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Dr. Rajesh V Chawda
Associate Professor, Department
of Orthopaedics, Smt SCL
General Hospital And NHL
Medical College, Ahmedabad,
Gujarat, India

Dr. Vijay J Patel
Post-Graduate Resident,
Department of Orthopaedics,
Smt SCL General Hospital and
NHL Medical College,
Ahmedabad, Gujarat, India

Dr. Vatsal Y Patel
Post-Graduate Resident,
Department of Orthopaedics,
Smt SCL General Hospital and
NHL Medical College,
Ahmedabad, Gujarat, India

Functional outcome of distal tibia fractures managed with anatomical locking plates

Dr. Rajesh V Chawda, Dr. Vijay J Patel and Dr. Vatsal Y Patel

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Abstract

Background: Distal tibia fractures accounts for almost 10% of all tibial fractures. This injury is most frequent in middle aged group probably resulting due to high energy trauma. Optimal fixation with due respect to scarce soft tissue envelope is one of the important succeeding factor in the management.

Material and Methods: We studied 25 cases of distal tibial fractures presented to our institution between June 2016 to Aug 2018. All cases treated with plate osteosynthesis as a definitive fixation with standard medial approach for ORIF and with MIPPO wherever feasible.

Results: our study included Twenty Five patients of distal tibia fracture treated with distal tibia locking plate with minimum follow up of three months and maximum follow up of two years. This study observed patients with minimum age of 27 years and maximum age of 66 years with a mean age of 45 years where maximum numbers of patient in age group 46-60 years. Out of 25 patients 23 were male and two patients were female. Functional outcome measured using AOFAS SCORE where 14(56%) patients showed excellent results, 5(20%) patients showed good results, 5(20%) patients showed fair results and 1(4%) patient had poor results shown.

Conclusions: Selection of appropriate operative methods to address this injury is crucial part in the management. Minimal soft tissue handling and stable internal fixation in order to achieve early rehabilitation protocol with lesser soft tissue related complications.

Keywords: distal tibia fractures, MIPPO, distal tibial anatomical locking plates, AOFAS score

Introduction

Distal tibial fractures is one of the most complex injuries involving the ankle joint, accounting for approximately 7% of all tibial fractures. They are also known as “Pilon” or “Plafond” fractures in various literatures ^[1, 4]. Fracture distal tibia involve fracture in distal diaphyseal, metaphyseal, intraarticular region of tibia fracture, distal fibula with or without syndesmosis joint injuries and with or without medial malleolus injury ^[3].

Increase in high velocity road traffic accidents especially two wheelers, have been leading to an increased incidence of complex fractures of the distal tibia which has made their treatment all the more difficult. It may present as isolation but also seen frequently in polytraumatized patients associated with marked metaphyseal and articular comminution, wide displacement, chondral impaction, associated fibular fracture and articular debris ^[1].

Treatment of the fractures of distal tibia is a challenging task because of many reasons. With less soft tissue coverage over the bone, comminution of weight bearing articular surface of distal tibia high chances of nonunion. (5% to 6.6 %). Open injuries are often difficult to manage with primary internal fixation ^[5].

Considerable advances in the method of internal fixation and new Innovations in implants and operative techniques have helped to meet such difficulties. The surgical management of distal tibial fractures has evolved over the past years in a large part due to an improved understanding of the importance of the soft tissue envelope. The ultimate goals of distal tibia fractures are restoring anatomic articular surface, maintaining joint stability, Restoring mechanical alignment, Achieving fracture union, Regaining functional and pain free weight bearing and motion while avoiding complications ^[2].

At present era innovations of newer precontoured anatomical locking plates with specifications like low profile, locking combinations hole with undercuts,

Correspondence

Dr. Rajesh V Chawda
Associate Professor, Department
of Orthopaedics, Smt SCL
General Hospital And NHL
Medical College, Ahmedabad,
Gujarat, India

optimal distal application of head screw and also availability of guiding blocks with advances in operative technique like MIPPO (minimal invasive percutaneous plate osteosynthesis) has improved the bony fixation, preserved the vascularity and surrounding soft tissue so that overall outcome can be improved [5].

In this study an attempt has been made to evaluate the results of fractures of distal tibia fixed with distal tibia locking plate in terms of fracture type, modality of treatment used, duration of union time and extent of functional outcome to the patient and compare those results with other study results.

Materials and Methods

We included Twenty Five patients with distal tibia fractures treated with distal tibia locking plate at our institute between June 2016 to August 2018.

Inclusion criteria for our study

1. All patients above the age of 18 years
2. distal tibia fractures with both intrarticular and extraarticular variety
3. Closed and open grade 1 and grade 2 fractures

Exclusion criteria

1. All open grade type 3 distal tibia fracture
2. distal tibia fracture with associated vascular injury
3. pathological distal tibia fractures
4. pediatric distal tibia fractures

All patients were managed with fracture protocol norms of institute and stabilized primarily after thorough clinical examination. Patients were taken for surgery as soon as after anesthetic clearance. Preoperative planning and mode of fixation decided by age of patients, trauma velocity, open vs closed fractures, local swelling and skin condition and associated co-morbidities.

In our study following modalities were used (i) ORIF with plates and screw fixation (ii) MIPPO (Minimal Invasive Percutaneous Plate Osteosynthesis) (iii) External fixator with or without nailing in fibula as a temporary fixation prior to definitive plate osteosynthesis.

In this study all twenty five patients of distal tibia fractures were fixed with distal tibia locking plate. For fixation of distal tibia locking plate different operative techniques were used. First if fractures of distal tibia were associated with severe soft tissue edema plus ecchymosis and on clinical assessment if we found that it was not possible to do definitive internal fixation with distal tibia locking plate, then we primarily fixed those fractures with closed reduction and external fixator plus associated distal fibular fracture managed with CR and nailing, later on those patients were treated with removal of external fixator and definitive internal fixation with distal tibia locking plate. If on clinical assessment we found that after 2 to 3 days of pin traction and elevation, soft tissue was favourable for internal fixation as primary definitive management then we went for direct closed reduction plus MIPPO distal tibia locking plate fixation or primary definitive ORIF with distal tibia locking plate. Description of the techniques were described below.

(i) External Fixator with Fibula Nailing

Fibula nail had been put as per standard tip entry technique. After proper fibular fixation, one Steinmann pin inserted in calcaneum from medial to lateral direction. Another two Steinmann pins were inserted into tibial shaft. Now two more

Steinmann pins inserted into distal shaft of metatarsals. Reduction would be done by manipulating tibial as well as calcaneum Steinmann pins. (delta frame construct) All Steinmann pins were connected once proper reduction and stability of fracture confirmed under image intensifier and later on clamps fixed in reduced fracture position.

(ii) Minimally invasive percutaneous plate osteosynthesis (Mippo) technique

This technique is commonly used for closed extraarticular fractures, Open grade 1 fractures and fractures without comminution. These are indirect fracture reduction techniques and they maintain fracture alignment by plating the fracture without compression. Operative exposure and soft tissue stripping are minimized with preservation of the vasculature and periosteum. The technique of biologic plating aimed to improve rates of fracture union, decrease the use of supplementary bone grafting, and decrease the incidence of complications such as infection or refracture. The philosophy is therefore similar to that of intra medullary nailing. The mechanical features of bridge plating cause indirect bone healing and relative stability.

Provisional fixation of tibial fractures

Under IITV a tibial reduction is assessed. The intraarticular fragments are anatomically reduced preferably without opening the fracture site. K wires may be used to joystick the fracture fragments into proper position. Once the intraarticular reduction, length, alignment and rotation are achieved and compared with the opposite limb. Fracture is then provisionally fixed with K wires.

Skin incision for distal tibia using medial approach for MIPPO

There are two limbs of the incision. One distally, for application of screws in the metaphyseal region and one proximally for application of screws in the shaft. In some cases, we have put stab incision in the proximal part to apply screws into the proximal holes of the plate. The length of the distal incision varies from 3-10 cm, centering it on the tip of the medial malleolus. We try to keep the incision as small as possible.

iii) Open reduction and internal fixation

All patients having intraarticular fractures, highly comminuted, open grade 2 fractures with bone loss, those fractures that can not be reduced with closed reduction and internal fixation techniques.

Method: After fixation of fibula with nail or plate we had moved to tibia in almost all cases. Definitive Open reduction and internal fixation: Identify Main articular fragments and zones of comminution/impaction. Determine best approach to visualize and manipulate articular segments to achieve anatomic articular reduction. Each reduced fragment is provisionally stabilized with Kirschner wires placed out of the way of the anticipated definitive fixation implants. Confirm articular reduction fluoroscopically. Reduce metaphyseal as to epiphysis/diaphysis to restore anatomic axial alignment in the coronal, sagittal, and transverse planes. Apply distal tibia locking plate. Confirm accuracy of reduction. Remove provisional K- wires, clamps. Careful layered wound closure and splint application with the foot in a neutral plantigrade position.

Postoperative check x-ray to see reduction and joint congruity, implant placement. Below knee slab is given for 6-

8 weeks. Postoperative physiotherapy is started as tolerated by patients. Intravenous antibiotics for first 3 days followed by Oral Antibiotic drugs till 10 days.

Partial weight bearing walking (PWBW) to full weight bearing was started once further collapse is not expected radiologically i.e. usually around 12 weeks. Initially full weight bearing is allowed with support like crutches or walker and then gradually without support.

The course of healing was documented radiologically (AP and lateral) and clinically. The moment of complete healing was defined as follows: radiologically complete bone regeneration at the fracture site and a patient capable of pain-free, 100% loading of the injured limb. Delayed healing was defined as inadequate consolidation at six months after the operation. Evaluation of any possible loss of reduction that might have occurred by comparing the postoperative radiographs.

Assessment and analysis of any complications observed and the necessary revision operations with regard to cause, the role of the implant and operative technique. Assessment done with functional and anatomical score (AOFAS SCORE) Patient got discharged after 3 to 4 days of surgery. Regular post operative follow ups were taken at outdoor patient clinic at 1 month and 3 months postoperatively and noted range of motion, assessment of union clinically and radiologically.

Results

This study included Twenty Five patients of distal tibia fracture with or without Intraarticular involvement and with or without fibula fracture treated with distal tibia locking plate with minimum follow up of three months and maximum follow up of two years.

This study observed patients with minimum age of 27 years and maximum age of 66 years with a mean age of 45 years where maximum numbers of patient in age group 46-60 years. out of 25 patients 23 were male and two patients were female. In this study common mode of trauma for distal tibia fracture is road traffic accident (76%) followed by domestic fall (24%). In this series of 25 patients, 13 patients have LEFT sided, 11 patients had RIGHT sided and one patient had bilateral distal tibia fractures where 15 patients had closed fractures considerable swelling and 10 having open fracture, out of 10 open fractures 6 patients having grade one open fractures and remaining 4 patients having grade two open fractures.

Table 1: Distribution according to ao classification

Type Of Fracture	Ao Classification	Number Of Patients
Extraarticular (21)	A1	9
	A2	7
	A3	5
Intraarticular (4)	B1	1
	B2	2
	B3	0
	C1	0
	C2	1
	C3	0

In this study, We observed that two patients were treated with external fixator and secondary plating due to compromised soft tissue envelope, one patient required multiple interventions, eighteen patients were treated with mippo plating and four patients were treated with open reduction and internal fixation.

In this study of 25 patients, seven patients were not associated with fibula fracture, one patient was associated with proximal

fibula fracture, eighteen patients were associated with distal fibula fracture.

in this study, functional outcome measured using aofas score where 14(56%) patients showed excellent results, 5(20%) patients showed good results, 5(20%) patients showed fair results and 1(4%) patient had poor results shown (figure 1.)

Table 2: Functional Outcomes According To aofas Score

Functional Results	Number Of Patients	Percentage
Excellent	14	56
Good	5	20
Fair	5	20
Poor	1	4

In this study, soft tissue and wound related postoperative complications were found. more as compared to implant related complications shown in Table No. III.

Table 3: Complications Seen During Study

Complications	Number Of Patients
Superficial Infections	1
Deep Infections	3
Plate Impingement	1
Osteomyelitis & Non Union	1
Implant Failure & Fibrous Nonunion	1



A



B



C



D



E



F

Fig 1: (a) preoperative radiograph anteroposterior and lateral view (b) immediate post operative radiograph ap and lateral view (c) follow up radiograph at 1 month (d) follow up radiograph 3 months (e) and (f) clinical range at final follow up.

This study shows that radiological union appear between 3 to 4 months out of which maximum patients had radiological union by 16weeks and allowed to weight bearing by same time period which is shown in Table No. IV

Table 4: Radiological Union during Study

Radiological Union(In Weeks)	No. Of Patients
5-10	0
11-15	10
16-20	13
Non Union	2

This study shows 21(84%) patients had excellent to good recovery of plantarflexion and dorsiflexion movements, 3(12%) patients had fair recovery of movements and 1(4%) patient had poor recovery of movements (Figure 1).

Table 5: Data Description Regarding Ankle Movements

Ankle movements (Dorsiflexion And Plantarflexion)	Number of patients	Percentage (%)
Excellent	16	64
Good	05	20
Fair	03	12
Poor	01	4

Discussion

Management of Distal tibia fractures requires thorough understanding of fracture personality, decision regarding implant to be used and clinical conditions of local soft tissue with optimal reduction and stable osteosynthesis.

Ruedi and allgower [6] suggested to follow four AO principles to be followed while managing these fractures (i) to restore fibular length (ii) to reconstruct articular congruity (iii) to fill metaphyseal defect with bone graft (iv) to stabilize medial column with buttress plate. To have a knowledge about Mechanism of injury would help in management as rotational injury presents with a less comminution and lesser soft tissue damage while axial compression presents with higher degree of comminution and severe soft tissue trauma and albeit a difficult one to manage with [7].

At Many trauma centers, results of osteosynthesis of tibial plafond injuries have not been good or excellent. Thin and Traumatized soft tissue envelope at injury site confers higher complication rate. Meticulous handling of soft tissue without compromising internal fixation is one of the key to achieve a desired functional outcome.

In this study, we observed results of 25 patients with MEAN AGE group of 45 years with majority of patients in between 46-60 years. In this study, we observed MALE predominance (92%) with LEFT side involvement (52%) and one patient had bilateral lower end tibia fractures. We found Road Traffic Accidents (76%) most common cause for Distal Tibia Fractures probably conferred higher comminuted pattern with more severe soft tissue trauma.

All patients were treated within five days of admission as MIPPO technique was used which has an advantage of minimal soft tissue injury during procedure. Open fractures treated as standard protocol norms with debridement and temporary external fixator with primary closure of wounds if soft tissue didn't permit primary internal fixation.

In this study, four patients treated with primary ORIF out of this four two having intraarticular extension, 18 patients were treated with primary CR and MIPPO, two patients treated with CR primary external fixator and later on converted in to locking plate fixation. Remaining One patient was treated with Multiple interventions starting from External fixator, secondary plating, antibiotic cement beads and finally illizarov fixation as it was associated with nonunion following osteomyelitis.

In this study, 4(16%) patient had postoperative infections, 1 patient had superficial infection which was treated by antibiotics postoperatively, 3 patient had deep infection (12%), 1patient had plate impingement (4%) was observed in one patient hampering day to day activities, 1(4%) patient had done weight bearing early and ultimately implant failure and fibrous nonunion. 1(4%) patient had nonunion with chronic osteomyelitis.

In this study average time for radiological union was 15 weeks. In this study of 25 patients, 21 (84%) patients had excellent to good ankle movement recovery.

We did not put primary bone graft to any of our patients. We removed plates in 3 cases with deep infection after union and

in one case where non union and osteomyelitis required antibiotic cement bead followed by ilizarov fixator. Fair to poor results pertaining to outcome probably due to these complications had been seen in present study.

In this study, outcome measured by AOFAS score, mean AOFAS score in this study is 88, with 14 patients had excellent results(56%),5 (20%) had good results, 5(20%) patients had fair results,1 (4%) had poor results and comparison with other studies shown in table VI.

Table 6: Comparison of functional outcomes with other studies.

Aofas Scores	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Ahmed <i>et al.</i> [8]	64	20	8	8
P.Joveniaux <i>et al.</i> [9]	30.6	24.75	36.6	7.9
This Study	56	20	20	4

The fixation with locking anatomical plates not only helps in achieving reduction in difficult situations, but also helps in union, because it facilitates preservation of the blood supply to the fragment and anatomical reduction of the fracture.

Its greatest advantage is anatomical reduction and undisturbed fracture hematoma.

It is also effective in extra articular fractures of the distal tibia because intramedullary nails often do not provide enough stability in distal end with lesser working length and external fixators usually applied for primary stabilization until soft tissue get subsided, delays the return to work with fixators.

MIPPO with smaller incisions, lesser soft tissue dissection, lesser bleeding and strong implant construct, which allows us to do internal fixation even in compound fracture type 1 and 2. Removal of implant after minimal invasive procedure is also easy and require minimal soft tissue dissection. MIPPO using locking plates is particularly effective in managing fractures of osteoporotic bones.

There were fewer incidences of delayed union and non-union, plate exposed and other complications. But in spite of all these, there is a decreased need for bone grafting and incidence of infection is less due to limited exposure and low profile anatomical contoured plate.

However our study comprised lower number of patients and relatively shorter duration of follow up. Future longer follow up with larger numbers of patient require to further directives in the management.

Conclusion

Optimal Fixation with distal tibia plate provide stabilization and allowed early mobilization. With good articular reduction along with correction of length and rotation with Stable fixation and good postoperative rehabilitation, good to excellent results achieved. Application of proper operative method specially MIPPO distal tibia locking plate fixation provide good outcome with lesser soft tissue related complications.

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