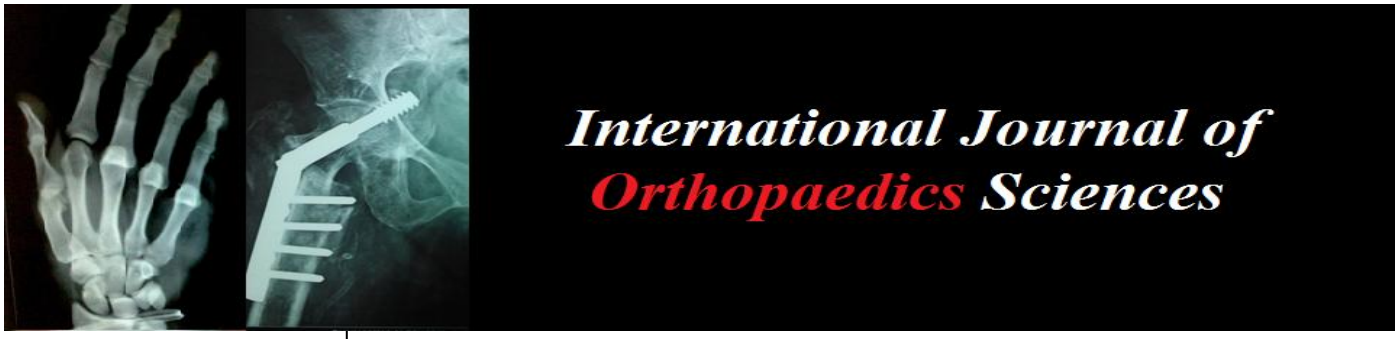

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Dr. Haranadh Kadimi
Department of Orthopaedics, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India

Corresponding Author:
Dr. Haranadh Kadimi
Department of Orthopaedics, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India

A study of functional outcome of medial distal tibia locking compression plate fixation in distal tibia fracture

Haranadh Kadimi

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Abstract
Introduction: Distal tibial fractures, particularly those involving the tibial plafond or pilon region, are challenging due to their anatomical complexity, limited soft tissue envelope, and proximity to the ankle joint. High-energy trauma such as road traffic accidents or falls from height are common causes. Traditional management methods like casting or intramedullary nailing often lead to complications such as malalignment, non-union, or joint stiffness. Locking compression plating (LCP), particularly via the medial approach, offers improved stability, anatomical reduction, and preserves fracture biology, making it a valuable surgical option.
Aim: To assess the functional outcome of medial distal tibia locking compression plate fixation in distal tibia fractures.
Objective
- To assess postoperative functional outcomes of the ankle joint.
- To evaluate postoperative complications.
- To analyze clinical and radiological outcomes using standard scoring systems.

Methodology: This prospective comparative study was conducted on patients with closed tibial shaft fractures who were treated using either suprapatellar or infrapatellar nailing techniques. Patients were randomly allocated into two groups. Standard preoperative, intraoperative, and postoperative protocols were followed. Variables such as operative duration, radiation exposure, VAS for knee pain, and postoperative alignment were recorded. Functional outcomes were assessed at regular intervals using the AOFAS score and Johner & Wruhs criteria. Data were analyzed using SPSS version 26.
Results: Most patients (53.7%) were aged 30-60 years, with a male predominance (61%). Falls were the leading cause of injury (68.3%). The right side was more commonly affected (73.2%). Majority (63.4%) had Gustilo-Anderson Grade II fractures. Mean fracture union time was 18.07 weeks. Fibula fixation was performed in 87.8% of cases. Pain scores significantly decreased over time. Postoperative complications included delayed union (9.8%), infection (7.3%), and rare cases of malunion or nonunion (2.4% each). Radiological outcomes were excellent in 68.3% and good in 22%. Functionally, 73.2% of patients had excellent results per AOFAS score, with 19.5% good and 7.3% fair outcomes.
Discussion: The study demonstrated that medial distal tibia LCP fixation provides favorable clinical and functional outcomes in managing distal tibial fractures. Early mobilization, minimal soft tissue disruption, and strong construct stability contributed to effective recovery. Compared to other modalities like external fixation or intramedullary nailing, the locking plate showed fewer complications and better union rates. Literature supports that MIPO (Minimally Invasive Plate Osteosynthesis) with LCP offers biomechanical and biological advantages, preserving blood supply and reducing infection risks. However, soft tissue management remains critical to avoid wound complications.
Conclusion: Medial distal tibia locking compression plate fixation is a reliable and effective treatment for distal tibia fractures. It offers excellent radiological alignment and functional outcomes with minimal complications when applied judiciously. This method supports early mobilization, rapid recovery, and is particularly beneficial in cases unsuitable for intramedullary fixation. Future studies with larger cohorts and longer follow-up are recommended to further validate these findings.

Keywords: Distal tibia fracture, tibial plafond, pilon fracture

Introduction
Because of their involvement of the weight-bearing articular surface and proximity to the ankle joint, distal tibial fractures, notably tibial plafond or pilon fractures, are complicated

injuries. High-energy injuries like falls from a height or car accidents frequently cause these fractures, resulting in comminution and severe soft tissue damage. Injury causes complex fractures in low-energy injuries, particularly in osteoporotic bones.

Due to the restricted soft tissue envelope, inadequate vascularity, and increased risk of problems such as nonunion, malunion, and infection, distal tibial fracture management is difficult. In nondisplaced fractures, conservative therapy using long leg casts or below-knee plaster might occasionally be beneficial, but in displaced or unstable fractures, it frequently causes protracted immobilization, which can cause joint stiffness, muscle atrophy, and bad functional outcomes.

Surgical treatment seeks to reestablish anatomical alignment, joint congruity, and early mobilization. Each method, though, has its drawbacks:

Due to the extensive surgical exposure needed, surgery provides precise reduction and stabilization but is linked to soft tissue problems such as infection, delayed healing.

Although closed intramedullary nailing protects soft tissues, particularly when used for distal fractures, it has its own set of difficulties. The hourglass-shaped distal tibia has little room for safe distal locking, which frequently causes problems in achieving and maintaining anatomical alignment. Malalignment, such as valgus/varus or rotational deformities, is a frequent issue.

Open fractures damage are especially amenable to external fixation, whether it be used as a definitive cure or as a temporary stabilization procedure. Although it facilitates wound care and reduces additional harm to the soft tissue, it comes with hazards like pin tract infections, less fracture control, joint stiffness, and patient pain. In complicated cases, staged protocols and hybrid methods are frequently used, beginning with external fixation to provide initial stability and facilitate soft tissue healing, and then progressing to definitive internal fixation. Improvements in precontoured anatomical plates and minimally invasive plating methods have also enhanced outcomes in recent years.

The surgical approaches for distal tibial fractures, each has its drawbacks.

Methodology

Study Design and Setting

This study is a prospective, comparative clinical analysis conducted to evaluate and compare the clinical, radiological, and functional outcomes of tibial shaft fractures treated using two surgical approaches: the suprapatellar (SP) and infrapatellar (IP) techniques for intramedullary nailing

Ethical Considerations

This study was conducted following ethical guidelines established by the Declaration of Helsinki and was approved by the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth, Karad. All participants were informed in detail about the nature and purpose of the study, including potential risks and benefits, and written informed consent was obtained prior to inclusion. Participation was entirely voluntary, with assurance that refusal or withdrawal would not affect the standard of care. Patient confidentiality was strictly maintained by anonymizing data and limiting access to the research team. As both surgical approaches are standard practices, no experimental techniques were used, and the risk to participants remained minimal, with all procedures conducted under established clinical protocols.

Patient Selection

All patients with distal tibial fractures meeting the inclusion criteria were considered
for the study.

Inclusion Criteria

- Patients aged over 18 years.
- Those with simple fractures of the lower 3rd of the tibia, including intraarticular or
- periarticular fractures in the same region.
- Open fractures classified as Gustilo-Anderson grades I, II, and IIIA where soft
- tissue injury had healed, and skin condition was adequate for definitive treatment.

Exclusion Criteria

- Patients under 18 years of age.
- Open fractures classified as Gustilo-Anderson grade IIIB or higher, where soft
- tissue injuries had not healed or skin condition was poor.
- Patients presenting with concomitant vascular injury

Sample Size and Randomization

A total of 41 patients fulfilling the inclusion criteria were enrolled during the study period.

Simple random sampling was utilized to select participants, reducing potential selection bias.

Surgical Procedure

All patients underwent a comprehensive evaluation, including detailed medical history, physical examination, laboratory tests, and CT imaging. After receiving a full explanation of the study objectives and procedures, eligible participants provided informed consent. Initial management involved immobilization using a slab until swelling reduced, followed by open reduction and internal fixation with plating. The duration of postoperative hospital stay was documented from the day of surgery until discharge. Follow-up assessments were conducted on postoperative days 14, 30, and at six weeks, with suture removal performed on day 14. The time taken to resume normal daily activities was recorded. Each patient was monitored for a minimum of six months postoperatively, with evaluations focusing on wound healing, pain, joint stiffness, and signs of infection. Functional outcomes were assessed at the six-month mark using the American Orthopaedic Foot and Ankle Society (AOFAS) scoring system.

Postoperative Care and Rehabilitation

Pain was evaluated based on ankle joint scores.

Clinical evaluation utilized the AOFAS score.

Radiology: X-rays (anteroposterior, lateral, and mortise views).

Assessments were conducted up to 6 months postoperatively.

Statistical Analysis

The collected data were organized using Microsoft Excel. For continuous variables, means and standard deviations were computed, whereas categorical variables were summarized using percentages. Relevant statistical tests were applied based on the nature of the data, with a p-value of less than 0.05 considered statistically significant. Data analysis was conducted using OpenEpi version 2.3.1 and SPSS software version 21.

Result

Table 1: Distribution depending on age

Age in years	Frequency	Percentage
18 to 30	14	34.1
30 to 60	22	53.7
>60	5	12.2
Total	41	100

A significant proportion of patients (53.7%) were within the 30-60 year age group, suggesting that distal tibial fractures are most prevalent among middle-aged adults. This is likely due to higher physical activity levels and occupational risks in this age group. Young adults (18-30 years) comprised 34.1%, while the elderly population (>60 years) accounted for only 12.2%, possibly reflecting lower exposure to high-energy trauma in older adults. Mean age was years.

Table 2: Distribution depending on gender

Gender	Frequency	Percentage
Male	25	61
Female	16	39
Total	41	100

Males accounted for a higher proportion (61%) of distal tibia fracture cases compared to females (39%).

Table 3: Distribution depending on mode of injury

Mode of injury	Frequency	Percentage
Road traffic accident	13	31.7
Fall	28	68.3
Total	41	100

Falls were the predominant mode of injury, responsible for 68.3% of cases, while road traffic accidents (RTAs) accounted for 31.7%. This suggests that low-energy trauma like falls—potentially from standing height—are main of distal tibia fractures in this population, especially among older adults or females.

Table 4: Distribution depending on outcome depending on Ankle society score

Ankle society score	Mean	SD
Pain (40)	32.2	2.9
Function (50)	44.8	2.4
Alignment (10)	8.2	1.2
Total range of motion	39.2 Degree	

The Ankle Society score showed good postoperative recovery, with an average pain score of 32.2/40, function score of 44.8/50, and alignment score of 8.2/10. These values suggest minimal residual pain, high functional restoration, and good anatomical alignment post-surgery.

Discussion

The present study evaluates the demographic, clinical, radiological, and functional outcomes of distal tibia fractures managed using medial distal tibia locking compression plate (LCP) fixation. The majority of fractures occurred in patients aged 30-60 years (53.7%), consistent with findings from prior studies by Dr. K. Suriya Kulothungan, Joveniaux P, Kumar D, Illur Vikas, and Ramavtar Saini, all of which reported similar middle-aged predominance. This likely reflects increased exposure to occupational and physical activity-related risks in this age group. Males comprised 61% of the cases, aligning with previous literature, and suggesting greater male exposure to trauma due to lifestyle or environmental factors. Falls were the most common mechanism of injury (68.3%), differing from some studies like those by Kulothungan and Kumar D, which identified road traffic accidents as more frequent. This difference could be attributed to geographic and environmental variations influencing injury mechanisms. Right-sided fractures were more prevalent (73.2%), echoing findings from Kulothungan and Kumar D, while Saini *et al*. reported equal distribution.

The most frequent Gustilo-Anderson classification was Grade II (63.4%), indicating moderate soft tissue injury and suitability for internal fixation techniques. Postoperative hospital stays were typically short, with 63.4% of patients discharged within five days, suggesting efficient perioperative care compared to longer durations reported in earlier research by Li Yongchuan *et al*. Most fractures united between 15-20 weeks (mean: 18.07 weeks), aligning with union times in studies by Kulothungan, Kumar D, and Illur Vikas. Fibular fixation was performed in 87.8% of cases, supporting its importance in maintaining limb alignment and stability. Pain scores decreased steadily from a median of 8 on day 14 to 2 at six months, reflecting successful pain management and rehabilitation. Postoperative complications were low, with delayed union in 9.8%, infection in 7.3%, and rare instances of malunion or nonunion, consistent with other studies showing low complication rates.

Radiologically, 68.3% of cases had excellent outcomes, and functionally, 73.2% achieved excellent recovery. Ankle Society and AOFAS scores indicated positive postoperative function and alignment, comparable to outcomes reported by Joveniaux, Kumar D, and Vikas. Overall, the study supports medial distal tibia LCP fixation as a reliable and effective method, with results largely in agreement with existing literature, despite some regional and methodological differences.

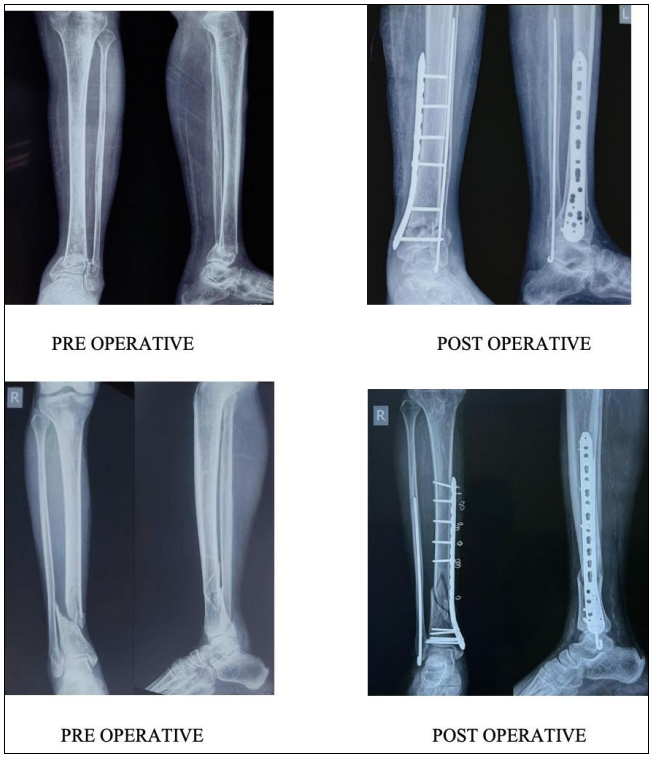

Fig 1: Case of distal tibia plating

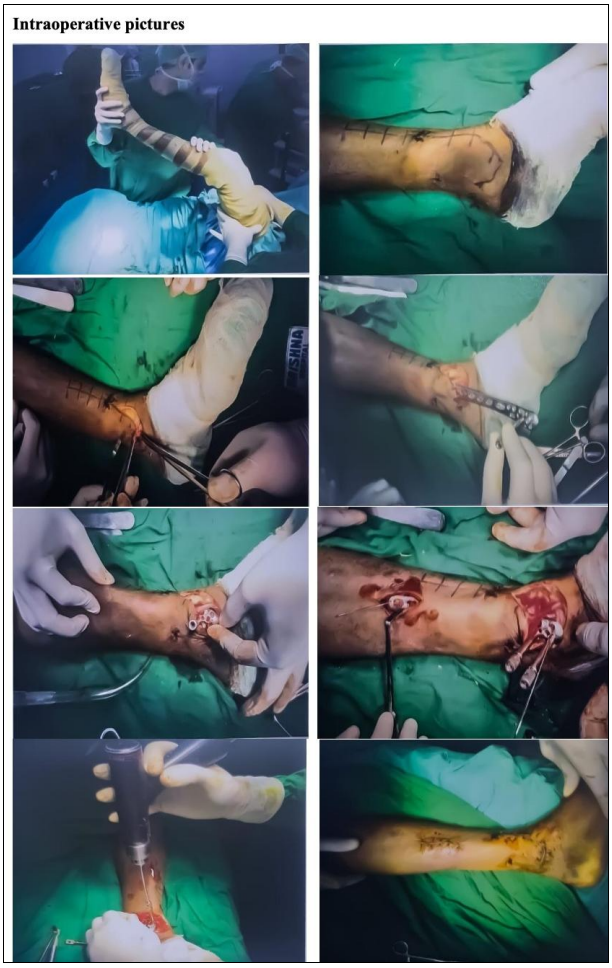

Fig 2: Steps in Medial Distal Tibia Plating

Conclusion

Distal tibia fractures occur more frequently in individuals aged 30 to 60 years, with a slightly higher incidence in males. Falls were identified as the leading cause of injury, and the right leg was more commonly affected. The majority of fractures fell under Gustilo-Anderson Grade II, and most patients experienced hospital stays shorter than five days. Fracture healing typically occurred within 15 to 20 weeks, suggesting good recovery times when treated appropriately. Locking compression plate fixation was shown to be an effective treatment option, resulting in predominantly excellent radiological and functional results. While infection and delayed union did occur, they were infrequent. The Ankle Society Scores indicated satisfactory pain control, joint function, and alignment, highlighting the success of this surgical method. Overall, the findings support locking compression plating as a dependable and stable technique for managing distal tibia fractures, offering positive clinical outcomes.

Conflict of Interest

Not available.

Financial Support

Not available.

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