

Original Research Article

A prospective study of distal 1/3rd tibia fracture treated using locking compression plate by minimally invasive percutaneous plate osteosynthesis technique

P. Sai Vikranth*, N. Vamshi Varennya

Department of Orthopaedics, Mahavir Institute of Medical Sciences, Vikarabad, Hyderabad, India

Received: 03 May 2020

Revised: 26 July 2020

Accepted: 28 July 2020

***Correspondence:**

Dr. P. Sai Vikranth,

E-mail: drvikranth57@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Distal tibia fractures are common and represent 6-8% of all lower limb fractures treated by an orthopaedic surgeon. Anatomical reduction with good fracture stability and minimal soft tissue dissection give good functional results. Locking compression plate combined with minimally invasive percutaneous plate osteosynthesis (MIPPO) technique has yielded good results. In this prospective study, authors studied 30 patients treated with LCP using MIPPO technique to know the functional outcome.

Methods: A total 30 patients were studied in this technique, which include both male and females of different age groups treated with LCP using MIPPO technique. All the patients were followed up for 12 months between March 2018 to March 2019 in orthopaedic department. The functional and radiological outcomes were assessed.

Results: A total 30 patients both male and females were studied with age groups between 18 to 65 years. Average follow-up was 12 months using Olerud and Molander scoring system authors had excellent results in 16 patients (54%), good in 9 patients (30%), fair in 4 patients (12%) and poor outcome in 1 patient (4%).

Conclusions: Surgery with locking compression plate along active physiotherapy proved to be better for distal tibia fractures.

Keywords: Distal tibia fracture, Locking compression plate, Minimally invasive percutaneous plate osteosynthesis technique, Olerud and molander scoring system, Range of motion

INTRODUCTION

High speed motor vehicle accidents generally result in complex fractures and distal tibia fractures are one of the most common fractures.¹ surgical or conservative management of these tibia fractures is sometimes difficult due to minimal soft tissue around the bone and poor vascularity.² Surgical management with open reduction and internal fixation generally lead to extensive soft tissue dissection and periosteal stripping with high rates of complications like infections (range 9-25%), delayed union and non-union (range 9-23%).^{3,4} To reduce complications MIPPO technique plays a pivotal role in

reducing soft tissue injury and preserve fracture hematoma.⁵ Locking plates used as internal and external fixators depending upon type of fracture and involvement of soft tissue.⁶ MIPPO technique have demonstrated success in maintaining reduction and stable union, this has distinct advantages and disadvantages that require careful planning during surgery.⁷ Conservative treatment by cast leads to prolonged immobilization, ankle and knee stiffness affecting quality of life. A locking plate has a high degree of stability and protection against losses of reduction and minimization of bone contact when compared to a conventional plate.⁸ The purpose of this study is to evaluate outcome of displaced, comminuted

distal third closed extra articular tibia fractures fixation with LCP plate using MIPPO technique.

METHODS

This was a prospective clinical study conducted at tertiary care centre with 30 patients with closed distal 1/3rd tibial fractures were studied. All the cases were treated at department of orthopaedics Mahavir Institute of Medical Sciences and General Hospital, Shivareddypet, Vikarabad between March 2018 and March 2019 at the study institution and followed for a minimum of 12 months. All the fractures in this series were post-traumatic.

Patient selection

Patients admitted to Mahavir Institute of Medical Sciences and General Hospital, Shivareddypet, Vikarabad with fracture distal 1/3rd tibia.

Inclusion criteria

All patients above the age group of 18 years and surgically managed closed were included in this study. Extra-articular distal tibia fractures as per AO/OTA classification 43 A1, 43 A2, 43 A3 (Figure 1).⁹

Exclusion criteria

Exclusion criteria were patients with open distal tibia fractures, patients lost in follow-up, patients managed conservatively for other medical reasons and patients with neurovascular compromise.

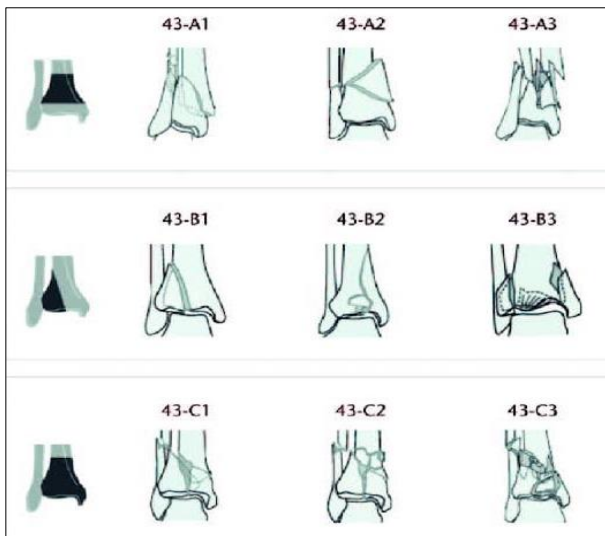


Figure 1: OA/OTA classification of distal tibia fracture.

Implant used

The plates and screws are manufactured from 316 L stainless alloy with gun drilling technique. The pre-

contoured 3.5 mm locking compression plates are available for both right and left tibias from 6 holed to 8 holed.

Surgical procedure

After giving the spinal anesthesia, patient in supine position on c-arm compatible table, the entire injured extremity is prepared, draped with tourniquet application and applying traction and counter traction method the anatomical fracture reduction is achieved and held with reduction forceps, confirmed under C arm. A small longitudinal incision is made for plate insertion at the level of medial tibial plafond at medial malleolus tip and extended proximally. A premeasured and pre-contoured metaphyseal LCP is inserted, using the threaded drill guide as a handle, into the subcutaneous tunnel and the fracture is reduced and position of plate confirmed. Use the bending instruments to contour the locking compression plate to the anatomy (Figure 3: A1, A2, A3, A4). Another incision is made at the proximal end of the plate, position confirmed visually and the plate was fixed with 4.0 mm cortical screws. First screw is inserted at the distal end of the plate close to the joint line and the second screw is inserted at the proximal end of the plate percutaneously. After confirming fracture reduction, a lag screw is inserted through the plate to reduce the fracture gap. locking screws were inserted in the mid-section of the plate and associated 1/3rd fibula fracture treated with rush nail or recon plate fixation.



Figure 2: (A1) Preop X-ray (A2) intra-op picture (A3) Immediate post op X-ray (A4) 6th month follow-up X-ray.

Postoperative

Patients care was done as per hospital protocol which includes antibiotics, analgesics, vitals monitoring, input output charting, along with foot end elevation were given as per the patient compliance. Blood transfusion depending upon the preoperative general condition and intraoperative blood loss. Non-weight bearing was started after first post-operative week till 6 weeks depending on

the fracture pattern. Partial weight and full weight bearing exercises started depending on healing process till fracture union respectively. Rehabilitation of the affected limb was started at the end of 2 weeks. Gentle exercises to the ankle

were allowed. At 4 to 6 weeks gentle active range of motion of the ankle was allowed. At 6 to 8 weeks active range of motion in all planes were allowed.

Table 1: Olerud and Molander scoring system.

| Parameter | Degree | Score |
|--------------------------------------|--|-------|
| Pain | None | 25 |
| | While walking on uneven surface | 20 |
| | While walking on even surface outdoors | 10 |
| | While walking indoors | 05 |
| | Constant and severe | 00 |
| Stiffness | None | 10 |
| | Stiffness | 00 |
| Swelling | None | 10 |
| | Only evenings | 05 |
| | Constant | 00 |
| Stair climbing | No problems | 10 |
| | Impaired | 05 |
| | Impossible | 00 |
| Running | Possible | 05 |
| | Impossible | 00 |
| Jumping | Possible | 05 |
| | Impossible | 00 |
| Squatting | No problems | 05 |
| | Impossible | 00 |
| Supports | None | 10 |
| | Taping, wrapping | 05 |
| | Stick or crutches | 00 |
| Work activities of daily life | Same as before injury | 20 |
| | Loss of tempo | 15 |
| | Change to a simple job/part time work | 10 |
| | Severely impaired work capacity | 00 |

Follow-up

All patients were followed up at 2nd, 4th, 6th and 8th weeks, 3rd months, 6th months and 12th months and were assessed clinically, radiologically and functionally by Olerud and Molander scoring system (Table 1).¹⁰

Statistical analysis

Descriptive and inferential statistical analysis has been carried out in the present study which included sex distribution, age distribution, mechanism of injury, relationship between age and mechanism of injury, relationship between sex and cause of injury, type of fracture, time to radiological union, complications and results were analysed on percentage basis.

RESULTS

Total of 30 distal tibia fractures were studied and treated using the MIPPO technique. With minimum of 12 months

follow-up. Of total 30 patients 21 (70%) are males and 9 (30%) are females (Table 2).

Table 2: Sex distribution.

| | N | % |
|----------------|----|-----|
| Males | 21 | 70 |
| Females | 9 | 30 |
| Total | 30 | 100 |

Table 3: Age distribution.

| Age in years | N | % |
|-----------------|----|-----|
| 20-30 | 13 | 44 |
| 31-40 | 7 | 24 |
| 41-50 | 3 | 10 |
| 51-60 | 4 | 12 |
| Above 60 | 3 | 10 |
| Total | 30 | 100 |

Table 4: Mechanism of injury.

| Mode of injury | N | % |
|----------------|-----------|------------|
| RTA | 22 | 73 |
| Trivial fall | 6 | 20 |
| Assault | 2 | 7 |
| Total | 30 | 100 |

Table 5: Side affected.

| Side | N | % |
|--------------|-----------|------------|
| Right | 19 | 65 |
| Left | 11 | 35 |
| Total | 30 | 100 |

Table 6: Classification of fracture.

| AO/OTA type | N | % |
|--------------|-----------|------------|
| 43 A1 | 16 | 53 |
| 43 A2 | 10 | 35 |
| 43 A3 | 4 | 12 |
| Total | 30 | 100 |

Table 6: Functional results (Olerud and Molander scoring).

| Grading | N | % |
|--------------|-----------|------------|
| Excellent | 16 | 54 |
| Good | 9 | 30 |
| Fair | 4 | 12 |
| Poor | 1 | 4 |
| Total | 30 | 100 |

Table 8: Relationship between age and mechanism of injury.

| Age group | N | % |
|-------------------------------|-----------|------------|
| Age group <50 years | | |
| RTA | 12 | 40 |
| Trivial fall | 3 | 10 |
| Assault | 3 | 10 |
| Age group >50 years | | |
| RTA | 7 | 24 |
| Trivial fall | 3 | 10 |
| Assault | 2 | 6 |
| Total | 30 | 100 |

As per the age distribution the predominant age group was between 20-30 (44%), followed by 31-40 (24%), then 41-60 and above 60 of approx. 10% each (Table 3). Mechanism of injury is mainly RTA (73%), followed by trivial fall (20%) and assault (7%) (Table 4). The side effected s right side 65% then left which is of 35% (Table 5). As per OA classification the fractures types are mainly of 43A1 nearly 53%, followed by 43A2 nearly 35% an 43A3 of 12% (Table 6). All patients were followed up at 2nd, 4th, 6th weeks, 3rd month, 6th month and 12th month and were assessed clinically, radiologically and functionally

by Olerud and Molander scoring system (Table 7). All fractures were healed showing restoration of anatomy was excellent in 16 patients (54%), good in 9 patients (30%), fair in 4 patients (12%) and poor outcome in 1 patient (4%). MIPPO technique was done using locking compression plate. Patients were operated within 10 days. Depending on the medical and surgical co-morbidities the injury-surgery interval lasted from 2 to 10 days. Average time duration of surgery was 60 mins to 90 minutes. In this study 24 patients (80%) showed radiological union within 16 weeks and 5 cases (16%) united within 24 weeks and 1 patient (4%) had implant failure due to premature weight bearing against medical advice. Average time taken for union was 18 weeks. In this study the relationship between age and mechanism of injury is observed which shown RTA as the most common mechanism of injury, followed by trivial fall and assault both in <50 years and >50 years age group (Table 8).

DISCUSSION

Surgical management of distal tibia fractures involves a challenging task due to soft tissue status and fracture pattern. Patients require a long-term follow-up and prolonged time for union. Results depends on good anatomical reduction, fracture union and better early functional mobility.¹¹ Preservation periosteal blood supply plays an important role in fracture union which can be achieved with MIPPO technique, which has less post-operative complications.¹² The study revealed average age group sustained fractures range from 18 years to 65 years.¹³ Male predominance was high due to road traffic accidents where females mainly sustained injuries due to trivial fall. This study 30 fractures of distal tibia treated with MIPPO showed overall outcome of more right-side tibia fractures were noticed compared to left ranging 70%. Functional outcome was measured using Olerud and Molander scoring system. Complications in this study showed one implant failure due to premature weight bearing, there were no post-operative infections observed and no other complication related to surgery like wound dehiscence, compartment syndrome or non-union were observed.^{14,15} Associated fibula fixation with plate osteosynthesis or rush nailing will lower the incidence of malunion for distal tibia fractures. Associated fibula fracture at same level plays a crucial role in fracture fixation, stability and post-operative union. Many shown distal fibula fracture fixation performed first to achieve good alignment. In this study routine fracture fixation was done similar to the other studies and no other secondary procedures performed. While comparing to other studies shown similar results in the age factor in relation to sex showed an average age group of 20 to 30 years with more male predominance by Bahari et al.¹⁶ The associated fibula fracture fixation shown minimal complications similar to the other studies by Kumar et al.¹⁷ High energy fractures due to RTA are the major contribution when compared to other studies shown similar results. 51% of fractures due to high energy trauma showed by Grose et al.¹⁸ Various studies shown results using various techniques where

fracture union took average time period of 16-28 weeks. In this study the union period was between 16-24 weeks (average time period was 17 weeks) as compared to Colling et al had an average time period of union of 21 weeks.¹⁹

CONCLUSION

Using MIPPO technique in LCP surgery shows a good biological advantage by preserving periosteal blood supply which is of most important concern in fracture healing. Surgery along with image intensifier also helps in fracture reduction and makes plate fixation easier. Early mobilization of patients can be achieved with rigid LCP fixation using MIPPO. Post-operative infection rate as also declined with this procedure. Complications like ankle stiffness can be reduced. Thus, authors conclude LCP plate fixation using MIPPO technique gives better radiological and functional results.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

- Collinge C, Kuper M, Larson K, Protzman R. Minimally invasive plating of high-energy metaphyseal distal tibia fractures. *J Orthop Trauma*. 2007;21(6):355-61.
- Farouk O, Krettek C, Miclau T, Schandelmaier P, Guy P, Tscherne H. Minimally invasive plate osteosynthesis and vascularity: preliminary results of a cadaver injection study. *Injury*. 1997;28(Suppl 1):A7-A12.
- Janssen KW, Biert J, Kampen A. Treatment of distal tibial fractures: plate versus nail: a retrospective outcome analysis of matched pairs of patients. *Int Orthop*. 2007;31:709-14.
- Hasenboehler E, Rikli D, Babst R. Locking compression plate with minimally invasive plate osteosynthesis in diaphyseal and distal tibial fracture: a retrospective study of 32 patients. *Injury*. 2007;38:365-370.
- Ronga M, Shanmugam C, Longo UG, Oliva F, Maffuli N. Minimally invasive osteosynthesis of distal tibia fracture using locking plates. *Orthop Clin North Am*. 2009;40(4):499-504.
- Casstevens C, Le T, Archdeacon MT, Wyrick JD. Management of extraarticular fractures of the distal tibia: intramedullary nailing versus plate fixation. *J Am Acad Orthop Surg*. 2012;20(11):675-83.
- Egol KA, Kubiak EN, Fulkerson E, Kummer FJ, Koval KJ. Biomechanics of locked plates and screws. *J Orthop Trauma*. 2004;18:488-93.
- Gao H, Zhang CQ, Luo CF, Zhou ZB, Zeng BF. Fractures of the distal tibia treated with polyaxial locking plating. *Clinical Orthopaed Related Res*. 2009;467(3):831.
- Martin JS, Marsh JL, Bonar SK, De Coster TA, Found EM. Assessment of the AO/ASIF fracture classification for the distal tibia. *J Orthop Trauma*. 1997;11:477-83.
- Olerud C, Molander H. Scoring scale for symptom evaluation after ankle fracture. *Arch Orthop Trauma Surg*. 1984;103(3):190-4.
- George W, Wood II. General principles of fracture treatment. Terry Canale in *Campbell's Operation Orthopaedics*, 10th edition, St. Louis, Mosby; 2000:2671.
- Helfet DL, Shonnard PY, Levine D, Borrelli J. Minimally invasive plate osteosynthesis of distal fractures of the tibia. *Injury*. 1999;28:S-A42-S-A48.
- Mushtaq A, Shahid R, Asif M, Maqsood M. Distal tibial fracture fixation with locking compression plate (LCP) using the minimally invasive percutaneous osteosynthesis (MIPO) technique. *European J Trauma Emerg Surg*. 2009;35(2):159-64.
- Teeny S, Wiss DA, Hathaway R. Tibial plafond fractures, errors, complication and pitfalls in operative treatment. *Orthop Trans*. 1990;14:265.
- Dillin L, Slabaugh P. Delayed wound healing, infection, and non union following open reduction and internal fixation of tibial plafond fractures. *J Trauma*. 1986;26:1116-9.
- Bahari S, Lenehan B, Khan H, Mcelwain JP. Minimally invasive percutaneous plate fixation of distal tibia fractures. *Acta Orthop Belg*. 2007;73:635-40.
- Vassilios S. MIPPO. An Update *Current Orthopaedics*. 2008;22(3):202-782.
- Deepak K, Ganesan GR, Phagal VV. Minimally invasive plate versus intramedullary interlocking nailing in distal third tibia fractures. *J Dent Med Sci*. 2014;3:15-7.
- Grose A, Garden MJ. Open reduction and internal fixation of tibial pilon fractures using a lateral approach. *J Orthop Trauma*. 2007;21:530-7.
- Cory C, Protzman R. Outcomes of minimally invasive plate osteosynthesis for metaphyseal distal tibial fractures. *J. Orthop Trauma*. 2010;24:24-9.

Cite this article as: Vikranth PS, Varenya NV. A prospective study of distal 1/3rd tibia fracture treated using locking compression plate by minimally invasive percutaneous plate osteosynthesis technique. *Int J Res Orthop* 2020;6:951-5.