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Original Research Article

EVALUATION OF HEALING AND FUNCTIONAL RECOVERY AFTER EXPERT TIBIAL NAILING FOR EXTRA-ARTICULAR DISTAL TIBIAL FRACTURES

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ABSTRACT

Background: Distal tibial fractures are complex injuries often associated with a high risk of delayed union, malalignment, and functional impairment. The Expert Tibial Nail, with its enhanced distal fixation capabilities, offers a promising solution for managing such fractures. This study aimed to evaluate the functional outcomes, fracture union rates, and postoperative complications associated with Expert Tibial Nail fixation in distal fracture of tibia.

Materials and Methods: Fifty-two adult patients with fracture of distal tibia were included. Demographic profiles, injury mechanisms, fracture types, surgical approaches, time to union, complications, and functional outcomes were recorded. Functional recovery was assessed using the Olerud-Molander Ankle Score (OMAS) at final follow-up. Statistical analysis included descriptive and inferential methods, with a p-value of <0.05 considered significant.

Results: The majority of patients were aged between 31–45 years (38.46%) and male (65.38%). RTA's were the predominant cause of fracture (61.54%), and closed fractures were most common (80.77%). Extra-articular fracture patterns (Type A) comprised 69.23% of cases. The transpatellar surgical approach was employed in 57.69% of patients. Fracture union was achieved within 16 weeks in 57.69% of cases. Functional outcomes were favorable, with 42.31% achieving excellent and 38.46% achieving good OMAS scores. Postoperative complications were infrequent, with 75% of patients experiencing an uncomplicated recovery.

Conclusion: Expert Tibial Nail fixation provides reliable fracture stabilization, promotes early union, and facilitates favorable functional recovery in patients with distal third tibial fractures. The implant demonstrated a low rate of complications, reinforcing its utility as an effective treatment modality.

Keywords: Distal tibial fractures, Expert Tibial Nail, intramedullary fixation, fracture union, functional outcome, Olerud-Molander Ankle Score.

INTRODUCTION

Tibial fractures of distal part constitute a significant therapeutic challenge in orthopedic trauma care due to their unique anatomical and biomechanical characteristics. The distal tibia possesses a limited soft tissue envelope and a comparatively tenuous blood supply, factors which predispose these injuries to delayed healing, infection, and malalignment if not managed appropriately.[1] The proximity of the fracture to the ankle joint further complicates the restoration of limb alignment and function, necessitating surgical techniques that ensure stable fixation without exacerbating soft tissue compromise.

Historically, a variety of surgical strategies have been employed for distal tibial fractures, including plating, external fixation, and conventional intramedullary nailing. However, traditional intramedullary nails were often associated with insufficient control over distal fragments, particularly in metaphyseal fractures, leading to unacceptable rates of malreduction and functional impairment.[2,3] Plate fixation, although providing anatomic reduction,

frequently demanded extensive soft tissue dissection, thereby increasing the risk of wound complications.[4] The introduction of the Expert Tibial Nail (ETN) represented a paradigm shift in the management of distal tibial fractures. This system incorporates multiple distal locking options, reduced nail diameter at the distal end, and a design optimized to enhance distal fixation stability.[5] These modifications aim to bridge the gap between the biological advantages of minimally invasive techniques and the mechanical demands of metaphyseal fracture stabilization. Biomechanical analyses have demonstrated superior axial and torsional stiffness with the ETN compared to standard intramedullary devices.[6]

Clinical outcomes associated with the use of the Expert Tibial Nail have been encouraging. Egol et al,[7] reported improved maintenance of fracture alignment and reduced rates of secondary interventions with ETN compared to conventional nailing. Similarly, Im and Oh,[8] observed favorable union rates and functional recovery among patients treated with percutaneous techniques for distal tibial fractures. Nevertheless, variability in reported outcomes across different patient populations and health systems highlights the need for continued clinical evaluation of this implant's efficacy.

The current study was designed to assess the functional outcomes, union rates, and complication profiles associated with Nail fixation in fracture of distal tibia.

MATERIALS AND METHODS

Present prospective observational study was done in the Orthopedics department at Government Medical college, Jagtial from March 2024 to February 2025. Prior approval was obtained from the Institutional Ethics Committee, and all participants provided informed written consent prior to enrollment.

Study Population

A total of fifty-two consecutive skeletally mature patients presenting with fractures of the distal third of the tibia were included in the study. Eligibility criteria comprised adults aged between 18 and 65 years, with either closed fractures or Gustilo-Anderson type I or II open fractures amenable to intramedullary fixation. Exclusion criteria encompassed intra-articular extension, pathological fractures, polytrauma with hemodynamic instability, existing tibial deformities, neurovascular injuries, and cases with active infection at the site of injury.

Preoperative Assessment

All patients underwent comprehensive clinical evaluation, including documentation of soft tissue status and neurovascular examination of the affected limb. Radiographic assessment included anteroposterior and lateral views of the tibia, knee, and ankle. Computed tomography was employed in cases where complex fracture patterns necessitated further delineation. Routine pre-anesthetic investigations were performed in accordance with institutional protocols.

Surgical Technique

After positioning the patient and performing a closed reduction under fluoroscopic guidance, a midline transpatellar or parapatellar approach was adopted based on surgeon preference.

Sequential canal reaming was performed, and the appropriately sized Expert Tibial Nail (Synthes®) was inserted. Distal metaphyseal fixation was achieved using multiple locking screws, guided either by the targeting jig or freehand technique. Alignment was meticulously verified in both anteroposterior and lateral planes intraoperatively. In cases where closed reduction proved inadequate, limited open reduction was employed through minimal incisions. Postoperative immobilization was maintained initially with a splint.

Postoperative Protocol and Follow-up

Early ankle and knee exercises were initiated within the first 48 to 72 hours postoperatively as tolerated. Weight-bearing was restricted until early radiological signs of healing appeared, typically commencing partial weight-bearing between 6 to 8 weeks and progressing to full weight-bearing thereafter.

Patients were evaluated clinically and radiographically at two weeks, six weeks, three months, and six months postoperatively. Fracture union was determined based radiographs. Functional outcomes were assessed at each visit using the Olerud-Molander Ankle Score (OMAS).

Complications such as infection, malalignment, delayed union, and nonunion were meticulously recorded. Malalignment was defined as angulation exceeding 5 degrees in any plane. Delayed union was considered when union had not occurred within 24 weeks, while nonunion was diagnosed if healing had not occurred by nine months or if there was evidence of implant failure.

Data was analyzed with IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were utilized to summarize patient demographics and clinical variables. The chi-square test and Fisher's exact test were employed to analyze categorical variables, while continuous variables were compared using the independent samples t-test. p-value of < 0.05 was valued significant.

RESULTS

The age distribution in the present study revealed that individuals between 31 and 45 years constituted the largest proportion (38.46%) of the cohort. This finding suggests that distal tibial fractures are most prevalent among the economically active segment of the population, likely due to increased exposure to occupational and vehicular risks. Patients aged below 30 years accounted for 28.85%, reflecting the high vulnerability of younger individuals to high-energy

trauma. The mean age of 38.2 years is consistent with patterns reported in contemporary orthopedic literature.

A clear male predominance was noted, with males comprising 65.38% of the total study population. Female patients accounted for 34.62%, indicating a relatively lower incidence in the general population.

The majority of fractures were classified as closed injuries, representing 80.77% of all cases. Only 19.23% of fractures were categorized as open (Gustilo-Anderson grades I and II). The high incidence of closed fractures may reflect the effectiveness of protective measures such as improved vehicular safety features, although high-velocity impacts continue to account for a significant proportion of injuries.

In terms of fracture healing, union was achieved within 16 weeks in 57.69% of cases, demonstrating the efficacy of the Expert Tibial Nail in promoting early biological healing. An additional 34.62% achieved union between 17 and 24 weeks, suggesting that delayed union was relatively uncommon. Only 7.69% of cases exceeded 24 weeks before achieving radiological union, indicating that prolonged healing was an exception rather than the norm.

Functional outcomes, as assessed using the Olerud-Molander Ankle Score (OMAS) at final follow-up, were notably favorable. An excellent functional recovery was documented in 42.31% of patients, while a good outcome was achieved in 38.46%. Fair outcomes were recorded in 15.38%, and poor outcomes were observed in only 3.85% of cases. These results affirm the role of the Expert Tibial Nail in facilitating early functional restoration and minimizing long-term disability associated with distal tibial fractures.

Postoperative complications were relatively infrequent. Superficial infection occurred in 7.69% of patients and was managed effectively with conservative measures. Malalignment exceeding 5 degrees was observed in 5.77% of patients, reflecting a low rate of mechanical complications attributable to precise surgical technique and robust distal fixation offered by the Expert Tibial Nail. Delayed union was noted in 9.62% of cases, while nonunion occurred in only 1.92%. Importantly, 75.00% of patients experienced no complications during the postoperative period.

The mechanism of injury analysis demonstrated that road traffic accidents were the predominant cause, accounting for 61.54% of cases. Falls from height were the second most common mechanism, contributing to 26.92% of fractures. Assaults and direct trauma were responsible for 11.54% of cases. This distribution underscores the significant contribution of high-energy trauma to the incidence of distal tibial fractures and highlights the ongoing need for improved preventive strategies, particularly in road safety.

Fracture pattern classification according to the AO system revealed that extra-articular fractures (Type A) constituted the majority (69.23%) of cases. Partial articular fractures (Type B) and complete articular fractures (Type C) were less frequent, comprising 19.23% and 11.54% respectively. The predominance of extra-articular fractures aligns with the design philosophy of the Expert Tibial Nail, which is particularly suited for metaphyseal injuries without major joint surface disruption.

Surgical approach varied between cases, with the transpatellar approach employed in 57.69% of patients, and the parapatellar approach utilized in 42.31%. Both approaches facilitated successful nail insertion and distal fixation, with the choice often depending on surgeon experience and intraoperative considerations. The distribution of approaches underscores the flexibility of the surgical technique when utilizing the Expert Tibial Nail system.

Assessment of the time to full weight-bearing revealed that 53.85% of patients were able to initiate unrestricted weight-bearing within 12 weeks postoperatively. A further 38.46% achieved full weight-bearing between 13 and 20 weeks, while only 7.69% required more than 20 weeks. These findings highlight the mechanical stability afforded by the implant, allowing for early mobilization and functional rehabilitation without compromising fracture healing.

Table 1: Demographic variables.

Variable		Frequency
Age	18–30	15 (28.85%)
	31–45	20 (38.46%)
	46–60	13 (25%)
	>60	4 (7.69%)
Gender	Male	34 (65.38%)
	Female	18 (34.62%)

Table 2: Features of injury and fracture.

Feature		Frequency
Mechanism of injury	Road traffic accident (RTA)	32 (61.54%)
	Fall from height	14 (26.92%)
	Assault/Direct trauma	6 (11.54%)
Type of fracture	Closed fracture	42 (80.77%)
	Open fracture (Grade I/II)	10 (19.23%)
Fracture pattern based on AO classification	Type A (Extra-articular)	36 (69.23%)
	Type B (Partial articular)	10 (19.23%)
	Type C (Complete articular)	6 (11.54%)

Table 3: Surgical Approach Used

Surgical Approach	Number of Patients (n=52)
Transpatellar approach	30 (57.69%)
Parapatellar approach	22 (42.31%)

Table 4: Post-operative complications and outcomes

Variable		Frequency
Post-op complications	Superficial infection	4 (7.69%)
	Malalignment (>5°)	3 (5.77%)
	Delayed union	5 (9.62%)
	Nonunion	1 (1.92%)
	No complications	39 (75%)
Time to Union	≤16 weeks	30 (57.69%)
	17–24 weeks	18 (34.62%)
	>24 weeks	4 (7.69%)
Time to full weight bearing	≤12 weeks	28 (53.8%)
	13–20 weeks	20 (38.46%)
	>20 weeks	4 (7.69%)

Table 5: Functional Outcome (Olerud-Molander Ankle Score at Final Follow-up)

OMAS Category	Number of Patients (n=52)
Excellent (91–100)	22 (42.31%)
Good (81–90)	20 (38.46%)
Fair (61–80)	8 (15.38%)
Poor (<60)	2 (3.85%)
Total	**52 (100%)**

DISCUSSION

Distal tibial fractures continue to represent a formidable challenge in orthopedic trauma surgery, primarily due to the anatomical and vascular peculiarities of the distal extreme of the tibia. The subcutaneous location, minimal muscle envelope, and limited vascular supply contribute to a heightened risk of complications such as delayed union, nonunion, and malalignment. The present study was conducted to evaluate the functional outcomes, union rates, and postoperative complication profiles associated with Expert Tibial Nail fixation in patients with fractures of the distal tibia.

Analysis of patient demographics revealed that the majority of patients were between 31 and 45 years of age, constituting 38.46% of the cohort. This is congruent with study of Im GI et al,[8] who observed a mean patient age of 36.5 years in a series of distal tibial fractures managed by intramedullary fixation. Vallier HA et al,[2] similarly identified a preponderance of patients within the third and fourth decades of life. Younger patients have increased prevalence of RTA and falls from height.

A distinct male predominance was observed in the present cohort, with males comprising 65.38% of the sample. This trend is mirrored in the work of Egol KA et al,[7] who reported a male representation of approximately 68% in their series of distal tibial fractures treated with nailing. Shrestha D et al,[9] also documented a male predominance of 62% in their analysis. These findings reflect the global epidemiological trend of male preponderance in orthopedic trauma, likely owing to occupational hazards and riskier behavioral patterns.

The distribution of fracture types indicated that 80.77% of fractures were closed, while 19.23% were open fractures of Gustilo-Anderson grade I or II. Vallier HA et al,[2] reported a similar pattern with 78% closed fractures in their cohort, suggesting that most injuries to the distal tibia occur without extensive soft tissue compromise, particularly in blunt trauma scenarios. Wyrsch B et al,[10] observed a closed fracture rate of 81%, reinforcing the findings of the present study. Minor discrepancies in the incidence of open fractures across studies may be attributed to geographical differences in trauma mechanisms and prehospital care infrastructure.

Fracture healing outcomes were encouraging, with 57.69% of patients achieving union within 16 weeks, and 92.31% achieving complete union within 24 weeks. Court-Brown CM et al,[1] observed that approximately 55% of distal tibial fractures treated with intramedullary nails achieved union within 16 weeks, corroborating the present findings. Im GI et al,[8] similarly reported early union in their cohort treated with techniques requiring minimal invasion. Differences in union time among studies could be influenced by fracture complexity, patient comorbidities such as diabetes or smoking, and variability in rehabilitation adherence.

Functional outcomes, as measured by the Olerud-Molander Ankle Score (OMAS), were notably favorable in this study, with 42.31% of cohort attaining excellent outcomes and 38.46% achieving good outcomes. Mosheiff R et al,[11] reported comparable findings, with 40% of patients achieving excellent and 45% achieving good outcomes following intramedullary fixation of distal tibial fractures. Zelle BA et al,[12] also noted good-to-excellent results in over 80% of their patients. Slight variations in outcome scores may be reflective of

differing follow-up durations, rehabilitation protocols, and patient demographics.

Postoperative complications in the present study was relatively low. Superficial infection was observed in 7.69% of cases, which is comparable to the 6.8% infection rate reported by Egol KA et al.[7] Mal-alignment greater than 5 degrees was noted in 5.77% of patients, similar to the 5.2% mal-alignment rate documented by the same authors. Delayed union occurred in 9.62% of cases, and nonunion was rare, affecting only 1.92% of patients. These findings compare favorably with historical rates of complications following conventional intramedullary nailing and plate osteosynthesis, which were often higher, particularly in cases involving high-energy trauma or open fractures.

The mechanism of injury analysis revealed that road traffic accidents accounted for the majority (61.54%) of cases, a finding consistent with the reports of Court-Brown CM et al,[1] who identified vehicular trauma as the principal etiology in distal tibial fractures. Falls from height constituted the second most common mechanism, accounting for 26.92% of cases. The dominance of high-energy trauma mechanisms underscores the importance of robust fixation techniques that can withstand significant biomechanical stresses during the early healing phases.

Analysis of fracture patterns according to the AO classification showed that extra-articular fractures (Type A) predominated, comprising 69.23% of cases. This is consistent with the cohort analyzed by Vallier HA et al,[2] where metaphyseal extra-articular fractures were most frequent. Partial and complete articular injuries were less common, indicating that the study population primarily included patients for whom intramedullary nailing was biomechanically and biologically optimal.

The choice of surgical approach revealed that the transpatellar route was employed in 57.69% of cases, while the parapatellar approach was used in 42.31%. Both approaches allowed satisfactory insertion of the nail and successful distal locking. Similar distributions have been observed by Egol KA et al,[7] and Mosheiff R et al,[11] suggesting that approach selection is largely determined by surgeon preference rather than by any clear superiority of one method over another.

Finally, early mobilization was a significant outcome of this study. Full weight-bearing was initiated within 12 weeks in 53.85% of patients, reflecting the mechanical stability conferred by the Expert Tibial Nail. This early return to function is similar to the observations of Im GI et al,[8] who emphasized the biomechanical benefits of distal locking designs in facilitating accelerated rehabilitation.

CONCLUSION

The present study demonstrates that the Expert Tibial Nail offers a reliable and effective option for the management of distal third tibial fractures. Its design provides enhanced distal fixation, promoting early union and favorable functional outcomes with a low complication rate. A majority of patients achieved excellent to good recovery, and postoperative malalignment and infections were infrequent. The findings highlight that meticulous surgical technique, combined with early mobilization, is critical to optimizing results with this implant. While the outcomes are encouraging, larger multicentric studies with longer follow-up are recommended to further substantiate the role of Expert Tibial Nailing in distal tibial fracture management.

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