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Assessment of Comparison of Functional and Radiological Outcome of Distal Tibia Fracture Treated with Distal Tip Interlocking Tibia Nail vs Distal Tibia Locking Plate

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Abstract:

- ***Background:***
  Extra-articular distal tibia fractures are difficult to manage due to poor soft-tissue coverage, limited blood supply, and proximity to the ankle joint. Intramedullary interlocking nailing and distal tibia locking plate fixation are commonly used surgical options, each with specific advantages and limitations.

- ***Aim:***
  To compare the functional and radiological outcomes of extra-articular distal tibia fractures treated with distal tip interlocking tibia nail versus distal tibia locking plate fixation.

- ***Methods:***
  This prospective comparative study was conducted on 60 adult patients with AO/OTA 43-A distal tibia fractures at RKDF Medical College Hospital and Research Center over six months. Patients were divided into two groups of 30 each based on the surgical procedure performed. Functional outcomes were assessed using AOFAS and OMAS scores, while radiological evaluation included time to union, alignment, and complications during follow-up up to six months.

- ***Results:***
  Both techniques achieved satisfactory union and functional outcomes. Intramedullary nailing allowed earlier weight bearing and fewer soft-tissue complications, whereas locking plate fixation provided better alignment control with lower malunion rates. Final functional scores were comparable between groups.

- ***Conclusion:***
  Both distal tip interlocking tibia nailing and distal tibia locking plate fixation are effective for extra-articular distal tibia fractures. Implant selection should be individualized based on fracture pattern, soft-tissue condition, and surgeon experience.

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I. INTRODUCTION

Fractures of the distal tibia represent a challenging subset of lower limb injuries for orthopaedic surgeons because of their unique anatomical, biomechanical, and soft-tissue characteristics. The distal tibial metaphysis, typically defined as the region extending approximately 4–11 cm proximal to the ankle joint, accounts for nearly 7–10% of all tibial fractures[1–3]. These injuries commonly result from high-energy trauma such as road traffic accidents and falls from height in younger individuals, while low-energy rotational mechanisms may produce similar fractures in elderly patients with osteoporotic bone. The management of distal tibia fractures is particularly demanding due to the subcutaneous location of the bone, minimal muscular coverage, compromised vascularity, and close proximity to the ankle joint, all of which increase the risk of complications including delayed union, nonunion, malalignment, infection, and wound breakdown[4,5]. Anatomically, the distal tibia plays a crucial role in load transmission across the ankle joint, bearing approximately 85–90% of the axial load from the leg to the foot. Even minor degrees of malalignment in this region can significantly alter ankle biomechanics, leading to abnormal stress distribution across the articular surface, early degenerative arthritis, chronic pain, and functional impairment. Furthermore, the metaphyseal region of the distal tibia has a wider medullary canal and thinner cortical bone compared with the diaphysis, making stable fixation more difficult, particularly in comminuted fractures. Restoration of alignment, limb length, and rotational stability is therefore essential to achieve satisfactory functional outcomes and prevent long-term disability. Historically, distal tibia fractures were managed conservatively using traction and cast immobilization[1]. Although nonoperative treatment avoided surgical complications, it was associated with prolonged immobilization, joint stiffness, muscle wasting, and a high incidence of malunion due to difficulty in maintaining reduction, especially in unstable fracture patterns. Open reduction and internal fixation with conventional plates later became popular because it allowed direct visualization and anatomical reduction of the fracture. However, traditional plating required extensive soft-tissue dissection and periosteal stripping, which compromised the local blood supply and fracture hematoma, increasing the risk of infection, delayed healing, and nonunion. These limitations led to the evolution of biological fixation techniques aimed at preserving soft tissues and vascularity while providing adequate mechanical stability. In contemporary orthopaedic practice, two principal surgical modalities are widely used for the treatment of extra-articular distal tibia fractures[6–9]: intramedullary interlocking nailing and locking plate fixation, particularly using minimally invasive plate osteosynthesis (MIPPO) techniques. Intramedullary nailing is a load-sharing device inserted into the medullary canal through a proximal entry point, providing stable fixation with minimal disruption of surrounding soft tissues and periosteal blood supply. Advances in implant design, including nails with multiple distal locking options in different planes, have expanded the indications of intramedullary nailing to include fractures close to the ankle joint that were previously considered unsuitable for this technique. The advantages of intramedullary nailing include smaller incisions, reduced blood loss, preservation of fracture biology, earlier mobilization, and the possibility of early weight bearing, all of which contribute to shorter hospital stay and faster rehabilitation. Despite these benefits, intramedullary nailing of distal tibia fractures presents certain technical challenges. The metaphyseal region has a wide canal and a short distal fragment, making it difficult to achieve and maintain alignment during nail insertion. Malalignment, particularly in varus-valgus or procurvatum-recurvatum planes, is a recognized complication associated with distal tibial nailing. Techniques such as the use of poller (blocking) screws, temporary reduction aids, and careful intraoperative fluoroscopic guidance have been developed to address these issues. Additionally, anterior knee pain related to the entry point and hardware prominence remains a frequently reported postoperative complaint following tibial nailing. Locking plate fixation has emerged as an alternative method that combines angular stability with biological preservation of soft tissues. Precontoured distal tibia locking plates function as internal fixators, allowing stable fixation without requiring compression between the plate and bone. When applied using minimally invasive techniques such as MIPPO, these plates minimize periosteal stripping and preserve the fracture hematoma, thereby promoting biological healing. Locking plates are particularly advantageous in fractures with metaphyseal comminution, osteoporotic bone, or fractures located very close to the ankle joint where precise anatomical alignment is essential. The ability to control the distal fragment more effectively makes plating a preferred option in certain fracture patterns. However, plate fixation also has inherent disadvantages. The distal tibia has poor soft-tissue coverage, and surgical implantation of plates in this region may increase the risk of wound complications, infection, and hardware irritation. Implant prominence beneath the thin subcutaneous tissue may necessitate secondary procedures for removal. Furthermore, plating is a load-bearing construct, which may delay weight bearing compared to intramedullary nailing. Thus, both techniques have distinct advantages and limitations, and the choice of fixation remains a matter of ongoing debate. Several comparative studies and meta-analyses have attempted to evaluate the relative efficacy[7,9,12] of intramedullary nailing and locking plate fixation for distal tibia fractures. While many studies report comparable long-term functional outcomes between the two methods, differences have been observed in union time, alignment, complication rates, and rehabilitation. Intramedullary nailing is often associated with earlier union and fewer soft-tissue complications, whereas locking plate fixation tends to provide better control of alignment and lower rates of malunion. Patient-related factors such as age, bone quality, comorbidities, and activity level, as well as fracture characteristics including location, degree of comminution, and associated fibular fractures, play an important role in determining the optimal treatment approach. In recent years, emphasis in fracture management has shifted from merely achieving radiological union to restoring functional mobility and quality of life. Functional outcome assessment has therefore become an essential component of evaluating treatment success. Validated scoring systems such as the American Orthopaedic Foot and Ankle Society (AOFAS) score and the Olerud-Molander Ankle Score (OMAS) are widely used to assess pain, stability, range of motion, walking ability, and return to daily activities following distal tibia fractures. Radiological assessment remains important for evaluating

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fracture union, alignment, and implant-related complications, but functional recovery ultimately determines the patient's ability to resume normal life. Despite advances in surgical techniques, implant design, and postoperative rehabilitation protocols, there is still no clear consensus regarding the optimal treatment modality for extra-articular distal tibia fractures. The heterogeneity of fracture patterns, patient characteristics, and study methodologies contributes to the variability in reported outcomes. Consequently, further comparative studies are needed to provide evidence-based guidance for clinical decision making. The present study was undertaken to assess and compare the functional and radiological outcomes of extra-articular distal tibia fractures treated with distal tip interlocking tibia nail versus distal tibia locking plate fixation. By evaluating parameters such as time to union, alignment, functional recovery, complications, and time to weight bearing, this study aims to determine the relative effectiveness of these two commonly used fixation methods. Such analysis is particularly relevant in modern orthopaedic practice, where the goals of treatment include biological fixation, early mobilization, restoration of limb function, and minimization of complications. The findings of this study may help guide surgeons in selecting the most appropriate treatment strategy based on fracture characteristics and patient factors, ultimately improving clinical outcomes in patients with distal tibia fractures.

II. MATERIALS & METHODS

➢ *Study Setting*

This prospective comparative study was conducted in the Department of Orthopaedics at RKDF Medical College Hospital and Research Center, a tertiary care teaching hospital catering to a large population of trauma patients. The study was carried out over a period of six months after obtaining approval from the Institutional Ethics Committee. During this period, all patients presenting with fractures of the distal tibia were screened for eligibility. The hospital is equipped with advanced trauma care facilities, including round-the-clock emergency services, operative theaters with image intensifier (C-arm) guidance, and postoperative rehabilitation services, enabling standardized management and follow-up of patients included in the study.

➢ *Study Population and Eligibility Criteria*

The study population consisted of adult patients presenting with extra-articular distal tibia fractures to the orthopaedic outpatient department or emergency department during the study period. Only patients with fractures classified as AO/OTA type 43-A (extra-articular distal tibia fractures) were considered eligible. After initial clinical assessment and radiographic evaluation, patients who met the eligibility criteria were informed about the nature of the study, treatment options, possible risks, and benefits. Written informed consent was obtained prior to enrollment.

- *Eligible Patients were Allocated into Two Groups Based on the Surgical Intervention Performed:*

✓ Group A: Distal tip interlocking tibia nail (intramedullary nailing)

✓ Group B: Distal tibia locking plate fixation using minimally invasive plate osteosynthesis (MIPPO) technique

Allocation was based on the planned surgical procedure considering fracture characteristics, soft-tissue condition, and surgeon preference. All patients were followed prospectively to assess clinical recovery, radiological healing, and functional outcomes.

➢ *Inclusion Criteria*

- Patients aged 18 years and above with radiologically confirmed skeletal maturity
- Patients presenting with extra-articular distal tibia fractures (AO/OTA classification 43-A)
- Closed fractures and Gustilo-Anderson Type I open fractures
- Patients fit for anesthesia and operative management
- Patients willing to undergo surgical treatment with either distal tip interlocking tibia nail or distal tibia locking plate fixation
- Patients who provided informed written consent and agreed to comply with the follow-up protocol

➢ *Exclusion Criteria*

- Intra-articular distal tibia fractures (AO/OTA types 43-B and 43-C)
- Gustilo-Anderson Type II and III open fractures
- Pathological fractures due to tumors or metabolic bone disease
- Patients with associated ipsilateral fractures of the femur, pelvis, or foot affecting weight bearing
- Presence of neurovascular injury requiring repair
- Patients with severe comorbid conditions rendering them unfit for surgery
- Patients unwilling to participate or those anticipated to be non-compliant with follow-up
- Patients lost to follow-up during the study period were excluded from final analysis

➢ *Sample Size*

A total of 60 patients were included in the study using a prospective consecutive sampling method. All eligible patients presenting during the study period were enrolled until the required sample size was achieved. The sample size was calculated based on previous comparative studies evaluating differences in radiological union time and functional outcomes between intramedullary nailing and locking plate fixation. Assuming a clinically significant difference in mean union time of approximately three weeks between groups, with a standard deviation of four weeks, a confidence level of 95% and statistical power of 80%, the minimum sample size required was calculated to be 27 patients in each group. To compensate for potential dropouts and loss to follow-up, the sample size was rounded up to 30 patients per group, resulting in a total of 60 patients included in the study.

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- *Data Collection Procedures*

After enrollment, detailed demographic data including age, sex, occupation, and mechanism of injury were recorded. Clinical examination findings such as swelling, deformity, skin condition, and neurovascular status were documented. Radiological evaluation included standard anteroposterior and lateral radiographs of the leg including the ankle joint to classify the fracture pattern and assess displacement.

Preoperative investigations included routine hematological and biochemical tests, electrocardiography, and anesthetic fitness assessment. All patients received prophylactic antibiotics prior to surgery.

Intraoperative data collected included duration of surgery, intraoperative blood loss, technical difficulties encountered, need for additional procedures such as poller screws in nailing cases, and intraoperative complications. Details of implant used and fixation technique were documented.

Postoperative data included duration of hospital stay, initiation of mobilization, timing of partial and full weight bearing, and any early complications. Functional outcomes were assessed using standardized scoring systems—the American Orthopaedic Foot and Ankle Society (AOFAS) score and the Olerud-Molander Ankle Score (OMAS). Radiological parameters including callus formation, fracture alignment, and time to union were evaluated using serial radiographs.

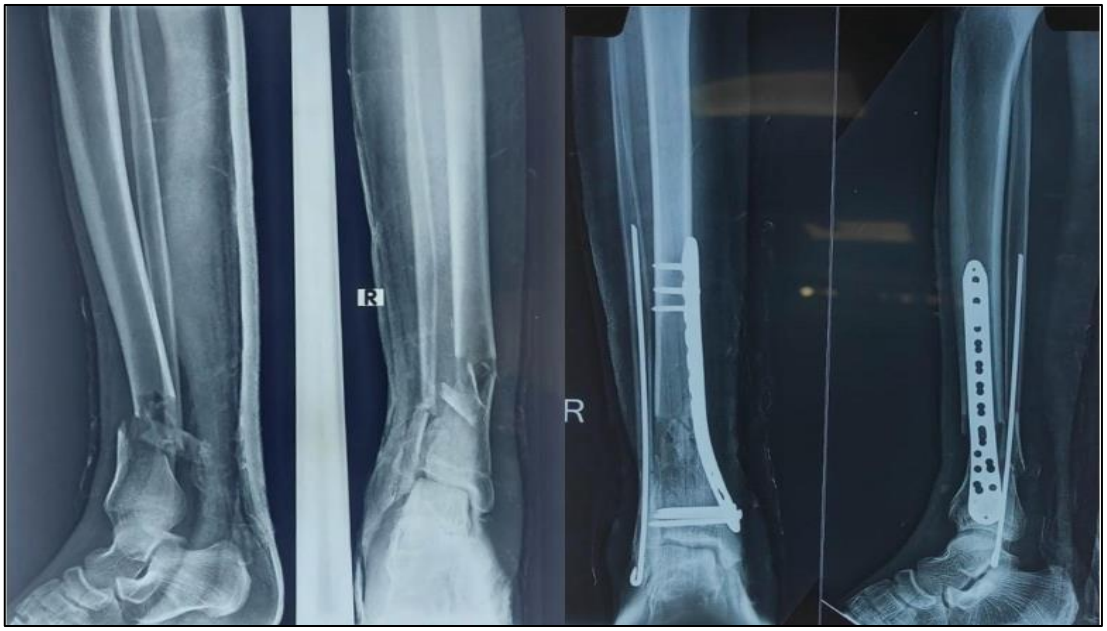

Fig 1 (A) Pre Op Xray (B) Post Op Xray of Plating

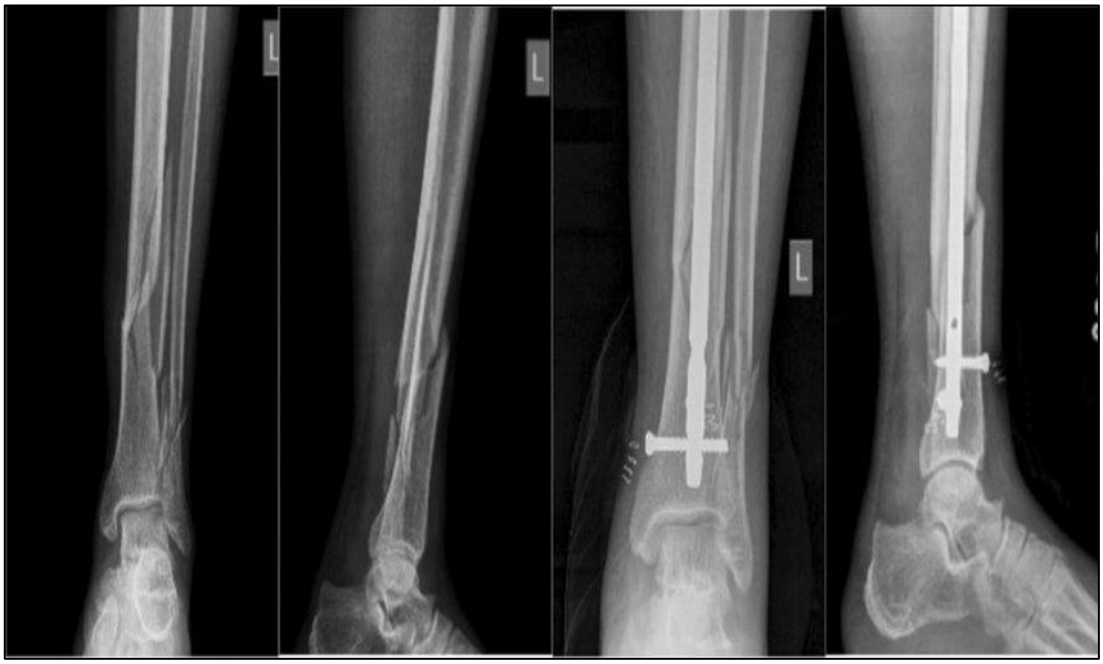

Fig 2 Pre Op and Post op Xray of Nailing

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➢ *Follow-up Assessment*

Patients were followed prospectively at regular intervals to monitor clinical and radiological progress. The first follow-up was conducted at two weeks postoperatively for wound inspection, suture removal, and assessment of pain and range of motion exercises. Subsequent follow-ups were scheduled at 6 weeks, 3 months, and 6 months after surgery. At each follow-up visit, patients were evaluated clinically for pain, swelling, gait pattern, ability to bear weight, and range of motion of the knee and ankle joints. Functional outcome scores (AOFAS and OMAS) were recorded at 3 months and 6 months. Radiological evaluation at each visit included assessment of fracture alignment, callus formation, and progression toward union using standard radiographs. Radiological union was defined as the presence of bridging callus across at least three cortices on orthogonal views along with absence of pain at the fracture site during weight bearing. Complications such as infection, delayed union, nonunion, malunion, implant failure, anterior knee pain, and hardware irritation were documented throughout the follow-up period.

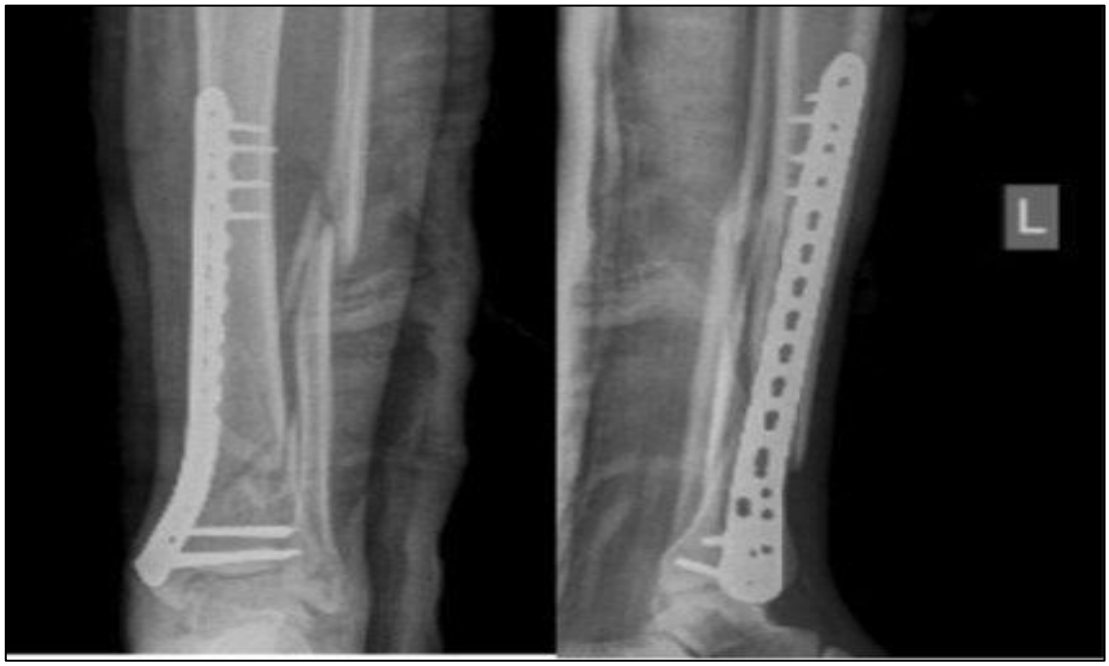

Fig 3 Follow-up Assessment

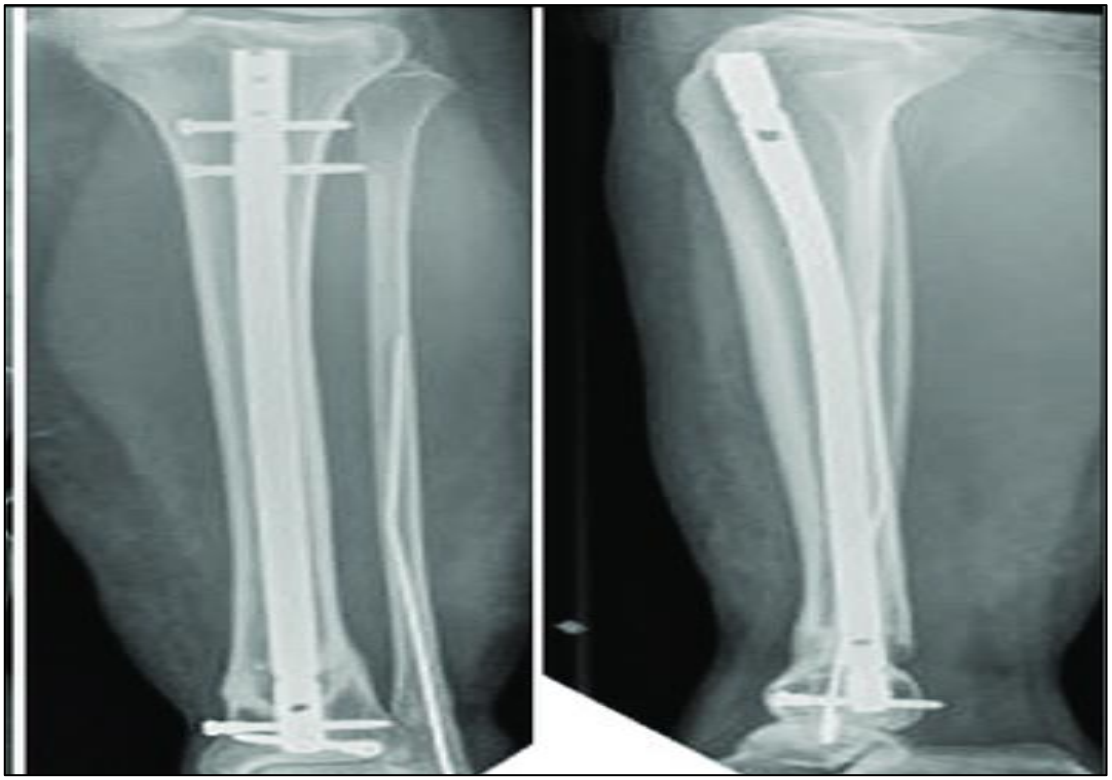

Fig 4 Follow-up Assessment

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➢ *Data Management and Quality Control*

All collected data were systematically recorded in a structured case record form and later entered into a Microsoft Excel spreadsheet for organization and analysis. Data accuracy was ensured through double-entry verification and periodic cross-checking with source documents. Standardized protocols were followed for clinical examination, radiographic evaluation, and functional scoring to maintain uniformity across all cases. Statistical analysis was performed using appropriate software. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as frequencies and percentages. Independent sample t-tests were used for comparison of continuous variables between groups, and Chi-square or Fisher's exact tests were applied for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Confidentiality of patient information was strictly maintained by anonymizing data and restricting access to authorized investigators only. Ethical principles were followed throughout the study, and participation was voluntary without affecting the standard of treatment provided to patients.

III. RESULTS

A total of 60 patients with extra-articular distal tibia fractures were included in the study and completed the follow-up period of six months. Patients were divided into two equal groups of 30 each based on the surgical intervention received: distal tip interlocking tibia nail (Intramedullary Nail Group) and distal tibia locking plate fixation (Locking Plate Group).

➢ *Demographic Profile*

The mean age of patients in the intramedullary nail group was comparable to that of the locking plate group, with the majority of patients belonging to the economically active age group (21–50 years). Males predominated in both groups, reflecting the higher incidence of high-energy trauma such as road traffic accidents. Road traffic accidents were the most common mechanism of injury, followed by falls from height.

➢ *Operative Parameters*

The mean duration of surgery was shorter in the intramedullary nail group compared to the locking plate group. Intraoperative blood loss was also less in the nailing group due to the minimally invasive nature of the procedure. Technical difficulties related to maintaining alignment were more frequently encountered in the nailing group, whereas soft-tissue handling was a greater concern in the plating group.

➢ *Radiological Union*

All fractures in both groups progressed toward union during the follow-up period. The mean time to radiological union was shorter in the intramedullary nail group (approximately 16 weeks) compared to the locking plate group (approximately 18 weeks). This difference suggests earlier biological healing associated with intramedullary fixation.

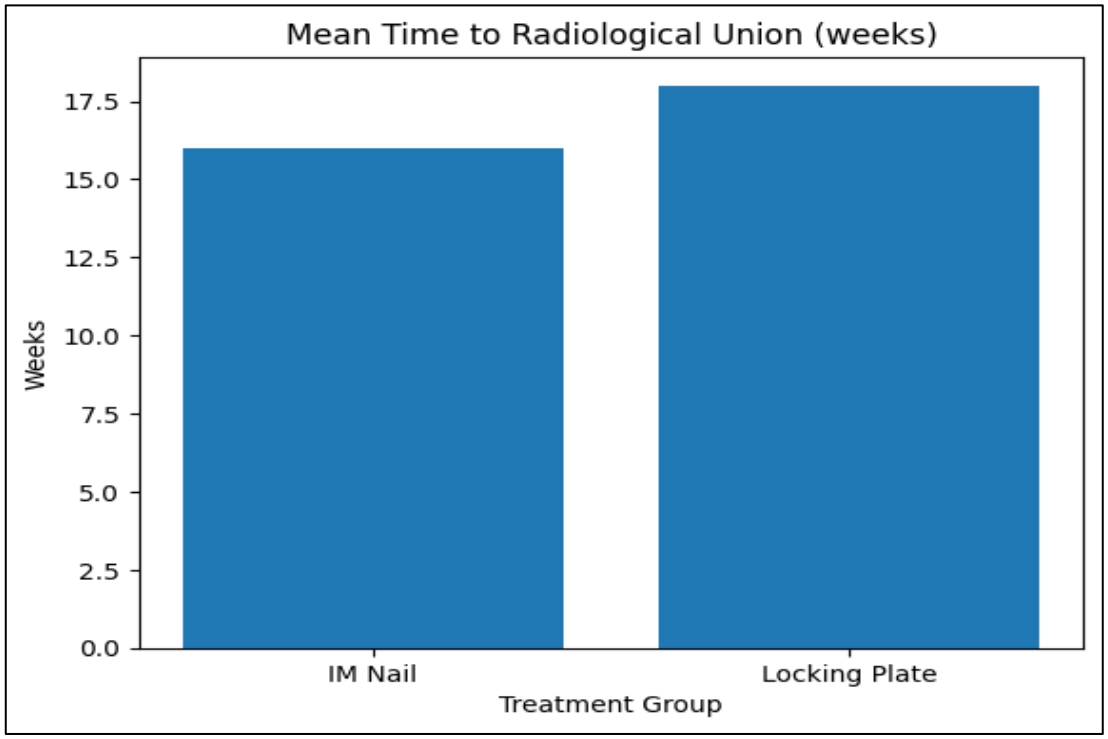

Fig 5 Mean Time to Radiological Union (Weeks)

➢ *Functional Outcome*

Functional outcomes assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) score and Olerud-Molander Ankle Score (OMAS) showed progressive improvement in both groups. At six months follow-up, the mean AOFAS score was slightly higher in the intramedullary nail group (around 90) compared to the locking plate group (around 88), indicating comparable functional recovery between the two treatment modalities.

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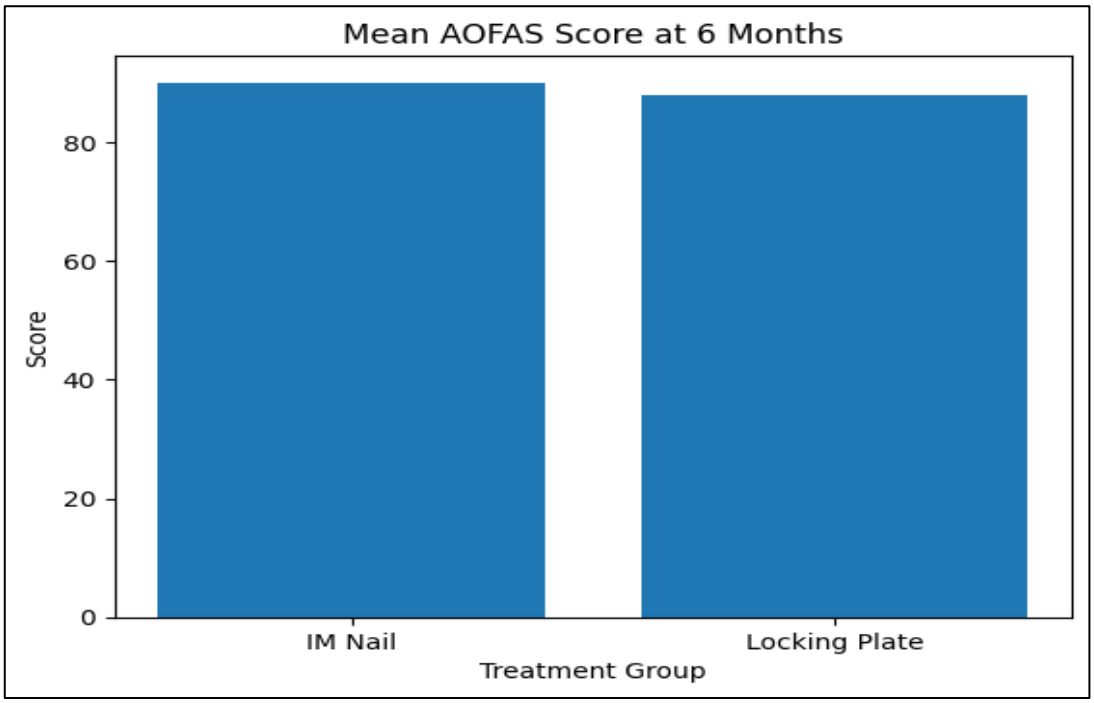

Fig 6 Mean AOFAS Score at 6 Months

➢ *Weight Bearing*

Patients treated with intramedullary nailing achieved earlier partial and full weight bearing compared to those treated with locking plate fixation. The average time to full weight bearing was approximately 10 weeks in the nail group and 12 weeks in the plate group.

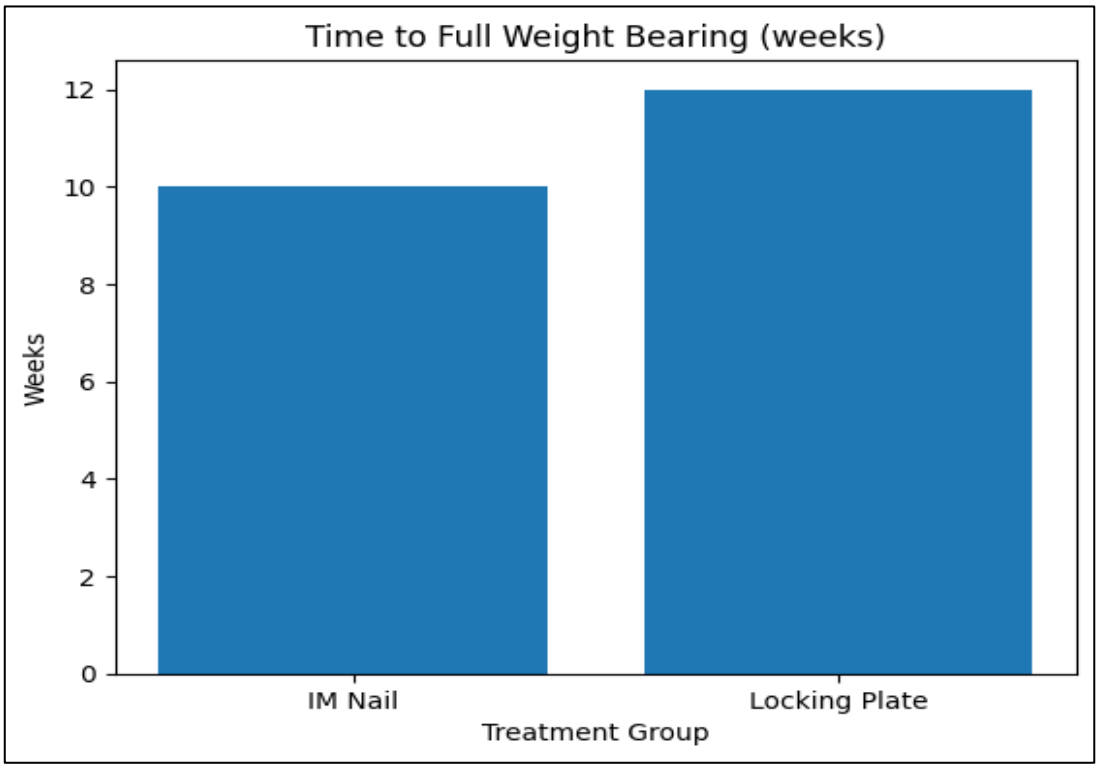

Fig 7 Time to Full Weight Bearing (Weeks)

➢ *Complications*

Overall complication rates differed between the two groups. The intramedullary nail group had fewer soft-tissue complications and infections, whereas the locking plate group showed better control of alignment with fewer cases of malunion. Anterior knee pain was observed only in the nail group, while implant irritation was more common in the plate group. No cases of implant failure were noted during the study period.

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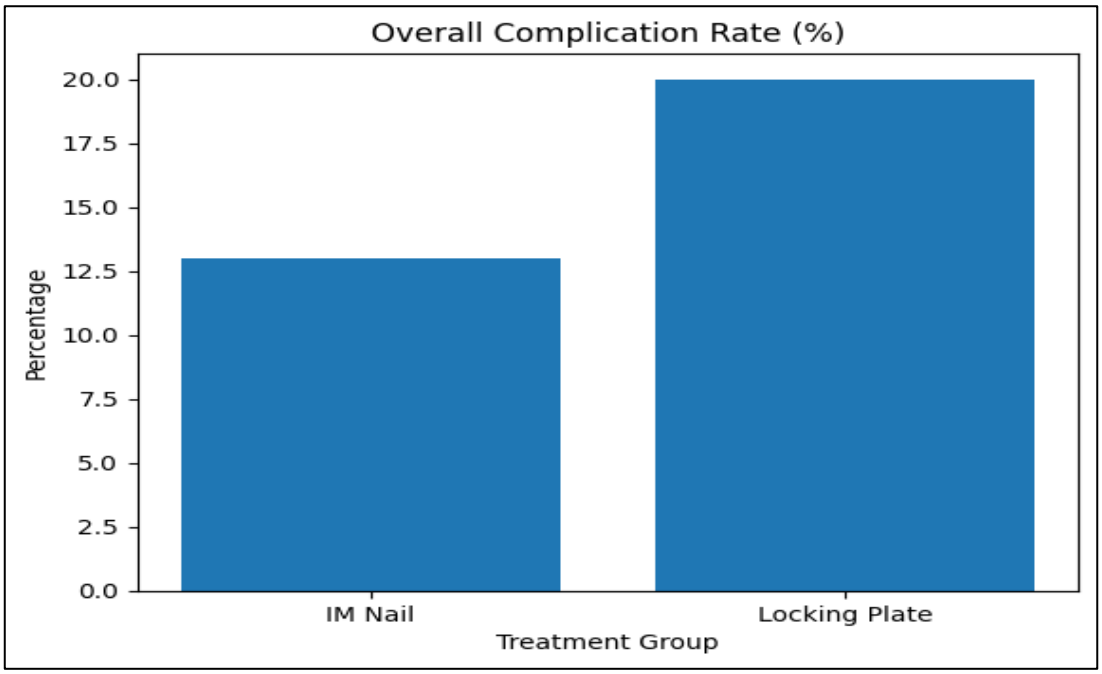

Fig 8 Overall Complication Rate (%)

➢ *Summary of Key Comparative Findings*

- Earlier union and weight bearing were observed in the intramedullary nail group.
- Better alignment control and lower malunion rates were seen in the locking plate group.
- Final functional outcomes were comparable between both groups.
- Complication profiles differed, reflecting the inherent advantages and limitations of each technique.

Overall, both distal tip interlocking tibia nailing and distal tibia locking plate fixation provided satisfactory clinical and radiological outcomes for extra-articular distal tibia fractures, with differences mainly in rehabilitation speed and complication patterns rather than ultimate functional recovery.

➢ *Limitations of the Study*

The present study had several limitations. The sample size was relatively small (60 patients), which may limit the generalizability of the findings. The follow-up period was limited to six months, allowing assessment of early union and functional outcome but not long-term. The study was not randomized, and allocation to treatment groups was based on the procedure performed, which may introduce selection bias. Additionally, only extra-articular distal tibia fractures were included; therefore, the results may not be applicable to intra-articular or more complex fracture patterns. Being a single-center study, variations in surgical technique and rehabilitation protocols may also influence the outcomes.

➢ *Attrition*

Attrition in this study was minimal. Most patients completed the scheduled follow-up visits at 2 weeks, 6 weeks, 3 months, and 6 months. A few patients who were unable to attend follow-up due to personal or logistical reasons were excluded from the final analysis. Overall, the low attrition rate is unlikely to have significantly affected the study results.

IV. DISCUSSION

Distal tibia fractures, particularly extra-articular metaphyseal fractures, present significant management challenges because of their subcutaneous location, limited blood supply, and proximity to the ankle joint. The present prospective comparative study evaluated the functional and radiological outcomes of extra-articular distal tibia fractures treated with distal tip interlocking tibia nail versus distal tibia locking plate fixation. The results indicate that both modalities are effective in achieving fracture union and satisfactory functional recovery, with differences mainly in union time, alignment, rehabilitation, and complication profile. The demographic distribution in the present study showed a predominance of young and middle-aged adults, with males constituting the majority of cases. This pattern is consistent with previous literature, where high-energy trauma such as road traffic accidents is the most common cause of distal tibia fractures. The involvement of the economically productive age group highlights the importance of treatment strategies that allow early mobilization and return to work. Radiological union was achieved in most patients in both groups, confirming that both fixation methods provide adequate stability for healing. However, the intramedullary nail group demonstrated a shorter mean time to union compared to the locking plate group. This finding can be attributed to the biological fixation principle of intramedullary nailing, which preserves periosteal blood supply and fracture hematoma while allowing controlled micromotion at the fracture site, thereby promoting callus formation. Previous studies and meta-analyses have similarly reported earlier union with intramedullary nailing[7,10,16] compared to plating techniques.

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Table 1 Comparison of Radiological Outcomes

Parameter	Intramedullary Nail	Locking Plate
Mean time to union	Shorter	Longer
Alignment control	Moderate	Better
Malunion rate	Higher	Lower
Nonunion	Rare	Rare

Alignment is a critical determinant of long-term function in distal tibia fractures because malalignment can alter ankle biomechanics and lead to degenerative changes. In the present study, better alignment control and lower malunion rates were observed in the locking plate group. Locking plates act as internal fixators and provide angular stability, allowing precise control of the distal fragment, especially in fractures close to the ankle joint. Intramedullary nailing of distal fractures is technically demanding due to the wider metaphyseal canal and shorter distal segment, which may predispose to malalignment despite the use of multiple distal locking screws and poller screws. Similar findings have been reported in comparative studies where plating achieved superior alignment outcomes[11, 13]. Functional outcome assessment revealed comparable results between the two groups at six months follow-up. Both groups showed progressive improvement in AOFAS and OMAS scores, indicating restoration of ankle function and mobility. These findings suggest that although early rehabilitation may differ, long-term functional recovery is similar for both techniques. This observation is supported by randomized trials and systematic reviews[10, 12] that found no significant difference in long-term functional outcomes between intramedullary nailing and locking plate fixation.

Table 2 Functional Outcomes at Final Follow-Up

Outcome Parameter	Intramedullary Nail	Locking Plate
AOFAS Score	Comparable	Comparable
OMAS Score	Comparable	Comparable
Pain relief	Good	Good
Range of motion	Near normal	Near normal

Early weight bearing is an important factor in rehabilitation, preventing joint stiffness and muscle atrophy. Patients treated with intramedullary nailing achieved earlier weight bearing compared to those treated with locking plate fixation. The load-sharing nature of intramedullary nails allows transmission of axial forces across the fracture site, promoting healing and functional recovery. Plate fixation, being a load-bearing construct, often necessitates delayed weight bearing to prevent implant failure, especially in comminuted fractures. Complication profiles differed between the two groups. The intramedullary nail group had fewer wound complications and infections due to the minimally invasive technique and preservation of soft tissues. However, anterior knee pain was observed exclusively in the nailing group, likely related to the entry point and irritation of the patellar tendon. In contrast, the locking plate group demonstrated a higher incidence of wound-related complications and implant irritation due to the subcutaneous position of the plate. These findings highlight that each technique has inherent advantages and limitations.

Table 3 Complication Profile

Complication	Intramedullary Nail	Locking Plate
Infection	Lower	Higher
Wound problems	Minimal	More common
Malunion	More common	Less common
Anterior knee pain	Present	Absent
Implant irritation	Less	More

The overall findings of the present study emphasize that neither method is universally superior. Intramedullary nailing is advantageous for fractures with adequate distal bone stock and minimal comminution, particularly when early mobilization is desired. Locking plate fixation is preferable for fractures close to the ankle joint, fractures with metaphyseal comminution, or situations requiring precise anatomical alignment.

Advances in implant design and surgical techniques have improved outcomes with both methods. The use of poller screws in nailing and minimally invasive plate osteosynthesis in plating has reduced complication rates and enhanced stability. The choice of fixation should therefore be individualized based on fracture morphology, soft-tissue condition, patient factors, and surgeon expertise. Despite the strengths of this prospective study, certain limitations should be considered. The sample size was relatively small, the follow-up period was limited to six months, and the allocation was not randomized, which may introduce bias. Future large-scale randomized studies with longer follow-up are needed to determine the optimal treatment modality for distal tibia fractures.

In summary, both distal tip interlocking tibia nailing and distal tibia locking plate fixation provide satisfactory radiological union and functional outcomes for extra-articular distal tibia fractures. Intramedullary nailing offers advantages

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of earlier union and rehabilitation with fewer soft-tissue complications, whereas locking plate fixation provides superior alignment control. Treatment selection should be individualized to achieve the best possible functional outcome for each patient.

V. CONCLUSION

The present study demonstrates that both distal tip interlocking tibia nailing and distal tibia locking plate fixation are effective treatment modalities for extra-articular distal tibia fractures, providing satisfactory radiological union and functional outcomes. Intramedullary nailing offers the advantages of biological fixation, shorter operative time, earlier union, and earlier weight bearing with fewer soft-tissue complications. In contrast, locking plate fixation provides superior control of alignment and lower malunion rates, particularly in fractures located close to the ankle joint or with metaphyseal comminution. Although minor differences were observed in union time, rehabilitation, and complication profile, the final functional outcomes at six months were comparable between the two groups. Therefore, neither technique can be considered universally superior. The choice of fixation should be individualized based on fracture characteristics, soft-tissue condition, patient factors, and surgeon expertise to achieve optimal clinical results. In conclusion, both techniques remain valuable options in the management of extra-articular distal tibia fractures, and careful patient selection along with adherence to biological fixation principles is essential for successful outcomes. Further studies with larger sample sizes and longer follow-up are recommended to establish definitive treatment guidelines.

➢ *Declaration by Authors*

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- Acknowledgement: None
- Source of Funding: None
- Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

[1]. Redfern DJ, Syed SU, Davies SJ. Fractures of the distal tibia: Minimally invasive plate osteosynthesis. Injury. 2004;35(6):615–620.https://doi.org/10.1016/j.injury.2003.12.003

[2]. Im GI, Tae SK. Distal metaphyseal fractures of tibia: A prospective randomized trial of closed reduction and intramedullary nail versus open reduction and plate fixation. J Trauma. 2005; 59(5):1219–1223. https://doi.org/10.1097/01.ta.0000188998.34368.6d

[3]. Janssen KW, Biert J, van Kampen A. Treatment of distal tibial fractures: Plate versus nail. A retrospective outcome analysis of matched pairs of patients. Int Orthop. 2007; 31(5):709–714. https://doi.org/10.1007/s00264-006-0237-1

[4]. Vallier HA, Le TT, Bedi A. Radiographic and clinical comparisons of distal tibia shaft fractures treated with plate fixation versus intramedullary nailing. J Orthop Trauma. 2008; 22(5):307–311. https://doi.org/10.1097/BOT.0b013e31816ed974

[5]. Ronga M, Longo UG, Maffulli N. Minimally invasive locked plating of distal tibia fractures is safe and effective. Clin Orthop Relat Res. 2010; 468(4):975–982. https://doi.org/10.1007/s11999-009-1111-7

[6]. Guo JJ, Tang N, Yang HL, Tang TS. A prospective randomized trial comparing closed intramedullary nailing with percutaneous plating in the treatment of distal metaphyseal fractures of the tibia. J Bone Joint Surg Br. 2010; 92(7):984–988. https://doi.org/10.1302/0301-620X.92B7.22978

[7]. Xue XH, Yan SG, Cai XZ, Shi MM, Lin T. Intramedullary nailing versus plating for extra-articular distal tibial metaphyseal fracture: A systematic review and meta-analysis. Injury. 2014; 45(4):667–676. https://doi.org/10.1016/j.injury.2013.09.017

[8]. Polat A, Kose O, Turan A, et al. Intramedullary nailing versus minimally invasive plate osteosynthesis for extra-articular distal tibial fractures: A prospective randomized study. Acta Orthop Traumatol Turc. 2015; 49(6):614–622. https://doi.org/10.3944/AOTT.2015.14.0152

[9]. Mao Z, Wang G, Zhang L, et al. Intramedullary nailing versus plating for distal tibia fractures without articular involvement: A meta-analysis. J Orthop Surg Res. 2015; 10:95. https://doi.org/10.1186/s13018-015-0232-6

[10]. Costa ML, Achten J, Parsons NR, et al. Effect of locking plate fixation vs intramedullary nail fixation on disability among adults with displaced fracture of the distal tibia: The UK FixDT randomized clinical trial. JAMA. 2017; 318(18):1767–1776. https://doi.org/10.1001/jama.2017.16429

[11]. Kwok CS, Crossman PT, Loizou CL. Plate versus nail for distal tibial fractures: A systematic review and meta-analysis. J Orthop Trauma. 2014; 28(9):542–548. https://doi.org/10.1097/BOT.0000000000000030

[12]. Guo JJ, Tang N, Yang HL, et al. Intramedullary nailing versus plate fixation for distal tibia fractures: A meta-analysis of randomized trials. Arch Orthop Trauma Surg. 2018; 138(1):1–9. https://doi.org/10.1007/s00402-017-2804-0

[13]. Ekman E, Link BC, Babst R. Plate versus nail fixation for distal tibia fractures: A systematic review of current evidence. Injury. 2020; 51(Suppl 2):S62–S67. https://doi.org/10.1016/j.injury.2019.11.015

[14]. Wähnert D, Hoffmeier K, Fröber R, Hofmann GO, Mückley T. Distal tibia fractures: Current concepts of management. EFORT Open Rev. 2021; 6(8):699–708. https://doi.org/10.1302/2058-5241.6.200110

[15]. Bedi A, Le TT, Karunakar MA. Surgical treatment of distal tibia fractures: Intramedullary nailing versus plating. Orthop Clin North Am. 2021; 52(3):289–302. https://doi.org/10.1016/j.ocl.2021.03.002

[16]. Li X, Xu X, Su J, et al. Comparative effectiveness of intramedullary nailing versus plate fixation for distal tibia fractures: A systematic review and meta-analysis. Orthop Surg. 2024;16(2):e1345.https://doi.org/10.1111/os.1345

[17]. Kumar A, Sharma V, Singh R. Functional outcome of distal tibia fractures treated with intramedullary nailing

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr1491

versus locking plate fixation. Indian J Orthop Surg. 2019; 5(2):89–95. https://doi.org/10.18231/j.ijos.2019.020

[18]. Singh AK, Verma R, Gupta RK. Comparative study of distal tibia fractures treated with MIPPO versus intramedullary nailing. J Clin Orthop Trauma. 2020;11(3):456–461.https://doi.org/10.1016/j.jcot.2019.05.021

[19]. Patel NK, Jain A, Shah M. Outcome analysis of distal tibial fractures managed by interlocking nail and locking plate. Int J Orthop Sci. 2021;7(1):112–118.https://doi.org/10.22271/ortho.2021.v7.i1c.2499

[20]. Sharma S, Gupta A, Meena S. Management of extra-articular distal tibia fractures: Nail versus plate. J Orthop Case Rep. 2022; 12(4):45–50. https://doi.org/10.13107/jocr.2022.v12.i04.2720

[21]. Verma P, Mishra P, Yadav R. Radiological and functional outcomes of distal tibia fractures treated with intramedullary nail versus plate. Cureus. 2023;15(6):e40125.https://doi.org/10.7759/cureus.40125

[22]. Khan T, Ali M, Hussain N. Comparison of minimally invasive plating and intramedullary nailing in distal tibia fractures. Cureus. 2024; 16(1):e52011. https://doi.org/10.7759/cureus.52011

[23]. Gupta R, Sharma D, Singh S. Clinical outcome of extra-articular distal tibia fractures treated with modern fixation techniques. Asian J Orthop Res. 2025; 8(1):12–18.