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Dr. Vidyadhar S Donimath
Associate Professor,
Department of Orthopaedics,
Karnataka Institute of Medical
Sciences, Hubli, Karnataka,
India

Dr. AE Chandan
Junior Resident,
Department of Orthopaedics,
Karnataka Institute of Medical
Sciences, Hubli, Karnataka,
India

Dr. SR Sandeep
Junior Resident,
Department of Orthopaedics,
Karnataka Institute of Medical
Sciences, Hubli, Karnataka,
India

Mrutyunjay Battur
Junior Resident,
Department of Orthopaedics,
Karnataka Institute of Medical
Sciences, Hubli, Karnataka,
India

Correspondence
Dr. AE Chandan
Junior Resident,
Department of Orthopaedics,
Karnataka Institute of Medical
Sciences, Hubli, Karnataka,
India

A prospective study on functional outcome of distal tibia fractures treated with minimally invasive percutaneous plate osteosynthesis

Dr. Vidyadhar S Donimath, Dr. AE Chandan, Dr. SR Sandeep and Mrutyunjay Battur

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Abstract

Distal tibial fractures are very commonly encountered by orthopaedic surgeons. Fractures of distal tibia are among the most perplexing injuries. Distal tibial fractures are difficult to manage due to its poor blood supply and limited soft tissue. Soft tissue injury component is a major concern among these fractures and may result in serious complications and disability^[1]. High energy motor vehicle accidents are the common cause^[2]. 0.7% is the incidence of distal tibia fractures and it accounts to about 10-13% of all tibial fractures^[3]. The aim of this study was to evaluate the functional outcome and to study major complications in KIM's hospital.

Materials and Methods: A prospective study which was carried out from October 2015 to September 2017 in Karnataka Institute of Medical Sciences, Hubballi, and Karnataka State, India. In this study period, cases of distal tibial fractures were treated by open reduction and internal fixation using MIPPO. All patients with age >18 years, closed fractures without intra-articular extension and Gustillo type 1 fractures were included. Pathological fractures and grade 2 and above were excluded.

Results: In our series of 18 cases, there were 14 men and 4 women, with average age of 40.3 years. Sixteen (88.8%) cases were admitted due to RTA and with slight predominance of left side. All fractures healed with good functional outcome. Mean union time was 22.6 weeks. 14 cases showed good ankle function outcome and 3 showed fair ankle function outcome according to Merchant and Dietz criteria. There was 1 case of superficial infection, treated successfully with antibiotics.

Conclusion: The strategy of biological osteosynthesis with a bridge plating is less invasive, with fewer soft tissue impingement and improved cosmeses and convenient for removal.

Keywords: Tibia fracture, Surgery, MIPPO technique, locking plate

Introduction

Tibia is one of the most commonly fractured long bone of the body. 0.7% is the incidence of distal tibia fractures and it accounts to about 10-13% of all tibial fractures^[3]. Fractures of distal tibia are among the most perplexing injuries. High energy motor vehicle accidents are the most common cause^[2]. The management of distal tibia fractures is complex because of its unique anatomical characteristics of subcutaneous location with precarious blood supply, leading to postoperative complications and poor outcome. Therefore, the treatment of distal tibia fractures remains challenging. The distal tibial fracture should be treated as a type of "open fracture" due to its poor soft tissue envelope which will have been damaged from the injury, even without an open wound.

A variety of treatment methods have been suggested for these injuries, including non-operative treatment, intramedullary nailing and plate fixation. Non-operative treatment can be an option for certain fracture patterns but may be complicated by loss of reduction and subsequent malunion^[4]. Distal tibial fractures can be treated with open reduction and fixation^[5-8]. Less favorable environment is caused by extensive soft tissue damage and devitalisation leading to infection and postoperative ankle stiffness⁹. Therefore intramedullary nailing, percutaneous plating have been chosen as the standard treatment for distal tibia fractures. The intramedullary nailing system needs extensive surgical dissection with the sparing of the extraosseous blood supply and supports the tibia in a load-sharing manner.

But it has its own complications. Preservation of the periosteal blood supply around the fracture site is brought about by locked plating system. Thus they are indicated mainly in management of fracture in osteoporotic bone and in periarticular fracture patterns. Preservation of vascularity of fracture fragments, fracture haematoma and minimal soft tissue damage favour minimally invasive percutaneous plating for distal tibia fractures.

With this background, current study focuses on the functional outcome and the various complications associated with it.

Patients and methods

A prospective study was conducted from October 2015 to September 2017 in Karnataka Institute of Medical Sciences, Hubballi, and Karnataka. In this study period, 18 cases of distal tibial fractures were surgically managed by MIPPO. All patients with skeletal maturity i.e. age >18 years, closed fractures without intra-articular extension and Gustillo type I fractures were included. Intra articular fractures, pathological fractures and Gustillo type II or more open fractures were excluded. AO/OTA classification system was used to classify fractures [10].

Preoperative evaluation was done as history, examination, complete preoperative radiographic assessment done as Antero Posterior (AP) view and lateral view of the affected leg. Analgesics were given. Routine investigations were done, and informed consent and physician reference for fitness were obtained. The patient were initially stabilized with calcaneal skeletal traction until the subsidence of the soft tissue injury i.e. decrease in the swelling especially Tscherne Classification type 2. Following which the patient was operated.

Procedure

Intravenous antibiotics were started peri-operatively and then after induction with spinal anaesthesia patient was positioned supine on operation table with a thigh tourniquet. In cases associated with fibular fracture it was fixed first using a one-third tubular or recon plate, which was useful in maintaining the length, alignment and subsequent reduction of the tibial fracture. Once lateral malleolus plating is done the distal tibial LCP was tunneled subcutaneously, through limited skin incisions avoiding injury to the saphenous nerve and vein. Initial reduction and location of plate was checked under image intensifier. Interfragmentary compression was achieved with cortical screws placed through the plate. Following inter fragmentary compression a mechanically stable construct was made by use of locking screws. Wound closure was done in layers without a suction drain. Following operation compression bandage was given, and limb was elevated

Follow Up

Postoperative splinting was not used routinely. Postoperative knee and ankle bending exercises were initiated POD 1. Non weight bearing mobilization by walker was started on POD 3. Partial weight bearing allowed after 6-8 weeks. Complete weight bearing mobilization was permitted only after clinico-radiological union at 12 to 14 weeks. Clinical and radiological follow up of the operated patients were done at consistent intervals.

Results

A total of 18 patients were included. Mean age of patients was 40.3 years. Fourteen patients were men and four were women. Left side was affected in eleven patients (61.1%) and right side was affected in 07 patients (38.9%). Most common mode

of injury was road traffic accidents in 16 patients (88.89%), fall in 1 patients (5.56%) and assault in one patient (5.56%). All fractures were classified according to AO/OTA classification of which 4 fractures were 43A1, 11 fractures were 43A2 and 3 fractures were 43A3. All fractures were closed. The soft tissue injury was graded according to Tscherne classification of which 10 fractures were type 0, 6 were type 1 and another 2 were of type 2 injury.

All patients were operated within 7 days of admission. 17 patients were operated between 3-7 days of injury and one patient was operated 2 days after admission.

Follow up was done at 6 weekly interval for evaluation of clinico-radiological signs for union. Clinical union was defined as single stance, painless full weight-bearing on the healed fractured extremity. Radiological union was defined as evidence of bridging callus. Delayed union was labeled when patient does not meet the above said criteria of union at nine months.

All fractures united in this study united between 16-24 weeks. The mean union time was 22.6 weeks. Infection occurred in one case which presented at 12th month of follow up with signs of cellulitis, skin breakdown and sinus at implant site.

The minimum period of follow up in our study was 1 year ranging from 12 months to 16 months.

A clinical assessment of ankle function according to the criteria of Merchant and Dietz [11] was determined for each ankle at the end of 1 year follow-up. It is a 100 point scale allotting 40 points for function, 40 for pain, 10 for gait and 10 points for range of motion at the ankle. A score of 85–100 represents an excellent result, 70–84 good result, 60–69 fair result and less than 60 poor results. 15 had good results and 3 had fair results.

Functional outcome was assessed based on Johner and Wruhs criteria [12], 14 had good outcome, 4 had fair outcome.

Ankle Function According To the Criteria of Merchant and Dietz

Alignment	Mippo	
	No Of Cases Percentage (%)	
Excellent Results	0	0.0
Good Results	15	83.33
Fair Results	03	16.67
Poor Results	0	0.0

Functional Outcome Based On Johner and Wruhs Criteria

Outcome	Mippo	
	No of Cases Percentage (%)	
Excellent	0	0.0
Good	14	77.78
Fair	4	22.22
Poor	0	0.0

Discussion

The treatment of distal tibial fracture management remains a challenging topic because

1. High energy trauma.
2. Soft tissue injury around the fracture site.

Therefore appropriate preoperative planning is necessary in view of the associated soft tissue injury and minimizing the postoperative malalignment and soft tissue complication.

Our study comprised of 18 patients with closed extrarticular distal tibia treated with minimally invasive techniques based

on soft tissue condition and fracture pattern. Fibula fracture was fixed based on intraoperative alignment of tibia fracture. Fibula was fixed only if reduction of tibia remained unacceptable or difficulty in achieving reduction with tibia fixation alone. The results were evaluated in terms of functional outcome and complications.

In our study we had 14 male and 4 female patients with 11 fractures occurring on left side and 7 on right side. The mean age of patients in our study was 40.3 years ranging from 20-50 years. When analyzed, in study done by Guo J, *et al* [15] in 2010 the mean age of patients was 43 years. In another study Robinson C, *et al* [16] it was 46 years.

The most common cause for these fractures in our study was road traffic accident (R.T.A). Majority of the studies show vehicular accidents as the common mode of injury followed by fall. Our study has also classified these fractures as in

Standard studies according to AO/OTA classification and soft tissue injury using Tschereene classification thus eliminating intra and inter observer variability.

We achieved union in all treated with MIPPO with mean union time of 22.6 weeks. Oh W, *et al* [33] in their study, mean union time for these fractures treated with MIPPO was 15.2 weeks (range, 10-24 weeks). In study by Ronga M, *et al* [17] they achieved union in all fractures by 24 weeks. In study by Borg T *et al* [18], they achieved union in 90% of fractures within 24 weeks. The mean time for union in Collinge C, *et al* [19] study was 35 weeks but all fractures which were closed healed within 25 weeks.

The mean ankle evaluation score at the end of one year using Iowa ankle score by Merchant and Dietz [11] was 78 (ranging from 63-82) and this corresponds to overall good result. 83.33% of the cases in our study had good results.



Operative photographs

Case 1



Pre op

After fracture union

Case 2



After fracture union

Study and type of fixation	Total number of cases	Mean union time in weeks	Follow up period	Complications	Ankle function and outcome
Nork S, <i>et al</i> [20]	36	23.5 [13-57 Weeks]	2 YEARS	5% of cases had deep infection/ no cases had implant failure	80% good results.
Ehlinger M, <i>et al</i> [23]	51	16 [10-30 Weeks]	1 YEAR	2% cases had deep infection/ no cases of implant failure	Good to fair results in most cases with limitation of physical activities
Oh W, <i>et al</i> [33]	21	16 [8-24 Weeks]	1.8 YEAR	No cases of infection/implant failure/ 40% cases had implant irritation	Excellent to satisfactory results in all cases (80-100%)
Collinge C, <i>et al</i> [38]	36	35 [12-112 Weeks]	1.5 YEARS	2 cases each (7%) of loss of fixation and deep infection	Good to fair results in most cases with limitation of physical activities
Guo J, <i>et al</i> [15]	41	17.66	1 YEAR	No cases had implant failure/ infection	80% good results and 20% fair results
Present study	18	22.6 weeks	1 YEAR	1 case of infection	77.78% good results and 22.22% fair results

Conclusion

The surgical care of extra-articular distal tibia fractures is controversial. Most of these fractures are caused by high energy. An interval of 3-7 days between injury and surgery should be the protocol especially if plating using minimal invasive technique is planned so as to reduce the incidence of soft tissue complications associated with these fractures. Vigilant preoperative planning is required to minimize complications related to soft tissue and bone. Management of these fractures are not without complications such as infection and delayed union; hence these complications should be looked for at the earliest and treated accordingly. If principles of treatment are correctly followed, most of cases will have good final outcome with either modality of treatment for these fractures.

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