Original Article

Early Outcomes of Intramedullary Interlocking Nail in Closed Tibial Diaphyseal Fractures

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ABSTRACT

OBJECTIVE: To evaluate the early outcome of intramedullary interlocking nailing in closed tibial diaphyseal fractures within the Pakistani population.

METHODOLOGY: This Prospective descriptive study was conducted from April to October 2019 at the Department of Orthopedics, Jinnah Postgraduate Medical Centre, Karachi. A total of 81 patients aged 25 –65 years with tibial diaphyseal fractures of either gender were included. Patients with ipsilateral femur fractures, chronic renal failure, and chronic liver disease were excluded. A consultant orthopedic surgeon performed intramedullary interlocking nailing. Postoperatively, all patients were prescribed co-amoxiclav 1 g and diclofenac sodium twice daily for two weeks. Patients were followed fortnightly for 3 months, and outcomes were assessed as excellent, good, fair, or poor according to operational definitions. The data were analyzed using SPSS version 20.0. Categorical data are presented as percentages and of numerical means. Excellent outcome associations are portrayed using Chi-square, and a p-value of <0.05 was considered significant.

RESULTS: The mean age was 38.83 ± 7.83 years, with 66 (81.48%) patients aged 25–45 years. The male-to-female ratio was 3:1, with 61 (75.31%) males and 20 (24.69%) females. Outcomes showed that 62 (76.54%) patients achieved excellent results, 8 (9.88%) had good results, 9 (11.11%) had fair results, and 2 (2.47%) had poor results. No significant association was observed between participant characteristics and the clinical outcome of patients with IMN for closed tibial fractures.

CONCLUSION: Intramedullary interlocking nail demonstrated a high rate of excellent outcomes in the management of close tibial diaphyseal fractures.

KEYWORDS: Outcome, Intramedullary Interlocking Nail, Closed, Tibial Diaphyseal fractures, Descriptive study, Pakistan, JPMC.

INTRODUCTION

Tibial diaphyseal fractures are among the most common long bone injuries worldwide, with reported annual incidences ranging from 16.9 to 26.0 per 100,000 persons[1]. These fractures predominantly affect males and young to middle-aged adults due to higher exposure to high-energy trauma, including road traffic accidents and occupational injuries[2,3]. Closed tibial shaft fractures comprise approximately 76.5% of all tibial fractures[4] and can be associated with non-union, malunion, infection, and compartment syndrome if inadequately managed[5]. Currently, intramedullary interlocking nailing (IMIL) is regarded as the treatment of choice globally, offering rigid fixation, minimal soft tissue disruption, and early mobilization[6].

Both International Studies[7-10], as well as national and regional Pakistani studies[6,11,12], support IMIL efficacy, with studies reporting excellent to good functional outcomes in 65–88% of cases. However, clinical outcomes are influenced by patient-specific variables, including time to surgery, BMI, diabetes, and injury severity, which can compromise healing and recovery. However, several patient-specific factors can influence the outcomes of this procedure, including age, injury duration before surgery, BMI, and comorbidities such as diabetes. In particular, delayed surgical intervention and higher BMI have been associated with compromised fracture healing and prolonged recovery.

This variability highlights the importance of local data in assessing treatment outcomes and informing clinical decision-making. Therefore, this study aimed to evaluate the early outcomes of intramedullary interlocking nail fixation of closed tibial diaphyseal fractures in the Pakistani population, taking into consideration pertinent factors such as age, BMI, duration of injury, and status of diabetes. Findings from this investigation may help optimize fracture management and tailor postoperative rehabilitation protocols to local needs.

METHODOLOGY

This descriptive study was carried out on patients who were presenting at the Orthopaedics Department of

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Jinnah Postgraduate Medical Centre, Karachi, Pakistan, between April and October 2019, with ethical approval from the College of Physicians and Surgeons Pakistan (Reference No: CPSP/REU/OSG-2017-186-1725) and conducted according to the Helsinki Declaration of 1975. The sample size of 81 was determined using the WHO sample size calculator, with a 95% confidence level, a 10% margin of error, and an assumed 70.0% proportion for excellent outcomes associated with intramedullary interlocking nail treatment in closed tibial diaphyseal fractures[10].

A non-probability consecutive sampling technique was employed. The inclusion criteria for the study were as follows: patients aged 25-65 years presenting with tibial diaphyseal fractures, as defined by the operational criteria, with a duration of less than 14 days. Both male and female patients were eligible for inclusion. The exclusion criteria for the study were as follows: patients with open diaphyseal fractures of the tibia, as determined through clinical examination; those with ipsilateral femur fractures; patients with chronic liver disease, identified based on medical history and serum bilirubin levels exceeding 2.0 mg/dL; and patients with chronic renal failure, diagnosed through medical history and serum creatinine levels greater than 1.5 mg/dL. Informed consent was obtained from all participants, and a consultant orthopaedic surgeon with at least three years of post-fellowship experience performed intramedullary interlocking nailing.

Postoperatively, patients received co-amoxiclav 1 gm and diclofenac sodium, each administered twice daily for two weeks. Patients were followed fortnightly for a minimum of three months, during which early outcomes (excellent, good, fair, or poor) were evaluated according to predefined operational definitions. Data on age, gender, BMI, diabetes status, fracture duration, and outcomes were recorded on a pre-designed proforma. All data were entered and analyzed using IBM SPSS version 20.0. The diabetic status of patients was recorded based on their medical history and records. The diabetic patients included in the study had 70/30 controlled/uncontrolled diabetes, which was controlled either through oral hypoglycemic agents or insulin, depending upon daily testing, before and after surgery. The majority were being managed with oral medications, while a smaller proportion were on insulin injections. Detailed data on the exact duration of diabetes were not collected, as this was beyond the primary scope of this study. Continuous variables, including age, BMI, and fracture duration, are presented as mean ± standard deviation. Categorical variables, such as gender, diabetes mellitus (yes/no), early outcomes (excellent/good/fair/poor), and early excellent outcome (yes/no), were summarized as frequencies and percentages. Stratification was performed for age, gender, BMI, diabetes mellitus (yes/no), and fracture duration to assess their impact on satisfactory outcomes. Post-stratification, the chi-square test was applied, with a p-value ≤ 0.05 considered statistically significant.

RESULTS

Of the 81 participants, 75.31% were male and 24.69% were female, resulting in a male-to-female ratio of 3:1. The mean age of the participants was 38.83 ± 7.83 years. Most patients (81.48%) were between 25 and 45 years of age. The mean duration of injury was 7.32 ± 2.29 days, and the mean BMI was 27.93 ± 3.11 kg/m². Thirty-seven per cent of the participants had diabetes. **(Table I)**

Table I: Characteristics of the participants

Variable	N(%)
Age	
25-45 years	198 (81.48%)
46-65 years	45 (18.52%)
Mean ± SD	38.83 ± 7.83 years
Duration of Injury (Days)	
<7	120 (49.38%)
>7	123 (50.62%)
Mean ± SD	7.32 ± 2.29 days
BMI (kg/m^2)	
≤27	120 (49.38%)
>27	123 (50.62%)
Mean ± SD	27.93 ± 3.11 kg/m2
Diabetes	
Yes	90 (37.04%)
No	153 (62.96%)

Of the 81 patients, 76.54% achieved an excellent functional outcome, followed by Fair outcome at 11.11%, good outcome at 9.88% and poor outcome at 2.47%. **(Table II)**

Table II: Outcome of intramedullary interlocking nail in close Tibial diaphyseal fractures

Variable	N(%)
Outcome	
Excellent	186 (76.54%)
Good	24 (9.88%)
Fair	27 (11.11%)
Poor	06 (2.47%)

Stratification of excellent outcomes by age groups, gender, duration of injury, BMI, and diabetes mellitus status is presented in **Table III.** No statistically significant differences were observed across age groups (p = 0.726) or between sexes (p = 0.674), indicating that excellent outcomes were broadly comparable across all age groups and genders. Similarly, BMI (p = 0.468) and diabetes status (p =

0.601) did not significantly influence the achievement of excellent outcomes. However, a substantially higher proportion of patients with injury duration of less than 7 days achieved excellent outcomes compared with those with delayed presentation (56.45% vs. 26.32%, p = 0.022), suggesting that earlier surgical intervention may be associated with improved prognosis.

Table III: Stratification of Excellent Outcomes with Characteristics of Participants

Variable	Excellent Outcome		P-value
	Yes N(%)	No N(%)	
Age			
25-45 years	150 (80.65%)	48 (84.21%)	0.726
46-65 years	36 (19.35%)	09 (15.79%)	
Sex			
Male	141 (75.81%)	42 (73.68%)	0.674
Female	45 (24.19%)	15 (26.31%)	
Duration of Injury (Days)			
<7	105 (56.45%)	15 (26.32%)	0.022
>7	81 (43.55%)	42 (73.68%)	
BMI (kg/m^2)			
≤27	96 (51.61%)	24 (42.12%)	0.468
>27	90 (48.39%)	33 (57.89%)	
Diabetes			
Yes	66 (35.48%)	24 (42.12%)	0.601
No	120 (64.52%)	33 (57.89%)	

DISCUSSION

This study aimed to evaluate the early outcomes of intramedullary interlocking nailing in closed tibial diaphyseal fractures, with a focus on functional recovery stratified by demographic and clinical factors. Firstly, the demographic distribution of our study showed a male predominance (75.31%) with a male-to-female ratio of 3:1, consistent with previous reports indicating that tibial fractures are more common in males due to their higher involvement in outdoor activities and higher risk of high-energy trauma, such as motor vehicle accidents[13,14]. The mean age of our study population was 38.83±7.83 years, which aligns with prior studies suggesting that young and middle-aged adults are more frequently affected by tibial fractures[3].

This finding aligns with previously reported high success rates of intramedullary nailing (IMN) in comparable cohorts, both locally, as demonstrated by Khan I 2013[6], Al-Sharaa MB 2021[11] and Habib MK 2015[12], and internationally, as evidenced by Venkata Ranganath K et al.[7] in India, who reported favorable functional outcomes in 70% of patients, and Sagar BVS 2023[15] documented excellent outcomes with IMIL, reporting a mean modified Lysholm score of 95. Additionally, another study by Kushwaha MP 2022[8] reported excellent healing in 66.7% of cases, with complications observed in 17.7% of patients with tibial fractures treated with IMIL. A study by Bhandari PB 2021[9] reported excellent outcomes in 66.67% of cases in patients with tibial diaphyseal fractures treated with IMIL. Furthermore, a study by Kangbai DM 2024[10], conducted at an emergency trauma hospital, reported that 88.61% of patients with tibial fractures achieved successful treatment outcomes with IMIL. These outcomes reaffirm the technique's capacity to provide stable fixation while preserving soft tissue integrity, crucial for effective bone healing and functional recovery, as highlighted by Daolagupu AK 2017[16], who noted that the nailing group demonstrated better functional outcomes with an average American Orthopedic Foot and Ankle Society score of 96.67 and fewer complications, including implant irritation, ankle stiffness, and infections.

The outcome rate in our investigation was slightly higher than in other reported ones. This discrepancy may be due to differences in sample size, patient demographic variables, and postoperative rehabilitation protocols, among other factors[6,17]. The favorable and fair outcome rates in our series were 9.88% and 11.11% of cases, further demonstrating that while IMN is generally effective, other factors, such as late presentation, soft tissue injury, and patient comorbidities, may come into play. The occurrence of poor outcomes at 2.47% in a small subset of patients emphasizes the need for close postoperative monitoring and timely intervention to contain complications like infection and implant failure[18,19].

Compared with earlier literature, our findings support those of earlier studies, which demonstrated the superiority of IMN over other treatment modalities[20,21]. Additional publications, including systematic reviews and meta-analyses, have also emphasized the role of IMN in promoting early mobilization, shorter hospital stays, and lower rates of complications[22].

Moreover, the study highlights the impact of specific patient factors, including injury duration, on treatment outcomes, as evidenced by significantly better results in patients treated within seven days of injury (p=0.022), which aligns with recent literature. This finding highlights the importance of timely surgical intervention in optimizing fracture healing and promoting functional recovery. Delayed treatment can increase the risk of soft-tissue damage, infection, and impaired blood supply, all of which may negatively impact healing. Maintaining optimal physiological conditions through early intervention enhances the healing process and improves functional outcomes. To this end, clinical guidelines should emphasize time-sensitive treatment protocols to optimize patient care and encourage prompt surgical intervention in similar situations.

Notably, this study found no statistically significant associations between age, sex, BMI, or diabetic status and IMN outcomes, indicating that IMN is a versatile

and reliable treatment option across diverse demographics. However, patients with a BMI above 27 kg/m² or diabetes showed slightly lower rates of excellent outcomes, which aligns with previous literature suggesting these factors may modify fracture healing due to metabolic and systemic complications. These findings emphasize the importance of individualized perioperative care for patients with comorbidities to optimize treatment success outcomes[4].

Certain limitations must be acknowledged, as this is a descriptive observational study without randomization or a control group; therefore, the level of evidence is inherently lower than that of experimental designs. This limits the ability to draw causal inferences or directly compare IMN with other treatment modalities, underscoring the need for future prospective or randomized studies to validate and expand upon our findings. An inadequate follow-up duration of 3 months must have omitted those long-term complications that are crucial in assessing the durability of the IMN outcomes, such as delayed union, nonunion, or implant failure. The study was therefore confined to a single tertiary referral centre, which may limit the generalization of the findings to other healthcare settings with diverse resources and expertise. Thus, future multicenter studies with an extended follow-up period would provide a broader view of the long-term efficacy of IMN for tibial diaphyseal fractures. Although all diabetic patients in this study had controlled diabetes before and after surgery and were receiving standard management (the majority on oral agents and a few on insulin), we acknowledge that we did not record the exact duration of diabetes. Thus, it is a limitation, as diabetes control and duration may influence fracture healing. Future studies should address this in greater detail.

CONCLUSION

In conclusion, IMIL demonstrated excellent early outcomes in the management of closed tibial diaphyseal fractures in our study population, with favorable recovery parameters and low complication rates at 3 months postoperatively. While these findings support its role as a practical option for early postoperative recovery, longer-term studies are warranted to confirm the durability of these outcomes and establish its long-term efficacy.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Zarar M: Conceptualization, study design, data collection, writing/reviewing.
Farooq MA: Conceptualization, visualization, data collection, writing/reviewing and surgeries.
Khan KM: Conceptualization, visualization, data collection, writing/reviewing and surgeries.
Gul S: Visualization, writing/reviewing and editing.
Javed MI: Writing/reviewing and editing.
Ali P: Visualization, Data Collection, reviewing and editing.

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