

ORIGINAL ARTICLE

**Functional outcome of Medial Distal Tibial Locking
Compression Plate Fixation In Distal Tibial Fractures-A
Prospective Study**

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ABSTRACT

The study aim to assess the Functional outcome of the fracture of distal tibia treated with Medial Distal Tibial Locking compression plate. In the Current study, 30 patients with the distal tibia fractures underwent reduction & internal fixation by open & MIPPO technique with the medial distal tibial locking compression plate. The study was conducted from JULY 2018 to DECEMBER 2020 at Department of the Orthopedics in Sree Balaji Medical College & Hospital. All patients had excellent clinical & functional outcome. The age of patient ranged from 23 - 62 years with the fracture seen commonly in the 4th & 5th decade of life. Out of the 30 patients, 18 (60%) were male & 12(40%) were female, indicating male predominance. All the cases were then evaluated using the IOWA ankle score, AOFAS scoring periodically & only final follow up scores were taken for compilation of results. Functional results Based on IOWA Ankle score In MIPPO group among 18 patients, 15 patients had excellent results with 2 good and 1 fair result. In ORIF group among 12 patients, 8 patients had excellent results with 3 good and 1 fair result. Based on AOFAS Score In MIPPO group among 18 patients, 14 patients had excellent results, 3 had good result, 1 fair result and no poor result. In ORIF group among 12 patients, 7 patients had excellent results with 3 good result, 2 fair result and no poor result. Implant failures or deformity was not seen in any cases. The Current study provides ample stability of the fracture & facilitates early motion. It also helps in achieving the rapid union & allows the preservation of blood supply to the fragment & achieve fracture reduction. The biggest advantage of fixation of the fracture with distal tibial locking plate is that anatomical reduction is achieved & added advantage in MIPPO is fracture hematoma is not disturbed. This study shows that LCP with MIPO technique provides better healing of fracture with good recovery and lesser complications of treatment.

Keywords: LCP, MIPO Technique, Plate Fixation, Distal Tibial Fractures

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INTRODUCTION

Distal tibial fractures are high velocity injuries mostly seen in RTAs & are very common in males of 30-40 years age. These fractures are also seen in other situations like in falls, collisions or direct blows. Among all the tibial fractures, fractures of the distal tibia constitute less than 7% & lesser than 10% among all lower extremity fractures. Distal tibial fractures are difficult to treat by both conservative & surgical treatment. Distal tibia fractures are challenging to treat due to the subcutaneous nature of the bone, limited soft tissue cover & poor blood supply [1, 2]. The main aim of the treatment is to realign the fracture, regain the limb length, achieve union & early & good functionality [3]. Fractures of the distal tibia presents with the metaphyseal flare which leads to decreased implant contact resulting in less stability & malalignment which in turn leads to alteration in biomechanics of the ankle leading to pain & functional disability. Distal tibial fractures usually have high complication rates both due to injury per se & also due to treatment [4, 5]. The reasons for complications in fractures of distal tibia are :

- Distal tibia bears lot of weight & is a locomotive structure,
- It is Inherently unstable,
- Has minimal soft tissue covering
- Mostly Comminuted

- Distal tibia has Poor vascular supply.
- These Fractures are primarily associated with injury of the soft tissue.,
- Variety of treatment approaches have been used based on fracture pattern like conservative method, external fixators, intramedullary nail & conventional plate⁶ but all of these treatment methods has its advantages & disadvantages [7].

Conservative treatment is used in stable fractures with limited shortening, but they are associated with complications like deformity, restricted movements & development of premature Osteoarthritis of ankle especially in pilon fractures [8, 2. 9].

External fixator is considered as option in open fractures but can lead to inaccurate reduction, malunions, non-unions & pin tract infections [10, 11]. Intramedullary nailing is difficult due to wide medullar canal of the distal tibia which result in reduced stability due to larger diameter of the distal part of tibia in relation to diameter of the nail . Classic open reduction & the internal plate fixation require extensive soft tissue dissection & periosteal stripping, with high rates of complications like infection, delayed union & nonunion [12, 13]. Minimally invasive techniques offer fixation in the biological manner with preservation of bone's vascularity, soft tissue covering & containment of fracture hematoma. Nevertheless, has been associated with complications like angular deformities, hardware failures & non-unions.

The recent development in this regard is the "Locking compression plate" Comprising of the plate & screw systems where screws are locked at a fixed angle in the plate. The anatomical design of the LCP which is contoured to bone shape prevents the fracture from being displaced which is advantage over the regular plate where fracture displacement is common due to the inaccurate contouring. Since the plate is not tightly compressed against the bone, it does not disrupt the periosteal vascular supply providing favorable condition for the bone healing. Despite the advances in diagnosis & implant design, these fractures remain challenging to treat [14]. The study aim to assess the Functional outcome of the fracture of distal tibia treated with Medial Distal Tibial Locking compression plate.

MATERIAL AND METHODS

This prospective study was undertaken at SBMCH Chennai to analyze the functional outcome of Medial distal tibial LCP for the treatment & prognosis of the distal tibial fractures depending on the type of fracture. The study included Patients presenting to OPD or causality with distal tibia fracture at Department of the Orthopedics in Sree Balaji Medical College & Hospital, Chennai (Tamilnadu) & were treated with medial Distal tibial LCP

INCLUSION CRITERIA:

- Patients willing to participate in the study.
- Skeletally mature patients.
- Only closed fractures.
- Minimum follow up of 6 months.
- Both bone fractures of leg.
- Isolated Distal Tibial Fracture
- 43 Type A & 43 Type C fracture according to AO classification

EXCLUSION CRITERIA:

- Age less than 16 years
- Compound fractures.
- Associated Calcaneum & Talus fractures.
- 43Type B fractures according to AO classification
- Sever mangled extremity.
- Associated spinal & abdominal injuries.
- Pathological fractures.

The study population included 37 patients of these patients 5 failed to come for further follow up & 2 patients passed away due to unrelated reasons. Hence the study population was 30 patients. The study was conducted from JULY 2018 to DECEMBER 2020. The study shall be spread over the period of 30 months, but recruitment of new patients shall stop by July 2020, minimum follow up period shall be 6 months. Thus, the study consists of a recruitment period of 24 months & study period will spread over the period of 30 months.

Treatment protocol: - 5 stages

- First aid
- Primary treatment

- Definitive treatment
- Management of complications
- Rehabilitation

A rapid evaluation of the vital functions will be carried out on receiving the patients inside the casualty & attempts will be made to stabilize the vitals. Any associated injuries like head trauma, chest injuries & abdominal injuries will be taken care by specialty departments respectively. History of age, sex, injury mode, duration from injury & co-morbid conditions (if any) is taken. A general examination & detailed clinical examination of the patient will be carried out assessing site of injuries for any wounds, swellings, proximal & the distal joints status, neurovascular status of the limb, will be done.

A dose of tetanus toxin will be given if any abrasions are present.

Required x-rays are taken & AK slab is applied to immobilize the limb.

The regular investigations & anesthetic workup will be done after the preliminary care & patient would be taken up for surgery as soon as possible.

Patients were treated with either open surgical approach or MIPPO.

SURGICAL TECHNIQUE:

- Complete the preoperative radiographic assessment & prepare the preoperative plan. Determine plate length & instruments to be used.
- Broad spectrum Intra venous antibiotics is given immediate pre- operatively.
- Regional Anesthesia
- Position the patient in supine position on a radiolucent operating table
- Locking Plate Osteo-synthesis is done either with Open or MIPO technique

FIBULA

Fibula is exposed using lateral approach & reduced & is fixed with 1/3rd tubular plate & 3.5mm cortical screws.

TIBIA

Using modified anteromedial approach [15], skin incision is placed nearly 1 cm lateral to tibial crest & along tendon of anterior tibialis. The skin incision extends distally & medially till the distal tip of medial malleoli. Plane of dissection is medial to anterior tibial tendon. Fracture fragments were identified, reduced & held temporarily with K wires & then they are fixed definitively with 3.5 mm medial distal LCP plate with locking screws. After the completion of fixation procedure, thorough wound wash was given, & wound was closed in layers with appropriate sutures & sterile dressing was done & slab was applied. For the type A AO fractures MIPPO technique was utilized. Incision was placed proximal to medial malleoli & fracture was reduced indirectly & plate was introduced through the incision under guidance of image intensifier & secured with 3.5mm system. Proximally screws were introduced through stab incisions & fixed [9]. Open reduction and MIPPO were both used in case of fractures of AO type C & fracture fragments were fixed with the LCP plate [16, 17].

POST-OPERATIVE PROTOCOL [18, 14]

- Drain was removed after 48hrs
- Intra-venous antibiotics is given for 5 days & was followed by course of oral antibiotics for 7 days. Analgesics are given as per required
- After post-operative day 12 alternate suture were removed and on 14th day all sutures were removed
- Ankle mobilization was started with non-weight bearing walking with walker support after the removal of sutures.
- X-rays were taken at regular intervals & evaluated for the fracture healing, alignment & for any evidence of mal-alignment
- Partial protected weight bearing is started when first sign of callus is noticed in follow up x-rays. Usually after 8 - 10 weeks
- Walking with full weight bearing is started when the union is seen in 3 of 4 cortices.

FOLLOW-UP:

Patients will be followed up for the minimum time period of 6 months

- 1st follow-up: at 4th week
- 2nd follow-up: at 8th week
- 3rd follow-up: at 12th week
- 4th follow-up: at 6 months
- All the cases were then evaluated using the IOWA ankle score, AOFAS scoring periodically & only final follow up scores were taken for compilation of results.

RESULTS

The primary objective of the treatment is to achieve sound clinical & radiological union without functional disability. A total number of 30 patients have been examined in this study. All cases were fixed using medial LCP.

AGE DISTRIBUTION

The age of patient ranged from 23 - 62 years with the fracture seen commonly in the 4th & 5th decade of life.

Table 1: AGE DISTRIBUTION

| Age Group in years | No. of patients(N) | Percentage (%) |
|--------------------|--------------------|----------------|
| 20- 30 | 4 | 13.3 % |
| 30 -40 | 5 | 16.7 % |
| 40-50 | 12 | 40.0 % |
| 50-60 | 7 | 23.3 % |
| 60-70 | 2 | 6.7 % |
| Total | 30 | 100 % |

SEX DISTRIBUTION

Out of the 30 patients, 18 (60%) were male & 12(40%) were female, indicating male predominance.

TABLE 2: SEX DISTRIBUTION

| Sex | No. of patients | Percentage |
|--------|-----------------|------------|
| Male | 18 | 60% |
| Female | 12 | 40% |
| Total | 30 | 100% |

DISTRIBUTION ACCORDING TO MODE OF INJURY

In our Study, 18 (80%) of patients suffered injury after RTA & 7 (23.3%) patients suffered injury due to fall, 5 (16.7%) due to other causes. Showing RTA has the most common cause.

Table 3 : MODE OF INJURY

| Mode of Injury | No. of Patients | Percentage |
|----------------|-----------------|------------|
| RTA | 18 | 60% |
| Fall | 7 | 23.3% |
| Other | 5 | 16.7% |
| Total | 30 | 100% |

DISTRIBUTION ACCORDING TO SIDE OF INJURY

There were 18(60%) patients with right distal tibia fracture & 12 (40%) patients with left distal tibia fractures.

Table 4: SIDE AFFECTED

| Side | No. of patients | Percentage |
|-------|-----------------|------------|
| Right | 18 | 60% |
| Left | 12 | 40% |

FRACTURE PATTERN

The fracture pattern was classified based on AO-OTA system

Table 5: FRACTURE PATTERN

| A.O. Classification | No. of patients | Percentage (%) |
|---------------------|-----------------|----------------|
| A ₁ | 2 | 6.7% |
| A ₂ | 4 | 13.3% |
| A ₃ | 3 | 10% |
| B ₁ | - | - |
| B ₂ | - | - |
| B ₃ | - | - |
| C ₁ | 10 | 33.3% |
| C ₂ | 6 | 20% |
| C ₃ | 5 | 16.7% |
| Total | 30 | 100% |

ASSOCIATED INJURIES:

16 out of 30 cases studied had an associated fracture of lower third of fibula. 1 patient had fracture of distal radius, one had 2nd metacarpal fracture, 1 patient had proximal phalanx fracture & 3 patients had head injury.

STATISTICS OF SURGERY:

All the 30 cases were operated under the spinal anesthesia. Among 30, 18 cases were operated with MIPPO technique & 12 cases were operated with ORIF

Table 6: METHOD OF TREATMENT

| Method of treatment | No. of cases |
|---------------------|--------------|
| MIPPO with LCP | 18 |
| ORIF with LCP | 12 |
| Total | 30 |

FOLLOW UP:

Minimum follow up required for our study was 6 months. In our study minimum follow up was 7 months & maximum follow up was 20 months & average follow up period was 12.5 month.

DURATION BETWEEN INJURY & OPERATION

Table 7: DURATION BETWEEN INJURY AND OPERATION

| Duration between injury & operation indays | No. of patients | Percentage among operated patients % |
|--|-----------------|--------------------------------------|
| 7 | 7 | 23.3% |
| 8 | 8 | 26.7% |
| 9 | 5 | 16.7% |
| 10 | 8 | 26.7% |
| 11 | 2 | 6.7% |

DURATION OF THE FRACTURE UNION:

18 cases were operated by MIPPO with LCP & fractures united with an average of 18.05 weeks. 12 cases operated by ORIF with LCP & in them fracture united with an average of 19.5 weeks. Total average duration of fracture union was 18.7 weeks.

Table 8: DURATION OF FRACTURE UNION

| Time (weeks) | No. of patients |
|-----------------------|-----------------|
| 16 th week | 1 |
| 17 th week | 4 |
| 18 th week | 8 |
| 19 th week | 10 |
| 20 th week | 6 |
| 21 st week | 1 |

FUNCTIONAL RESULTS(IOWA)

Patients were evaluated using IOWA ankle evaluation score & patients were categorized in to:

| | | |
|---|-----------|----------|
| 1 | EXCELLENT | 100 – 90 |
| 2 | GOOD | 89 – 80 |
| 3 | FAIR | 79 – 70 |

Table 9: FUNCTIONAL RESULTS (IOWA)

| Results | No. of patients | Percentage |
|-----------|-----------------|------------|
| Excellent | 23 | 76.7% |
| Good | 5 | 16.7% |
| Fair | 2 | 6.6% |

FUNCTIONAL RESULTS(AOFAS)

Patients were evaluated using the American Orthopedic foot & ankle society (AOFAS) score & patients were categorized in to:

- 85-Excellent
- 70 to 80-Good
- 55 to 65-Fair
- < 50- Poor

Table 10: FUNCTIONAL RESULTS (AOFAS)

| Results | No. of patients | Percentage |
|-----------|-----------------|------------|
| Excellent | 21 | 70% |
| Good | 6 | 20% |
| Fair | 3 | 10% |
| Poor | 0 | 0 |

FUNCTIONAL RESULTS ACCORDING TO METHOD OF TREATMENT

Comparison between MIPPO and ORIF group based on IOWAAnkle Score:

In MIPPO group among 18 patients, 15 patients had excellent results with 2 good and 1 fair result.

In ORIF group among 12 patients, 8 patients had excellent results with 3 good and 1 fair result.

Table 14: Comparison Between Mippo And Orif Based On Iowa Ankle Score

| Crosstab | | | | | | |
|-----------------------|-------|--------------------------------|------------------------|--------|--------|--------|
| | | | IOWA ankle Total score | | | Total |
| | | | Excellent | Good | Fair | |
| Modality of Treatment | MIPPO | Count | 15 | 2 | 1 | 18 |
| | | % within IOWA ankleTotal score | 65.2% | 40.0% | 50.0% | 60.0% |
| | ORIF | Count | 8 | 3 | 1 | 12 |
| | | % within IOWA ankleTotal score | 34.8% | 60.0% | 50.0% | 40.0% |
| Total | | Count | 23 | 5 | 2 | 30 |
| | | % within IOWAankle Total score | 100.0% | 100.0% | 100.0% | 100.0% |

There is a no significant association between modality of treatment and Iowa ankle score with p-value<0.05[0.67], chi-square value 1.178, df 2.

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) | Sig. (2-sided) |
|--------------------|--------------------|----|-----------------------|----------------|
| Pearson Chi-Square | 1.178 ^a | 2 | .055 | .679 |

Comparison between MIPPO and ORIF based on AOFASTotal score

In MIPPO group among 18 patients, 14 patients had excellent results, 3 had good result, 1 fair result and no poor result. In ORIF group among 12 patients, 7 patients had excellent results with 3 good result, 2 fair result and no poor result.

Table 15: Comparison between MIPPO and ORIF based on AOFASTotal score

| | | Crosstab | | | | | |
|---------------------|-------|----------------------------|-------------------|--------|--------|----|--------|
| | | | AOFAS Total score | | | | Total |
| | | | Excellent | Good | Fair | | |
| Method of Treatment | MIPPO | Count | 14 | 3 | 1 | 0 | 18 |
| | | % within AOFAS Total score | 66.7% | 50% | 33.3% | 0% | 60.0% |
| | ORIF | Count | 7 | 3 | 2 | 0 | 12 |
| | | % within AOFAS Total score | 33.3% | 50% | 66.7% | 0% | 40.0% |
| Total | | Count | 21 | 6 | 3 | 0 | 30 |
| | | % within AOFAS Total score | 100.0% | 100.0% | 100.0% | 0% | 100.0% |

There is a no significant association between method of treatment & AOFAS Score with p -value<0.05 [0.65], chi-square value 1.528, df 2.

Chi-Square Tests

| | Value | df | Asymp. Sig.(2-sided) | Sig. (2-sided) |
|--------------------|---------------------|----|----------------------|----------------|
| Pearson Chi-Square | 1.5288 ^a | 2 | .046 | .600 |



PRE OP



**POST OP
UNION**



DORSI FLEXION



PLANTAR FLEION

Fig 1: Distal tibial fractures, Pre and Post Operation

DISCUSSION

Distal tibial fractures occur due to a range of low to high energy axial-loading injuries. This relatively rare injury (<10% of lower limb fractures) occurs in adults mostly due to RTAs or because of the fall from the height. The soft tissue status, severity of fracture comminuting at time of injury will have an impact on long term results. Aim of the surgical treatment is to attain anatomical realignment of articular surface with adequate stability to enable early motion. The objective of this study is to determine efficacy of the LCP in treatment of fractures of the distal tibia. Our findings were analysed & compared with those obtained by numerous other studies using different treatment modalities. Our findings are as follows:

AGE DISTRIBUTION:

Our study revealed the average age of patients suffering with such injuries has 43.56years (23 to 62). It is comparable with the study on similar fractures conducted by below authors.

| Study | MinAge | MaxAge | Average |
|-------------------------------------|--------|--------|---------|
| Shrestha D <i>et al</i> [19] | 20 | 65 | 38.75 |
| Cory Collinge <i>et al</i> [20] | 17 | 62 | 43 |
| Heather A Vallier <i>et al</i> [21] | 16 | 77 | 39.1 |
| Present Study | 21 | 62 | 43.56 |

SEX DISTRIBUTION

In our study, the male predominance for such kind of injuries were high i.e 60% which is comparable to the study conducted by Andrew Grose *et al* [22] & Heather A Vallier *et al* [21] which was 67% & 69 % possibly due to occupational injuries etc.

FRACTURE PATTERNS PERCENTAGE

The present study had comparable results to other studies. A study conducted by Cory collinge *et al* [20] showed 16% C1, 32% C2 & 24% C3. Andrew Grose *et al* [22] also had fractures types 2% B1, 4% B2, 12% B3, 6% C1, 12% C2, 64% C3. Heather Vallier *et al* [21] also had fractures 31% A, 21% B, & 44% C. In our study we had excluded Type B fractures according to AO classification as plating is not the treatment for it. Type B fractures are included in studies by Andrew Grose *et al* [22] & Heather A Vallier *et al* [21].

MECHANISM OF THE INJURY

In our study most common mode of injury was RTA which is comparable with the study conducted by [22, 21, 19, 23, 24].

DURATION OF FRACTURE UNION:

The average duration for fracture union in various studies conducted using various methods was 16-28 weeks. Our study has an average fracture union time of 18.77 weeks. With MIPPO procedure union time was 18.05 weeks & with ORIF union time was 19.5 weeks which were comparable with following studies conducted using the LCP.

Mast *et al* [25] reported 78% satisfactory results in 37 patients with minimum follow up interval of 6 months. In a study that established open reduction with plates & the screw fixation as standard. Ruedi & Allgower [26] achieved 74% acceptable results in 84 patients. These results did not deteriorate for 9 years. Ovadia & Beals [27] reviewed 34 fractures equivalent to Ruedi Type III treated with traditional open reduction & plate fixation. Good to excellent outcome was attained in only 47%. Complications were numerous & although not sub-classified based on fracture types, superficial infections or skin loss developed in the 9 patients (11%), osteomyelitis developed in the 5 patients (6%), 17 patients (12%) required either ankle Arthrodesis or arthroplasty. Teeny & Wiss [28] studied sixty tibial plafond fractures. 60% of those were secondary to high energy trauma. They reported 50% poor results when open reduction & the plate fixation was used. When the subsets of 30 Ruedi Type-III fractures was analyzed there were 12 (40%) acceptable outcomes with 37% of them complicated by a skin slough or the deep infections. Mc Ferran *et al* [29] reported on 52 tibial plafond fractures treated with ORIF. 40% of these were Ruedi Type III injuries. Overall, 40% of the patients suffered some complications, like osteomyelitis occurring in 43% of fractures & wound breakdown requiring soft tissue cover in the 62% of fractures.

In our present study there is no significant association between AO type A (group A) & Type C (group C) in IOWA ankle score with p-value > 0.05 [0.159] & between AO type A (group A) & type C (group c) in AOFAS total score with p-value > 0.05 [0.294]. However most of the cases in group A had excellent results & in group C majority had excellent results with few good - fair results.

In our present study there is a no significant association between Method of treatment (MIPPO and Open reduction) & Iowa ankle score with the p-value < 0.05 [0.67] & between Method of treatment (MIPPO and Open reduction) & AOFAS score with the p-value < 0.05 [0.65]

However, MIPPO group had a greater number of excellent results & in Open group majority had excellent results with few good - fair results.

In our study mean time for radiological union was 18.7 weeks with no incidence of delayed union & non-union. In a prospective study by Sunil Kumar [30] studied all about distal tibia fractures treated with IM nail vs Minimal invasive plating which had 53 patients in nailing group (group A) & 55 patients in Plating group (group B), mean radiological union in nail group was 20.1 week & plating group was 17.5 weeks, Functional outcome based on AOFAS score for nailing group was 90.8 & plating group was 96.8, this was comparable with the MIPPO group in our study.

CONCLUSION

In the Current study, 30 patients with the distal tibia fractures underwent reduction & internal fixation by open & MIPPO technique with the medial distal tibial locking compression plate.

This procedure has resulted in optimum stabilization of such fractures. It provides ample stability & facilitates early motion. It also helps in achieving the rapid union as it allows the preservation of blood supply to the fragment & achieve fracture reduction. The biggest advantage of fixation of the fracture with distal tibial locking plate is that anatomical reduction is achieved & added advantage in MIPPO is fracture hematoma is not disturbed. It is also helpful for extra articular fractures within 5 cm of the joint because intra-medullary nails may not always provide adequate stability in such fractures because of the wide intra-medullary canal of the distal tibia⁷⁴. This study shows that LCP with MIPO technique provides better healing of fracture with good recovery and lesser complications of treatment.

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