

Outcome of Distal Tibia Fractures Treated with Minimally Invasive Percutaneous Plate Osteosynthesis

Mahammadarif Khatri

Alipura, Bodeli, District-Chhota Udepur, Gujarat, India, Pin No. 391135

Abstract: *The management of distal Tibia fractures has been a great challenge to orthopaedic surgeons due to soft tissue damage, extensive comminution, intra-articular extension and lack of vascularity. Fifty adult patients treated by anterolateral 3.5mm distal Tibial LCP by MIPPO technique between December 2014 and July 2017 were included in the study. The radiological outcome was assessed by Tenny and Wiss score and the functional outcome by AOFAS scale. Of the 50 patients in the study, 36 were males and 14 were females. The mean age was 49.32 years (range: 21-75 years). The majority of cases were AO type 43A3 (36%). Complete fracture union was achieved by 21 weeks (14-30 weeks). At final follow up 18 fractures united with no angulation at fracture site while 1 united in valgus (<10 degree) and 1 varus (<5 degree) and 3 in sagittal angulation (<10° angulation in both) which were consistent with an acceptable limits. Then mean AOFAS score was 79.16 after 8 months, with 26 cases having excellent outcome, 14 good, 8 acceptable and 2 cases with bad outcome. The complications in this study were angular deformity -8, Infection -6, non-union -4, implant breakage -2. Anterolateral distal Tibial plating by MIPPO technique gives good functional and radiological outcome with advantage of minimal soft tissue dissection without stripping the periosteum and preventing subsequent devascularisation of fracture fragments but it requires a long learning curve. Thus we conclude that anterolateral distal Tibial locking plate is a good option for managing the distal Tibial fractures.*

Keywords: distal tibia fractures

1. Introduction

Plafond fractures are a result of impaction of talus on the distal tibia. (1) These fractures account for 1% to 10% of all lower extremity injuries. (2) Treatments of these fractures remain challenging (2) due to the precarious vasculature around the distal tibia. Subcutaneous location of the tibia adds to wound complications.

Low energy fractures occur in older age group due to rotation injury resulting in extra articular fracture without much soft tissue injury with fewer incidences of wound complications and infection. (3) The most important variables that affected the final clinical result are the type of fracture, associated soft tissue injury, method of the treatment and quality of reduction.

Conservative treatment of these fractures quite often results in a number of complications including malunion, nonunion and ankle stiffness. 4, 5) Indications for minimally invasive plate osteosynthesis of distal fractures include displaced fractures involving the tibial plafond and those unstable fractures too distal for safe stabilization with intramedullary nails.

Numerous classifications have been proposed for these fractures; however AO-OTA alpha numeric classification is the most comprehensive and commonly quoted classification. This led to change in the philosophy of treating such injuries. Currently, two methods are gaining popularity. One method is wire fixators, which is useful for highly comminuted fractures with significant soft tissue damage. Other is MIPO technique (Minimal invasive plating osteosynthesis) when there is minimal articular comminution and the soft tissue envelope is minimally damaged. Minimally invasive techniques

maintain alignment without compression; the operative exposure and soft tissue stripping are minimized with vascular pedicle preserved throughout. Traditionally, these difficult fractures have been managed by open reduction and rigid internal fixation with a compression plate. A high rate of good to excellent results has been reported. (6) However, this technique has not produced consistent outcomes and has a high incidence of complications, including infection, poor wound healing and non-union. (7)

Conventional plate osteosynthesis with open reduction can therefore further devitalize fragments and lead to higher incidence of nonunion, infection and implant failure. (8) Therefore, minimally invasive osteosynthesis, if possible, offers the best possible option as it permits adequate fixation in a biological manner. (9, 10) Locking plates (LPs) have the biomechanical properties of internal and external fixators, with superior holding power because of fixed angular stability through the head of locking screws, independent of friction fit. (11) This present study describes the minimally invasive technique and its usefulness in distal tibial fractures.

2. Materials & Methods

This Prospective study was conducted from 1st December 2014 to 31st July 2017 at department of orthopaedics, Mgm medical college & hospital, Navi Mumbai. There were totally 50 patients of which 36 were males and 14 were females. All the patients were selected based on a strict inclusion and exclusion criteria. Inclusion criteria were skeletally mature patients, AO type 43 A, B and C fractures, closed fractures, grade one and two open fractures. Exclusion criteria were grade III C compound fractures with bone loss, associated tarsal fractures,

associated spinal and abdominal injuries, pathological fractures, bed ridden patients, patients with neurological

disorder, psychiatric and pregnant patients. The fracture distribution is illustrated in Table 1.

Objective Criteria

Rating	Ankle/ subtalar motion	Tibiotalar alignment	Tibial shortening	Chronic swelling	Pronation/ supination	Equines deformity
Excellent	> 75% normal	Normal	None	None	Normal	None
Good	50-75%	Normal	None	Minimal	Normal	None
Fair	25-50%	<5° angulation	< 1cm	Moderate	Moderate decrease	None
Poor	< 25%	>5° angulation	> 1cm	Severe	Marked decrease	Present

Subjective Criteria

Rating	Pain	Return to work	Recreational activity	Limited walking	Pain medication	Limp
Excellent	None	Same work	Normal	No	None	None
Good	Mild	Same work	Mild modification	No	None	None
Fair	Moderate	Modified	Significant modification	Yes	Non narcotic	Occasional
Poor	Severe	Unable	None	Yes	Narcotic	Yes

Table 1: Fracture distribution

Sex	MALE	36	50
	FEMALE	14	
Side	RIGHT	24	50
	LEFT	26	
Mode of Injury	SLIP AND FALL	14	50
	RTA	30	
	FALL FROM HIEGHT	6	
Fracture Type	CLOSED	30	50
	GRADE 1	12	
	GRADE 2	8	
Age Distribution	18-20 YR	2	50
	31-40 YR	14	
	41-50 YR	6	
	51-60 YR	20	
	61-70 YR	6	
AO Classification	>70YR	0	50
	A1	16	
	A2	4	
	A3	12	
	C1	8	
	C2	7	
Total No. of Patient	C3	5	50

Detailed clinical and radiological examination was carried out in all patients in orthopaedic emergency-Trauma Ward/ OPD. Ankle Mortise views were taken if malleolar fractures or ankle joint injuries were suspected. A 3D CT scan may be required to asses any intra-articular fractures. Most of the patients were immobilized with above knee slab and some were given calcaneal pin traction if severe swelling and blisters were present as well as for compound fractures till wound has healed. Patients were taken up for surgery after the initial swelling and blisters have resolved and afte the appearance of wrinkle sign. The average period from time of admission to surgery was 12 days.

All patients were operated under spinal anaesthesia with patient supine, affected leg elevated on a pillow, on a Radiolucent table with a tourniquet. In all cases a medial approach to distal tibia was used. A vertical incision starting from medial malleolus was made. Incision was deepened until periosteum. Periosteum was preserved. A submuscular epiperiosteal tunnel was created using blunt tip of the LCP. Fracture reduction was done indirectly or directly under the guidance of image intensifier and plate was temporarily stabilized by k-wire. Then distal locking and proximal Locking was done. Fibula was not fixed unless it was involved at level of syndesmosis. Postoperatively limb was immobilized in above knee POP slab. All patients were mobilized with standard walking frame with nonweight bearing on operated limb from the first postoperative day under supervision of the

physiotherapist and the Partial weight bearing was started once callus was visible on x-ray and gradually increased according to clinical and radiological signs. Follow up was done at 6 weeks, 12 weeks, 6 months and 1 year.

Functional and Radiological Outcome:

The American Orthopaedic Foot & Ankle Society (AOFAS) scale was used in our study to assess the functional outcome. This scale consists of subjective and objective variables classified into three major categories: pain (40 points), function (50 points), and alignment (10 points).

Total Score Functional Outcome

- Above 89 points Excellent
- From 80 to 89 points Good
- From 70 to 79 points Acceptable
- Less than 69 points Bad

Radiologically acceptable outcomes includes the fracture union with <5° of angulation in both sagittal and coronal plane, 1cm shortening, with articular step less than 2mm. We have used the Tenny and Wiss (12) score to assess quality of post-operative reduction.

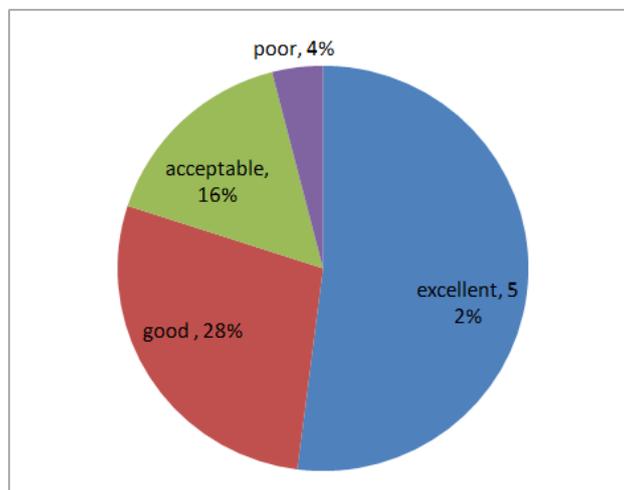
Table 2: Teeny and Wiss radiological score

ANATOMICAL SITE QUALITY OF REDUCTION	SCORE		
	1	2	3
Lateral malleolus displacement	0-1 MM	2-5 MM	5 MM
Medial malleolus displacement	0-1 MM	2-5 MM	5 MM
Posterior malleolus displacement	0-0.5 MM	0.5-2 MM	2 MM
Mortise widening	0-0.5 MM	0.5-2 MM	2 MM
Fibular widening	0-0.5 MM	0.5-2 MM	2 MM
Tallar tilt	0-0.5 MM	0.5-2 MM	2 MM
Articular gap	0-0.5 MM	0.5-2 MM	2 MM

Final Score	Radiological Outcome
9	Anatomic
10 – 12	Good
13 - 16	Fair
> 16	Poor

Functional Outcome

Results	No. of cases	Percentages
Excellent	26	52
Good	14	28
Fair	8	16
poor	2	4

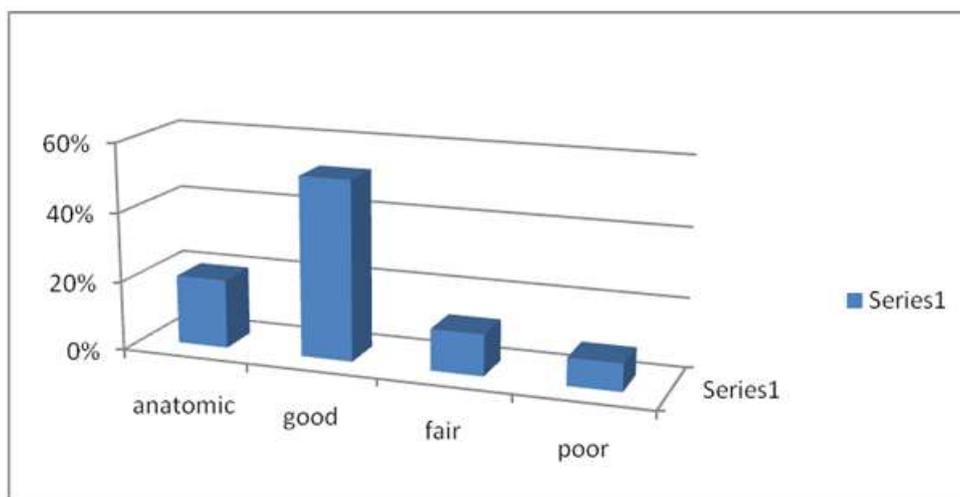


Tiney and Wiess Radiological Outcome

Teeny and Wiss score (Radiological outcome)	outcome	No. Of cases
9	ANATOMIC	10
10 - 12	GOOD	26
13 - 16	FAIR	6
>16	POOR	8

Teeny and Wiss score (Radiological outcome)	Percentage
ANATOMIC	20%
GOOD	52%
FAIR	12%
POOR	16%

Tiney and Wiess Radiological Outcome in Our Study



Tiney and Wiess Radiological Outcome Graphical Presentation

3. Discussion

Distal diaphyseal tibia fracture with or without intra articular extension is one of the difficult fractures to manage. None of the treatment options available perfectly fulfill requirements of fracture characteristics of distal diaphyseal tibia. Distal tibia has got circular cross sectional area with thinner cortex as compared 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 and implant failure. ORIF with conventional plate which needs stripping of periosteum is also not an ideal treatment option because tibia is subcutaneous bone and periosteum provides 2/3 rd of blood supply.

Similarly external fixators as a definitive method of treatment for distal diaphyseal tibia fracture are also reported with higher rate of infection, implant failure and malunion or nonunion and hence recommended only for temporary method of stabilization in open fracture with severe soft tissue injury.

Conservative management should be reserved for undisplaced fractures and in those patients with absolute

contraindications to surgery. Disadvantages of nonoperative treatment include non-union, malunion, post traumatic stiffness of ankle due to prolonged immobilization with subsequent reflex sympathetic dystrophy. Surgical management includes plate and screw fixation - DCP/LCP by ORIF or MIPPO technique. Intramedullary nails like regular interlocking nails and specialized expert Tibial nail can be used. External fixation devices like ring fixators, ankle sparing/spanning, delta frame fixators and hybrid fixator or combinations of the above are used. The advantages of MIPPO are biological reduction, reduced duration of surgery, lesser tourniquet time and smaller incision.

Results of operative treatment depend on the severity of the initial injury, the quality of bone and soft tissue, stability of the reduction, the degree of comminution and articular incongruity.

The mean age of the patients in our study was 45.44 years and the most common mechanism of injury was road traffic accidents. The mean duration from the time of trauma to surgery was 12 days and in another study by Collinge C, et al (12) the same interval was 7 days. Most cases were managed by definitive anterolateral plating as single stage surgery.

In those cases with grade I and grade II compound fractures initial calcaneal pin traction and in two cases

delta frame external fixator for soft tissue healing were applied. Later all patients were taken up for definitive fixation by MIPPO technique. Of the 50 cases 10 cases had fibula fracture at the supra syndesmotom level for which internal fixation of fibula was not done, 16 cases with grade I and grade II compound fracture were fixed with k wire and remaining 24 cases with fracture at trans-syndesmotom and infra-syndesmotom level was fixed using 1/3rd tubular plate. We achieved postoperative anatomical alignment in 80% with less than 5 degrees of angulation in coronal and sagittal plane and 1 cm of shortening. Mean duration of surgery was 80 min and average intra operative blood loss was 200ml.

Hazarika et al, in a series of 20 patients treated with minimally invasive LCP for fractures of distal tibia had 87.5% of good to excellent result and concluded that this approach preserves bone biology and minimize surgical soft tissue trauma. (13)

Rongo et al, studied 19 cases of distal tibia fractures, with MIPPO method and concluded that with high rate of union and low rate of complications, LCP by MIPPO is a reasonable alternative for treating distal tibia fractures. (14)

Ozkaya et al, in a retrospective review of 22 patients with distal third tibial fractures treated with titanium locking compression plates found that this technique resulted in prolonged secondary healing with 81% good to excellent results. However with non-locking contoured plate, they observed shorter healing time due to relative stability. (15)

4. Conclusion

With all currently available treatment options, distal diaphyseal tibial fracture with or without intra articular extension is one of the difficult fractures to manage. Before selection of fixation method, fracture pattern, concomitant articular extension, condition of soft tissue are important factors to be considered. The present case series though small in number shows that MIPPO with LCP is an effective treatment method with high percentage of union and low rate of complications by preserving most of the osseous vascularity, fracture haematoma and thus providing for a more biological repair.

References

- [1] Rockwood and Green's, "Fracture in adults" 7th edition, chapter 56, 1928-29.
- [2] Campbell's Operative Orthopaedics, Twelfth Edition, S. Terry Canale, MD, Harold B. Boyd Professor and Chair, Department of Orthopaedics Surgery, University of Tennessee- Campbell Clinic Memphis, Tennessee, James H. Beaty, MD, Professor, Department of Orthopaedic Surgery, University of Tennessee- Campbell Clinic, Chief of Staff, Campbell Clinic Memphis, Tennessee.
- [3] Schatzker J, Tile M, The rationale of operative fracture care, 3rd edition: p 475-76.

- [4] Digby JM, Holloway GM, Webb JK. A study of function after tibial cast bracing. *Injury*. 1983; 14 (5):432-9.
- [5] Ruedi T, Webb JK, Allgower M. Experience with the dynamic compression plate (DCP) in 418 recent fractures of the tibial shaft. *Injury*. 1976;7 (4):252-7.
- [6] Schutz M, Sudkamp NP. Revolution in plate osteosynthesis: New internal fixator systems. *J Orthop Sci*. 2003;8 (2):252-8.
- [7] Fisher WD, Hamblen DL. Problems and pitfalls of compression fixation of long bone fractures: A review of results and complications. *Injury*. 1978;10 (2):99-107.
- [8] Hazarika S, Chakravarty J, Cooper J. Minimally invasive locking plate osteosynthesis for fractures of the distal tibia – results in 20 patients. *Injury*. 2006;37 (9):877-87.
- [9] Redfern DJ, Syed SU, Davies SJ. Fractures of the distal tibia: minimally invasive plate osteosynthesis. *Injury*. 2004;35 (6):615-20.
- [10] Ronga M, Shanmugam C, Longo UG, Olivia F, Maffulli N. Minimally invasive osteosynthesis of distal tibial fractures using locking plates. *Ortho Clin North Am*. 2008;40 (4):499-504
- [11] Deniz GÜLABİ, 1 Özgür TOPRAK, 1 Cengiz EN, 2 Cem Coşkun AVCI, 1 Erkal BİLEN, 3 Fevzi SAĞLAM The mid-term results of treatment for Tibialpilon fractures, *Turkish Journal of Trauma & Emergency Surgery: Ulus Travma Acil Cerrahi Derg* 2012;18 (5):429-435.
- [12] Collinge C, Kuper M, Larson K, Protzman R "Minimally Invasive Plating of High-Energy Metaphyseal Distal Tibia Fractures". *J Orthop Trauma*; 21 (6):355-360.
- [13] Hazarika S, Chakravarty J, Cooper J. Minimally invasive locking plate osteosynthesis for fractures of the distal tibia – results in 20 patients. *Injury*. 2006;37 (9):877-87.
- [14] Ronga M, Longo UG, Maffulli N. Minimally invasive locking plating of distal tibia fractures is safe and effective. *Clin Orthop Relat Res*. 2010;468 (4):975-82
- [15] Ozakaya U, Parmakszoglu AS, Gul M, Sokucu S, Kabukcuoglu Y. Minimally invasive treatment of distal tibial fractures with locking and non locking plates. *Foot Ankle Int*. 2009;30 (12):1161-7