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Original Research Paper

Orthopaedics

SURGICAL MANAGEMENT OF DISTAL THIRD TIBIA FRACTURE BY MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS

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ABSTRACT

Background- The management of distal tibia fractures is still a subject of debate for orthopaedic surgeons in terms of both, reduction and fixation. The subcutaneous location and soft tissue anatomy of the tibia predispose it to angular and rotational instability. The disadvantage of traditional plating techniques is that it requires large exposure to approach distal tibia, a bone characterized by limited soft tissue coverage and poor vascularity. Minimally invasive plating offers many advantages over conventional open techniques. It causes minimal soft tissue dissection and surgical trauma to the bone. Minimally invasive plate osteosynthesis (MIPO) maintains the biological configuration of the distal tibia and fracture hematoma and also provides a biomechanically stable construct, enabling biological healing. **Purpose**: To study the functional and radiological outcome of patients with distal thirds diaphyseal-metaphyseal tibial fractures treated by minimally invasive plate osteosynthesis and to document major and minor complications associated with this treatment modality. **Materials and Methods**: A prospective observational study of cases of distal third diaphyseo-metaphyseal tibial fractures meeting the inclusion criteria who were admitted in Adichunchanagiri institute of medical sciences, Department of Orthopaedics, BG nagara between 01-02- 2021 to 01-07-2022 was carried out. Fractures were classified according to AO classification [1] and minimally invasive plate osteosynthesis was done. After a minimum follow up period of 6 months the functional and radiological outcomes were assessed using Olerud -Molander Ankle scoring system [2] and antero-posterior and lateral radiographs on follow up. **Results**: A series of 50 cases with distal 1/3rd tibia fractures were studied comprising of 30 males and 20 females. The largest contribution came from the age group of 31-40 and 41-50 years (50%). Road traffic accidents was the commonest cause of injury (60%). Most common fracture pattern was AO Type 43 A2. Associated fibula fracture was present in 24 patients of which 15 patients underwent fixation with ORIF with 1/3rd tubular plate or CRIF with Rush pin. Majority of patients, time interval between injury and surgery was less than 5 days (36 patients). A total of 5 cases were found to develop complications including superficial (3 cases) and deep infection (2 case). The time to union was between 16-28 weeks. Average time to union was 24 weeks. Olerud and Molander score was used for functional evaluation, post fixation. At the end of 6 months excellent functional outcome was achieved in 27 cases, good results in 21 cases and fair result in 2 cases. **Conclusion**: This single center, medium size population series demonstrated good to excellent results in a majority of the patients after distal tibia fracture fixation using minimally invasive plate osteosynthesis, with outcomes and complications comparable to other studies in literature. Our study shows that plating with MIPO is an effective treatment for closed distal one-third tibia fractures, considering union time and complications rate. Low energy trauma had lesser complications. Younger age promotes early union and functional recovery.

KEYWORDS : tibia fracture, road traffic accidents, surgical fixation, minimal invasive plate osteosynthesis

INTRODUCTION

The process of rapid and unplanned urbanization has resulted in an unprecedented revolution in the growth of motor vehicles worldwide. The alarming increase in morbidity and mortality owing to road traffic accidents over the past few decades is a matter of great concern globally. Worldwide, every year almost 1.2 million people killed in road traffic, while the number of people that are injured could be as high as 50 million[3]

Fractures are the commonest injury among the victims of non-fatal road traffic accidents and it commonly involves the bones of the lower extremity. Tibial fractures are the most common type of long bone fractures and are the most common open ones too. On the basis of the fracture location in the bone, distal tibia fractures have the second highest incidence of all tibia fractures[4].

Distal tibia fracture is a therapeutic challenge in modern orthopaedics. Due to fracture pattern, peri-articular location, minimal soft tissue coverage, the surgical treatment is complex one. Various modality of surgical treatment such as closed intramedullary nailing, Open Reduction Internal Fixation with conventional plate osteosynthesis and external fixation has been tried so far. But none of them have good functional outcome but high complication rate (20-50%). Closed intramedullary nailing of distal tibia fracture can be a good option in AO type A fractures but the hourglass shape of the distal tibia does not allow anatomical reduction resulting in rotational and angular malalignment. Closed nailing is not an option, if the fracture is an intraarticular fracture. External fixation is indicated in severe soft tissue injury or as a temporary stabilizing device. Pin tract infection, mal-reduction and joint stiffness are the drawbacks of external fixation. Though ORIF with conventional plating provides anatomical reduction and addressing the rotational, angular mal-reduction, it is associated with extensive soft tissue dissection and periosteal stripping which devitalize the fracture fragment resulting in non-union, infections and wound dehiscence[5]. The newer technique of fixation of distal tibia fractures , minimally invasive percutaneous plate osteosynthesis involves less soft tissue handling and the minimal periosteal stripping resulting in low infection rate and faster healing. The pre-contoured anatomical locking plate used on the medial aspect prevents the varus collapse, implant failure and also secure the fracture reduction without further displacement.

In biological osteosynthesis, the fracture hematoma and soft tissue attachment of the comminuted fragments are not disturbed, thereby preserving the osteogenic capacity and vascularity of the fragments. The fracture site is stabilized by fixing the plate to the proximal and distal major fragments by minimal soft tissue dissection. Rotational and angular

alignment and limb length are restored by indirect reduction, thereby improving the functional outcome. In biological internal fixation recognition of the optimum requirements for bone healing now takes precedence, with mechanical stabilization being less rigid while still allowing painless function and reliable healing.

To overcome the above complications associated with conventional techniques the newer MIPPO technique can address several of the issues associated with intramedullary nailing and conventional plating, while amalgamating all biological benefits of closed reduction and fixation.

MATERIALS AND METHODS

This is a observational prospective clinical study conducted in the Department of Orthopaedics, Adichunchanagiri institute of Medical Sciences, B.G NAGARA after obtaining ethical clearance. This study consisted of 50 patients diagnosed with the distal tibia fracture. Patients fulfilling inclusion criteria was included in the study for a period of 18 months from 01/02/2021 to 01/07/2022.

Inclusion Criteria

1. Age: 20-80 years
2. Distal 1/3rd tibia and fibula fracture
3. Closed fractures and fracture with puncture wounds (Gustilo-Anderson type I)
4. Partial Intra-articular fractures without displacement (<2mm step off)
5. Patients with type 2 diabetes mellitus with hba1c values less than or equal to 7

Exclusion Criteria

1. Patients with proximal 2/3rd tibia fractures.
2. Patients with severely comminuted intra articular fractures.
3. Patients with severely crushed soft tissues (Gustilo-Anderson type II onwards)
4. Skeletally immature patients.
5. Patients with type 2 diabetes mellitus with hba1c values more than 7.
6. Patients with peripheral vascular disease.
7. Fractures with associated neuro-vascular injury.

SAMPLING

Study population: All patients attending OPD and casualty in Orthopaedics department of Adichunchanagiri institute of medical sciences with distal tibia fractures treated with minimally invasive plate osteosynthesis meeting the inclusion criteria.

Sampling Technique - Consecutive sampling

Operative Procedure

The principles which have been followed in surgical fixation are- a) Anatomical, congruent reduction b.) Stable fixation c) Early mobilization and rehabilitation.

A careful preoperative planning was done including Xrays in orthogonal views,consideration of intraoperative reduction techniques and Choice of implants. Ideal time to operate distal tibia fracture by MIPPO technique is within seven days of injury before the fracture site become sticky and the evidence of wrinkle sign.

Under spinal anaesthesia, in Supine position on a radiolucent table with bump in ipsilateral gluteal region. Tourniquet applied to the ipsilateral limb.

Incision starts about 5–8 cm proximal to the ankle joint just lateral to the palpable tibial crest.It runs in a straight line over the ankle joint towards the base of the navicular, following the medial border of the anterior tibial tendon.A straight incision provides a better approach to the anterior part of the tibia than a curved incision.

Fig No.1 Depicting Incision Site And Deep Dissection

The dissection is deepened through the periosteum, just medial to the anterior tibial tendon. Leave the tendon sheath intact, and to immediately repair any traumatic or inadvertent disruption that exposes the tendon directly. A medial 3.5mm pre-countered plate can be slide in a MIPO fashion by holding the locking sleeve. Minimal exposure and careful handling of the periosteum are essential to prevent any further vascular damage of the fracture fragments.

The dissection is advanced down onto the periosteum which is completely preserved. In this anatomical space (epi-periosteal), the tunneling towards the diaphysis can usually easily be achieved with the blunt tip of the plate.

Depending on the fracture situation, the plate is usually positioned on the anteromedial aspect of the tibia. Reduction of the fracture fragments achieved with the patella holding clamps. Reduction and position of the plate is checked under the C-arm guidance. After satisfactory reduction, small nicks are made on the skin and bone is drilled.with the help of sleeve locking screws are passed securing the reduction. After fixation of plate,proper wash was given and skin closure was done with skin stapler.

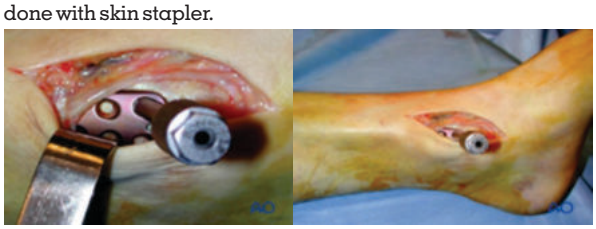

Fig No.2 Pre-countered 3.5mm LCP Plate passed after creating tunnel between Soft tissue and bone periosteum and saphenous nerve is protected with the help of blunt retractor

Post-operative Protocol

- Analgesics, antibiotics, above knee POP slab and limb elevation was given.
- Check X ray (Anteroposterior and lateral view of distal tibia with ankle– Implant full length)
- Wound inspection done on 2nd,5th and 10th day
- Suture removal on 10th post operative day followed by B/K application.
- Patient advised non weight bearing until 4 Weeks.
- Radiological examination once in every 6 weeks
- Once radiological union started partial to full weight bearing was allowed.
- All cases were assessed using the OMAS scoring.

OUTCOME MEASUREMENT

The functional outcome was measured by using standard questionnaires and consisted of OMAS Score. The Olerud and Molander Score[2] is a self-administered patient questionnaire with a score of 0 (Totally impaired) to 100 (Completely impaired) and is based on nine different parameters shown in Figure no.3. Scores of 91-100 were graded as excellent, 61-90 as good, 31-60 as fair and 0-30 as poor results.

SL NO.	SCORE	INTERPRETATION
1	91-100	EXCELLENT
2	61-90	GOOD
3	30-0	POOR

Parameter	Degree	Score
Pain	None	25
	While walking on uneven surface	20
	While walking on surface outdoors	10
	While walking indoors constant and severe	5
Stiffness	None	10
	Stiffness	0
Swelling	None	10
	Only in evenings	5
	Constant	0
Stair climbing	No problems	10
	Impaired	5
	Impossible	0
Running	Possible	5
	Impossible	0
Jumping	Possible	5
	Impossible	0
Squatting	No Problems	5
	Impossible	0
Supports	None	10
	Taping, Wrapping	5
	Stick or Crutch	0
Work, Activities of daily life	Same as before injury	20
	Loss of Tempo	15
	Change to simpler job	15
	Severely impaired work capacity	0

Fig No.3 Olerud and Molander Scoring

Radiographic assessment was done comparing the anteroposterior and lateral views of the affected and the normal leg with both the knee and ankle joints included. The joint orientation angles were used to access axial deviation in frontal and sagittal planes. The fracture was designated as united, when there was periosteal bridging callus at the fracture site at least in three cortices in the anteroposterior and lateral views.

Follow Up

The patients were followed up at intervals of 4 weeks, 12 weeks, 18 weeks, 24 weeks, 12 months to assess the radiological union. After 4 weeks patient is allowed to partially bear weight. The fracture was designated as united, when there was periosteal bridging callus at the fracture site at least in three cortices in the anteroposterior and lateral views. Patient were allowed to bear weight according to radiological union and consolidation at fracture site. Patients were assessed at the end of follow up period according to the Olerud and Molander functional scoring system.

RESULTS

- In the study fractures were common in the 30-50 age group with mean age being 46 which is comparable to study by Ronga et al[5]. Range 21-80 years. Overall, 31 patients were younger than 50 years, and 19 were more ≥ 50 years of age.
- Study had a male preponderance with 60% male and 40% females which is comparable with Shukla et al [6] and Shrestha et al [7] having right extremity most commonly affected.
- Most common mode of injury was RTA followed by slip and fall. Less common mode of injury was fall from height.
- According to AO classification, majority of patients had AO type 43A fractures of which 43A2 was the most common type (45%).
- Complications- 2 patients had superficial infections which subsided with antibiotics according to culture sensitivity and no need for implant removal was required. One patient had deep infection secondary to trauma and uncontrolled diabetes after 3 months for which implant removal and debridement was done. 2 patients developed ankle stiffness due to prolonged immobilization.
- Time to union-Mean time to union was 22.2 weeks comparable to Ronga et al (22.3 weeks). Patients younger than 50 years showed earlier union and good functional recovery, as compared with patients older than 50 years, which was statistically significant.
- OMAS Score- After 6-12 months of follow up, OMAS score was 100 for 12 patients, 95 for 20 patients, 90 for 15 patients and 85 for 03 patient. Functional SCORE was excellent in 27 (54%) patients, good in 21 (42%) patients.

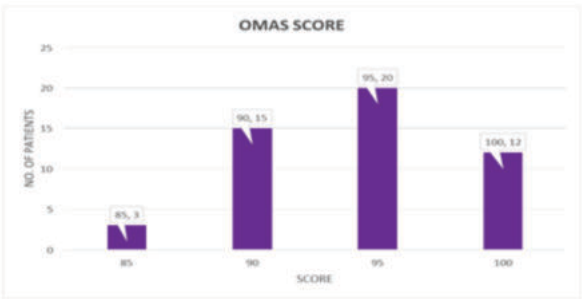

Fig No.4 OMAS score after 6-12 months of follow up

DISCUSSION

With a better understanding of biomechanics, biology, and biomaterials, innovative surgical approaches have evolved over time, ultimately improving patient outcomes in terms of function. It can be difficult to treat severely comminuted distal tibia fractures. Plate osteosynthesis for fracture fixation is a difficult treatment, and surgical skill is important to its success.

MIPO has gained wide application in the treatment of periarticular fractures of the tibia. It relies primarily on the indirect reduction of the fracture using various techniques, excellently described in the classic works of Mast and Ganz[8]. In this way, the fracture environment is better preserved, as well as the blood supply to the bony fragments. Theoretical advantages include less infection and wound problems and better fracture healing.

The new anatomically pre-contoured Locking plate system have the advantage to overcome the complications of the non-locking plates. Locked plate designs act as fixed-angle devices whose stability is provided by the axial and angular stability at the screw-plate interface instead of relying on the frictional force between the plate and bone, which is thought to preserve the periosteal blood supply around the fracture site. Locked plates are indicated for fracture management in osteoporotic bone and in periarticular fracture patterns, making them a feasible treatment option for distal tibia metaphyseal fractures.

In our study we used a single-stage fixation of all distal tibial fractures. We used medial distal tibial locking compression plate for all cases. This plate is a low-profile plate of 3.5mm system. The Medial distal tibial plate is a pre-contoured plate to that of the distal tibia and thus allows placement of the plate without disruption of fractures fragments. The thread holes in the plate locks to that of the screw head and minimize plate-bone interface and maintain the vascularity at the fracture site. In this prospective observational study, we had used both subjective and objective methods to assess the functional and radiological outcome of distal tibia fracture after management with minimally invasive plate osteosynthesis.

CONCLUSION

Distal metaphysio-diaphyseal tibia fracture with or without intra articular extension is one of the difficult fractures to manage with all currently available treatment options. Fracture pattern, concomitant articular extension, condition of soft tissue are important factors to be considered before selection of fixation method.

The present case series though medium in number shows that MIPO with LCP is an effective treatment method in terms of union time and complications rate which is comparable to other studies. The bone healing, though slightly delayed, was universal with this type of fixation. This technique can be used in fractures where locked nailing cannot be done like distal tibial fractures with small distal metaphyseal fragments,

vertical split and markedly comminuted fractures. Due to preserved vascularity, there is reduced incidence of delayed union and non-union. There was lesser incidence of infection due to limited exposure. Infection can also be prevented by careful handling of soft tissues and by minimising the operating time. Implant prominence and its related complications because of mismatching of the implant contouring and supra malleolar anatomy especially in thin built patients or mal-reduction of fracture still remains a challenge.

Prospective randomized controlled trial specially comparing newly available intramedullary nails which has various distal locking options is necessary to establish superiority of the technique.

Fig No.5 60yrs old female had history of self fall at home sustaining left distal tibia fracture. fixation done with MIPPO technique and follow up range of movements of ankle joint

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