

Original Research Article

CLINICAL OUTCOME OF OPEN TIBIAL FRACTURES TREATED WITH EXTERNAL FIXATION VERSUS INTRAMEDULLARY NAILING

Arnav P Urs¹, Bharath Alur Venkatesha², Kishan Kenchi Reddy³

¹Senior Resident, Department of Orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Bengaluru, Karnataka, India.

²Junior Resident, Department of Orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Bengaluru, Karnataka, India.

³Junior Resident, Department of Orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Bengaluru, Karnataka, India.

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Corresponding Author:

Dr. Arnav P Urs,
Senior Resident, Department of
Orthopaedics, Sanjay Gandhi Institute
of Trauma and Orthopaedics,
Bengaluru, Karnataka, India..
Email: arnavpurs@gmail.com

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ABSTRACT

Background: Open tibial fractures are frequently associated with severe soft tissue injury and remain a major challenge in orthopedic trauma. External fixation and intramedullary nailing are commonly employed treatment modalities, but their comparative clinical outcomes continue to be evaluated.

Objectives: To compare the clinical outcomes of open tibial fractures treated with external fixation versus intramedullary nailing.

Materials and Methods: This retrospective comparative study was conducted over one year at Bangalore urban district. Thirty patients with open tibial fractures were included, with 15 treated using external fixation and 15 treated with intramedullary nailing. Demographic characteristics, fracture union, time to full weight bearing, hospital stay, postoperative complications, and functional outcomes based on the Johner and Wruhs criteria were analyzed.

Results: Baseline characteristics were comparable between the groups. Intramedullary nailing resulted in significantly earlier fracture union (19.2 ± 3.8 vs. 24.5 ± 4.6 weeks), shorter hospital stay (9.6 ± 2.5 vs. 12.8 ± 3.2 days), and earlier full weight bearing (14.1 ± 3.1 vs. 18.7 ± 3.9 weeks) compared with external fixation ($p < 0.05$). Excellent or good functional outcomes were achieved in 86.7% of patients treated with intramedullary nailing compared with 53.3% of those treated with external fixation. The external fixation group showed higher rates of pin tract infection, delayed union, non-union, and reoperation.

Conclusion: Intramedullary nailing provided superior fracture healing, functional recovery, and overall clinical outcomes compared with external fixation in patients with open tibial fractures. When soft tissue conditions permit, intramedullary nailing should be considered the preferred definitive fixation method.

Keywords: Open tibial fracture, external fixation, intramedullary nailing, fracture union, functional outcome, orthopedic trauma.

INTRODUCTION

Open tibial fractures are among the most common high-energy orthopedic injuries encountered in trauma practice. Owing to the subcutaneous location of the tibia and its limited soft tissue coverage, these fractures are associated with a high risk of contamination, infection, delayed union, non-union, and soft tissue complications. Successful management requires prompt stabilization, meticulous wound care, and timely soft tissue

reconstruction to optimize fracture healing and limb function.^[1]

The severity of open tibial fractures is commonly classified using the Gustilo-Anderson classification, which remains the most widely accepted system for guiding treatment and predicting outcomes. Type III open fractures are associated with extensive soft tissue damage, higher infection rates, and poorer functional outcomes, often requiring complex reconstructive procedures.^[2]

External fixation has traditionally been used as an effective method for the initial stabilization of open tibial fractures, particularly in patients with severe soft tissue injury or polytrauma. It offers rapid fracture stabilization with minimal disturbance of the fracture site and facilitates repeated wound inspection and soft tissue management. However, prolonged external fixation may be associated with pin tract infections, malalignment, delayed union, and patient discomfort.^[3]

Intramedullary nailing has emerged as an alternative method for definitive fixation of open tibial fractures because it provides stable internal fixation, promotes early mobilization, and allows earlier weight-bearing. Prospective studies comparing external fixation with intramedullary nailing have demonstrated favorable union rates and improved functional outcomes with intramedullary nailing, particularly in selected Grade I to IIIA open fractures.^[4]

Several clinical studies have also shown that reamed or unreamed interlocking intramedullary nailing is associated with satisfactory fracture union, lower rates of malunion, and acceptable infection rates when combined with appropriate debridement and antibiotic therapy.^[5] A systematic review and meta-analysis further concluded that intramedullary nailing generally results in better clinical outcomes and fewer reoperations than external fixation in appropriately selected patients with open tibial shaft fractures.^[6]

Management of open tibial fractures remains challenging, and the choice of fixation depends on fracture pattern, degree of soft tissue injury, patient characteristics, and surgeon experience. Large multicenter studies have emphasized that treatment-related factors, including the method of stabilization and timing of soft tissue coverage, significantly influence fracture healing and long-term functional outcomes.^[7]

Despite advances in trauma care, the optimal fixation method for open tibial fractures continues to be debated. Therefore, the present study was undertaken to compare the clinical outcomes of open tibial fractures treated with external fixation versus intramedullary nailing in patients managed at a Bangalore urban district.

MATERIALS AND METHODS

Study Design

This was a **retrospective comparative observational study**.

Study Setting

The study was conducted in the **Department of Orthopaedics of a Bangalore urban district**

Study Duration

The study included patients treated over a **period of one year**.

Study Population

Medical records of patients diagnosed with open tibial fractures who underwent either external fixation or intramedullary nailing during the study period were reviewed.

Sample Size

A total of **30 patients** fulfilling the eligibility criteria were included in the study.

- **Group A (External Fixation):** 15 patients
- **Group B (Intramedullary Nailing):** 15 patients

Inclusion Criteria

- Patients aged 18 years and above.
- Open tibial shaft fractures (Gustilo-Anderson Grade I, II, IIIA, or selected IIIB fractures).
- Patients treated with either external fixation or intramedullary nailing.
- Complete medical records and radiological follow-up available for analysis.

Exclusion Criteria

- Patients younger than 18 years.
- Pathological fractures.
- Periprosthetic fractures.
- Fractures involving the proximal tibia plateau or distal tibial plafond.
- Patients treated conservatively.
- Incomplete medical records or inadequate follow-up.

Data Collection

Data were retrieved from hospital medical records, operative notes, inpatient case sheets, and radiographic records. The following information was collected:

- Age and sex.
- Mechanism of injury.
- Side of injury.
- Gustilo-Anderson fracture grade.
- Method of fracture fixation.
- Time to surgery.
- Time to radiological union.
- Duration of hospital stay.
- Complications (infection, delayed union, non-union, malunion, implant-related complications).
- Functional outcome at final follow-up.

Outcome Measures

Primary Outcome

- Fracture union and time to radiological union.

Secondary Outcomes

- Incidence of superficial and deep infection.
- Delayed union and non-union.
- Malunion.
- Requirement for secondary surgical procedures.
- Functional outcome assessed using the **Johner and Wruhs criteria** at final follow-up.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using **SPSS version 25.0**. Continuous variables were expressed as **mean ± standard deviation (SD)** and compared using the

independent Student's t-test. Categorical variables were presented as frequencies and percentages and analyzed using the **Chi-square test** or **Fisher's exact test**, as appropriate. A **p-value <0.05** was considered statistically significant.

RESULTS

A total of 30 patients with open tibial fractures were included in this retrospective study. Fifteen patients

were treated with external fixation (Group A) and fifteen underwent intramedullary nailing (Group B). The majority of patients were young adult males, and road traffic accidents were the most common mechanism of injury. Patients treated with intramedullary nailing demonstrated earlier fracture union, better functional outcomes, and fewer complications compared with those treated using external fixation.

Table 1: Baseline Demographic and Injury Characteristics

Variable	External Fixation (n=15)	Intramedullary Nailing (n=15)	p-value
Age (years)	36.8 ± 11.2	35.9 ± 10.6	0.81
Male	12 (80.0%)	11 (73.3%)	0.67
Female	3 (20.0%)	4 (26.7%)	
Road Traffic Accident	10 (66.7%)	11 (73.3%)	0.69
Fall from Height	3 (20.0%)	2 (13.3%)	
Assault/Others	2 (13.3%)	2 (13.3%)	
Gustilo Grade I	2 (13.3%)	3 (20.0%)	0.84
Gustilo Grade II	5 (33.3%)	6 (40.0%)	
Gustilo Grade IIIA	6 (40.0%)	5 (33.3%)	
Gustilo Grade IIIB	2 (13.3%)	1 (6.7%)	

Both treatment groups were comparable with respect to age, gender, mechanism of injury, and severity of open tibial fractures. Road traffic

accidents were the leading cause of injury in both groups.

Table 2: Comparison of Clinical Outcomes

Outcome	External Fixation (n=15)	Intramedullary Nailing (n=15)	p-value
Time to Union (weeks)	24.5 ± 4.6	19.2 ± 3.8	<0.001*
Hospital Stay (days)	12.8 ± 3.2	9.6 ± 2.5	0.003*
Full Weight Bearing (weeks)	18.7 ± 3.9	14.1 ± 3.1	<0.001*

**Statistically significant*

Patients treated with intramedullary nailing achieved significantly earlier fracture union, earlier full

weight bearing, and shorter hospital stay than those treated with external fixation (p<0.05).

Table 3: Functional Outcome at Final Follow-up (Johner and Wruhs Criteria)

Functional Outcome	External Fixation (n=15)	Intramedullary Nailing (n=15)	p-value
Excellent	3 (20.0%)	7 (46.7%)	
Good	5 (33.3%)	6 (40.0%)	
Fair	4 (26.7%)	2 (13.3%)	
Poor	3 (20.0%)	0 (0%)	0.041*

**Statistically significant*

Functional outcomes were significantly better in the intramedullary nailing group. Nearly 87% of patients treated with intramedullary nailing achieved

excellent or good outcomes compared with 53.3% in the external fixation group.

Table 4: Postoperative Complications

Complication	External Fixation (n=15)	Intramedullary Nailing (n=15)	p-value
Superficial Infection	4 (26.7%)	2 (13.3%)	0.37
Deep Infection	2 (13.3%)	1 (6.7%)	0.54
Delayed Union	3 (20.0%)	1 (6.7%)	0.28
Non-union	2 (13.3%)	0 (0%)	0.14
Malunion	2 (13.3%)	1 (6.7%)	0.54
Pin Tract Infection	5 (33.3%)	—	—
Reoperation	3 (20.0%)	1 (6.7%)	0.28

The external fixation group demonstrated a higher incidence of complications, particularly pin tract infection, delayed union, non-union, and reoperation. Although some individual complications did not reach statistical significance because of the small sample size, intramedullary nailing showed a more favorable overall complication profile and superior clinical outcomes.

DISCUSSION

Open tibial fractures remain among the most challenging orthopedic injuries because of the associated soft tissue damage, contamination, and high risk of infection and delayed union. Selection of an appropriate fixation method is essential to achieve stable fracture fixation, promote bone

healing, minimize complications, and restore limb function. The present retrospective study compared the clinical outcomes of external fixation and intramedullary nailing in patients with open tibial fractures. The findings demonstrated that intramedullary nailing was associated with earlier fracture union, shorter hospital stay, better functional outcomes, and fewer complications compared with external fixation.

The present study demonstrated significantly earlier fracture union in patients treated with intramedullary nailing. Similar findings were reported by Giannoudis et al., who reviewed the management of open tibial fractures and concluded that intramedullary nailing provides superior mechanical stability, promotes earlier fracture healing, and allows earlier rehabilitation while maintaining acceptable infection rates in appropriately selected patients.^[8]

A meta-analysis by Xu et al. also reported that intramedullary nailing resulted in lower rates of delayed union, malunion, and reoperation compared with external fixation. Although infection rates were comparable between the two treatment modalities, intramedullary nailing was associated with improved overall clinical outcomes and functional recovery. These observations are consistent with the findings of the present study.^[9]

Similarly, Zhang et al. demonstrated that unreamed intramedullary nailing was a better alternative to external fixation for Gustilo Grade IIIB tibial fractures, providing improved fracture union and functional outcomes with fewer fixation-related complications. The superior functional outcomes observed in the present study among patients treated with intramedullary nailing support these findings.^[10]

The present study also observed fewer postoperative complications in the intramedullary nailing group. These findings agree with the systematic review by Ma et al., who concluded that intramedullary nailing is associated with lower rates of malunion, pin tract infection, and secondary surgical procedures compared with external fixation, while maintaining satisfactory infection control when combined with adequate debridement and antibiotic therapy.^[11]

In the current study, functional outcomes assessed using the Johner and Wruhs criteria were significantly better in the intramedullary nailing group. Similar observations were reported by Wani et al., who found that early interlocking intramedullary nailing in open tibial shaft fractures resulted in excellent fracture stability, early mobilization, satisfactory union rates, and favorable long-term functional outcomes.^[12]

Early surgical debridement and meticulous wound management remain essential irrespective of the fixation method. Pollak et al. demonstrated that delayed debridement and inadequate soft tissue management significantly increase the risk of deep infection and poor fracture healing in open lower-limb trauma. Appropriate timing of debridement and

definitive fixation therefore plays an important role in optimizing clinical outcomes.^[13]

The management principles described in Rockwood and Green's *Fractures in Adults* emphasize individualized treatment based on fracture severity, soft tissue injury, patient condition, and available surgical expertise. While external fixation remains valuable for damage-control orthopedics and severe soft tissue injuries, intramedullary nailing is considered the preferred definitive fixation method for most Gustilo Grade I, II, and selected Grade III open tibial fractures because of superior stability, earlier rehabilitation, and improved functional recovery.^[14,15]

Overall, the findings of the present study support the growing evidence that intramedullary nailing offers superior clinical outcomes compared with external fixation in appropriately selected patients with open tibial fractures.

CONCLUSION

Intramedullary nailing demonstrated better clinical outcomes than external fixation in the management of open tibial fractures. Patients treated with intramedullary nailing achieved earlier fracture union, shorter hospital stay, earlier full weight bearing, and superior functional outcomes with fewer complications. Although external fixation remains an important option for severe open fractures and damage-control situations, intramedullary nailing may be considered the preferred definitive treatment for most open tibial shaft fractures when soft tissue conditions permit.

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