CASE SERIES

Clinical outcome of locking plate fixation in distal tibia fractures

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Abstract

A study was conducted to assess the outcome of close distal tibial fractures fixed with pre-contoured locking-plate using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique in terms of union and infection, at the Department of Orthopaedic Surgery King Edward Medical University/Mayo Hospital, Lahore from August 2013 to May 2017. Fourty cases with close distal tibial fractures were enrolled. Fractures were managed with locking compression plate using MIPPO technique. Patients were followed for 12 months post-fracture stabilisation. Of the 40 patients 24 were males and 16 females, with male to female ratio of 1.5:1. The mean age of the patients was 44.70±13.67 years with minimum and maximum ages of 18 and 60 years, respectively. All fractures united with the mean union time of 16±4 weeks. The infection rate was 5%. Locking compression plate when used with MIPPO technique provides early bone union and low infection rate.

Keywords: Distal tibia; locking plate; minimally invasive percutaneous plate osteosynthesis; infection.

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Introduction

Due to limited soft tissue coverage, subcutaneous location and poor vascularity, fractures of the distal tibia can be difficult to treat. They comprise 3% to 10% of all tibial fractures and less than 1% of the lower extremity fractures.[1]

According to the OA/OTA classification system, these fractures are classified in three categories.[2]

Type A, extra-articular fractures, which are subdivided into A1, A2, and A3 are based on the amount of metaphyseal comminution. Type B, also called partial articular fractures, in which a portion of the articular surface remains in contact with the shaft; these are subdivided into B1, B2, and B3, based on the amount of articular comminution and impaction. Type C is complete metaphyseal fractures with articular involvement; these are subdivided into C1, C2, and C3 based on the amount of metaphyseal and articular comminution.[2]

The choice of treatment method in unstable tibia distal end fractures with or without joint involvement remains controversial.[3] A variety of treatment options are available but all have been reported to have a high rate of complications.[4]

Conservative treatment can be applied to stable extra-articular fractures with minimal shortening; however, malunion, shortening, motion restriction and osteoarthritis have been reported in these fractures.[1]

External fixation is the treatment of choice in open fractures with soft tissue damage that precludes plate fixation and intramedullary nailing (IMN); however, malalignment, malunion, nonunion and pin tract infection (10-100%) have been reported.[3, 5, 6]

Open Reduction Internal Fixation with conventional plating requires extensive soft tissue dissection and periosteal elevation; it is associated with high rates of complications, such as infection, delayed union, and nonunion.[7]

In the last decade, minimally invasive percutaneous plate osteosynthesis (MIPPO) performed by indirect reduction, has become a successful treatment modality in complex fractures of the lower extremity with union rates ranging between 80% and 100%.[4]

Locking compression plate is a new modality in this field. It consists of a plate and screws, where screws are locked in the plate at fixed angles. Locking compression plating (LCP) provides angular stability for fracture fixation. Locked screws prevent the plate from pressing the bone, preserving periosteal blood supply. This system stimulates callus formation due to flexible elastic fixation. In addition, the anatomic shape of the plate prevents malalignment of the fracture and provides a better axial and angular weight distribution.[8] Although there have been many studies regarding the outcome of locking plate in distal tibia fractures, they still have several

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limitations like relatively small sample size and percentage of open fractures of the distal tibia ranging between 19% to 40% .[5]

The aim of this study was to assess the outcome of close distal tibia fractures fixed with pre-contoured locking plate in terms of bone union and infection. We compared our results with those reported by other authors using the same technique.[9]

Case Series

This study was conducted at the Department of Orthopaedic Surgery King Edward Medical University/Mayo Hospital, Lahore from August 2013 to May 2017. Fourty patients were enrolled. The inclusion criteria were: age 18 to 60 years and close distal tibia fractures or Gustilo-Anderson type 1 open fractures. Surgery was delayed for two weeks and the limb was kept elevated in below knee splint. Informed consent was taken from all the participants. Fractures were managed with 3.5mm locking compression plate using MIPPO technique. Fluoroscopy was used during the procedure. The patients were followed at six weeks, three months, six months and 12 months post-fracture stabilisation. In the post-operative follow-up we looked for surgical site infection, wound dehiscence, skin necrosis and plate exposure which are very common complications of the medial locking compression plate. We also looked at the x-rays for the union. The criteria for the union was described as the formation of mature callus on three out of four planes radiologically and no pain inducement after full weight bearing. The final data was analysed using SPSS version 20.

Good quality plain radiographs (antero-posterior, lateral and long leg alignment views) were obtained. The plate was planned to be applied on the antero-medial aspect of the distal tibia. No cultures were taken preoperatively.

The main fragments of the tibial fracture were aligned and reduced percutaneously. Separate stab incisions were required to achieve reduction. Reduction of large fragments was maintained using individual lag screws. A pre-contoured plate was used to adequately bridge the fracture site. The plate was used as a compression plate in stable extra articular fractures and as a bridge plate in 43B patterns. The plate extended proximally and distally so that at least three bicortical screws could be inserted both proximally and distally to the fracture. With the fracture adequately reduced, a small transverse incision was made distal to the medial malleolus, and a submuscular tunnel was created. The plate was then passed through this tunnel. The alignment and position of the plate was adjusted using unicortical Kirschner wires to control the track that the plate follows. In addition, since 43B is associated with distal one-third fibular fractures, the fixation of fibula helps to achieve proper reduction and alignment; hence, in those fractures fixing the fibula first was preferred. The final position of the plate was secured by passing one Kirschner wire through a hole proximal to the fracture site, and another through a hole distal to the fracture site. At this stage, the surgeon made a thorough assessment of the limb alignment and established that the correct rotation has been achieved by comparison with the other limb. Further screws were then inserted percutaneously as necessary, with at least three bicortical screws at either end. The stab incisions were sutured in the standard fashion, the wounds dressed, and the limb rested in a split plaster of Paris cast.

The limb was kept elevated for 48 hours. Following wound inspection, the split plaster of Paris cast was changed for a short leg lightweight synthetic cast for six weeks.

The cast was removed at six weeks, and outpatient physiotherapy was instituted to maximise the range of motion at the foot and ankle.

The weight bearing criteria was based on the type of fracture and the stability of fixation. In case of 43A or extra-articular fractures, it is when stable fixation is achieved. Partial weight bearing was allowed at six weeks and full weight bearing at three months. In case of 43B or partial articular fractures, weight bearing was avoided for three months and partial weight bearing was allowed only after three months and it continued to increase as tolerated by the patients.

Results

In this study 40 patients (24 males and 16 females) were

Table-1: Descriptive statistics of age (years)

Variables	Frequency (N=40)	Percentage (100%)
Gender of the patients		
• Male	24	60%
• Female	16	40%
Age of the patients in years	Mean± SD	44.70±13.67
Union in months		
• Three	12	30%
• Four	12	30%
• Five	16	40%
AO Classification		
• 43A1	4	10%
• 43A2	8	20%
• 43A3	12	30%
• 43B1	12	30%
• 43B2	4	10%

included. Male to female ratio of the patients was 1.5:1. The mean age of the patients was 44.70 ±13.67 years with minimum and maximum ages of 18 and 60 years respectively. Table 1. All fractures united. The average time period of union was 16±4 weeks. Twelve cases united in 12 weeks, another 12 cases united in 16 and 16 cases united in 20 weeks. Four cases were 43A1, 8 were 43A2, 12 were 43A3, 12 were 43B1 and four were 43B2.Table 1.

The overall infection rate was in 2(5%) patients. Infection that occurred within one-month post-operatively was managed with broad spectrum culture sensitive antibiotics for six weeks. Most of the deep-seated infections occurred in thin lean patients and 43B1 and B2 which resulted in plate exposure and final plate removal. Patients whose plates were removed, were managed with multiple debridement and cost until full union was achieved.

Discussion

The results of operative treatment in distal tibial fractures are dependent on the severity of the initial injury, BMI of the patient, associated injuries, co-morbidities and the quality and stability of the reduction.[10] The mechanism of the injury, the soft tissue status and degree of comminution affect long-term clinical results. Thin, lean patients have a higher chance of surgical site infection than fat or obese patients. SSI in thin, lean patients results in plate exposure and psychological problems resulting in plate removal. Middle aged people with co-morbid conditions, such as diabetes, are also at higher risk of developing SSI.[11] Higher energy trauma can cause more damage to the soft tissue leading to increased incidence of SSI. In addition, quality of reduction really is an important factor in achieving union. Thus we recommend usage of fluoroscopy with distal tibia fracture as an important step in achieving stable reduction. In this descriptive case series, 40 patients were operated on. The average time to union was 16 weeks which is comparable to other studies using the same technique. Table 2

Table-2: Comparison of the current study with previous clinical series.

Study	No of fractures	Study method	Fixation	Outcomes
Bahari S et al[1]	42	Prospective	MIPO	Union: (22.4weeks)
Ronga M et al[2]	19	Retrospective	MIPO	Union: (22.3wks)
Collinge C et all[3]	38	Prospective	MIPO	Union: (21wks)
Mushtaq A et al[4]	21	Prospective	MIPO	Union: (5.5months)
Gupta RK et al[5]	80	Retrospective	MIPO	Union: (19wks)
Hasenbohehler E et al [6]	32	Retrospective	MIPO	Union: (27.7wks)
Rajesh B et al[7]	24	Prospective	MIPO	Union: (18wks)
Current study	40	Prospective	MIPO	Union: (16wks)

The infection rate in this study was 5% which is on the higher side but still better than ORIF and comparable to other studies using MIPPO technique. Previously published infection rates with ORIF in the management of this injury range from 10% to 50%. While MIPPO technique offer low infection rate ranging from 3% to 10%.[12,13] The infection rate can be improved with modern technique and precautions during surgery to minimise the risk of infection. Tissue mishandling during making the tunnel and placement of tunnel more favourably on anteromedial aspect minimises the risk of SSI.

Conclusion

Minimally invasive technique in distal tibial fracture is relatively simple, safe and efficacious. The advantages of this technique with locking compression plate are;

reduced surgical time, decreased risk of wound infection, early restoration of maximum ankle moments, and early union of fracture

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