



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2021; 7(4): 477-480
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www.orthopaper.com
Received: 10-08-2021
Accepted: 12-09-2021

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Distal tibia metaphyseal fractures treated with minimally invasive percutaneous plate osteosynthesis

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DOI: <https://doi.org/10.22271/ortho.2021.v7.i4g.2920>

Abstract

Background: Tibia is the most commonly fractured bone amongst all long bones of the body. Fractures of the distal tibia are unique as the bone is subcutaneous with decreased muscular cover and decreased vascularity.

Minimally invasive percutaneous plate osteosynthesis is a technique which is based upon the principles of limited soft tissue stripping, maintenance of the osteogenic fracture hematoma, and preservation of vascular supply to the individual fracture fragments while restoring the axial and the rotational alignment, and providing sufficient stability.

Materials and Methods: This study was carried out at the Department of Orthopaedics, Navodaya Medical College Hospital and Research Centre, Raichur between the period Dec 2019 to Oct 2021. In this study, 30 patients with Distal Tibia Metaphyseal fracture were admitted at Navodaya Medical College Hospital and Research Centre, Raichur and examined according to protocol. The patients underwent Minimally invasive percutaneous plate osteosynthesis with Locking Compression plate. All cases were assessed using the IOWA ankle score and TEENY WISS radiological scoring.

Results: The average fracture healing time was 16 weeks (range 12–20 weeks). According to the IOWA ankle score, excellent results were found in 16 (53%) patients, Good results were found in 11(37%) patients and fair results were found in 3(10%) patients. Superficial infection occurred in 5 patients (16%), no cases of deep infection, implant failure and malunion.

Conclusion: Minimally invasive percutaneous plate osteosynthesis proves to be a safer technique in the management of Distal tibia metaphyseal fractures by providing good fracture healing, enabling rapid functional recovery, and avoiding major skin complications.

Keywords: distal tibia metaphyseal fracture, minimally invasive percutaneous plate osteosynthesis, locking compression plate

Introduction

Fractures of the distal tibia are unique as the bone is subcutaneous with decreased muscular cover and decreased vascularity. They remain one of the most challenging for treatment because of high complications [1]. There is a steep increase in frequency of these fractures because of higher incidences of Road Traffic Accidents and they account for 1% of all lower extremity fractures and 10% of all tibial fractures and they are bilateral in 0-8%.

The mechanism of injury is axial loading due to talus hitting hard on the lower end of the tibia [2]. The axial loading on the distal tibia determines the articular surface injury, metaphyseal comminution, joint impaction and associated soft tissue injuries [3, 4]. Though the mechanism of injury may be complex, the predominant force is vertical compression. The location of articular portion of the fracture is determined by the position of the foot at the moment of impact.

The conservative treatment by cast application lead to prolonged immobilization, leading to ankle and knee stiffness affecting quality of life of the patient [5]. The introduction of locking compression plate was a revolution in the management of these fractures where prolonged bed rest is avoided and return to work is satisfactorily helpful.

Minimally invasive plate osteosynthesis techniques have been developed, with union rates ranging between 80% and 100%. These techniques aim to reduce surgical trauma and to maintain a more biological favourable environment for fracture healing. They offer the advantage of fracture fixation without disturbing the soft tissue cover; less chances of

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infection, early mobilization of patient. Using a locking compression plate reduces the tendency for varus collapse and at the same time affords better stability. The successful management of these injuries, demands a thorough knowledge of the fracture pattern and technical aspects of fracture fixation; and a tailored post-operative management.

The goal of this technique is to apply stable plate fixation while maintaining the fracture biology and minimizing soft tissue problems [6-8].

This study analyses the functional and radiological outcome of extra articular distal 1/3rd tibial fracture fixation with minimally invasive percutaneous plate osteosynthesis technique.

Materials and Method

This study was conducted among 30 patients admitted to Navodaya Medical College Hospital and Research Centre, Raichur between Dec 2019 to Oct 2021 with Distal Tibia Metaphyseal fracture and were treated with Minimally invasive percutaneous Plate osteosynthesis.

Inclusion criteria included fracture meeting the AO criteria, age more than 18 years, Extra articular, Gustillo Andersson Type I, those who gave valid consent, presence of distal fragment of at least 3 cm in length without articular incongruity, competent neurological and vascular status of the affected limb and patients who meet the medical standards for routine elective surgery. Patient with intra articular extension, pathological fractures, poor medical health or who didn't give consent were excluded. An informed consent was obtained from each patient prior to participation in the study.

All the patients were examined in detail, the amount of swelling, presence of distal pulses and the neurological status were carefully assessed. X-rays were taken and the fractures were classified according to the system advocated by Ruedi and Allgöwer. The fracture was immobilized with a below knee slab and the limb was elevated on a Bohler-Braun splint. Blood investigations was carried out and were then worked up to obtain pre-anaesthetic clearance. The patients were operated after the subsidence of swelling. Prophylactic intravenous (iv) antibiotics were administered 30 minutes prior to surgery.

The patients were followed up every four weeks till radiological union and then every 3 months till 1 yr of surgery. At every follow up, radiological and clinical examination was done to assess the pain, tenderness, range of motion of ankle, fracture stability and the clinical union. X rays were taken in AP and Lateral views to look for signs of radiological union.

Ankle mobilization and knee flexion was started as early as possible depending upon condition of patient.

Under spinal/general anaesthesia, patient was placed in supine position. Pneumatic tourniquet was applied. Under all aseptic conditions, surgical parts were painted and draped. A 3-4 cm incision was performed in the metaphyseal region on the medial aspect of the distal tibia. A premeasured and prebent narrow 4.5-mm locking compression plate was inserted into the subcutaneous tunnel. The plate was manipulated until properly positioned, which was then verified using intraoperative fluoroscopy. One end of the plate was secured with a screw placed through a stab incision. Axial alignment of the fracture was performed using indirect reduction techniques and was confirmed by fluoroscopy. Stab incisions were used to place the screws. The wound was then closed and the limb was elevated on Bohler-Braun splint till suture removal was done.

Intravenous antibiotic regimen was continued for 5-7 days (12-14 days in compound fractures) after the surgery. Another 5 days of oral antibiotics were advised. Suture or staple removal was done at 10th-12th post operative day. Passive and active range-of-motion exercises are then initiated.

Results

There were 21 male and 9 female patients (mean 43.7, range 21- 65yrs). 23 (77%) of patients sustained injury following road traffic accidents, 7 (23%) patients sustained injury following self fall. There were 14 patients with right sided distal tibia fractures and 16 patients with left sided distal tibia fractures.

The fracture patterns were classified on the basis of AO/OTA classification. Out of 30 cases, 12 (40%) were A1, 12(40%) were A2, 6(20%) were A3. There were 9 cases of associated injuries with predominance of distal 1/3rd fibula fracture. Majority of the patients had presented to the hospital within 24 hrs of the injury. 21 patients had presented to hospital within 24 hrs of injury, 6 patients had presented between 24-48 hrs and 3 patients had presented after 48 hrs.

All Patients were operated at an average of 7 days from the time of arrival to hospital, and were discharged on an average of 12 days post surgery after removal of sutures.

Immediate post operative complication of wound infection was found in 5 patients which was superficial and no deep wound infection cases. Superficial wound infections healed with extended period of intravenous antibiotics. 3 patients got ankle stiffness due to the prolonged immobilization, after physiotherapy, the patient gained the normal ankle movement. No malunion was detected. There were no cases of implant failure.

All the fractures united with an average of 16 weeks. All cases were assessed using the IOWA ankle score and TEENY WISS radiological scoring.



Fig 1: Pre op X ray



Fig 2: Post op X ray



Fig 5: Plantar felexion



Fig 6: Squatting



Fig 3: 20 weeks follow up



Fig 4: Dorsiflexion

Discussion

Fractures of distal tibia are one amongst the most difficult fractures to be treated effectively. They result from low energy torsional or high energy axial-loading mechanisms. High energy fractures are commonly associated with severe soft tissue injury, comminution of metaphyseal and articular fracture fragments of tibial plafond and comminuted distal fibula fractures.

Tibial pilon fractures account for <10% of lower extremity fractures and occur in adults owing to fall from height or from road traffic accidents. The optimal treatment for these fractures remains. The treatment of distal tibia fractures are challenging because of the subcutaneous location, limited soft tissue and poor vascularity. The nonoperative treatment may be complicated by loss of reduction and malunion.

External fixation of distal tibia fractures can result in insufficient reduction, malunion, and pin tract infection. There is some concern about the use of Intramedullary nail in distal tibia fractures. Open reduction and internal fixation results in the extensive soft tissue dissection and may be associated with the infections and wound complications. The goal of the operative treatment is to obtain anatomic realignment of the fracture fragments and providing enough stability to allow early motion. This should be accomplished using techniques that minimize osseous and soft tissue devascularization in the hopes of decreasing the complications resulting from treatment.

Minimally invasive plate osteosynthesis (MIPPO) is the logical step in the surgical treatment of fractures. It relies on the indirect reduction of the fracture using various techniques, described in the classic works of Mast and Ganz. In this way, the fracture environment is better preserved, as well as the blood supply to the bony fragments [9, 10]. Theoretical advantages include less infection and wound problems and better fracture healing. It reduces the soft tissue injury and damage to bone vascularity, and also preserve the osteogenic fracture hematoma.

Helfet *et al.* [8] introduced a 2 stage MIPPO for distal tibia fractures.

Stage 1 – fibular internal fixation and spanning external fixation of tibia

Stage 2 – limited ORIF for distal tibia.

40% of their cases were intra articular fractures. 60% were extra articular fractures.

They had a 10% incidence of >50 valgus deformity and a 10% incidence of > 100 recurvatum deformity. The average ankle dorsiflexion achieved was 14° and plantar flexion was 42°.

The age group of patients in our study varied from 21 years to 65 years with the mean age of 43.7 years similar to the study by Bahari *et al.* [11], which was 43. There was male preponderance that is 70% in our study, and in the study conducted by Vasu Pai *et al.* [12], the male percentage was 65%. The mean duration from the time of injury to surgery was 7 days same as in another study conducted by Collinge C [7] *et al.* Our study had an average fracture union of 16 weeks which were comparable with studies conducted using the locking compression plates. Cory Collinge *et al* had an average fracture union of 21 weeks and Abid Mushtaq *et al* had an average of 22 weeks.

Table 1: Comparison of fracture union between Present Study and other series

Study	Average in weeks
Abid Mushtaq <i>et al.</i>	22
Cory Collinge <i>et al.</i>	21
Present Study	16

Sayed Redfern Devis *et al.* [13], in a study of 30 patients reported superficial skin infection in 1 patient and no deep infection. In our study , 5 patients developed superficial skin infection and no deep infections. Shrestha *et al.* [14], in a study of 20 patients reported that 1 patient had developed ankle stiffness and required extensive physiotherapy to regain range of movement. In our study, 3 patient had developed ankle stiffness and gained normal ankle movement after physiotherapy. According to the Teeny Wiss Radiological scoring system, we were able to achieve anatomic reduction in 17 patients, Good reduction in 10 patients and Fair reduction in 3 similar to the study conducted by Andre Grosse *et al.*

Table 2: Outcome evaluation according to Teeny Wiss Radiological scoring system

Study	Anatomic	Good	Fair	Poor
Patients	17	10	3	0

According to the IOWA scoring system, we were able to achieve excellent results in 16 patients (53%), good results in 11 (37%) patients and fair results in 3 (10%) patients.

Table 3: Outcome evaluation according to IOWA scoring system

Score	AO Type A1	Percentage
Excellent	16	53%
Good	11	37%
Fair	3	10%

Conclusion

According to our study, 30 patients with Distal tibia metaphyseal fracture, had undergone Closed reduction and internal fixation through MIPPO technique. This technique

had resulted in effective stabilization of these fractures. It provides adequate stability and permits early motion. This technique not only helps in achieving reduction in difficult situations, but also helps in early union, as it facilitates preservation of the blood supply to the fragment and anatomical reduction of the fracture.

The best advantage through MIPPO is that the anatomical reduction is achieved and fracture haematoma is not disturbed much. It is effective in extra articular fractures which occur within 5cm of the joint, as the Intramedullary nails often do not provide enough stability and external fixators usually applied for primary stabilization and until soft tissue edema gets subsided and delays the return to work with fixators.

Therefore, minimally invasive plate osteosynthesis using LCP proves to be a safer technique in the management of distal tibial fractures without intra-articular comminution by providing good fracture healing, enabling rapid functional recovery, and avoiding major skin complications.

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