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Evaluation of Anterolateral Plating of Distal Third Tibial Fractures: A Prospective Study

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Abstract
Background: *Distal one-third tibial fractures with or without articular involvement can be difficult to manage. Variety of treatment methods have been suggested for these injuries, including conservative treatment, external fixation with or without limited internal fixation, intramedullary nailing, plate fixation (medial or anterolateral) and more recently minimally invasive plate osteosynthesis (MIPO). All of these techniques have advantages and disadvantages. None of these techniques can be considered the "gold standard" for these injuries.*
Objective: *The objective of this prospective study was to evaluate the results of anterolateral plating of these fractures.*
Result: *We studied the outcome of 30 consecutive patients with closed distal tibial fractures using anterolateral plating. We followed patients for one year. All the fractures united. The average to union was 17.2 weeks One patient had limb length shortening of more than one cm (1.5 cm). Two patients developed superficial wound infection and one patient developed deep infection. Three patients had ankle stiffness and three had painless palpable implant. The average AO Foot and Ankle score was 84. 2 in our study.*
Conclusion: *We concluded distal one-third tibial fractures with or without articular involvement can be treated with anterolateral tibial plate.*
Keywords: *Anterolateral, Distal, Fracture, Plating, Tibia.*

Introduction

Distal one-third tibial fractures with or without articular involvement can be difficult to manage[1,2]. Metaphyseal reduction and restoration of articular alignment without soft tissue complication is always challenging[3]. Variety of treatment methods have been suggested for these injuries, including conservative treatment, external fixation with or without internal fixation, intramedullary nailing, plate fixation (medial or anterolateral) and more recently minimally invasive plate osteosynthesis (MIPO)[4-7]. But none of these techniques are without complications. Conservative treatment may result in malunion if the fracture extends to the articular surfaces. External fixation and intramedullary nailing have less soft tissue complications but have higher rates of malunion[1,8-11]. Intramedullary nailing has got limitations with far distal fractures and with fractures extending to the joint line[12]. Plate osteosynthesis has local soft tissue complications including wound dehiscence and infection[13]. The

purpose of this study was to evaluate the results of anterolateral plating of these fractures.

Fractures of distal tibia pose management challenges to an orthopedic surgeon because of following reasons,

1) Being subcutaneous incidence of open fractures is high[6].
2) Tendency to displacement after swelling subsides[14].
3) Precarious blood supply[15].
4) Presence of neighboring hinge joints which allow for little rotational malalignment.
5) Poor stabilization of distal fragment by conventional nails[6].
6) Increased incidence of post operative infections due to limited soft tissue coverage[6].

Patients and Methods

This prospective study was conducted on 30 patients in the Department of Orthopaedics, Government Medical College srinagar from August 20I6 to August 2018. 18 males and 12 females underwent anterolateral plating for distal tibial fractures. Closed distal 1/3 (up to the junction of middle and lower one third) fractures of tibia or tibia and fibula, AO type 43 A, B C1 and C2 were included in the study. Open fractures, AO type 43C3, pathological fractures and polytrauma were excluded from the study. All fractures with neurovascular injury and medically unfit patients were also excluded from the study. Fractures with impending or established compartment syndrome were also excluded. The surgery was performed after the stabilization of soft tissue condition averaging 9.5 days, which ranged from 5 to 16 days in our study. All the patients with fractured distal tibia were initially assessed and stabilized in the emergency department of our hospital. The fractured extremity was splinted and elevated in order to reduce swelling. Detailed radiographic evaluation in two perpendicular planes including leg and ankle was done (Figure 1). CT scan with 3D reconstruction was done in cases of complex intra-articular fractures in order to assess fracture comminution, displacement, and intra-articular extent. Fractures were classified using orthopedic trauma association OTA classification. Those patients arriving in the hospital immediately after trauma were kept either in below knee posterior splint or in calcaneal skeletal traction till soft tissue healing.

All the operations were carried out in spinal anaesthesia. Tourniquet was applied in all the cases. Preoperative prophylactic antibiotics were administered intravenously 9before surgery before inflation of tourniquet.

Anterolateral approach was used to reach the fracture site. A longitudinal incision centered at the ankle joint, parallel to the fourth metatarsal distally, and between the tibia and fibula proximally. Proximal extension of the incision end seven or eight centimeters above the joint. Distally the incision can be extended to the level of the talonavicular joint, allowing exposure of the talar neck. The superficial peroneal nerve usually crosses the surgical incision proximal to the ankle joint and was protected throughout the surgical procedure. The distal extent of the fascia overlying the anterior compartment and its confluence with the extensor retinaculum were identified. With close observation, the tendons of the anterior compartment musculature were identified through the retinaculum, allowing the superior and inferior extensor retinaculum to be incised longitudinally, immediately lateral to the course of the long toe extensor tendons and peroneus tertius. The longitudinal incision in the retinaculum is carried proximally through
the fascia of the anterior compartment. The entire contents of the anterior compartment were then retracted medially to expose the underlying anterolateral aspect of the distal tibia and the capsule of the ankle joint. Care was taken when inserting retractors below the anterior compartment as the anterior neurovascular bundle (anterior tibial artery and vein, and deep peroneal nerve) may be entrapped within anterior fracture

fragments or, after 1 to 2 weeks from the time of injury, adherent to this region.

A longitudinal capsulotomy was performed at the medial extent of the Chaput fragment, thereby exposing the tibiotalar articulation. Transversely oriented capsular vessels were often encountered and require ligation or cauterization. The central and posterior aspects of the tibial plafond were accessed by externally rotating the anterolateral (Chaput) fragment on the anterior distal tibiofibular syndesmotic ligaments.

Reduction was obtained with multiple Kirschner wires and was checked under image intensifier. Application of an external fixator or a distractor was required in few cases in order facilitate visualization and reduction of the joint some times. A lateral distractor was placed from the talar neck to the mid-tibia (from lateral to medial) to maximize joint visualization by distracting and plantar flexing the talus.

Plate was Slided submuscularly along the lateral tibial cortex, beneath the anterior compartment muscles and neurovascular bundle. Special care was taken to protect the superficial peroneal nerve, which typically crossed under the incision proximal to the ankle joint. The plate was temporarily held in place by K-Wires. The distal row of screws were placed just proximal to the joint. Fixation of the proximal portion of the plate was performed percutaneously through separate stab incisions. Associated fibula fracture was also fixed with 3.5 mm one third tubular plate with the same incision. Wound was closed, and postoperatively limb was elevated in a removable splint. Intravenous antibiotics were continued for 24 h after surgery. Postoperatively toe touch weight-bearing was started with the help of crutches as soon as pain and swelling subsided. Partial weight-bearing was allowed at 4–6 weeks and full weight bearing at 10–12 weeks depending upon clinical and radiographic assessment of fracture healing. The recommendations for the use of postoperative splint vary among authors with some authors advocate routine use of postoperative splint and others use it in selective patients. In our study, use of postoperative removable or plaster of paris brace was decided on patient and fracture-related factors like fracture comminution and articular involve ment as assessed by AP and lateral

radiographs and sometimes by CT scan as well as rigidity of fixation as assessed intra-operatively. This postoperative short-leg cast or brace was continued for 4–6 weeks[16]. Patients were followed up clinically and radiographically at two-weeks, intervals initially and then monthly till the fracture united, and the final follow-up was done at 1 year post surgery. The patients were assessed objectively by physical and radiographic examination. The development of any complication was carefully observed and documented at each follow-up visit. The final outcome was assessed at 1-year follow-up by American Orthopedic foot and ankle score[17,18]. AP and lateral radiographs were used to assess fracture healing at final follow-up.

Figure 1A and 1B: AP and lateral radiograph

Figure 2: showing fixation of fracture via anterolateral approach

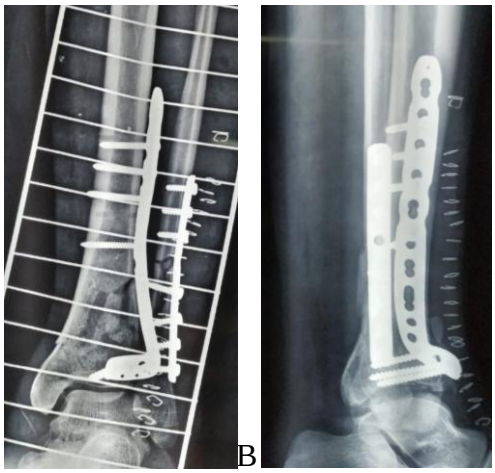

Figure 3A and 3B: Post-op radiographs

Results

All the 30 patients of distal tibial fractures operated by anterolateral plating were reviewed at 1 year follow-up. The mean age of our patients was 42.30 years ranging from 20 to 65 years. 60 % of patients in our series were males and 40 % were females. The fracture was found in 60% on right side (dominant side). Road traffic accidents were the most common cause in our series (Table 1). Fracture distribution as per OTA classification is shown in Table 2. All the fractures united at an average duration of 17.2 weeks ranging from 12 to 30 weeks. The complications are shown in Table 3. There was one case of delayed union. This patient took 30 weeks for the mature bridging callous to form across the fracture site. There were two cases of superficial wound infection and one case of deep infection. The superficial infections were cured with wound care and antibiotic administration. The deep infections was of delayed onset occurring after 2 months. This required removal of implant at 8 months. Till then, it was managed with intermittent antibiotic administration and incision and drainage of overlying abscess and local wound care. Fracture was united by the time there hardware was removed with further uneventful course. There were three cases of ankle stiffness and three cases of painless palpable implant. The average operation time was 80 min ranging from 60 to 130 min. The average AO foot and ankle score in our patients was 84.2 (Table 4)

Average immediate post-operative angulation in coronal plane was 2.42° and it was 2.54° in final follow up. Deformity in sagittal plane was 2.16° in immediate post-operative X-ray and 2.32° in final follow up. None of the patients had angular deformity of more than 5°; neither in sagittal nor in coronal plane in immediate postoperative period and in final follow up. One patient had limb length shortening of more than one cm (1.5 cm).

Bone Results were graded as per NICOLA MAFFULI et al[19] grading system (Table 5) and was excellent in 90% of patients and good in 10% of patients.

Table 1: Mode of injury

Mode of Trauma	Number of Patients	Percentage
RTA	15	50
Fall from height	6	20
Fall	6	20
Direct impact	3	10

Table 2: Radiological A0/0TA type fracture distribution in patients

AO/OTA Type	No.	Percentage
Type A	18	60
Type B	9	30
Type c	3	10

Table 3: Complications in patients treated with anterolateral plating technique with distal tibia fractures

Complication	No.	Percentage
Infection	3	
Ankle stiffness	3	
Palpable implant	3	

Table 4: Ankle score

Ankle score	No.	Percentage	Result
80-100	24	80	Excellent
60-80	3	10	Good
40-60	3	10	Satisfactory
<40	0	0	Poor

Table 5: NICOLA MAFFULI grading system

Grade	Criteria
Excellent	a)Union b)No infection c)Angular deformity of <7degrees. d)Shortening of less than 2.5cm
Good	Union with any two of the other criteria.
Fair	Union with any one of the other three criteria
Poor	Nonunion or refracture orUnion with none of the other three .

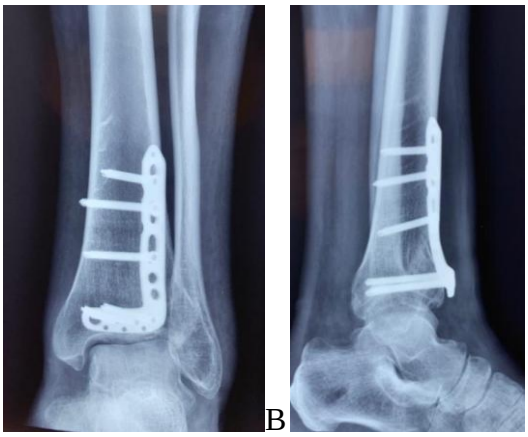

Figure 4A and 4B: United fracture.

Discussion

The treatment of distal tibial fractures often become difficult for orthopaedic surgeons because of the limited soft tissue around the bone, its subcutaneous location, and poor vascularity[2,4].The main objectives of the treatment of these fractures are maintenance of articular surface, restoration of limb alignment, avoidance of soft tissue complications and achieving fracture union[2,20]. Conservative treatment has higher rate of malunion and limb shortening[21]. Intramedullary interlocking nail is well accepted for the treatment of fractures of middle third of tibia. Many surgeons have recommended its use in distal tibial fracture. Medullary cavity in distal third of tibia widens distally. Hence nail is not snuggly fitted into the cavity and there is a chance of malunion of the fracture[22]. Its use is difficult in the fractures extending to the articular surface[23].

Janssen et al. found that in distal tibial fractures control of alignment was difficult with an intramedullary nail[9]. Guo et al. had no patient with more than 10° of angular deformity in both nailing and plating group[13]. Ehlinger et al. used intramedullary interlocking nail in fractures extending to distal articular surface[11]. Axial deviation greater than 5° was observed in 27.5% of patients. Plate osteosynthesis of distal tibial fracture is one of the good methods of treatment with less malalignment[24,25]. Vallier et al. reported angular malalignment of 5° in 23% of patients treated with nails and 8.3% of patients treated with plate[8]. In immediate postoperative radiograph and in final follow up none of the patient in our patients had more than 5° in sagittal and coronal plane. There are options of medial and lateral plates. Medial conventional plating gives good fracture reduction, but results in soft tissue complications[13,16,26,27]. Lateral plating has minimal soft tissue complication, as tibia is not subcutaneous laterally. Lee et al. conducted comparative study of medial and lateral plating for surgical treatment of distal tibia fractures[27]. In their study they achieved good functional outcomes with low malunion rate in both medial and lateral plating, however lateral plating had more advantages and fewer complications than medial plating[27]. In their study they had superficial would infection in 5% of patients with lateral plating. Manninen et al. had a study of 20 cases using lateral approach for fixation of distal tibia[28]. Ten percent of patients developed malunion after good primary reduction. Twenty percent of patients had superficial wound infection[28]. In our study 6% of the patients had superficial wound infection and they were treated conservatively. By using anterolateral incision fibular fracture can also be fixed eliminating the need for two separate incisions[26]. Minimally invasive percutaneous plate osteosynthesis has less soft tissue complications[5-7]. This method is technically demanding[7]. Very often it is difficult to achieve anatomical reduction of the fracture especially if it is intra-articular. Hardware being subcutaneously placed, its prominence may require an early removal[6,7,13,16]. Lau et al. and Shrestha et al. reported removal of implant due to skin impingement in 52% and 30% of the patients treated with minimal invasive plate osteosynthesis in distal tibia fractures respectively[6,7]. In the study of Maffulli et al. seven patients out of twenty had angulation of more than 7°.[5] This method of fixation is not recommended in the fractures with soft tissue injury medially[24].

Lau et al. reported late infection in 15% of his patients treated with this method[6]. Because of the stripping of the hexagonal recess and threads of

the locking screws there was difficulties in removing locking plates, which was less in conventional plate and screws[13]. But this problem was not encountered in the study of Shrestha et al[7]. Definitive treatment with external fixators in those fractures result in malunion, stiffness and pain than open reduction and internal fixation (ORIF)[1]. However, application of external fixator spanning the ankle joint as a first stage surgery followed by definitive ORIF as a second procedure reduces soft tissue complication and malunion[1,29]. In our study also wound complication was found significantly lesser with those patients who were immobilized in skeletal traction than with those who were immobilized in posterior slab in preoperative period. This result might be due to the fact that skeletal traction helps in maintaining the length of the limb, which is not achieved with slab immobilization. Wound complication was irrespective of AO type. Definitive surgical procedure after soft tissue healing might have been the reason of insignificant wound complication even in type C fractures.

Conclusion

We conclude that distal third tibial fractures with or without articular involvement can be treated with anterolateral tibial plate.

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