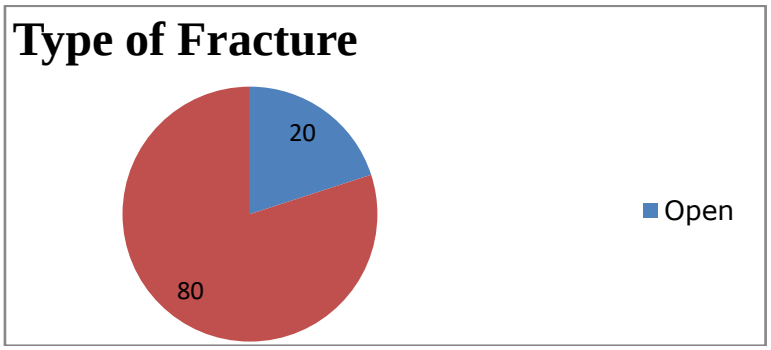

Fig-7: Fracture Gustillo Subtype

- In our study 80 % cases were of closed variety.

10) Duration of Surgery

Table 6: Surgery duration

DURATION(Mins)	NO. OF CASES	PERCENTAGE(%)
31-40	6	20
41-50	9	30
51-60	5	17
61-70	4	13
71-80	6	20
TOTAL	30	100

- Of the 30 cases, 6 (20%) cases took 31-40 minutes, 9 (30%) took 41-50 minutes, 5 (17%) took 51-60 minutes, 4 (13%) took 61-70 minutes, 6 (20%) took 71-80 minutes.
- Average duration of surgery was 53 mins.

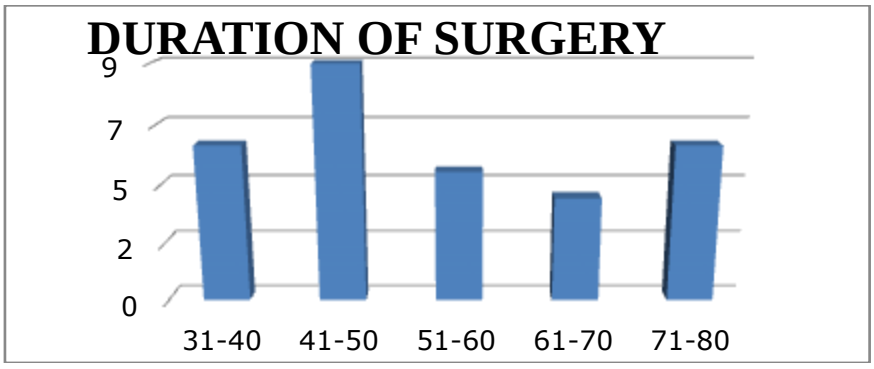

Fig 8: Surgery duration

11) Mobilization Protocol On Discharge

Table 7: Weight bearing protocol

MOBILIZATION	NO. OF PATIENTS	PERCENTAGE (%)
Non weight bearing Crutch walking	21	77
BED REST	09	23
TOTAL	30	100

- 9 patients were discharged with strict bed rest as they had systemic or other severe bony injuries requiring bed immobilization.
- In rest of all patients non weight bearing crutch walking was advised at the time of discharge.

12) Total Follow – Up Of Patients

- Duration of minimum follow up in the study was 6 months and duration for maximum follow up was 5 years.
- Average follow up in this study was 22.56 months.

13) Fracture Union

Table 8: Time for fracture union

TIME	NO. OF PATIENTS	PERCENTAGE (%)
0 – 15 weeks	5	17
16 – 20 weeks	14	46
>20 weeks	11	37
TOTAL	30	100

Average time of union was 19.13 weeks.

14**) complications**

Table 9: Complications found in the present study

COMPLICATIONS		NO. OF PATIENTS
Restriction of movement		04
Lower leg pain		02
Infection	Superficial	02
	Deep	01
Total		09

- In this study, there were four cases of restricted ankle movement, two cases of ankle pain.
- There were 3 cases with infection, of which 2 healed uneventfully and one with deep infection required implant removal after healing.

15) Deformities

Table 10: Malalignment complications

DEFORMITIES	NO. OF PATIENTS
Valgus Malalignment (<5degrees)	04
Varus Malalignment (<5 degrees)	04
Anterior Angulation	0
Posterior Angulation	0
Medial / Lateral shift	1
TOTAL	09

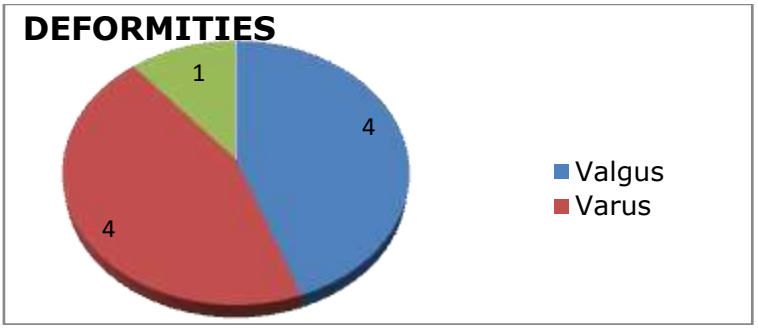

Fig 9: Malalignment complications.

- On final assessment, one patient was having union in a position of minimal deviation from anatomical alignment (<5 degrees), four varus and four had valgus deformities.

16) Ankle Range Of Movements

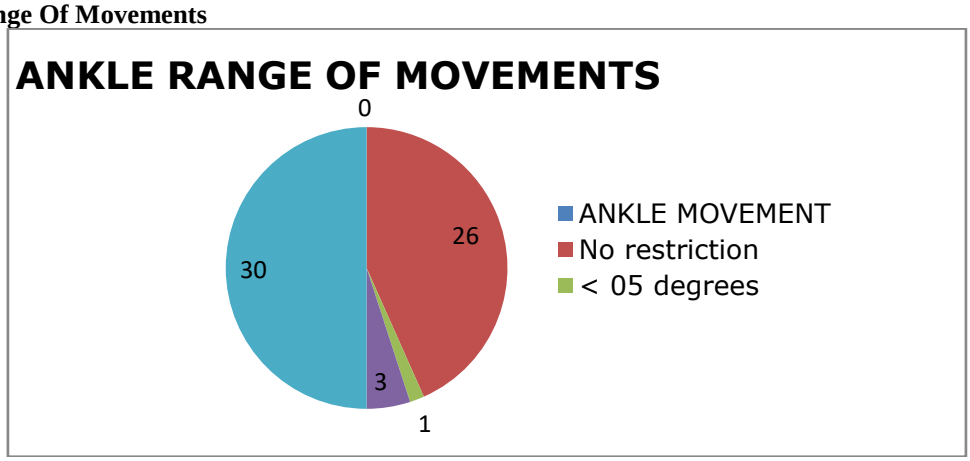

Fig 10: Ankle range of motion

In this study, there were four patients with restriction of ankle range of movement, of which one had pre operative restricted range of movement due to ankle arthritis on same side.

17) RESULTS

Table 11: Olerud ad Maleander score results

RESULTS	NO. OF PATIENTS	PERCENTAGE (%)
Excellent	26	86
Good	02	07
Fair	02	07
Poor	0	0
Total	30	100

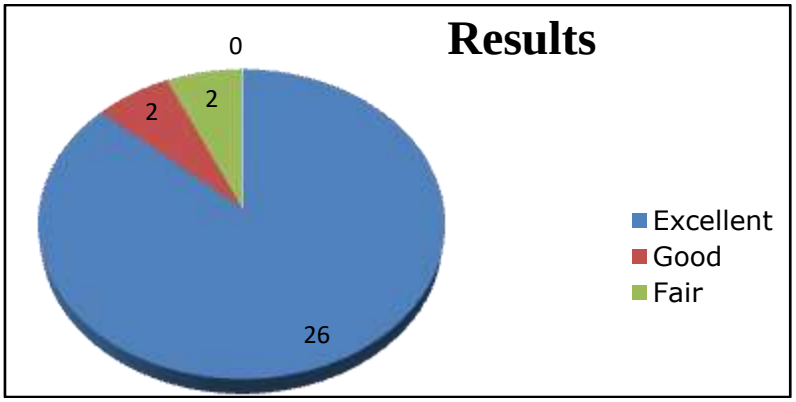

Fig 11: Results as per Olerud and Mallender

- There were 86 % of excellent results in our cases of study (Z = 3.944, p < .001, Significant).
- 95% Citation Index for observed proportion is (68.46, 95.88).

Fig 12: Preoperative (A, B) and postoperative(C, D) pictures showing union radiological union.

Fig 13: Preoperative (A, B) and postoperative(C, D) pictures showing union radiological union. This patient had Talus fracture which was fixed with screw at same setting.

DISCUSSION:

Age group in multiple studies is identical. Average duration of study is almost the same for all reference as well as pilot study [5, 6, 7]. We had patients of age ranging from 18-60 years, majority (77%) of the patients were in age group of 21-50 years, maximum incidence being in age group of 31-40 years. Average age in our series was 36.26 years. In present study the minimum age group of patient was 19 and maximum was 60 and average was found to be 36.2 in comparison to Cory Colllinge *et al.;* study where it was 17 and 62 respectively and average was 43 while in Hazarika *et al.;* study it was found to be 16 and 77 and average age group was 39.1.

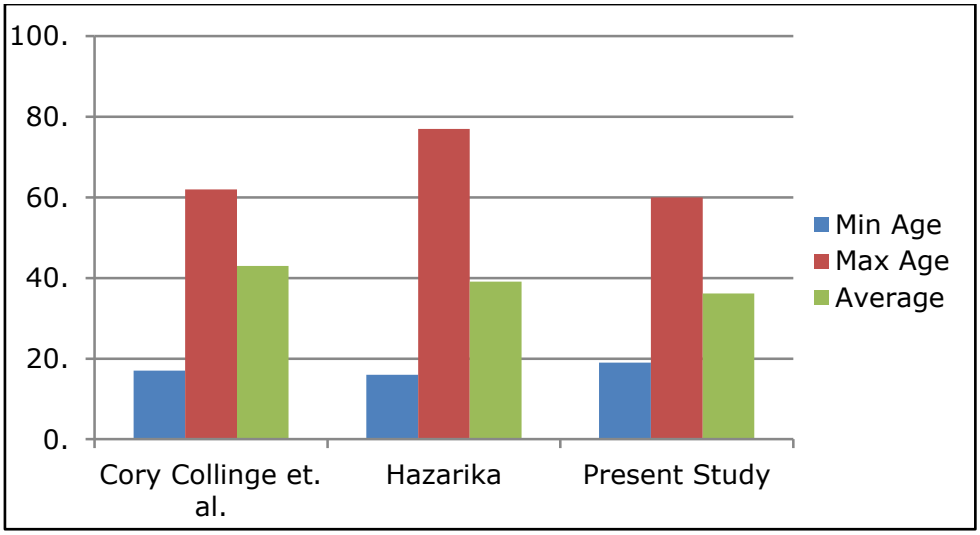

Fig 14: Comparative age parameters

People between the ages of 21-50 years are more prone to accident according to their profession and increased vehicular usage. In a study published in 2004 by Red fern *et al.;* [7] 20 patients were treated by MIPPO for closed fractures of the distal tibia. Their mean age was 38.3 years (range: 17–71 years). In this, fractures were classified according to the AO system. The mean time to full weight-bearing was 12 weeks (range: 8–20 weeks) and to union was 23 weeks (range: 18–29 weeks), without need for further surgery. There was one mal-union, no deep infection and no failures of fixation.

We had 27 males (90%) and 3 females (10%) patients in our study. The male – female ratio is 9:1.
The preponderance of males is because

1. Males are more outgoing, hence more vulnerable to vehicular accidents.
2. Due to usual society practice, certain tasks which involve high risk are done by males e.g. working at height, driving, labour and traveling.

Cory Colllinge *et al.;* [5] and Hazarika *et al.;* [6] both showed a male female ratio of 4:1 while Heather A Vallier *et al.;* [8] showed 2.3:1.

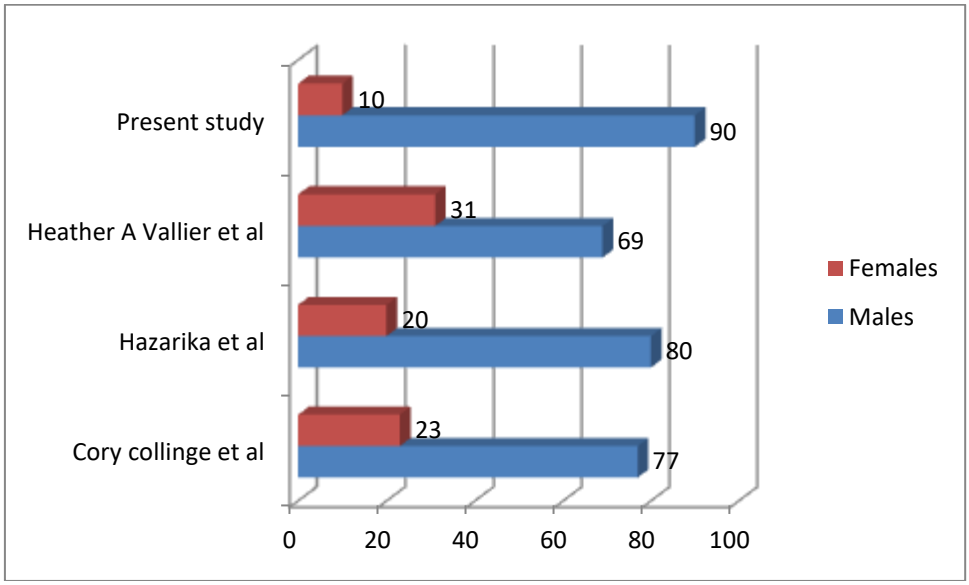

Fig 15: Sex ratios in various studies

Mode of Injury:

In our study, 26 patients were having history of road traffic accident (86.7%), 3 patients had history of fall from height (10%) and 1 had fall of heavy object on him (3.3%).

Cory Collinge *et al.;* [5] showed 100% of the fractures resulted from a high energy mechanism while Heather A V. *et al.;* 51% of the fractures were due to road traffic accidents and other high velocity trauma. In our study 16 (53%) patients had right side involvement and 14 (47%) had left side involvement. Hazarika *et al.;* [6] Cory Collinge *et al.;* [5**]** and Heather A Vallier *et al.;* [8] have not mentioned bout the side predilection in their study. In our study most of the trauma occurred due to road traffic accident; the results showing non-significant involvement on right side.

In our study total 15 (50%) patients had one or other forms of associated injuries in which 01 (7%) had head injury; 01 (7%) had blunt abdominal injury; 01 (7%) had chest injury; 01 (7%) had spine fracture, 11 (87%) patients had other appendicular bony injury.

Hazarika *et al.;* [6] mentioned, 9 (56.25%) patients presented with associated injuries where 2 patients were having head injury and 7 patients were having other bony injuries. In Cory [5] and Heather A V [8] study they have not specified for associated injury and its results. The very reason definitely points towards the high velocity and impact trauma that causes this type of injury which is sufficient to produce associated injuries whether bony or multi organ.

In our study 10 (34%) patients were operated after 5 days and 6 (20%) patients were operated within 24 hrs. Average duration of injury-operation interval was 4.76 days.

Major factors obviating the early surgery were;

- Increasing leg swelling
- Other associated injuries such as head injury or systemic injuries which required stabilization of patient
- Associated medical illness like diabetes, hypertension.

With Hazarika *et al.;* [6] 62% patients were operated in the period of 9-14 days.

In our study the average period of hospitalization was 14.28 days. 16 patients were discharged before 2 weeks (53%). 9 patients were discharged after 3 weeks of hospitalization and 5 patients were discharged between 2-3 weeks.

The difference in hospitalization period in our study was due to

- Delay in surgery due to leg swelling
- High number of associated bony injury
- Head injury and systemic injury
- Associated Open fractures

Hazarika *et al.;* [6] showed an average period of hospitalization to be 20 days.

We had 24 (80%) cases of closed fracture and 6 (20%) cases of open GRADE I fracture only in our study. Average union time for open fracture (22.67 weeks) is almost same with closed fracture (18.25 weeks). Heather Vallier *et al.;* [8] quoted 70% of patients with closed fractures and Hazarika *et al.;* [6] 60% of patients sustained closed fractures. In Cory Collinge [5] study they did not specify the grading of open injury.

In our study average time of radiological union was 19.13 weeks. Patients had radiological signs of union within 16-20 weeks. There was no case of delayed union or non union.

In Hazarika study, average period of union was 19.3 weeks. In Heather A Vallier study the average period of radiological union was 22 weeks (48 patients) with one non union and one delayed union. In Cory Collinge study the average time of radiological union was 21 weeks.

Borrelli, Josheph, Prickett [9] in 2002 in a did a human cadaveric study on extra osseous blood supply of the tibia and the effects of different plating techniques which suggested that open plating of medial aspect of the distal tibia caused a greater disruption of this extra osseous blood supply than did the percutaneous plating technique . Disruption of these extra osseous vessels following fracture and subsequent operation may slow healing and increase risk of delayed union and non union .This has been substantiated by multiple studies [10, 19, 20].

In 2012, Mehmet Atif Erol Aksekili [10] did a study on distal and diaphyseal tibial fractures by minimally invasive percutaneous plate osteosynthesis (MIPPO) in 35 patients. The mean duration of the union was 20.7 weeks and 17.96 in open and closed fractures, respectively. All cases showed union except one which had an implant failure. Necrosis at the wound developed in one case and infection in another. They concluded that MIPPO is an effective alternative treatment for tibial diaphysis and distal tibia fractures with low complications and high union rates.

Abid Mushtaq *et al.;* [11] in April 2009 reported that distal tibia, because being more superficial and having less soft tissue coverage when fractured, the treatment becomes challenging. The study aimed to see the results of distal tibia fixation with locking compression plate (LCP) using minimally invasive percutaneous plate osteosynthesis (MIPPO). Mean time for union was 5.5 months. Ultimately all fractures healed with good functional outcome. They concluded minimally invasive plate osteosynthesis technique for distal tibia fractures is associated with good results and

additional advantages. Early mobilization without risk of secondary displacement helps to prevent stiffness and contracture.

Red fern *et al.;* [7] had used MIPPO for closed fractures of the distal tibia. The mean time to full weight-bearing was 12 weeks (range: 8–20 weeks) and to union was 23 weeks (range: 18–29 weeks), without need for further surgery.

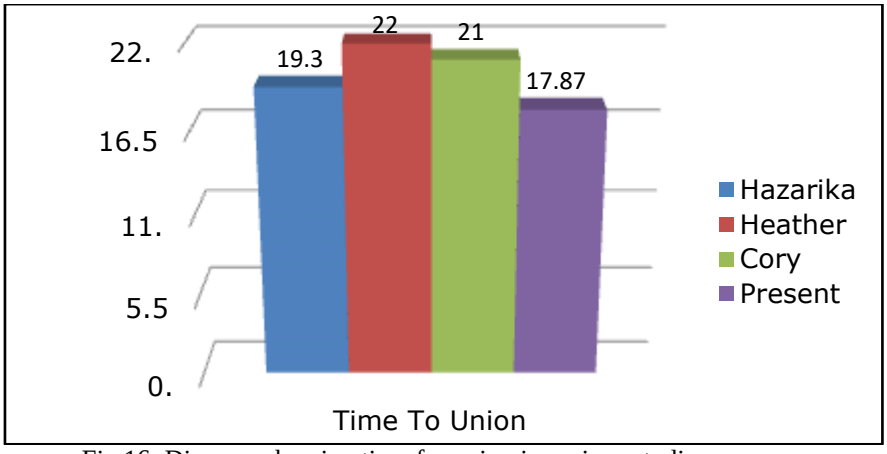

Fig 16: Diagram showing time for union in various studies

Radiological union in our study is identical to the above mentioned studies E. Hasenboehler *et al.;* [12] suggested in 2007, that MIPPO technique using LCP plate is a reliable approach towards diaphyseal and distal tibia shaft fractures that are not suitable for intramedullary nailing. Soft tissue complications, misalignment and knee irritation problems are avoided. Based on their clinical and radiological definition of fracture healing, out of 32 patients a total of 24 patients were classified as healed at 6 months, 27 patients at 9 months, and 29 patients at 15 months post-operatively.

COMPLICATIONS:

- We found the following complications in the cohort of 30 patients enrolled in the study.
- 1 patient developed infection necessitating premature implant removal.
- 4 patients showed radiological delayed union beyond 4 months.
- 1 patients developed arthritis of ankle joint necessitating ankle arthrodesis.
- 4 patients had temporary stiffness.
- 8 patients had mild deformity less than 5 degree in coronal plane.

1 patient developed reflex sympathetic dystrophy which resolved with medications and continued Physiotherapy in 8 months time with residual stiffness persisting. Commonest AO subtype was Type B1 in this study as compared to Francois J *et al.;* [12] with a predominant type B and C, Kolb D *et al.;* [23] with predominant type C about 39 % and Helfet *et al.;* [24] with type A (60 %) predominant .

In our study, 1 patient had deep infection which was treated with antibiotics. After 6 weeks of continued antibiotic suppression, the patient underwent implant removal followed by cast. The fracture united in consecutive radiographs at 3 months.

Two patients with local superficial redness were treated with oral antibiotics. Out of these, two patients had diabetes and were on treatment like oral hypoglycemic agent, two had lower leg pain/ankle pain; one had an obvious ligament laxity. Four patients had restriction of movements and eight patients had <5 degree of varus/valgus deformity, while one patient had lateral shift.

In our study, there was no case of non union. The study had AO type C fractures, C. oh, J. Ihn and B. Park[20] in 2001 did a study on 24 cases of unstable tibial fractures treated by minimal invasive percutaneous plate osteosynthesis of tibial fractures that would be inappropriate for intramedullary nailing showed that the minimal invasive plate technique proved to be feasible and worthwhile method of stabilization, while avoiding the severe complications associated with the other methods.

In 2008 Lau *et al.;* [14] had conducted a study among 48 patients with special attention to infection rate. Their results showed that the overall clinical outcome was good despite of the presence of these complications like late wound infection and skin impingement by the implant

Heather *et al.;* [8] mentioned one patient developed Acute Respiratory Distress Syndrome, one had deep intraarticular infection which was treated with

secondary debridement whereas with Cory Collinge *et al.;* [5] one patient had deep and one had superficial infection, two had post operative nerve palsy, three patients had wound hematoma/seroma, two died within two months of surgery due to medical illness two patients had articular mal alignment, one varus mal reduction and two mal reductions. Hazarika et al[6] showed one superficial infection due to skin necrosis which was treated with local debridement and antibiotics.

After discharge, patients were followed up at 4-6 weeks. The time of return to work and full activities were noted. In Hazarika [6] study, the patients were followed for a period of 1.5 year. In Heather[8] study the latest follow up was of 1.5 years while in Cory study it was 2 years. In our study, final follow up range was from 6 months to 1.5 years with an average follow up of 10.56 months.

In April 2010, Mario Ronga *et al.;* [15] published a study regarding the effectiveness of minimally invasive locked plates amongst 21 patients for a minimum period of 2 years (average: 2.8 years). According to the AO classification, there were 12 Type A, 5 Type B, and 4 Type C fractures. 2 patients were lost to follow-up. Union was achieved in all but one patient, by the 24th postoperative week. 4 patients had angular deformity less than 7°. No patient had a leg-length discrepancy more than 1.1 cm. 5 patients had ankle range of motion less than 20° as compared to the contralateral side. 16 patients had not returned to their pre-injury sporting or leisure activities. 3 patients developed delayed infection.

Multiple papers showed fair to good results viz; Oh, Jong-Keun, Oh, Chang-Cong, Jeon [16] Leung FK *et al.;* [17] Jian Zou, Wei Zhang, Chang-ging Zhang [21] in 2013 did a study i.e.; Comparison of minimally invasive percutaneous plate osteosynthesis versus open reduction and internal fixation for treatment of distal tibia fractures, which concluded that the strategy of biological osteosynthesis with a bridge plate might be superior to that of absolute stability for treating Type C tibia fractures

Taking into consideration Indian life style and working pattern, we have given more importance to knee range of motion which is necessary for squatting and sitting cross legged. The possible causes of restriction of movement were associated trauma at the time of injury, scarring of Quadriceps tendon due to prolonged immobilization and lack of physiotherapy due to less patient compliance.

In our study 26 (86%) patients had full range of motion and doing their routine work without difficulty. 4 (14%) patients had restriction of movement due to associated trauma.

Hazarika *et al.;* [6]
a series of 20 patients of distal tibial fracture
were treated using locking compression plates through MIPPO technique. This approach aims to pressure bone biology and minimize surgical soft tissue trauma. This provided 87.5% of good to excellent results. Fractures were classified according to the AO system and performed as scored
stage surgery after sterilization with external fixators primarily.

As a part of the continued development of biologically friendly plating and to facilitate minimally invasive plating techniques, the use of plates that allow screws to lock into the plate to create a fixed angle construct is gaining popularity.

CONCLUSION:

MIPPO is relatively safe and reliable modality for the treatment of AO Type B, C plafond tibial fractures. The MIPPO technique obviates the need of bone grafting as biology is minimally compromised. The AO type C fractures are prone to develop arthritis in lesser proportion with maximum type C fractures having good Orleand Mollander scores. AO type B has consistently shown good results with MIPPO technique.

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