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Clinico-radiological and functional outcomes of distal tibia extra-articular fractures (AO 43A1-A3) managed by minimal invasive plate osteosynthesis in a tertiary care hospital: a series of 21 patients

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ABSTRACT

Background: The fractures around distal tibia are challenging injuries due to limited soft tissue coverage, precarious blood supply and subcutaneous nature of the tibia. Minimal invasive plating for distal tibia fracture is a very good option for treatment, as this does not disrupt the blood supply and cause very little insult to soft tissue.
Methods: 21 patients with extra-articular fractures of distal tibia were operated using minimally invasive plate osteosynthesis (MIPO) technique of plating. They were followed up to six months in terms of radiological union and functional outcomes, and complications. Functional outcome was assessed using Olerud Molander scoring system.
Results: Good to excellent results were obtained in almost all the patients using Olerud and Molander scoring system, mean score being 80. These results were in comparison with the studies done earlier.
Conclusions: Our study concluded that clinico-radiological and functional outcomes of distal tibia extra-articular fracture managed by MIPO technique of plating are satisfactory with minimal complications.

Keywords: Distal tibia extra-articular, MIPO, Plating

INTRODUCTION

Fractures of the distal tibia can be challenging to treat because of the limited soft tissue, the subcutaneous bone and precarious vascularity. The aim in distal tibial fractures is to neutralize the metaphyseal fragment, realign limb length and early functional recovery.[1] Distal tibial fractures account for less than 10% of the fracture of lower extremity with fibula fractured in about 85% of cases with male predominance. Fractures which are treated conservatively have been associated with malunion, shortening, restricted range of motion and early osteoarthritis.[2,3] Surgical fixation is considered for most distal tibia fractures which require meticulous preoperative planning. Available options for stabilizing fractures are external fixator, interlocking nails and locking plates.[4]

External fixation can be a useful option in open fractures with soft tissue injury, but can lead to pin-track infections, septic arthritis, mal-alignment and delayed union.[5] IMIL nailing has been reported with higher rate of malunion whereas wound infection with delayed union or non-union requiring secondary procedures like bone grafting are some of the complications associated with conventional osteosynthesis with plates.[6-10]

Minimally invasive sub muscular and subcutaneous plate fixation (MIPO) is a very good option as it addresses the issues associated with intramedullary nailing, preserves fracture fragment vascularity and minimizes soft tissue insult while amalgamating all biological benefits of closed reduction and fixation.

This study aimed at assessing the clinico-radiological and functional outcomes of distal tibial extra-articular fractures using MIPO technique of plating.

METHODS

All the patients satisfying inclusion criteria who underwent MIPO for distal tibia extra-articular fractures from January 2019 to November 2020 at the Department of Orthopaedics, Government Medical College Jammu were included in the study. A written and informed consent was taken from all the patients for their inclusion in the study. Operative procedure as well as complications of the surgery and anaesthesia was explained well before hand. The collected data of all the patients included in the study design was analyzed using appropriate statistical methods. This study was an observational prospective study.

Inclusion criteria

Patients suffering from post-traumatic distal tibial extra-articular fracture, age group 20-60 years, AO type 43A1 to A3 (i.e. only extra-articular) were included in the study.

Exclusion criteria

Patients with pathological fractures, paediatric fractures (before physeal closure), severely mangled extremity, and old fractures with implant failure were excluded from the study.

A total of 23 patients were involved in the study but 2 were lost to follow up. The complete data of remaining 21 patients (n=21) is being presented here.

Appropriate radiographs (AP and lateral) of the involved limb with knee and ankle were taken (Figure 1). Computed tomographic (CT) scan was done in doubtful cases to rule out intra-articular extension of fracture line.

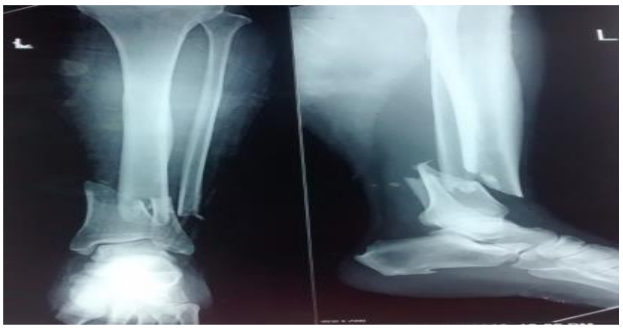

Figure 1: Radiographs showing distal tibia extra articular fracture (AO 43A2) in AP and lateral views.

All baseline blood investigation, electrocardiograph (ECG) and chest X-rays were done. The time to surgery was decided by the soft tissue condition and patient fitness. The patient was positioned supine on a radiolucent operating table under spinal or epidural anaesthesia and an anteromedial incision was given with medial malleoli as reference taking care not to injure the saphenous vein and nerve. Subcutaneous plane was made without stripping the periosteum and disturbing the fracture site. Fracture was reduced under c arm and precontoured plate was slided in retrograde manner beneath the skin tunnel. Plate was initially fixed with help of K wires (Figure 2). With separate stab incisions locking screws were used on either side of fracture site under C arm guidance. Reduction was confirmed under C arm and wound was irrigated with saline and closure done in layers. Suction drain was not used in any case. Sterile dressing was done and posterior slab was given with ankle in neutral position.

Figure 2: Picture showing plate being slided through skin tunnel and held with k-wires initially.

Post-operative protocol and follow up

Limb elevation was done postoperatively and IV antibiotics were given for 3 days followed by course of oral antibiotics. Weight bearing was restricted till radiological signs of fracture union were seen, however gentle ankle ROM was done by temporarily removing backslab. X-rays were done on 2nd postoperative day (Figure 3). Antiseptic dressing was done on second and seventh postoperative day. Stitch removal was done at around 2 weeks postoperatively. Patients were discharged when stable and when wound was settled. Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months and then at 1 year. Healing was judged by both clinical (pain and motion at fracture site) and radiological (bridging callus at fracture site) criteria and function outcome was reviewed using Olerud and Molander scoring system.

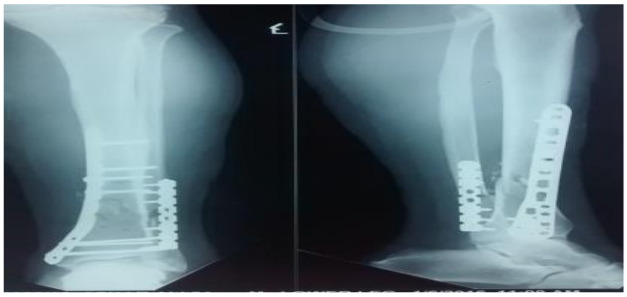

Figure 3: Immediate post-operative radiographs (fibula was fixed with a reconstruction plate).

RESULTS

This prospective study included 21 patients (n=21) out of which 15 (71.4%) were male and 6 (28.6%) were female with a male female ratio of 2.5:1. The most common age group was 40-50 years with mean age 40.7 years. The sex and age distribution are depicted in Figure 4 and 5 respectively.

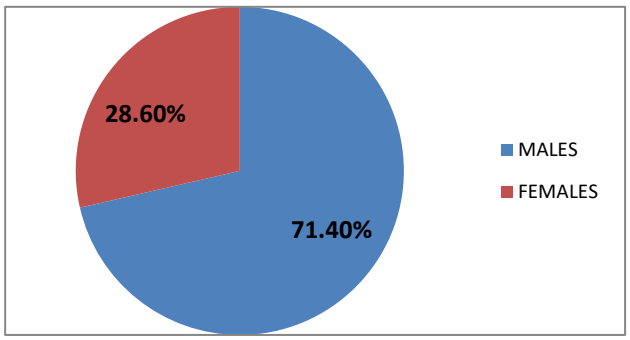

Figure 4: Sex distribution.

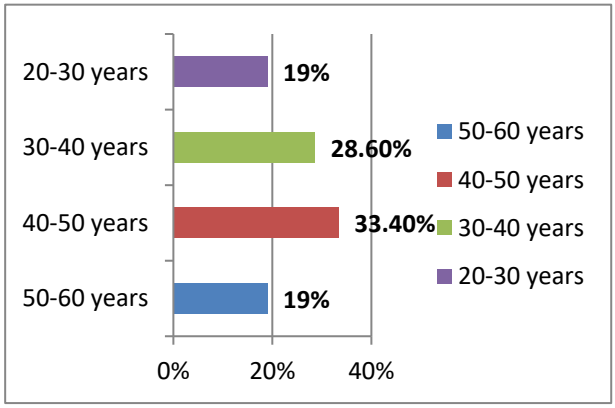

Figure 5: Distribution of patients according to age.

In present study the most common reason was high energy trauma due to injury following RTA (76.2%, 16 patients), second most common cause was fall from stairs, tree and slip on level ground (23.8%, 5 patients). All the fractures were classified using standard AO/OTA classification. All the injuries included in our study were closed injuries with 18 patients (85.7%) sustaining a concomitant fibula fracture and 3 patients (14.3%) had intact fibula. The fibula was fixed with plate or intramedullary rush nail in few cases depending upon fracture anatomy. In this study, 14 patients (66.7%) were operated in second week following admission after soft tissue healing and appearance of wrinkling sign and only 7 patients (33.3%) got operated within a week following trauma. Characteristics of various parameters in this study design are summarized in Table 1.

Average duration for radiological union was 18.4 weeks (range 17.6–24.2 weeks). In this study there were 2 cases of malunion and 1 patient landed up in non-union (smoker patient) that required a second surgery (iliac crest bone graft). There were 2 cases of superficial wound infections, one among them was diabetic and both cases were managed with appropriate culture specific antibiotics and serial wound debridements. There were 2 patients in study that complained of implant related hardware symptoms, both implants were removed after complete radiological union. One patient in this study had ankle stiffness that was managed with ankle physiotherapy. Complications seen in this study design are shown in Table 2.

Table 1: Various parameters studied.

Parameters studied	No. of patients	Percentage (%)
Mode of injury		
RTA	16	76.2
Fall	5	23.8
Fibula status		
Fracture	18	85.7
Intact	3	14.3
AO/OTA type		
A0 43A1	5	23.8
A0 43A2	9	42.9
A0 43A3	7	33.3
Delay in surgery (week)		
<1	7	33.3
>1	14	66.7
Functional outcome (OM score)		
Excellent	7	33.3
Good	10	47.7
Fair	2	9.5
Poor	2	9.5

Table 2: Complications encountered.

Complications	No. of patients	Percentage
Malunion	2	9.5
Varus >15 mm		
Shortening >1 cm		
Non-union	1	4.8
Infection	2	9.5
Hardware	2	9.5
Ankle stiffness	1	4.8

Using Olerud and Molander scoring system, 7 patients (33.3%) patients had excellent outcome at the end of one year follow up, 10 patients (47.7%%) had good outcome, 2 patients (9.5%) had fair outcomes and 2 patients (9.5%) had poor outcomes. Average Olerud Molander score achieved was 80.

DISCUSSION

Fractures around distal tibia are usually comminuted due to its subcutaneous location. Significant soft tissue damage along with limited vasculature furthers ads to difficulty in treating these fractures. Results of operative treatment are dependent on the severity of the initial injury, the quality

and stability of the reduction. Immobilization by splinting, icepacks and delaying surgery help in limiting further soft tissue injury and better preoperative soft tissue condition. Borelli et al in his study concluded that open reduction in the distal tibia further ads to vascular insult and delays union.[11] Anatomical reduction of the fracture before applying the plate is very important surgical step. Gupta et al in his study involving 79 patients reported that suboptimal pre contouring of the plate can result in delayed union, nonunion, prominent hardware, malleolar skin irritation and pain.[12] In our study design there is a higher incidence of male involvement with male female ratio of 2.5:1 and mean age being 40.7 years. These observations are in agreement with previous studies done by Aggarwal et al and Collinger et al.[13,14] The most common cause of distal tibia fracture in our study was RTA (76.2%) followed by fall. Same results have been reciprocated by Soni and Patel in their study.[15] Most of the patients (85.7%) in our study had ipsilateral fibula fracture which is also the result of previous studies done Bonnevialle et al.[16] In this study most patients (66.7%) were operated after the 1st week of admission. Radiological union was achieved within 17.6–24.2 weeks (mean 18.4 weeks). Comparison of union duration with other studies (Table 3).

Table 3: Comparison with previous studies.

Study	Method	Average fracture union (weeks)
Collinger et al[14]	MIPPO	21
Abidmushtaq et al[25]	MIPPO	22
Im et al[18]	ORIF	20
Hazrika et al[19]	MIPPO	19.3
Present study	MIPPO	18.4

Acceptable degree of alignment is 5 degree of varus/valgus, 10 degree of recurvatum or procurvatum and <1 cm of shortening. Out of 21 patients in study, 18 patients were found to have acceptable reduction and alignment post operatively and at 6 months follow up while there were 2 cases of malunion (9.5%) and 1 case (chronic smoker) of non-union (4.8%) that was addressed with autologous cancellous bone grafting. Redfern et al had 1 malunion in a series of 20 patients treated with MIPO with DTLCP in their study on minimally invasive plate osteosynthesis in distal tibial fractures.[8] Helfet et al in their series of 20 patients of distal tibial fractures treated by MIPO reported 4 cases of malunion.[20] We had 2 patients (9.5%) who had superficial wound infections (one among them was diabetic). There was no case of deep infection. Vasantharaman et al also reported 10% superficial infection in his review of 20 patients with distal tibia fractures managed by plating.[21] In our study there were just 2 cases of implant related hardware symptoms needing implant removal after radiological union. All patients had good ankle range of motion (equal to opposite ankle) except one patient who developed ankle stiffness which was managed by ankle physiotherapy.

The functional outcome using Olerud and Molander scoring system depicted 81% good to excellent results. Mean Olerud Molander score was 80. Also, 19% cases had fair to poor results (non-union, malunion and stiff ankle) (Table 4).

Table 4: Comparison of functional results with previous studies using OM score.

Study	Method	Accept-able	Not acceptable
Teeny et al[22]	ORIF	50	50
Im et al[18]	ORIF	88	12
Gao et al[23]	MIPPO	87	13
Hazarika et al[19]	MIPPO	87	13
Ozkaya et al[24]	MIPPO	81	19
Present study	MIPPO	81	19

CONCLUSION

The treatment of fractures around distal tibia are challenging but not impossible. Careful understanding of fracture anatomy, displacement and soft tissue status is of utmost important before planning surgery. MIPO technique of plating preserves the blood supply to the fracture fragments, doesn't interfere with fracture hematoma and has minimal complications. Clinic-radiological and functional results of patients at the end of our follow up were very encouraging and we conclude that MIPO plating of distal tibia fracture has satisfactory results in experienced hands.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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