

Original Research Article

Investigating the effectiveness of anterolateral distal tibia plate in treating distal tibial fractures in adults: a prospective study

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ABSTRACT

Background: “Pilon” fractures of the distal tibia are a term used usually by orthopaedic surgeons. High-energy trauma and related soft tissue injuries are the main causes. It might be challenging to treat distal one-third of tibial fractures that affect the articular process or not. The objective of this work is to analyze the result of the Anterolateral Distal Tibia Plate in distal tibial fracture treatment in adults.

Methods: After receiving permission from the ethical committee, this prospective interventional analysis was conducted among 25 patients who satisfied the inclusion standards and were given anterolateral distal tibia plates. The scoring system created by “Ovadia and Beals” was used to evaluate patients at the conclusion of the follow-up period.

Results: The participants in this research varied in age from 18 to 64, with a mean age of 36. 13 patients had a left tibia fracture and 12 patients had a right tibia distal end fracture. There were 4 open GA-I fractures and 21 closed GA-I fractures. 18 patients got fractures as a result of road traffic accidents (“high energy trauma”), and 7 patients sustained a fracture due to a fall (low energy trauma). The union of fracture occurred in 24(96%) patients and 1(4%) case showed delayed union. The average period of union was 18 weeks with the radiological signs of callus formation. 2 patients developed superficial and 1 patient developed deep infection.

Conclusions: Distal end tibial fractures especially with intra-articular involvement may be effectively treated by anterolateral plating within a single stage, offers advantages such as adequate fracture exposure, soft tissue preservation, and reliable fracture healing.

Keywords: Anterolateral distal tibia plate, Ovadia and Beals scoring system, Open reduction and internal fixation,

INTRODUCTION

The most frequently fractured long bone is the tibia. Its subcutaneous location makes it vulnerable to frequent injury.¹ The typical patient is approximately 37 years old, and men are nearly three times more likely to develop them than women.^{2,3} The incidence of tibia fractures has grown in India as a result of a gradual rise in the number of complicated trauma cases brought on by traffic accidents.⁴ Orthopaedic surgeons refer to distal tibia fractures as “pilon” fractures.⁵ The anatomist and radiologist Étienne

Destot popularized this phrase, which is derived from the term “pestle” in French.⁶ The trochlea serves as the pestle in his analogy of the “ankle joint anatomy”, while the distal extremities of the fibula and tibia serve as the mortar. A distal tibia fracture results from a hit that is directed axially, like during a fall from a height.

High-energy trauma and related soft tissue damage are the primary causes of distal tibia fractures. Distal one-third of tibial fractures with or without “articular involvement” may be challenging to handle, owing to inadequate blood

supply thin soft tissue coverage, and myriad treatment options.^{7,8} It is usually difficult to reduce the metaphyseal and restore articular alignment without compromising soft tissues.⁹ Numerous treatment approaches were recommended for these injuries, such as plate fixation (anterolateral or medial), intramedullary nailing, “external fixation” with or without “internal fixation”, and conservative treatment, more lately MIPPO (“Minimally Invasive Percutaneous Plate Osteosynthesis”).¹⁰⁻¹³ However, none of these methods is without complications. Soft tissue recovery is of utmost significance alongside bone healing in distal tibial fractures to have a favourable result.¹⁴

Conservative treatment of such fractures commonly leads to a variety of problems, such as malunion, non-union, as well as ankle stiffness.¹⁵ Intramedullary nailing has limits with distal fractures that reach the joint line and fractures that are very distal.¹⁶ Although utilizing plates during ORIF (“Open Reduction and Internal Fixation”) may induce soft tissue stress, it also aids in achieving a satisfactory fracture reduction, firm fixation, and preservation of the anatomical reduction, all of which eventually enable appropriate healing of the fractures.^{17,18} The medial plating technique, which has been used for many years, gives the tibia good exposure. However, there is a significant chance of infection, wound dehiscence, as well as hardware issues.^{19,20} If fixation of the fibula is necessary during medial plating, a second incision should be performed on the shin’s lateral side. It has been observed that single lateral plating produces positive outcomes for distal tibial & fibular fractures. Additionally, even in two-thirds of instances, arthritis may occur after surgically treating pilon fractures.²¹ Additionally, the outcome will rely on the patient's concomitant conditions, surgical scheduling, soft tissue damage, injury severity, and timing of the surgery.^{22,23} In distal tibia fracture investigations, both patients with and without fibular fracture fixation were included.

For the tibial pilon fracture treatment, the anterolateral method to the tibia has recently grown in favour.²⁴ Some research observed that this method gives the advantage of enhanced soft tissue coverage as well as the possibility for a reduced risk of wound healing issues by preventing an incision placement across the tibia’s subcutaneous border. Therefore, this current work has been chosen to measure the functional outcome and clinical findings while treating distal tibial fractures by anterolateral LCP (“Locking Compression Plate”).²⁵

METHODS

Prospective research from June 2019 to May 2021 was conducted in department of orthopaedics, Jhalawar medical college and SRG hospital, Jhalawar. Anterolateral distal tibia plates were used to treat 25 adult patients with lower third tibia fractures who were admitted and met the inclusion criteria. Statistical analysis was done with IBM SPSS software version 28.

Inclusion criteria

Inclusion criteria for current study were; fracture of the distal tibia (distal 1/4th) with or without fibula fracture, adults (≥ 18 years) and closed fractures and Gustilo-Andersons classification defines grade I open fractures.

Exclusion criteria

Exclusion criteria for current study were; underlying neuromuscular condition, Patients who are unsuited for surgery, Patient is unwilling to give consent, According to the Gustilo-Andersons Classification, an open distal tibial fracture of Grade II or Grade III and Pathological fractures or metabolic bone conditions.

Preoperative evaluation

All of the patients received encouragement and information about their cosmetic issues and post-operative safety measures. The proper, as well as valid written permission, was obtained. The patient was sent for surgery after a standard examination and a determination of surgical fitness. The studies were conducted like ECG, chest X-ray, HBsAg, HIV, Serum creatinine, Blood urea, Fasting blood sugar, and Hemoglobin percentage. The portion was prepared the day before the procedure. The equipment had already been checked and sterilized. Tetanus toxoid and an antibiotic dosage were administered preoperatively.

Operative procedure

The procedure was performed in Spinal Anaesthesia preferred by an anaesthetist, on a radiolucent operation table with sterile condition. All patients were operated on by Anterolateral Distal Tibia Plate using an anterolateral approach. The incision was either vertical or curvilinear, with its midpoint at the “ankle joint”, running parallel to the 4th “metatarsal distally” and between the fibula and tibia proximally (Figure 1). It was carefully avoided to damage the “superficial peroneal nerve”, which is located immediately below the skin (Figure 1). It was mobilized, identified, and protected during the surgical process.

The plane of inter-nervous was made between the peroneus brevis (“Superficial Peroneal Nerve”) and the peroneus tertius (“deep peroneal nerve”) (Figure 1). Direct reduction of fracture was conducted under C-arm guidance and fixed with Anterolateral Distal Tibia Plate and screws (Figure 1). The wound was washed and the closer of the wound was done layer by layer. In cases where fibula fracture needed to be fixed, it was fixed with K-wire/4mm CC screws/plating, any suitable method. In the end, sterile dressing with aseptic precaution was done and GT slab was used with the ankle in a neutral position.

Post-op protocol

We searched for immediate post-operative problems such as fat embolism, vascular injury, compartment syndrome,

and neurological harm. For five days after the procedure, intravenous antibiotic therapy was continued. Oral antibiotics have been recommended for a further 3 days. On the fifteenth postoperative day, staples or sutures were eliminated. It was suggested to elevate the limbs for the first 2 to 5 postoperative days.

Physiotherapy with active aided exercises with; active toe and ankle movements, knee mobilization and quadriceps exercises were started after the surgery as soon as the patient is pain-free and comfortable. From the 3rd postoperative day, the patients were permitted to walk using a walker while not putting any weight on the treated leg. Radiological and clinical follow-up was suggested after 2, 6, 12, 16, 20 & 24 weeks. A follow-up for each postoperative visit, lateral and antero-posterior radiographs were examined. Weight-bearing gradually improved based on the consolidation of the fracture, starting at 6-8 weeks, with complete weight-bearing often occurring after 3 to 4 months.

RESULTS

The age of the patients ranges between 18 to 64 years, with a mean age of 36 years with the fracture occurring most often in the 4th decade. (Table 1). Out of 25 patients, 6 (24%) patients were female as well as 19(76%) patients were male indicating male predominance due to travelling and working in factories and fields (Table 2).

Table 1: Age distribution.

Age (in years)	N	%
11-20	4	16
21-30	7	28
31-40	5	20
41-50	5	20
51-60	3	12
≥61	1	4
Total	25	100

Table 2: Sex distribution.

Sex	N	%
Male	19	76
Female	6	24
Total	25	100

In our research, out of 25 cases, 4(16%) cases were open and 21(84%) cases were closed GA-I fractures (Table 3). In the present study, the fracture pattern was categorized depending on Rudie & Allgower's classification of distal tibia fractures of the 25 cases examined, 12 (48%) cases were A1, 7 (28%) cases were A2, 5 (20%) cases were A3 and 1 (4%) case was type C3 (Table 4). The average healing time for all fractures has been 18.4 weeks. One delayed union had radiological callus development visible 24 weeks after the delayed union (Table 5).

According to objective criteria, in this research, in 68 per cent of cases, 17 patients indicated good outcomes, whereas in 8 per cent of cases 2 patients indicated poor outcomes (Ovadia and Beals) (Table 6).

Table 3: Clinical type of fractures.

Type	N	%
Closed	21	84
Open	4	16
Total	25	100

Table 4: Fracture pattern.

Type	N	%
A1	12	48
A2	7	28
A3	5	20
B1	0	0
B2	0	0
B3	0	0
C1	0	0
C2	0	0
C3	1	4

Table 5: Duration of fracture union.

Duration (weeks)	N	%
16	11	44
20	13	52
24	1	4
Total	25	100

Table 6: Results as per objective criteria.

Results	N	%
Excellent	17	68
Good	5	20
Fair	1	4
Poor	2	8

Table 7: Results as per subjective criteria.

Results	N	%
Excellent	16	64
Good	5	20
Fair	2	8
Poor	2	8

In this research, 64% of cases (16 pt.) indicated good outcomes whereas 8% of cases (2 pt.) indicated poor outcomes according to subjective criteria (Ovadia and Beals) (Table 7). There was no case of intraoperative complications in our research. Two of the patients had superficial skin infections, which were treated following pus culture as well as sensitivity testing with daily dressings and the proper drugs. The aforementioned medication successfully treated all of these illnesses. Ankle stiffness affected 2 of our patients.

This was likely owing to the patient's failure to adhere to the prescribed physiotherapy regimen since there was no way to track the ankle joint's physiotherapy after the patient was discharged. We had, 1 patient who developed a deep infection, which was treated with the elimination of implant and debridement, and the patient was put on external splintage with a patellar tendon bearing cast.

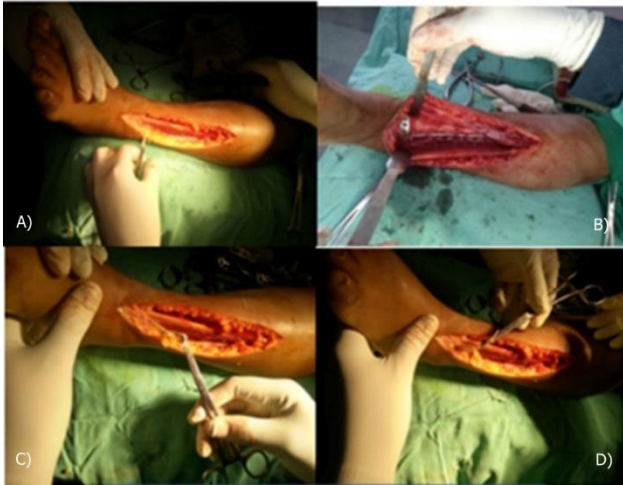


Figure 1: (A) Skin Incision, (B) plate fixed over distal tibia, (C) superficial peroneal nerve, (D) wound suturing.



Figure 2: Pre-operative X-ray.

DISCUSSION

The objective of this research was to determine the functional result of the pre-contoured LCP (Anterolateral distal tibia plate) in managing distal tibial fractures. Distal tibia fractures are among the fractures that are challenging to repair successfully, particularly if the fracture extends intra-articular. The purpose of surgical intervention is to achieve the joint surface's anatomic realignment while maintaining adequate stability to permit early mobility of the ankle joint and prevent ankle stiffness. The

Anterolateral method to the distal tibia which is employed in this method gives the advantages of enhanced soft tissue coverage and unlike the anteromedial approach, there is a lower rate of wound healing issues like wound breakdown over subcutaneous tibia border and implant exposer.



Figure 3: Post- operative X-ray.



Figure 4: Follow up 4 weeks.



Figure 5: Follow up 20 weeks.

The average patient age in our research was 36 years (range 18-64 years), which was 38 years in the study by Vallier et al and 35 years in the study by Gupta et al.^{23,26}



Figure 6: Planter flexion.



Figure 7: Dorsiflexion.

Table 8: Duration of fracture union.

Study	Method	Average fracture union (weeks)
Dinesh Kumar et al ¹⁴	ORIF	16-20
Devendra Lakhota et al ³⁰	ORIF	19.1
Im et al ²⁹	ORIF	20
Hazarika et al ²⁸	MIPPO	19.3
Our study	ORIF	18.4

Comparable research on fractures of a similar kind may be found below. The male preponderance for distal tibia fracture in our study was 76%, which was 90% in the study by Shabbir et al²⁷ and 69% in the study by Vallier et al. This majority may be owing to the fact that males dominate women in occupational injuries, travel, and other factors. For fracture pattern percentage, a Study by Devendra Lakhota et al showed 33.3% C1, 19% C2, and 9.6% C3.²⁸

Dinesh Kumar et al also had fracture types 27.8% A, 50% B, as well as 22.2% C.²⁹ Fractures in the proportions of 31 per cent A, 21 per cent B, and 44 per cent C were also present in Vallier et al.²³ We had a greater ratio of a kind A fracture because of the selecting procedure on the basis of the study's goals, as we had exclusion criteria for Gustilo-Andersons open grade II and III which are most likely type B & C. In this study, the mean time for fracture union is 18 weeks which is similar to investigations conducted using LCP. The mean period for fracture union in different trials carried out utilizing different methods was 16 to 20 weeks. Kumar et al had a mean time of fracture union was 16-20 weeks, Lakhota et al had a mean of 19.1 weeks and Hazarika et al had 19.3 weeks (Table 8).^{14,18,30,31}

Limitations

Limitations of the study are its low volume of patients, short duration of follow-up, and no control group to compare the results. Long-term investigations are also required to compare the total complication rates and evaluate the functional results of fixing the “distal tibial anterolateral plating” in patients. A bigger sample size as well as a longer follow-up time are required to study the “anterolateral fixation” of tibial pilon fractures with varus forces.

CONCLUSION

We found that distal end tibial fractures especially with “intra-articular involvement” may be efficiently treated by anterolateral plating in a single stage. It also offers advantages such as adequate fracture exposure, soft tissue preservation, and reliable fracture healing. A satisfactory fixation can be performed with precise surgical scheduling, delicate soft tissue manipulation, and an average 9 cm incision depending on the needs of the fracture pattern. Because to the plate's appropriate soft tissue coverage, revision surgery for implant removal owing to implant prominence can be avoided with anteromedial plating.

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