

Original article
Orthopaedics

OUTCOME FOLLOWING MINI EXTERNAL FIXATION FOR OPEN FRACTURES OF PROXIMAL AND DISTAL METAPHYSIS OF TIBIA

Atul A. Patil¹, Vijay Vasant Nemade¹,
Ashutosh Appa Ushir², Nitin Kumar²

¹ - Associate Professor, Department of Orthopaedics. Smt. Kashibai Navale Medical College and General Hospital, Narhe, Pune (M.S.) India

² - PG student, Department of Orthopaedics. Smt. Kashibai Navale Medical College and General Hospital, Narhe, Pune (M.S.) India

Corresponding Author:

Dr. Vijay Vasant Nemade. D. N. B. (Orthopaedics)
C-304, Sun Universe, Behind Union Bank,
Near Navale Bridge, Mumbai – Bangalore highway,
Off Sinhagad Road, Narhe,
Pune. (Maharashtra) 411041.
Telephone number: 9764044104
Email id: nemadevijay5@gmail.com

Article submitted on: 12 December 2017

Article Accepted on: 02 January 2018

Abstract:

Background: Treatment of metaphyseal fractures of proximal and distal tibia in situations like open fractures, severe soft tissue swelling and skin blisters or impending compartment syndrome is challenging. Minimally invasive techniques using Mini External Fixator allows stable fixation of fracture in cancellous bone of Metaphyseal region, minimal soft tissue disruption during fixation, easy wound care, early joint mobilization and union. Aim of our study is to evaluate a simple, minimally invasive, surgeon and patient friendly, low cost, technique of Mini External Fixator for the management of metaphyseal fractures of proximal and distal tibia.

Materials and Methods: 27 patients of proximal and distal metaphyseal fractures of tibia with either open fracture or closed fracture with severe soft tissue swelling and skin blisters or impending compartment syndrome were treated at our institute between February 2010 and August 2015. Inclusion criteria was proximal and distal tibial metaphyseal fractures with either open fracture or closed fracture with severe soft tissue swelling and skin blisters or impending compartment syndrome. Comminuted intra-articular and articular surface depression fractures requiring open reduction and bone grafting were excluded from the study. Percutaneous Mini External Fixator was used as primary modality of treatment in all these Patients. The functional results were assessed according to Klemm and Borner scoring system.

Results: 27 patients were followed up for an averaged period of 23 months (range 6 to 33 months). 16 Patients had proximal metaphyseal fractures of tibia and 11 Patients had distal metaphyseal fractures of tibia. 15 Patients had open fractures and 12 Patients had poor skin condition due to Blebs/Abrasions/ Ecchymosis. After treatment with MEX Fixation 25 fractures united satisfactorily and the mean time to union was 13 weeks. Two Patient had non-union. In these Patients, open wound was completely healed while the patients were in Mini External Fixator. They were treated with second stage Minimally Invasive Plate Osteosynthesis.

Conclusion: Our study results demonstrated good results with MEX Fixator for proximal and distal metaphyseal fractures of tibia associated soft tissue injuries, skin blisters or impending compartment syndrome. Union and soft tissue healing, both of these are achieved in a single stage.

Keywords: Metaphyseal fractures, Tibia, Mini External Fixator.

Introduction

Treatment of metaphyseal fractures of proximal and distal tibia in situations like open fractures, severe soft tissue swelling and skin blisters or impending compartment syndrome is challenging. The principles for treatment are to have satisfactory reduction, to achieve axial limb alignment, stable fixation and minimal soft tissue and periosteal stripping. The goals are to achieve union, to achieve full knee and ankle range of motion and to minimize complications. Open reduction and internal fixation with plating has got its own morbidity, especially in conditions of open fractures and poor skin condition or deficient skin cover.¹⁻⁸ Minimally invasive techniques using Mini External Fixator allows stable fixation of fracture in cancellous bone of Metaphyseal region, minimal soft tissue disruption during fixation, easy wound care and early joint mobilization.^{8,1}

We evaluated the results of patients of metaphyseal and metadiaphyseal fractures of proximal and distal tibia with either open fractures or closed fractures with severe soft tissue swelling and skin blisters or impending compartment syndrome. They were treated with percutaneously applied Mini External Fixator with minimal percutaneous additional internal fixation wherever necessary. Aim of our study is to evaluate a simple, minimally invasive, surgeon and patient friendly, low cost, technique of Mini External Fixator for the management of metaphyseal fractures of proximal and distal tibia.

Materials and Methods

This study involved retrospective evaluation of 27 patients of fractures of proximal and distal metaphysis of tibia associated with either open

wound or poor local skin condition due to Blebs/Abrasions/Ecchymosisor impending compartment syndrome. All these patients were treated at our institute between February 2010 and August 2015. Permission of the study was granted by Institutional Review Board. Inclusion criteria was proximal and distal tibial metaphyseal fractures with either open fracture or closed fracture with severe soft tissue swelling and skin blisters or impending compartment syndrome. All Patients with closed fractures without any skin and soft tissue problems were treated by other modalities of treatment and were excluded from the study. Comminuted intra-articular and articular surface depression fractures requiring open reduction and bone grafting were excluded from the study. 29 Patients fulfilling the inclusion and exclusion criteria were evaluated, out of which 2 patients follow up data was not adequate and hence data of 27 Patients was evaluated.

Antero-posterior and lateral radiographs were used to assess the fracture pattern and degree of displacement. Percutaneous Mini External Fixator was used as primary modality of treatment in all these Patients. The procedures were done under spinal anesthesia (except in polytrauma situations where general anesthesia was given for performing simultaneous other surgical procedures). The Patients were positioned on radiolucent fracture table. Knowledge of neurovascular anatomy was prerequisite for wire placement. Reduction was achieved with traction given by assistant and manipulation done by surgeon. After achieving adequate reduction 2 to 4 k-wires were placed in the juxta-articular bone parallel to the joint line. Another 3 k-wires were placed

in diaphysis and all these wires were connected on both sides with knearled rods and beta clamps. In some cases we used long square nails instead of the knearled rods.^{8,12} Additional fixation with intra-medullary rod (rush nail or radius square nail) was done percutaneously for associated fibular shaft fracture to enhance the stability.² The K wires used in the tibia were 2.5 mm and specially made long 12-inch K wires. The Fixator configuration for the upper end fractures consisted of a uniplanar frame with triangularization in the proximal fragment for rotational stability. The frame for lower end consisted of a uniplanar frame, which in certain cases included a k-wire in the calcaneum for juxta articular fixation.



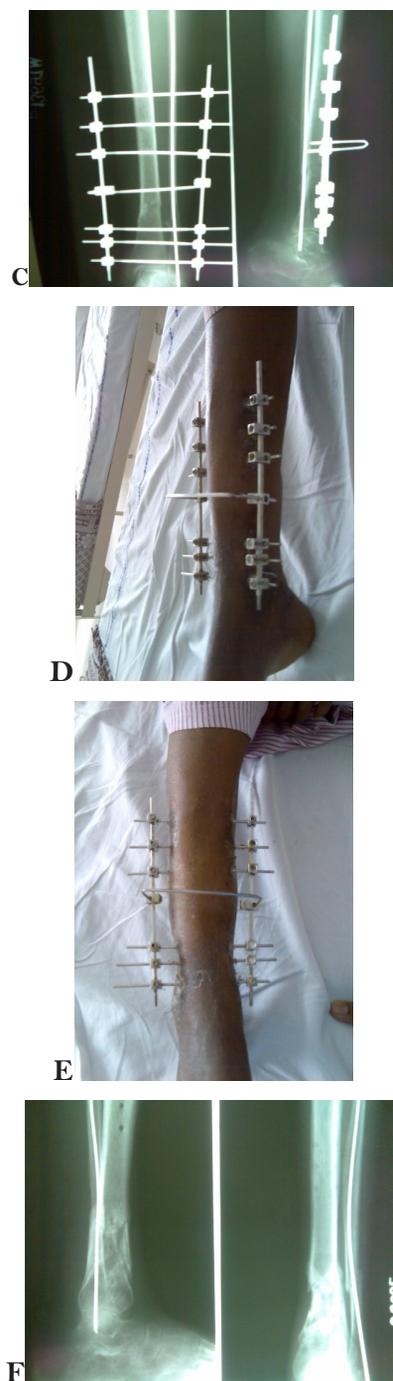


Figure 1:

A & B. Antero-posterior and lateral Radiographs showing distal metaphyseal fracture.

C. Immediate post-operative Antero-posterior and lateral Radiographs.

D & E. Post-operative clinical photograph from side and front showing Mini External Fixator configuration.

F) Antero-posterior and lateral Radiographs after removal of fixator.

All cases with open fractures were immediately taken to operation theatre, debridement was done and Mini External Fixator was applied at the same time. In all cases closed reduction was done and MEX Fixator was applied per-cutaneously under fluoroscopic guidance. The use of an image intensifier was made in all cases. Limb elevation was done till soft tissue swelling had resolved completely. On the first postoperative day, all cases were mobilized with knee and ankle range of motion exercises. All patients were ambulatory with non-weight bearing on crutches or walker till early radiological signs of union. The MEX Fixator was kept in situ till clinical and radiological signs of union were seen. At 12 to 16 weeks (when radiological signs of union were present) Fixator was removed. Additional internal fixations (Intra-medullary fibular rods) were not removed at the time of MEX Fixator removal.(Figure 1F) Brace was given and partial weight (starting from 25% of body weight) bearing was allowed after the removal of Fixator and gradually full weight bearing was allowed over the period of next 4 weeks. The cases were followed up twice monthly till union and three monthly thereafter. At each follow up visit outcome was assessed with following four parameters:

1. External wound healing.
2. Presence or absence of pin tract infection and/or any other complication.
3. Radiological examination to assess fracture healing.
4. Range of motion at knee and ankle joints.

The functional results were assessed according to Klemm and Borner scoring system.⁹

Results

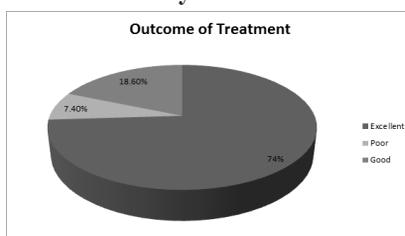
27 patients were followed up to an average period of 23 months (range 6 to 33 months). 19 cases were males and 8 were females. The age of the patients was ranging from 18 to 60 with an average of 44. 16 Patients had proximal metaphyseal fractures of tibia and 11 Patients had distal metaphyseal fractures of tibia. 15 Patients had open fractures and 12 Patients had poor skin condition due to Blebs/Abrasions/Ecchymosis. 3 of these patients had associated severe soft tissue swelling and possibly impending compartment syndrome. Open fractures were classified according to the method of Gustilo and Anderson. Three patients were of polytrauma with head injury and other bone fractures. One Patient had a Scaphoid fracture on the same side, the second Patient had fracture shaft femur on the same side and the third Patient had fracture distal end of the radius. All Patients with open fractures were immediately taken to operation theatre, debridement was done and Mini External Fixator was applied.

Table 1:
Showing numbers of various types of soft tissue injuries associated with fractures.

Site of fracture	Open fractures number	Soft tissue swelling and skin blisters number	Impending compartment syndrome number
Proximal tibia	9	7	2
Distal tibia	6	5	1

The mean duration of surgery was 70 minutes (range from 40 to 120 minutes). The mean trauma to surgery interval was 3 days (range 1 to 5 days). The median hospital stay was 11 days. 25 patients had Good/Excellent fracture union (92.5% of cases). Two Patients had non-union. In this Patients, open wound was completely healed while the patients were in Mini External Fixator. They were treated with second stage Minimally Invasive Plate Osteosynthesis. The mean time to union was 14 weeks (range 12 to 16 weeks) 20 Patients had full range movement at both, knee and ankle joints. Four Patients had reduced knee flexion. (ROM 0° to 110°) Two patients had 10° of dorsiflexion loss. One patient had 5° of dorsiflexion and 10° of plantarflexion loss of ankle range of motion. One fracture has healed in 7° of varus. In remaining cases varus – valgus alignment was less than 5°. Two cases had 4° to 5° of procurvatum deformity. Therefore total 92.60% of patients had Good to Excellent results (Good Results in 18.60%+ Excellent Results in 74% of patients.) and 7.40% of patients had poor results. (Graph 1)

Graph 1:
Functional outcome according to the Klemm and Borner scoring system⁹



There was no case of skin and soft tissue dehiscence or tissue necrosis, osteomyelitis, septic arthritis, deep vein thrombosis, pulmonary embolism. Complications included pin site infection (n=5) and nonunion (n=2) Pin site infections were treated with oral antibiotics and pin site dressings.

Discussion

Treatment of proximal and distal metaphyseal fractures of tibia in situations like open fractures, severe soft tissue swelling and skin blisters or impending compartment syndrome is challenging. Traction and cast bracing provides poor results.^{1,7,10} Open reduction and internal fixation with plating or closed reduction and internal fixation with interlocking nailing is many times not possible in cases where the fracture is compound or poor skin and soft tissue conditions such as multiple extensive abrasions, blisters over skin and impending compartment syndrome.^{1,2,7,8,11} External fixators are preferred in such situations till the skin and soft tissue wounds heal.¹ After this second surgical procedure is required to achieve osteosynthesis.

Mini External Fixator has many advantages in such situation. It is applied per-cutaneously and hence causes minimal additional surgical trauma.^{1,8} It can also be safely applied rapidly in polytrauma situations. Being Minimally Invasive it preserves vascularity of the fracture fragments and preserves fracture haematoma

which contains all the chemical mediators required for bone growth and union. Trauma to surgery interval is less with this form of treatment as waiting for skin and soft tissue injuries and swelling to resolve is not required.¹ It provides superior cancellous bone fixation in the metaphyseal region and therefore allows early range of motion to the joints. This reduces hospital stays and cost.

Since k-wires are elastic they allow micro motion at fracture site without shear and hence stimulate fracture healing.¹¹ Mini external fixator avoids soft tissue trauma and periosteal stripping and allows easy wound care, dressings, pin care, and monitoring of compartment pressure and neurovascular status.

The learning curve associated with MEX Fixation is very less. The inventory required for the fixation is also minimal and the fixator is light in weight. Hence it is essentially a patient as well as surgeon friendly fixator when applied to this region. The stable fixation offered permits early knee and ankle joint mobilization, which is of great advantage.

The present results compared with those in literature (treated with external fixation) provide evidence that closed reduction and Mini External Fixation provides effective cure of external wounds and early healing of fractures both in single stage surgery.^{3,8}

Disadvantages of Mini External Fixation are:

1. This modality of treatment cannot be used in tibial diaphyseal and intra-articular fractures.
2. Anatomical reduction cannot be achieved in all the cases.
3. Weight bearing mobilization cannot be done while during fixator.

4. The procedure relies on the use of a C Arm image intensifier.

Conclusion

Our study results demonstrated good results with MEX Fixator for proximal and distal metaphyseal fractures of tibia associated soft tissue injuries, skin blisters or impending compartment syndrome. Union and soft tissue healing rates are very encouraging and both of these are achieved in a single stage.

References

1. KatariaH , Sharma N , Kanojia RK . Small wire external fixation for high – energy tibial plateau fractures. *Journal of Orthopaedic Surgery* 2007; 15(2):137-43.
2. Krishan A, Peshin C, Singh D. Intramedullary nailing and plate osteosynthesis for fractures of the distal metaphyseal tibia and fibula. *Journal of Orthopaedic Surgery* 2009;17(3): 317-20.
3. Marsh JL, Bonar S, Nepola JV, Decoster TA, Hurwitz SR. Use of an articulated external fixator for fractures of tibial plafond. *Journal of Bone and Joint Surgery Am.* 1995;77:1498-1509.
4. Stannard JP, Finkemeier CG, Lee J, Krejor J. Utilisation of the less invasive stabilization system internal fixation for open fractures of the proximal tibia: A multi-center evaluation. *Indian journal of orthopaedics*2008 Oct-Dec;42 (4); 426-430.
5. Lee JA, Papadakis SA, Moon C, Zalavras CG. Tibial plateau fractures treated with the less invasive stabilisation system. *International Orthopaedics* 31(3): 415 – 418.
6. WyrshB,Macferran MA, Mcandrew M, Limbird TJ, Harper MC, Johnson KD, et al. Operative treatment of fractures of tibial plafond. A Randomised Prospective Study. *The Journal of Bone and Joint Surgery* 78: 1646-57(1996).
7. Robinson CM, Mclauchlan GJ, Mclean IP, Courtbrown CM. Distal metaphyseal fractures of the tibia with minimal involvement of the ankle. Royal Infirmary, Edinburgh, Scotland.
8. Marsh JL, Smith ST, Do TT. External fixation and limited internal fixation for complex fractures of the tibial plateau. *Journal of Bone and Joint Surgery Am.* 1995;77:661-673.
9. Singh VK, Singh Y,Singh PK, GoyalRK,Chandra H. Unreamed intramedullary nailing with oblique proximal and biplaner distal interlocking screws for proximal third tibial fractures. *Journal of Orthopaedic Surgery* 2009;17(1): 23-7.
10. Drennan DB, Locher FG, Meylahn DJ. Fractures of the tibial plateau. Treatment by closed reduction and spica cast. *Journal of Bone and Joint Surgery Am.* 1979;61:989-995.
11. Pai V, Coulter G, Pai V. Minimally invasive plate fixation of the tibia. *Int Orthop.*2007 August;31(4):491-496.