

Outcome of Unreamed Tibia Interlocking Nail in Fractures of Shaft of Tibia in Adults: A Prospective Study

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Abstract

Introduction: Tibial shaft fractures are prevalent long bone fractures in orthopedic practice, often accompanied by soft tissue injury, delayed union, and extended functional recovery. Intramedullary interlocking nailing has emerged as a recognized therapeutic method due to its ability to offer stable fixation while maintaining fracture biology. Unreamed tibial interlocking nailing may provide supplementary biological benefits by reducing endosteal vascular disturbance. This study assessed the clinical, radiological, and functional effects of unreamed tibial interlocking nailing in adult patients with tibial shaft fractures.

Methods: This prospective observational study was carried out in the Department of Orthopedics at GK General Hospital in Bhuj, Gujarat, India, from April 2024 to October 2025. Forty adult patients with tibial shaft fractures received treatment by unreamed tibial interlocking nails. Patients were monitored clinically and radiologically at regular intervals for up to six months. Fracture healing was measured utilizing the Radiographic Union Scale for Tibial Fractures (RUST).

Results: Of the 40 patients, the predominant age group was 31–40 years (14/40, 35%), followed by 41–50 years (12/40, 30%). Male patients accounted for 31/40 (77.5%). Road traffic accidents were the mechanism of injury in 24/40 (60%) patients. Closed fractures occurred in 28/40 (70%), whereas open fractures occurred in 12/40 (30%). Radiological union was achieved in 17/40 (42.5%) patients between 13 and 16 weeks, and complete union within 16 weeks was observed in 30/40 (75%) patients. The average RUST score at three months was 9.55. The most prevalent postoperative consequence was anterior knee discomfort (10%), succeeded by infection (7.5%), delayed union (5%), hardware impingement (5%), and malunion (2.5%).

Conclusion: Unreamed tibial interlocking nailing shown adequate radiological healing and positive functional results in adult tibial shaft fractures. The preservation of fracture biology by stable fixation has led to acceptable complication rates and dependable clinical recovery, hence affirming its ongoing significance in the treatment of specific tibial shaft fractures.

Keywords: Fracture Union, Prospective Observational Study, Unreamed Intramedullary Nail, RUST score, Tibial shaft fracture.

Introduction

Tibial shaft fractures are prevalent long bone fractures observed in orthopedic practice due to the tibia's subcutaneous positioning and its critical function in weight bearing. These fractures commonly arise from high-energy trauma, including vehicular accidents, occupational injuries, and sports-related incidents, and are typically accompanied by variable levels of soft tissue injury. Tibial shaft fractures are susceptible to problems such as delayed union, non-union, infection, and malalignment due to insufficient soft tissue coverage and impaired vascularity [1,2]. Recent evaluations consistently endorse biologically preserving fixation techniques designed to enhance fracture healing and functional rehabilitation [3].

A variety of therapeutic techniques have been employed for the therapy of tibial shaft fractures, including conservative casting, external fixation, plate osteosynthesis, and intramedullary nailing. While conservative treatment can yield satisfactory results in many instances, extended immobility may lead to stiffness, postponed rehabilitation, and functional impairments. External fixation is sometimes utilized for severe open injuries; however, it may lead to pin tract infections and patient discomfort. Intramedullary interlocking nailing has emerged as the recommended therapy for displaced tibial shaft fractures due to its provision of stable fixation, preservation of fracture biology, and facilitation of early mobilization [4,5].

Intramedullary interlocking nailing offers robust fixation while maintaining the biological conditions essential for fracture healing. Significant discourse persists concerning reamed versus unreamed methodologies. Reaming facilitates the insertion of a bigger diameter nail, perhaps enhancing construct stability, but unreamed fixation may maintain endosteal circulation and minimize operational trauma [6–8]. Current research indicates that outcomes are

influenced by nail selection, fracture characteristics, soft tissue condition, and postoperative rehabilitation regimens [9–11].

While positive results have been documented for both reamed and unreamed fixation, the evidence is inadequate to definitively prove the universal advantage of one approach over the other for all fracture forms [12,13]. This prospective study aimed to assess the clinical and radiological results of unreamed tibial interlocking nailing in adult tibial shaft fractures.

Materials and Methods

This prospective observational study was carried out in the Department of Orthopedics at GK General Hospital in Bhuj, Gujarat, India, from April 1, 2024, to October 31, 2025. Forty adult patients diagnosed with tibial shaft fractures and treated with unreamed tibial interlocking nailing were included in the study.

Adult patients aged 18 years or older with tibial shaft fractures suitable for operative fixation using unreamed tibial interlocking nails who provided written informed consent were included in the study.

Patients with pathological fractures, Gustilo-Anderson type III-C open fractures, fractures extending into the knee or ankle joint, neglected fractures, patients medically unfit for surgery, and those unwilling to participate were excluded. A convenience sample method was utilized, encompassing all eligible patients who presented throughout the study period.

Baseline demographic and clinical characteristics, including age, sex, occupation, mechanism of injury, affected side, fracture type, and concomitant injuries, were documented. Fractures were categorized according to the AO classification system [14]. A comprehensive physical examination, systemic assessment, and thorough localized evaluation were conducted. Standard laboratory tests and radiographic assessment, including anteroposterior and lateral radiographs of the afflicted limb, were conducted. Fractures were categorized according to the AO classification for tibial shaft fractures.

All procedures were performed under spinal or general anesthesia with the patient in the supine position on a radiolucent operating table. Following closed reduction under fluoroscopic guidance, an entry point was created through the proximal tibia. A guidewire was advanced across the fracture site without medullary canal reaming. An appropriately sized unreamed interlocking tibial nail was inserted over the guidewire, and proximal and distal locking screws were placed under fluoroscopic guidance. Fracture reduction, implant position, and alignment were confirmed intraoperatively. Postoperatively, intravenous antibiotics, pain management, thromboprophylaxis where indicated, and progressive rehabilitation with weight bearing according to fracture stability were provided according to institutional protocols. Follow-up appointments were arranged immediately after surgery and subsequently at one, two, three, and six months. (Figure 2) Postoperative antibiotic administration and rehabilitation were provided according to institutional protocol. Follow-up visits were scheduled immediately postoperatively and subsequently at one month, two months, three months, and six months.

The primary outcome was radiological fracture union assessed using the Radiographic Union Scale for Tibial Fractures (RUST). The RUST score evaluates healing across four cortices on anteroposterior and lateral radiographs. Each cortex is scored from 1 to 3, resulting in a total score ranging from 4 to 12, with higher scores indicating more advanced fracture healing [15].

Interpretation of RUST Score

RUST Score	Interpretation
4–6	Poor or minimal radiographic healing
7–9	Partial/progressing fracture union
10–12	Advanced radiographic union or complete fracture healing

Secondary outcomes included postoperative complications such as delayed union, infection, non-union, implant-related complications, anterior knee pain, malunion, ankle stiffness, and leg length discrepancy.

Data were input into Microsoft Excel and analyzed utilizing Statistical Package for the Social Sciences (SPSS) version 20. Continuous variables were presented as mean $\pm$ standard deviation, whereas categorical variables were reported as frequencies and percentages. Statistical analysis was performed using SPSS version 20. Continuous variables were

expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. Comparisons between categorical variables were performed using the Chi-square test or Fisher's exact test when appropriate. Continuous variables were analyzed using the independent-samples t-test. Statistical significance was defined as $p < 0.05$.

The Institutional Ethics Committee of Gujarat Adani Institute of Medical Sciences, Bhuj, accepted the study. Informed consent in writing was secured from all individuals before registration. All procedures were performed in compliance with institutional ethical guidelines and the Declaration of Helsinki.

Results

Forty patients with tibial shaft fractures received fixation using unreamed tibial interlocking nailing and completed follow-up assessments.

Patient Characteristics

The age of the participants ranged from 18 to 70 years. The largest proportion of patients belonged to the 31–40-year age group (14/40, 35.0%), followed by the 41–50-year age group (12/40, 30.0%). Patients aged 18–30 years constituted 11/40 (27.5%), while 2/40 (5.0%) were aged 51–60 years and 1/40 (2.5%) was aged 61–70 years (Table 1). Male patients constituted 31/40 (77.5%), whereas females accounted for 9/40 (22.5%).

Mechanism of Injury and Fracture Characteristics

Road traffic accidents were the most common mechanism of injury, accounting for 24/40 patients (60.0%), followed by falls in 13/40 (32.5%) and assaults in 3/40 (7.5%). Closed fractures were observed in 28/40 patients (70.0%), whereas open fractures were present in 12/40 patients (30.0%) (Table 2). According to the AO fracture classification, type 42-A fractures were the most common (28/40, 70.0%), followed by type 42-C (8/40, 20.0%) and type 42-B (4/40, 10.0%).

Radiological and Functional Outcomes

Radiological union was achieved in 17/40 patients (42.5%) within 13–16 weeks, while 13/40 patients (32.5%) achieved fracture union within 12 weeks. Overall, 30/40 patients (75.0%) demonstrated radiological union within 16 weeks of surgery (Table 3).

The mean RUST score at three months was 9.55, indicating satisfactory radiographic progression of fracture healing.

Complications

Anterior knee pain occurred in 4/40 patients (10.0%) and was the most common postoperative complication. Infection was observed in 3/40 patients (7.5%). Delayed union and hardware impingement were each reported in 2/40 patients (5.0%), while malunion occurred in 1/40 patient (2.5%). No implant failures were recorded during the study period (Table 4).

Associated Injuries

Associated injuries were observed in 22/40 patients (55.0%). Fibular fracture was the most frequent associated injury, followed by head injury, rib fracture, ankle injury, and floating knee.

Table 1: Age Distribution of Study Participants

Age Range (Years)	Number of Patients	Percentage (%)
18–30	11	27.50
31–40	14	35.00
41–50	12	30.00
51–60	2	5.00
61–70	1	2.50
Total	40	100

Table 2: Type of Injury

Type of Injury	Number of Patients	Percentage (%)
Closed	28	70
Open	12	30
Total	40	100

Table 3: Time to Radiological Union

Union Time (Weeks)	Number of Patients	Percentage (%)
<12	13	32.5
13–16	17	42.5
17–20	6	15
21–30	2	5
>30	2	5
Total	40	100

Table 4: Postoperative Complications

Complication	Number of Patients	Percentage (%)
Anterior knee pain	4	10
Delayed union	2	5
Infection	3	7.5
Malunion	1	2.5
Hardware impingement	2	5

Discussion

This prospective observational study assessed outcomes after unreamed tibial interlocking nailing in adult tibial shaft fractures, revealing good fracture union and an acceptable complication profile.

The majority of patients in this series were between the economically active age range of 31 to 50 years. This distribution aligns with other research indicating that tibial shaft fractures mostly impact active adults due to heightened susceptibility to high-energy trauma and occupational accidents [16–17].

Closed fractures constituted the predominant kind of injury in this investigation. Comparable distributions have been documented in recent research assessing intramedullary fixation methods, wherein closed injuries constitute the majority of surgically managed tibial shaft fractures [16,18].

The radiological findings in this trial were positive, with 75% of fractures uniting after sixteen weeks. These findings endorse the conservation of fracture biology while ensuring sufficient mechanical stability. Prior randomized studies and systematic reviews have shown similar union outcomes between reamed and unreamed methods, while reamed fixation may diminish implant-related problems in specific closed fractures [7,8,19].

Recent comprehensive evaluations suggest that functional recovery following tibial intramedullary nailing may be affected by postoperative rehabilitation and early weight-bearing protocols, with certain patients attaining reduced union times without a rise in complication rates [20]. Therefore, treatment recommendations must consider fracture features, soft tissue state, patient profile, and institutional knowledge [21,22].

The outcomes of this study endorse the ongoing application of unreamed tibial interlocking nailing as a dependable therapeutic modality for adult tibial shaft fractures.

Limitations

This research possesses multiple limitations. The sample size was rather limited, potentially constraining the generalizability of the findings. The investigation was performed at a single center without a comparative group receiving reamed nailing or other fixation techniques. The follow-up time was restricted to the evaluation of early

postoperative results and may not reflect long-term functional recovery or problems associated with the implant. Future multicenter studies with bigger sample sizes and extended follow-up durations are advised.

Conclusion

Unreamed tibial interlocking nailing is an efficacious surgical method for addressing adult tibial shaft fractures. The current investigation demonstrated successful radiological union, positive functional results, and a minimal occurrence of problems. The majority of fractures healed within sixteen weeks and exhibited favorable functional recovery. The recorded RUST scores additionally corroborated consistent fracture repair. The data indicate that unreamed tibial interlocking nailing is a suitable therapeutic option, especially when the preservation of biological healing mechanisms is emphasized.

Conflict of interest: No! Conflict of interest is found elsewhere considering this work.

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