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Functional Outcomes in Patients After Minimally Invasive Percutaneous Plate Osteosynthesis with Locking Compression Plate for Distal Tibia Fracture

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ABSTRACT
Distal tibial fractures are often caused by high-energy axial compression and rotational forces. Operative treatment is typically required for these fractures, with Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) using Locking Compression Plates (LCP) emerging as a promising alternative. This technique respects the biology of the distal tibia and fracture hematoma, offering a biomechanically stable construct. To assess the functional outcomes and time to union in patients undergoing MIPPO with LCP for distal tibial fractures. This prospective study included 50 patients with distal third tibial fractures, classified according to the AO/OTA system, treated with MIPPO and LCP at our institution between 2023 and 2024. Patients were followed up for a mean duration of 6 months. Functional outcomes were assessed using the Olerud and Molander scoring system. All 50 fractures united with an average time to union of 18 weeks. 4 patients developed ankle stiffness and 4 others experienced superficial infections, which were successfully treated with oral antibiotics. No fixation failures were observed. MIPPO with LCP is an effective treatment for distal third tibial fractures in adults, especially when intramedullary nailing is not suitable. This technique offers lower complication rates compared to open reduction and plating, making it a preferred choice for managing these fractures.

INTRODUCTION

Distal tibia fractures represent about 1-10% of all lower extremity fractures[1]. Conservative treatment by cast application lead to prolonged immobilization, leading to ankle and knee stiffness affecting quality of life of the patient[2]. Conventional osteosynthesis is not suitable because distal tibia is subcutaneous bone with poor vascularity. Closed reduction and minimally invasive plate osteosynthesis (MIPPO) with locking compression plate (LCP) has emerged as an alternative treatment option because it respects biology of distal tibia and fracture hematoma and also provides biomechanically stable construct. For the past decade, plating using fracture reduction has been successful in treating complex fractures of the lower extremity especially distal tibia. The goal of this technique is to apply stable plate fixation while maintaining the fracture biology and minimizing soft tissue problems[3-5]. Recently, there has been an increasing trend toward use of a locking plate for treatment of complex fractures of the distal part of the tibia[6,7]. Compared with a conventional plate, a locking plate imparts a higher degree of stability and better protection against primary and secondary losses of reduction and minimization of bone contact[8,9]. Locking plates have the biomechanical properties of internal and external fixators, with superior holding power because of fixed angular stability through the head of locking screws[10]. The locking compression plate (LCP) is a part of plate and screw system that merges locking screw technology with conventional plating techniques. The locking compression plates have combination locking and compression holes (combi holes). The combi holes allow placement of standard cortex and cancellous screws on one side or threaded cortical screws on the opposite side of each hole. Biological fixation principles advocate realigning by manipulation at a distance to fracture site, leaving comminuted fragments out of the mechanical construct, preserving soft tissues with limited operative exposure[11]. Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) is one such method in which percutaneously inserted plate is fixed at a distance proximal and distal to the fracture site through minimal exposure. The basic principles of this technique include indirect closed reduction, extraperiosteal dissection, anatomic alignment and relative stability which permit limited motion at the fracture site and create secondary bone healing with callus formation.

MATERIALS AND METHODS

This is a prospective study. 50 patients with extra articular and intra articular fractures of distal third tibia classified according to AO/OTA classification admitted to Alluri Sita Ramaraju Academy of Medical Sciences, Eluru from the September 2023-September 2024 had undergone minimally invasive percutaneous plate osteosynthesis technique for distal tibia fractures. There were 40 males and 10 females with an average age of 50 years (24-70 years). Patients were followed up post operatively for a mean duration of 6 months and functional outcome was evaluated as per the Scoring System of Olerud and Molander[12]. All adults age >18 years were included in the study and simple fractures unfavourable for interlocking nailing and complex fractures of lower third tibia were included in the study. Patients were subsequently followed up 3rd, 6th, 12th week and then every monthly till 6 months post surgery to assess fracture healing. Partial weight bearing was started once callus was visible in X ray and gradually increased according to clinical and radiological signs of fracture healing. Fracture was considered united when visible bridging callus was seen in at least three cortices in anterior-posterior and lateral x rays of leg and absence of pain on weight bearing clinically.

RESULTS AND DISCUSSIONS

The age of patients ranged from 24-70 years with the fracture being most common in 5th and 6th decade and an average of 52.4 years (Table1).

Table 1: Showing Age Distribution

Age	No. Of Patients	Percentage
21-30	2	4
31-40	6	12
41-50	14	28
51-60	16	32
61-70	12	24
Total	50	100

Out of 50 patients, 40 (80%) were males and 10 (20%) were females., the male preponderance was because of outdoors and fieldwork among male population. There were 28 (56%) patients with right sided distal tibia fractures and 22 (44%) patients with left sided tibial fractures. In this study 38 patients (76%) sustained injury due to road traffic accidents and 12 patients (24%) due to self fall (Table 2).

Table 2: Showing Mode of Injury

Mode of injury	No. of patients	Percentage
RTA (high energy trauma)	38	76
Self fall (low energy trauma)	12	24
Total	50	100

The fracture patterns were classified on the basis of AO/OTA classification. Out of the 50 cases studied, 16 (32%) were 43A1, 14 (28%) were 43A2, 8 (16%) were 43A3, 4 (8%) were 43B1, 6 (12%) were 43B2 and 2 (4%) was 43B3 (Table 3).

Table 3: Showing Fracture Pattern

Type	No. of Patients	Percentage
A1	16	32
A2	14	28
A3	8	16
B1	4	8
B2	6	12
B3	2	4
C1	-	-
C2	-	-
C3	-	-

There were 36 cases of associated injuries out of which 28 cases were distal third fibula fractures among which 6 were treated conservatively[10], were treated with rush nailing and 6 were treated with plating. 6 were middle third fibula fractures which were treated conservatively and 2 were distal third fibula fracture with acetabulum fracture which were treated conservatively. All patients were operated at an average of 5.2 days from the time of arrival to hospital ranging from 3-12 days (Table 4).

Table 4: Showing Time Between Arrival and Surgery

Time duration	No. of patients	Percentage
Within 6 hours	0	0
1-5 days	30	60%
>5 days	20	40%

All patients were taught static quadriceps exercises from the 1st postoperative day. The above knee Plaster of Paris slab was converted to below knee Plaster of Paris slab support at the time of suture removal and was started on knee physiotherapy. Non-weight bearing was continued till 14-20 weeks until fracture union was seen radiologically. Patients were followed up 3rd, 6th, 12th week and then every monthly till 6 months post surgery. During every follow up patients were checked for range of movements at ankle and knee and both objective and subjective scores were recorded along with recording of radiographs. All the fractures united at an average of 19.6 weeks (16-24 weeks). There were 4 cases of delayed union with 24 weeks of radiological callus formation (Table 5).

Table 5: Showing Duration of Fracture Union

Duration (In Weeks)	No. of patients	Percentage
16	10	20
18	10	20
20	14	28
22	12	24
24	4	8
Total	50	100

There were 4 cases of superficial skin infection, which were treated with alternate day dressing and antibiotics according to pus culture and sensitivity. The wounds healed uneventfully. Post operatively, 2 patients developed malleolar skin irritation owing to hardware prominence. There were 4 cases of ankle stiffness occurring as a delayed complication most probably owing to longer periods of immobilization in these patients. There were 2 cases of varus angulation, of <5 degrees. It was insignificant clinically and patient did not report any complication. Varus angulation was attributed to communition along the medial wall of distal tibia (Table 6). The objective and subjective evaluation was done as per the scoring system of Olerud and Molander 12, 12 patients scored 90, 20 patients scored 85, 6 patients scored 80, 2 patients scored 75 (Table 6,7).

Table 6: Complications

Complications	No. of Patients	Percentage
Superficial skin infection	4	8
Ankle stiffness		
1.>75%	0	0
2.50-75%	0	0
3.25-50%	2	4
4.<25%	2	4
Varus mal-alignment	2	4
Malleolar skin irritation	2	4

Table 7: Objective Data Table

Rating	No. of Patients	Percentage
Excellent	16	32
Good	22	44
Fair	10	20
Poor	2	4

Table 8: Subjective Data Table

Rating	No. of Patients	Percentage
Excellent	16	32
Good	24	48
Fair	10	20
Poor	0	0

Fig. 1: Depicting Pre-Operative Radiograph, Immediate Post-Operative Radiograph and Radiograph After 6 Months Follow Up

Distal diametaphyseal tibia fracture with or without intra articular extension is one of the difficult fractures to manage. None of the available treatment options fully meet the requirements for the fracture characteristics of distal diametaphyseal tibia. Distal tibia has got circular cross sectional area with thinner cortex as compare to triangular diaphysis with thicker cortex. So, intramedullary nail which is designed for tight interference fit at diaphysis cannot provide same

stability at distal fracture. Other potential complications of IMIL nailing are malunion (0-29%) and implant failure (5-39%)[13]. Open reduction and internal fixation (ORIF) with conventional plate which needs striping of periosteum is also not an ideal treatment option because tibia is subcutaneous bone and periosteum provides two thirds of blood supply. Non-union, delayed union and infection are reported with ORIF with plating[14,15]. Similarly external fixators as a definitive method of treatment for distal diametaphyseal tibia fracture are also reported with higher rate of infection, implant failure and malunion or non-union and hence recommended only for temporary method of stabilization in open fracture with severe soft tissue injury[10]. With the development of technique of MIPPO with LCP, which preserve extra osseous blood supply, respect osteogenic fracture haematoma, biologically friendly and stable fixation is available for distal tibia fracture. Indirect reduction method and sub-cutaneous tunnelling of the plate and application of locking screws with small skin incisions in MIPPO technique prevents iatrogenic injury to vascular supply of the bone[15]. Unlike conventional plates, LCP is a friction independent self stable construct which provides both angular and axial stability and minimizes risk of secondary loss of reduction through a threaded interface between the screw heads and the plate body. In spite of use of MIPPO with LCP as internal external fixators, anatomical reduction of the fracture by using indirect reduction manoeuvres before applying the plate is very important surgical step. Malreduction and suboptimal pre contouring of the plate can result delayed union, non union, prominent hardware, malleolar skin irritation and pain. Low profile metaphyseal LCP have been designed to reduce the hardware prominence related complications. Indirect reduction of fracture under C arm control can be difficult on a few occasions. 3mm k wires and reduction forceps were used to facilitate proper reduction in difficult cases. None of the cases required calcaneal pins or mechanical distracters. Concomitant fibula fracture also play the role in success of reduction especially when fracture is at same level of tibia. Some authors recommend fibula fixations before tibia fixation to achieve better tibial alignment and to prevent valgus malalignment, no clear indication or protocol exists as far as fibula fracture fixation is considered. MIPPO technique can restore alignment in high velocity distal diametaphyseal tibia fracture and patients can expect predictable return of function. The present study was under taken to determine the efficacy of the locking compression plates in treatment of the fractures of the distal tibial metaphysis using MIPPO technique. We evaluated our results and compared them with those obtained by various other studies utilizing different modalities of treatment, our analysis is as follows.

Age Distribution: Our study revealed the average age of patients with such injuries to be 52.4 years (24-70) which is higher than the studies by Cory Collinge[13] and Heather A Vallier[14] in which they had average age of 43 years and 39.1 years respectively.

Mechanism of Injury: Cory Collinge[13] observed 100% high-energy fractures in his study. Heather AVallier[14] could attribute only 51% of injuries to high energy trauma. However, our present study has 76% of injuries due to high energy trauma and 24% due to low energy trauma.

Fracture Patterns: The present study could not be compared with the other studies because the cases we encountered were extra-articular and partial articular in nature. However, study by Cory Collinge[13] showed 16% C1, 32% C2 and 24% C3. Heather AVallier[14] also had fractures 31% A, 21% B, 44% C. We had only 43 A and 43 B type of fractures which were fixed with LCP by MIPPO technique.

Duration of Fracture Union: The average time for fracture union in various studies conducted using various methods was 16-28 weeks. Our study had an average fracture union of 19.6 weeks, which were comparable with studies conducted using the locking compression plates. Cory Collinge[13] had an average fracture union of 21 weeks and Hazarika[14] had an average of 19.3 weeks.

CONCLUSION

The management of distal tibia fractures can be challenging because of the scarcity of soft tissue, their subcutaneous nature and poor vascularity. The timing of surgery should be optimized to allow the soft tissues to stabilize and to minimize the severe postoperative wound problems often associated with the surgical management of these complex fractures. Fractures of the distal tibia treated with closed reduction with locking compression plate by MIPPO technique result in effective stabilization and provide early motion. The greatest advantage of the MIPPO technique is the ability to reduce surgical tissue trauma and help to preserve the periosteal vascularity and osteogenic fracture hematoma which helps in fracture healing. Fractures of distal third are known for delayed union and malunion because of the precarious blood supply in this area and the MIPPO technique preserves the blood supply and thereby helps the fracture union. It is also effective in extra articular fractures occurring within 5cm of the joint where intramedullary nails

often cannot provide enough stability. It is a simple, has a rapid and straight forward application and has a reduced surgical time in more extra articular fractures and intra articular fractures due to newer anatomically contoured locking compression plates for the distal end tibia fractures. Further studies encompassing a larger group of patients with more varied fracture patterns and a longer follow up are required to know the efficacy of LCP using MIPPO technique to treat such fractures.

REFERENCES

1. Sirkin, M. and R. Sanders, 2001. THE Treatment of Pilon Fractures. Orthopedic Clin. North Am., 32: 91-102.
2. Charnley J., 1999. The closed treatment of common fractures. Cambridge. Colt Books Ltd., Vol.
3. Collinge, C. and R. Protzman, 2010. Outcomes of Minimally Invasive Plate Osteosynthesis for Metaphyseal Distal Tibia Fractures. J. Orthop. Trauma, 24: 24-29.
4. Collinge, C., R. Sanders and T. DiPasquale, 2000. Treatment of complex tibial periarticular fractures using percutaneous techniques. Clin. Orthop. Related Res., 375: 69-77.
5. Shrestha, D., B.M. Acharya and P.M. Shrestha, 2011. Minimally Invasive Plate Osteosynthesis with Locking Compression Plate for Distal Diametaphyseal Tibia Fracture. Kathmandu Uni. Med. J., 9: 62-68.
6. Namazi H. and K. Mozaffarian., 2007. Awful considerations with LCP instrumentation: a new pitfall. Arch Orthop Trauma Surg., 127: 573-575.
7. Hasenboehler, E., D. Rikli and R. Babst, 2007. Locking compression plate with minimally invasive plate osteosynthesis in diaphyseal and distal tibial fracture: A retrospective study of 32 patients. Injury, 38: 365-370.
8. Kääb, M.J., A. Frenk, A. Schmeling, K. Schaser, M. Schütz and N.P. Haas, 2004. Locked Internal Fixator. J. Orthop. Trauma, 18: 488-493.
9. Egol, K.A., E.N. Kubiak, E. Fulkerson, F.J. Kummer and K.J. Koval, 2004. Biomechanics of Locked Plates and Screws. J. Orthop. Trauma, 18: 488-493.
10. Ronga, M., C. Shanmugam, U.G. Longo, F. Oliva and N. Maffulli, 2009. Minimally Invasive Osteosynthesis of Distal Tibial Fractures Using Locking Plates. Orthopedic Clin. North Am., 40: 499-504.
11. Hazarika, S., J. Chakravarthy and J. Cooper, 2006. Minimally invasive locking plate osteosynthesis for fractures of the distal tibia-results in 20 patients. Injury, 37: 877-887.
12. Olerud, C. and H. Molander, 1984. A scoring scale for symptom evaluation after ankle fracture. Arch. Orthop. Traumatic Surg., 103: 190-194.
13. Vallier, H.A., T.T. Le and A. Bedi, 2008. Radiographic and clinical comparisons of distal tibia shaft fractures (4 to 11 cm proximal to the plafond): Plating versus intramedullary nailing. J. Orthop. Trauma, 5: 307-331.
14. Borrelli, J., W. Prickett, E. Song, D. Becker and W. Ricci, 2002. Extraosseous Blood Supply of the Tibia and the Effects of Different Plating Techniques: A Human Cadaveric Study. J. Orthop. Trauma, 16: 691-695.