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Research Article

Intramedullary Device Fixation for Distal Fibula Fractures Associated with Distal Tibia Injuries: Clinical Outcomes and Practice Implications

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Abstract

Background: Extra-articular fractures of the distal tibia and fibula, typically resulting from axial compression, bending or low-energy twisting forces, pose considerable management challenges. The necessity of fixing fibular fractures at the same distal third level, particularly when intramedullary nailing is employed for tibial fractures, remains a subject of debate.

Methods: This study evaluated the radiological outcomes, union rates and postoperative complications following intramedullary device fixation of fibular fractures associated with extra-articular distal tibia fractures. Outcome measures included time to radiographic union, operative time, incidence of wound complications and functional outcomes assessed using the American Orthopedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score and the Olerud Molander Ankle Score (OMAS).

Results: All patients achieved union of both tibia and fibula at a mean of 12 weeks. Functional outcomes were favorable, with a mean AOFAS score of 87 at six months. The majority of patients experienced satisfactory ankle function and minimal complications.

Conclusion: Intramedullary fixation of distal-third fibular fractures, in combination with tibial nailing for distal tibia fractures, yields excellent radiological and functional outcomes. This technique may offer a reliable alternative to plating in appropriately selected cases.

Keywords: AOFAS (American Orthopedic Foot and Ankle Society); OMAS (American Orthopedic Foot and Ankle Society)

Introduction

Extra-articular fractures of the distal tibia and fibula, typically resulting from axial compression, bending or low-energy twisting forces, pose considerable management challenges due to limited soft tissue coverage and proximity to the ankle joint. These fractures account for a significant portion of lower limb trauma, especially in young adults involved in road traffic accidents or elderly patients with osteoporotic bone. Malalignment, delayed union and soft tissue complications are common concerns when managing these injuries. The management of distal third fibula fractures, especially when associated with distal tibia fractures, remains controversial. The necessity of fixing fibular fractures at the same level, particularly when intramedullary nailing is employed for tibial fractures, is still debated in the literature [1]. Obtaining fibular alignment helps in the reduction of distal tibial fractures and allows for reduction prior to placement of a tibia intramedullary nail. In addition, when treating distal extra-articular tibiofibular fractures with intramedullary nailing, fibular fixation reduces the likelihood of late malalignment [2]. Aligning the fibula facilitates proper reduction of distal tibial fractures and assists in positioning before inserting the tibial intramedullary nail. Moreover, fibular fixation in extra-articular distal tibiofibular fractures may help prevent delayed malalignment [3]. Restoring the fibula's length, rotation and alignment offers a guide for distal tibial reconstruction and can assist in partially reducing the commonly displaced anterolateral or posterolateral bone fragments. The optimum management of such extra-articular pilon fractures remains conjectural with no clear guidelines depicting treatment [4]. Proper fibular reduction is crucial in avoiding valgus misalignment of the distal tibia. However, the ideal approach to treating extra-articular pilon fractures remains unclear, with no universally accepted guidelines.

Materials and Methods

Fifty-five adult patients treated between April 2024 and March 2025 at Gujarat Adani Institute of Medical Sciences, Bhuj in the Department of Orthopedics were included. Out of 55 patients identified, 34 were male and 21 were female ranging from 19 to 72 years.

Inclusion Criteria:

-Closed or Gustilo-Anderson Type I open fractures

-Ipsilateral distal third fibula fractures

-Treatment with locked intramedullary tibial nailing

-Intramedullary fibular fixation with a titanium fibular nail or long k wire or rush nail Exclusion Criteria:

-Polytrauma patients

-Pathological fractures

-Previous ipsilateral lower limb surgery

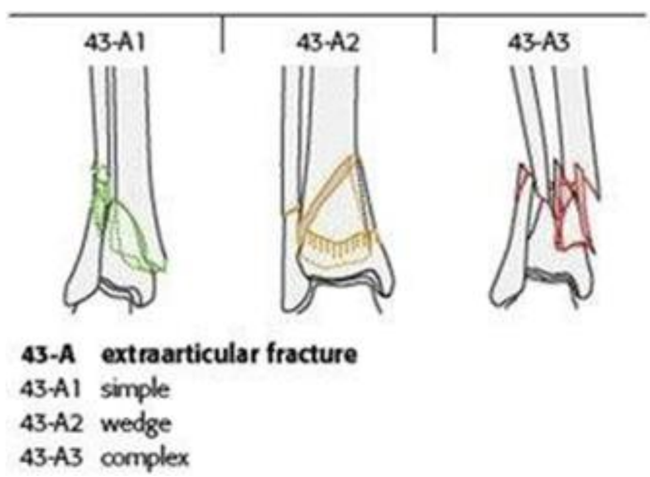

Figure 1: AO classification of extra articular distal tibia fractures [5].

Surgical Technique

The fibular fracture was reduced and stabilized using a small-diameter intramedullary fibular device inserted via a minimally invasive incision over the lateral malleolus. Fixing the fibula first helps restore the length, alignment and rotation of the lateral column, which facilitates indirect reduction of the distal tibia and provides a more stable anatomical reference for subsequent tibial nailing. This sequence minimizes the risk of malalignment, especially in distal-third fractures, where achieving proper tibial alignment can be challenging. An intramedullary device was chosen for fibular fixation due to its minimal soft tissue disruption, reduced risk of wound complications and biomechanical stability in comminuted or osteoporotic bone. Subsequently, tibial fixation was performed using a standard locked intramedullary nail under fluoroscopic guidance.

Following spinal or general anesthesia, proper limb alignment was achieved using manual traction. A small incision was then made over the lateral malleolus tip. An awl was employed to create an entry point at the distal fibula, through which a 2.5- or 3.0 mm elastic nail was inserted. The fracture was reduced under fluoroscopic guidance and the nail was directed proximally to engage the upper fragment of the fibula. Continuous fluoroscopic monitoring ensured accurate navigation and alignment by adjusting the nail’s position and trajectory during insertion [6].

Rush Rods

Pritchett he use of 3.2 mm Rush rods has been reported in the percutaneous management of unstable ankle fractures. These rods, made of steel and shaped with a chisel-like tip, are designed for intramedullary insertion with minimal surgical exposure [7].

Longkwire

A 1 to 1.5 cm incision is made just below the lateral malleolus, aligned with the long axis of the fibula, to expose the distal tip. Under image intensifier guidance, the entry point is confirmed using a forceps. Once verified, a 3.5 mm drill bit is used to create the entry portal. A 3 mm thick K-wire is then gradually inserted into the medullary canal of the fibula. The wire is carefully advanced across the fracture site and into the proximal fragment, with real-time monitoring using a C-arm to ensure proper alignment and trajectory throughout the procedure (Fig. 2) [8].

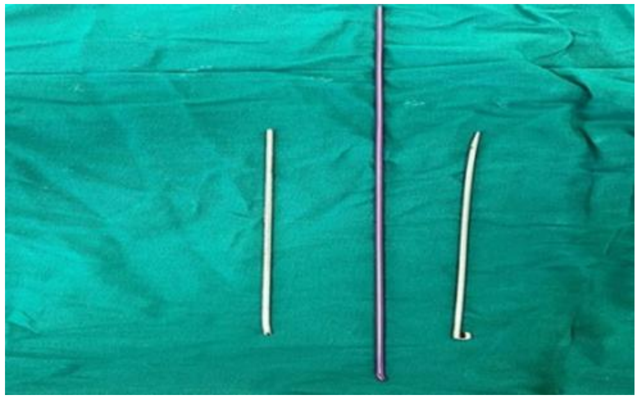

Figure 2: Long k wire, TENS and rush nail from left to right in order.

Postoperative Protocol

All patients received prophylactic antibiotics and thromboprophylaxis. Early mobilization with partial weight-bearing was encouraged from week 2, advancing to full weight-bearing as tolerated by week 6-8 based on radiographic signs of healing.

Outcomes Measured

Time to radiographic union Incidence of wound complications Ankle alignment and range of motion Functional outcome (AOFAS AND The Olerud Molander Ankle Score (OMAS) score at 6 months).

Pain (40 Points)	
Criteria	Points
None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0
Function (50 Points)	
Criteria	Points
Activity limitations, support requirement	
No limitations, no support	10
No limitation of daily activities, limitation of recreational activities, no support	7
Limited daily and recreational activities, can	4
Severe limitation of daily and recreational activities, walker, crutches, wheelchair, brace	0
Maximum walking distance, blocks	
Greater than 6	5
04-Jun	4
01-Mar	2
Less than 1	0
Walking surfaces	
No difficulty on any surface	5

Some difficulty on uneven terrain, stairs, inclines, ladders	3
Severe difficulty on uneven terrain, stairs, inclines, ladders	0
Gait abnormality	
None, slight	8
Obvious	4
Marked	0
Sagittal motion (flexion plus extension)	
Normal or mild restriction (30° or more)	8
Moderate restriction (15° - 29°)	4
Severe restriction (less than 15°)	0
Hindfoot motion (inversion plus eversion)	
Normal or mild restriction (75%-100% normal)	6
Moderate restriction (25-74% normal)	3
Marked restriction (less than 25% normal)	0
Ankle-hindfoot stability (anteroposterior, varus-valgus)	
Stable	8
Definitely unstable	0

Table 1: AOFAS Ankle-Hindfoot Scale, Subjective Portion (90 points total) [9].

Parameter	Degree	Score
Pain	None	25
	While walking on uneven surface	20
	While walking on surface outdoors	10
	While walking indoors constant and severe	5
Stiffness	None	10
	Stiffness	0
Swelling	None	10
	Only in evenings	5
	Constant	0
Stair climbing	No problems	10
	Impaired	5
	Impossible	0
Running	Possible	5
	Impossible	0
Jumping	Possible	5
	Impossible	0
Squatting	No Problems	5
	Impossible	0
Supports	None	10
	Taping, Wrapping	5
	Stick or Crutch	0
Work, Activities of daily life	Same as before injury	20
	Loss of Tempo	15
	Change to simpler job	15
	Severely impaired work capacity	0

Table 2: The Olerud Molander Ankle Score (OMAS) score [10].

Result

The comparison of AOFAS scores between the two groups shows that the mean score was higher in the Long K-wire group compared to the TENS group. However, the difference was not statistically significant, with a t-value of -0.708 and a p-value of 0.482 (Fig. 3-6).

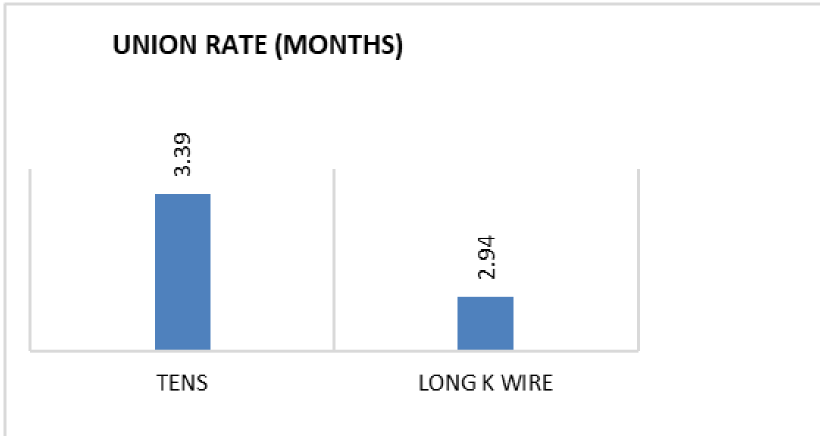

Figure 3: Union rate for Tens and Long K Wire Comparison of the Union Rate (Months) across the two sets shows the Union Rate (Months) is Higher in Tens group with a t-value of 1.437 and is statistically non-significant with a p value of 0.157.

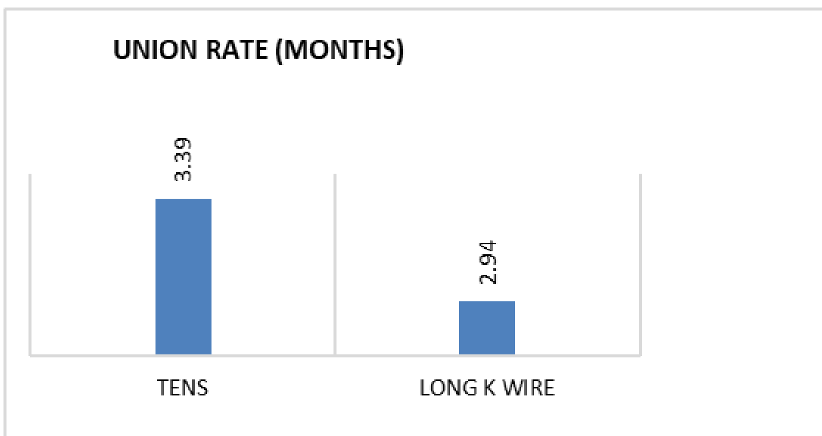

Figure 4: AOFAS Score Comparison between TENS and Long K-Wire.

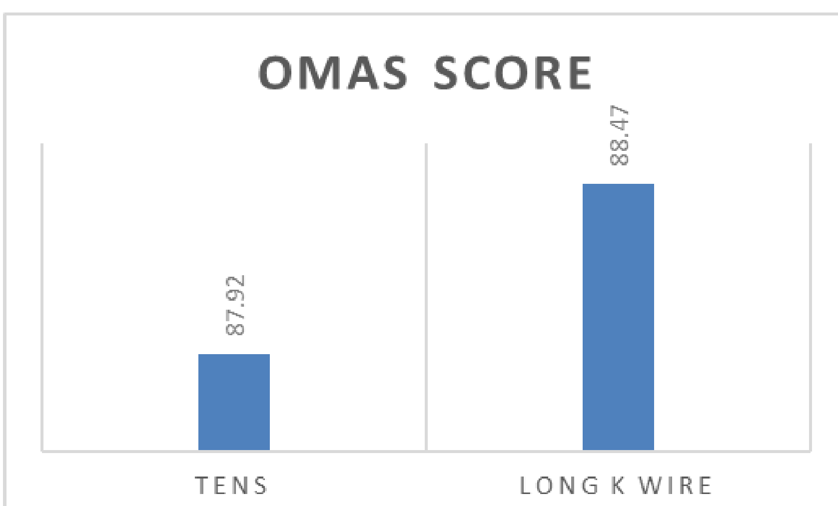

Figure 5: OMAS score for TENS and Long K-Wire. Comparison of the OMAS SCORE Across the two sets is higher in Long K Wire group with a t value of -0.295 and is statistically non-significant with a p-value of 0.769.

In terms of complications, 10.9% (n = 6) of the patients developed infections, while 89.1% (n = 49) had no reported complications.

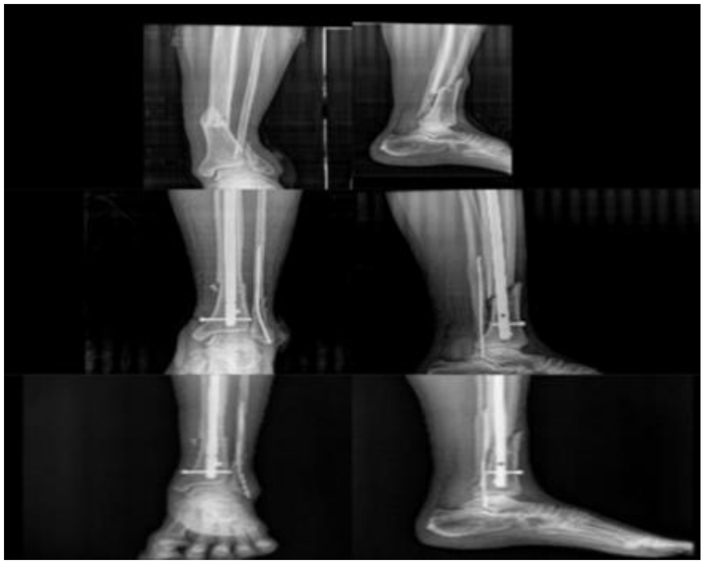

Figure 6: Image showing pre op x ray for distal tibia-fibula fracture, post op x ray treated by tibia interlocking nail and TENS and at 1 month union respectively.

Discussion

Orthopedic surgeons face numerous challenges when managing distal extra-articular tibial fractures. These injuries often result from high-energy trauma and are associated with poor outcomes due to limited soft tissue coverage and risks of infection, nonunion and malalignment [1-3]. Radiographic and clinical outcomes may be suboptimal, particularly when fixation strategies fail to address the biomechanical integrity of both the tibia and fibula. Preservation of hip-knee-ankle alignment, optimization of functional outcomes and reduction in malunion rates are central to successful treatment.

The fibula bears approximately 6% to 17% of body weight and plays a stabilizing role in the ankle mortise [4]. Fibular fixation has traditionally been used to restore lateral column alignment, reduce rotational deformity and support anatomic tibial reduction [5]. Several biomechanical and clinical studies support the notion that fibular fixation enhances the stability of distal tibia fractures and prevents malalignment [6]. However, this remains an area of debate, as some studies suggest that rigid fibular fixation may paradoxically increase nonunion rates due to altered load-sharing dynamics [7].

A meta-analysis by Li, et al., concluded that fibular fixation may reduce rotational malalignment during follow-up but does not significantly affect union rates, malreduction or infection risk [12]. Similarly, a study by Yoon, et al., emphasized that fibular fixation can be selectively employed in fracture configurations at higher risk of angular displacement or rotational instability [8].

In the present study, intramedullary fibular fixation was used as a minimally invasive approach in cases of associated distal tibia fractures. This technique offers advantages in patients with soft tissue compromise such as edema or fracture blisters, where open plating may lead to wound complications [2,9]. Intramedullary devices also allow for easier insertion through smaller incisions while maintaining fracture stability. Several authors have supported its use in cases where percutaneous techniques are preferred [10,11].

Our findings align with those of Xiong, et al., who demonstrated improved alignment and favorable outcomes with intramedullary fixation of fibula fractures in combination with tibial nailing [2]. While biomechanical support is important, implant selection must also consider the fracture pattern, comminution and soft tissue envelope. In this context, both TENS and long K-wire fixation provide viable options with good union rates and minimal complications.

Strengths and Limitations

Strengths

This study evaluates a relatively large sample of patients with distal tibia-fibula fractures, treated in a standardized manner at a single tertiary care center, improving internal consistency.

It compares two widely used intramedullary fixation methods for fibular fractures (TENS and long K-wire), offering practical insights for real-world orthopedic decision-making.

Functional outcomes were assessed using validated scoring systems (AOFAS and OMAS), enhancing the clinical relevance of the findings.

Radiological union and complication rates were systematically evaluated, providing a comprehensive outcome assessment.

Limitations

The study is retrospective in design, which may introduce selection bias and limit the ability to establish causality.

There was no randomization between TENS and K-wire groups, which may affect the comparability of outcomes.

The follow-up duration was limited to 6 months; long-term complications such as post-traumatic arthritis or hardware-related issues could not be assessed.

Radiological assessments were not blinded, introducing potential observer bias.

The study was conducted at a single center, which may limit generalizability to broader populations or different clinical settings.

Conclusion

Intramedullary fixation of distal-third fibula fractures, when combined with intramedullary fixation of distal tibia fractures, provides excellent radiographic and functional outcomes while minimizing soft tissue complications. This technique is a valuable alternative to plating in selected patients, particularly where minimal soft tissue disruption is crucial. Both TENS and long K-wire have their respective advantages and are suitable for different types of distal fibula fractures and patient profiles. The choice of implant should be guided by a comprehensive assessment of fracture configuration, bone quality and soft tissue status.

Conflict of Interests

The author declares no conflict of interest.

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Consent for Publication

Not applicable

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