

Original Research Article

Comparative study of functional outcome and complication in low profile recon plates vs anatomical anteromedial distal tibial plate in extra articular distal 4th tibia fibula fracture

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ABSTRACT

Background: Treatment of distal tibia fractures is challenging because of its subcutaneous location, poor vascularity and limited soft tissue envelope. Various modalities of surgical treatment such as intramedullary nailing, open reduction and internal fixation (ORIF) with conventional plate osteosynthesis and external fixation have reported good functional outcomes but had a high complication rate. We decided to review the results of treatment of extra articular distal 4th tibia fracture using low profile plates.

Methods: The 30 patients with distal 1/4rd tibia extra-articular fractures with or without associated fibula fractures were treated with anatomical anteromedial distal tibia plate vs low profile recon plate. The present prospective study was conducted in department of orthopaedics, MGMMC and M. Y. hospital, Indore between January 2023- May 2024.

Results: All fractures had excellent clinical and functional outcome, with an average operative time of 49 minutes. The age of the patients ranged from 18 to 60 years (mean 42.7 years). Assessment on basis of Karstorm and Oleruad score at 6-month post treatment showed that majority of patients had excellent score (56.7%). Poor outcome was reported in only 3.3% patient. Most common complication was ankle stiffness in both type of plating groups followed by deep infection.

Conclusions: Both types plate showed similar functional outcome. However, low profile recon plate had lesser complications as compared to anatomical plates i.e., hardware like sensation, wound dehiscence ankle stiffness, deep infection and screw breakage.

Keywords: Fracture distal tibia, Reconstruction plate, Anatomical plate

INTRODUCTION

The tibia is the major weight-bearing bone of the leg. It is the one of the commonest bone to be fractured, with incidence of distal tibial fracture being 0.6% constituting approximately 10%-13% of all tibial fractures.^{1,2} In most cases, they are due to a force directed from the foot towards the leg in the environment of outstanding high-

energy traumatic events, as fall down, traffic accident or sport injury.³ Distal tibia fractures can be challenging to treat because of the complex injury patterns and its proximity to the ankle, and with a close relationship with thin soft tissue envelope with operative treatment historically associated with significant complications.⁴⁻⁶ In a rate of 80% of this kind of traumas, fibula is involved. Furthermore, fibula tends to heal more rapidly than tibia.⁷

Distal extra articular tibia fractures are usually associated with significant soft tissue injury, and if they are not treated properly, they can cause significant long-term morbidity. The degree of associated soft tissue injury is higher in distal metaphyseal fractures than with shaft fractures.⁸ Precarious blood supply and lack of adequate muscle coverage make the patient prone to a gamut of complications such as delayed union, non-union, and wound-related complications.⁹ In most distal extra articular tibia fracture.¹⁰ The fundamental goal of the treatment of distal tibial fractures is 1) Restoration of normal or near normal alignment 2) Ensure joint stability and 3) articular congruity 4) Avoid complication.¹¹ Conservative treatment in this group of fractures can result in shortening, translation and rotational malunion in more than 30% of cases and joint stiffness in 40% of cases.¹² Operative treatment allows early motion, provides soft tissue access and avoids complications associated with prolonged immobilization.¹¹ In an effort to perform an appropriate osseous reconstruction and preserve the soft tissue envelope, multiple surgical approaches and fixation strategies have been proposed. Many osteosynthesis techniques can be used for these fractures such as; traditional ORIF external fixation with or without limited internal fixation, intramedullary nailing or, more recently, minimally invasive plate osteosynthesis (MIPO).¹³⁻¹⁷ Options for plate osteosynthesis include medial plating and anterolateral plating via a variety of surgical approaches.¹⁸ Locking plates (LPs) have the biomechanical properties of internal and external fixators, with superior holding power because of fixed angular stability through the head of locking screws independent of friction fit.¹¹ Open anatomical reduction and stable internal fixation allows axial alignment of the limb, permits early mobilisation, and results in the bony union from endosteal bone healing but it evacuates the osteogenic fracture haematoma and causes soft tissue stripping that can result in infection, wound necrosis and delayed or non-union.^{19,20} All of these techniques have advantages and disadvantages and there is no consensus concerning the management of these fractures.^{21,22} To date, various modalities of treatment of distal 4th tibia fibula fracture using plating has been reported. But still, there isn't a clear perspective regarding the best modality for managing these fractures. Each has been historically related to complications: Anatomical anteromedial distal end tibial plates cause higher complication which can be overcome with use of low-profile distal end tibia plate. The subcutaneous bone in distal medial end of tibia leads to further complication. Low profile plates are widely used in orthopedics surgeries and are easily bent and have lower thickness compared to other plates. Reconstruction plates or distal radius minimal T-plates are some known low profile plates. Since there is no definitive treatment for distal fracture and each of the proposed methods to treat this fracture has different benefits and complications, we decided to review the results of treatment of extra articular distal 4th tibia fracture using low profile plates. In advent of same the present study was undertaken with an aim to compare the functional outcome and complications in low

profile recon plate vs anatomical anteromedial distal tibial plate in extra articular distal 4th tibia fibula fracture for: operation time, hospital stay, union time, rate of infections and union complications (non-union and malunion)

METHODS

In this study, 30 patients with distal 1/4rd tibia extra-articular fractures with or without associated fibula fractures were treated with anatomical anteromedial distal tibia plate vs low profile recon plate. The present prospective study was conducted in Department of orthopedics, Mahatma Gandhi memorial medical college and M. Y. hospital, Indore between January 2023- May 2024.

Inclusion criteria

All patients with distal fourth extra articular fracture of tibia who validate consent, age between 18-60 years, associated fibula fracture and closed fracture, reported injury within 7 days of trauma, Gustilo Anderson grade 1 and patients fit for surgery were included.

Exclusion criteria

Patient with any other fracture in ipsilateral limb, patient with co morbidity like uncontrolled diabetes and immunocompromised state and pathological fractures were excluded.

On admission, all patients were evaluated clinically and were stabilized hemodynamically. Radiograph of ankle with leg AP and lateral views were taken and above knee slab was applied.

Routine investigations were carried out and pre anesthesia fitness for surgery was obtained. Patients were operated within 7 days of trauma with odd even method into two group anatomical vs recon plate group.

The data was collected and entered in Microsoft excel 2010 (Microsoft corp.) and analysed using the SPSS version 20.0 operating on Windows 10.

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Surgical technique

Patients were operated under Sub arachnoid block or general anesthesia after obtaining written informed consent. Above knee, tourniquet was applied in all cases. In patients where fibula was fractured at the level of tibial fractures, they were fixed with ORIF or 1/3rd tubular plates or CRIF with long k- wire. Fibula fractures associated with

distal tibia fractures aid in the reduction of tibia fracture, especially when the fracture is at the same level of tibia. 1st fix the fibula to achieve better alignment and to prevent valgus malalignment. For distal tibia fracture, an anteromedial approach was used, an incision of 3-4 cm was given over medial aspect of distal tibia, starting 1cm below and over the centre of medial malleolus and extended proximally over the tibia, subcutaneous tunnel was opened with the help of a tunnelling device, fracture reduction was achieved under fluoroscopic guidance and temporary placement of plate was done and held over the bone by k-wire. After confirming the reduction, cortical screw was placed, followed by locking screw placement in subchondral bone and in shaft. Before placing all the distal screws syndesmotic stability status was checked in each patient by externally rotating the ankle and by pulling the fibula with a hook. If syndesmotic instability was found, syndesmotic screws were applied. Then wash was given, closure was done in layers and aseptic dressing was done with short leg plaster.



Figure 1 (a-d): Distal 4th tibia fracture fixation by anatomical plate.

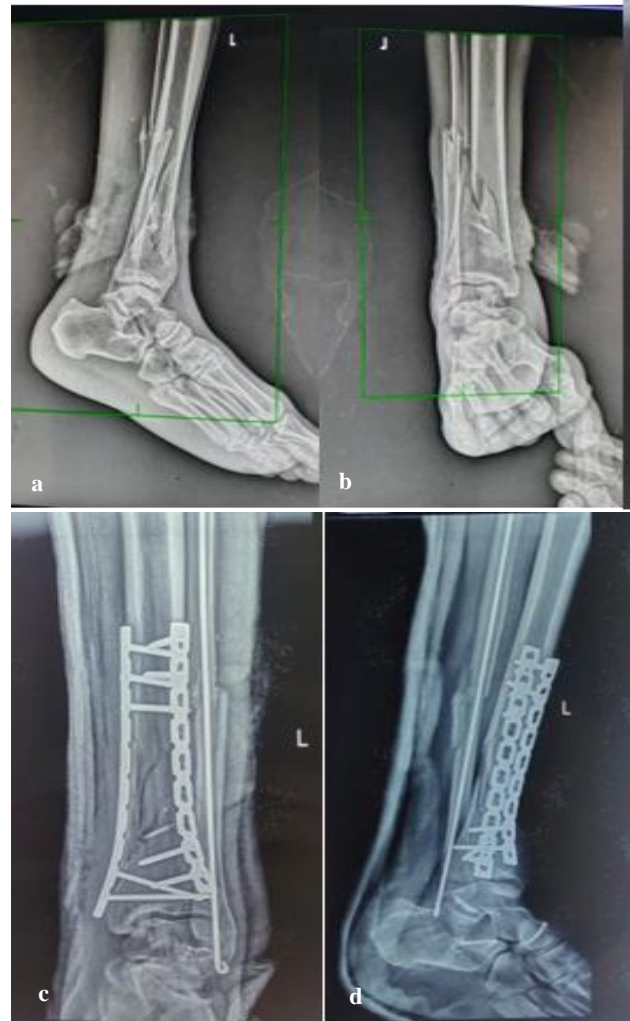


Figure 2 (a-d): Distal 4th tibia fracture fixation by reconstruction plate.

Post-operative protocol and follow-up

Antibiotic medication was given as per requirement. Sutures were removed on 14th post-operative day. Follow-up was done at 2nd, 4th, 8th, 12th week and finally at 6th month postoperatively. On each follow-up visit X- rays were carried out at immediate post op, 1 month, 3 month and 6 month and a functional assessment was done by Karstorm and Oleruad score. Non-weight bearing ambulation was allowed as soon as possible and ankle ROM exercises were started after 3rd postoperative week. Partial weight-bearing was allowed once the radiological union was noted on plain radiographs. After fracture consolidation, full weight-bearing was allowed.

RESULTS

In this study, 30 cases of distal 1/4th tibia fractures were treated with either anatomical plate or recon plate. The age of the patients ranged from 18-60 years with an average age of 42.7 years. The higher proportion 40% was for 35-45 years followed by 23.3% and 20% for age group 25-35 years and 45-55 years.

Table 1: Distribution on basis of age groups.

Age (in years)	N	Percent (%)
25-35	7	23.3
35-45	12	40.0
45-55	6	20.0
55-65	5	16.7
Total	30	100.0



Figure 3 (a-h): Patient follow up-40/m with fracture distal 4th tibia fibula using reconstruction plate, pre op X ray, post op X ray, 6 months post op and clinical images at 6 months follow up.



Figure 3 (a-h): Patient follow up-35/f with fracture distal 4th tibia fibula using anatomical plate, pre op X ray, post op X ray, 6 months post op and clinical images at 6 months follow up.

Table 2: Distribution on basis of mode of incident.

MOI	N	Percent (%)
Assault	5	16.7
Fall	6	20
RTA	19	63.3
Total	30	100

The above table shows the distribution of patients on basis of mode of incident. Mode of the trauma in maximum patient was road traffic accident (63.3%) followed by fall (20%) and remaining was due to assault (16.7%).

The above table shows the distribution of patients on basis of Karlstrom Olerud score at 6 months. Out of 30

patients, 14 patients (46.7%) showed satisfactory results, 7 (23.3%) showed moderate results, 5 (16.7%) showed good results and 4 (13.3%) showed poor results on the basis of Karlstrom Olerud score at 6 months.

Table 3: Distribution on basis of Karlstrom Olerud score at 6 months.

Karlstrom Olerud scores at 6 months	N	Percent (%)
Satisfactory	14	46.7
Moderate	7	23.3
Good	5	16.7
Poor	4	13.3
Total	30	100

Table 4: Complications between two types of plates.

Complication	Anatomical plate	Low profile recon plate	P value	Result
Malunion	-	-	-	-
Delayed union	-	-	-	-
Ankle stiffness	8 (53.3%)	3 (20%)	0.043	Sig.
Superficial infection	-	-	-	-
Implant breakage	-	-	-	-
Wound dehiscence	-	-	-	-
Non-union	-	-	-	-
Scar tenderness	1 (6.67%)	0	0.301	Non-sig.
Deep infection	2 (13.33%)	1 (6.67%)	0.54	Non-sig.
Osteomyelitis	-	-	-	-
Screw breakage	1 (6.67%)	0	0.301	Non-sig.
Screw cutout	-	-	-	-

Among the 30 patient complications are seen in 16 patients, 12 patients belong to anatomical plate group and rest are from recon plate group. In anatomical plate group 8 patient (53.33%) had ankle stiffness, 1 patient (6.67%) had scar tenderness, 2 patient (13.33%) had deep infection and 1 Patient (6.67%) had screw breakage and Recon plate group 3 patients (20%) had ankle stiffness and 1 patient (6.67%) had deep infection.

DISCUSSION

Distal tibia fractures result from low-energy torsional to high-energy axial loading mechanisms. High energy fractures are commonly associated with severe soft tissue injury, and comminuted distal fibula fractures. Distal 1/4th tibia fractures account for <10% of lower extremity fractures and occur in adults owing to falls from height or from road traffic accidents.

Treatment of distal tibia fractures can be challenging because of its subcutaneous location, poor vascularity and limited soft tissue envelope. The goals in the management of treatment of distal tibia fractures are anatomical reduction, maintenance of joint stability, restoration of axial alignment, achievement of fracture union, pain-free

weight-bearing and motion, without any wound complications.

Definitive fixation is advisable and proceeded only when the soft tissue injury was managed properly. This is indicated by the skin wrinkle sign once limb oedema, blisters, swelling subsides. In our study, internal fixation was carried out according to severity of soft tissue injury.

Ruedi and Allgower achieved 74% good functional results following ORIF for distal tibia fractures of low-velocity injuries.^{17,18} They could not reproduce similar results following the principles of open reduction internal fixation in high velocity injuries.¹⁹ This led to the development of procedures that respects the soft tissue envelope. These biological methods of fixation are currently the procedures of choice in the challenging distal tibia fractures.

Two methods are currently popular in distal tibia fracture management-Hybrid external fixators are used in severely comminuted distal tibia fractures with significant soft tissue damage. MIPO, is used in fractures without articular comminution and with minimal soft tissue damage.

Helfet et al introduced a 2 stage MIPO for distal tibia fractures.²¹ Stage 1-fibular internal fixation and spanning

external fixation of tibia and stage 2-limited ORIF for distal tibia.

MIPO reduces the iatrogenic soft tissue injury and damage to bone vascularity, and also preserve the osteogenic fracture hematoma. The MIPO technique enables a bridging fixation without disturbing the comminuted segments and the surrounding soft tissue.

The present study was undertaken to determine the efficacy and compare the functional outcome and complications in low profile recon plate vs anatomical anteromedial distal tibial plate in extra articular distal 4th Tibia Fibula fracture for: operation time, hospital stay, union time, rate of infections and union complications (non-union and malunion).

In our study, for all the patients soft tissue assessment was done prior to definitive fixation. None of the patient presented or developed compartment syndrome in affected extremity posthospitalization out of all 30 patients included in study.

Limitations

Limitations were to less sample size and short follow-up period.

CONCLUSION

Complications were observed in 16 patients, with a higher number of complications in the anatomical plate group compared to the recon plate group. The most common complication in the anatomical plate type group was ankle stiffness, hardware like sensation followed by deep infection, screw breakage, and scar tenderness. In contrast, in the recon type plate group, ankle stiffness was reported in 3 patients as followed by deep infection in 1 patient. In conclusion, low profile recon plate and anatomical plate both presented with similar functional outcomes in our study. However, low profile recon plate had lesser complications as compared to anatomical plates i.e., hardware like sensation, wound dehiscence ankle stiffness, deep infection and screw breakage.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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