

Outcome Analysis of Intramedullary Interlocking Nail in Tibial Diaphyseal Fractures: A Prospective Observational Study

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Abstract

Introduction: The preferred and universally accepted management modality for a tibia diaphyseal fracture is closed reduction and intramedullary interlocking nailing. The purpose of this study is to evaluate the functional and radiological outcome of intramedullary interlocking nails in individuals with diaphysis of tibia fracture.

Methods: A prospective observational study was carried out between September 2020 to February 2022. Thirty cases of the 33 patients with tibia diaphysis fractures who met the inclusion criteria were included in the study and were under regular follow-up. All patients had intramedullary interlocking nailing for diaphysis of tibia fracture, and routine follow-ups in the outpatient department to assess the outcome according to the modified Johner and Wruh criterion.

Results: Thirty cases were analyzed, and males (60%) were more frequently afflicted. More fractures were caused by road traffic accidents than by sports, falls from a height, or injuries sustained at home. A radiological union was observed at 12 to 16 weeks, while clinical union was observed at 10 to 14 weeks. Five individuals (16.7%) reported having mild anterior knee pain. Two patients with Gustilo II fracture experienced superficial infections. In 60% of the cases, there were excellent results, and in 33.3%, there were good results. Six percent of instances had a fair outcome.

Conclusion: Tibial IMIL nail can be employed with excellent and good results in closed, Gustilo I, and II tibial diaphyseal fractures. These enable early mobilization, quicker union, few problems, and an early resumption of activities done prior to the injury.

Keywords: Fracture union, intramedullary nailing, modified johner, tibial fractures and wruh criteria

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Introduction

The tibia diaphyseal fracture is a frequently occurring fracture often presenting to the hospital's emergency room.¹ These fractures can result from road traffic accidents, falls from heights, sports-related injuries, and even household trauma.² Fractures can be categorized as either closed or open. According to Gustilo and Anderson, open fractures are classified into three categories based on wound size, contamination level, and the extent of bone injury. Type I refers to an open fracture with a wound less than 1 cm long and relatively clean. Type II describes an open fracture with a laceration greater than 1 cm long, without extensive soft tissue damage, flaps, or avulsions. Type III involves more severe cases, such as open segmental fractures, open fractures with significant soft tissue damage, or traumatic amputations.³

These fractures are associated with high morbidities and

require prolonged rehabilitation to reach pre-injury activity levels.⁴ Treating a tibial fracture aims to minimize further soft-tissue damage while maintaining a secure fixation.⁵ Prolonged immobilization is necessary for the cast treatment of tibial fractures, and this is linked to decreased ankle motion.⁶ Stability is achieved with open reduction and internal fixation, frequently necessitating significant soft-tissue dissection and additional devascularization of the tibia underneath.⁵ Many of these problems can be resolved using less invasive submuscular and subcutaneous plate fixation procedures; reports have indicated consistent healing and a low incidence of soft-tissue injuries, especially for distal third shaft fractures.⁷ Most surgeons are already familiar with the fixation technique using intramedullary interlocking (IMIL) implants, either through the suprapatellar or infrapatellar approach.⁸ It prevents significant soft-tissue dissection, permits load sharing, and spares the extraosseous blood supply. It also allows early weight-bearing

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and early mobilization with control of rotation.⁹

This injury is one of the most commonly encountered and often confusing to deal with for an orthopedic surgeon because of the various treatment options available, the absence of conventional management guidelines, and the significant risk of soft tissue complications. The majority of the research on this topic is based on data from developed Western nations. We have been frequently managing these fractures with IMIL nails but no studies have been done to evaluate their outcome focusing on a developing nation, which might have altered the outcome. Our study aims to determine the functional and radiological outcome of IMIL nails in tibial diaphyseal fractures in our setup of a tertiary care center in the Western region of Nepal.

Methods

A single-center-based prospective observational study was conducted in a tertiary care center in the Western region of Nepal from September 2020 to February 2022, after obtaining ethical clearance from an Institutional Review Board. Verbal and written consent was taken from all patients included in the study.

Patients aged 18 years or above with closed or Gustilo type I and II tibial diaphyseal fractures presenting within one week of injury were included in the study. Fractures previously treated with external fixators, infected fractures, Gustilo type III fractures, fractures associated with polytrauma, and multiple trauma were excluded from the study. A total of 33 cases fulfilling the inclusion criteria were initially enrolled in the study; however, three patients were lost to follow-up for final outcome analysis. Hence, a total of 30 patients were analyzed for final outcome analysis.

All the patients fulfilling inclusion criteria were managed with closed reduction and internal fixation using an IMIL nail using a standard infrapatellar approach under spinal anesthesia. For post-operative rehabilitation, isometric quadriceps exercises and knee and ankle joints range of motion exercises were started on the second postoperative day. Weight-bearing as tolerated was started from the third postoperative day. Patients were followed up clinically and radiologically at regular intervals till clinical and radiological union and then at six months and nine months. Postoperative complications if any, were noted in each visit. Radiological evidence of bony union and signs of clinical union were noted during each follow-up. Radiographic assessment was done by using the Radiographic Union Score for Tibia (RUST).¹⁰ The RUST is based on callus formation and the visibility of fracture lines at four cortices observed on AP and lateral radiographs. Functional outcome was measured by Modified Johner and Wruh's criteria.¹¹

Data were entered in Microsoft Excel and statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, New York, United States).

Results

A total of 33 cases met our inclusion criteria within the study time frame. Among them, two were lost in follow-up and one patient succumbed to COVID-19. The final 30 cases were analyzed in our final study. Males (18, 60%) were more common than females. Most of the patients were young populations between the ages of 20 to 30 years. Road traffic accidents were

the most common cause (12, 40%) followed by falls from heights (9, 30%), sports activities (15%), household trauma (10%), and miscellaneous (5%). Closed tibia fractures (18, 60%) were more common than open fractures. 23.3% had Gustilo Anderson type I fractures and 16.7% had Gustilo II fractures as shown in table 1.

Table 1: Demographic details of patient

		(N), Percentage (%)
Gender	Male	(18), 60%
	Female	(12), 40%
Mechanism of Injury	Road traffic accident	(12), 40%
	Fall From Height	(9), 30%
	Sports activities	(4), 13.33%
	Household trauma	(3), 10%
	Miscellaneous injury	(2), 6.67%
Type of Fracture	Closed	(18), 60%
	Open GA Grade I	(7), 23.3%
	Open GA Grade II	(5), 16.7%

The range of hospital stay was 4-16 days with a mean duration of 8.2 days. Radiological union was seen in 12 to 16 weeks while clinical union was seen in 10 to 14 weeks as shown in table 2.

Table 2: Table showing number of patients having radiological and clinical union

	No. of patients showing radiological union	No. of patients showing clinical union
10 weeks	-	17
12 weeks	12	10
14 weeks	14	3
16 weeks	4	-
	Total=30	Total= 30

On evaluation of a complication, five patients (16.7%) complained of mild anterior knee pain. Two patients with Gustilo II fractures had a superficial infection that healed without sequelae. No cases of nonunion or neurovascular injury following surgery were recorded. One case had valgus angulation of 8 degrees while varus angulation of 5 degrees was seen in two patients. None of the cases had anteroposterior angulation. Shortening of about 1 cm was seen in one patient as shown in table 3.

Table 3: Table showing frequency of complications

Complications	Number of patients
Valgus angulation	1
Varus angulation	2
Shortening	1
Anterior knee pain	5
Superficial infection	2

On evaluating functional and radiological outcomes according to the modified Johner and Wruh criteria, excellent outcomes were seen in 60% of cases while good results were observed in 33.3%. Fair outcomes were observed in 6.7% of cases. As shown in table 4.

Table 4: Table showing final outcome as per modified Johner and Wruh criteria

	Grade	Percentage (%)
Modified Johner and Wruh criteria	Excellent	18, 60%
	Good	10, 33.3%
	Fair	2, 6.7%
	Poor	0%

Discussion

Tibial diaphyseal fractures are complex injuries with significant morbidity and potential complications. The results of this study reinforce the existing evidence that intramedullary nailing is a preferred method of treatment for these fractures due to its high rates of union and favorable functional outcomes. Our study demonstrated a high rate of excellent to good outcomes according to the modified Johner and Wruh criteria, similar to the findings reported by Johner and Wruh in their seminal work on the topic.¹¹

The radiological union in our study was observed between 12 to 16 weeks, which is consistent with the findings of several other studies.^{2,8} Similarly, clinical union observed between 10 to 14 weeks aligns with previous research indicating favorable healing times with intramedullary nailing.^{3,9}

The occurrence of anterior knee pain in 16.7% of our patients mirrors the findings of other studies which report anterior knee pain as a common complication post-nailing.^{4,7} However, the pain was mild and did not significantly affect the functional outcome, which is in agreement with the conclusions drawn by the existing literature.⁵

The low incidence of infections and malunions in our study correlates with the results of Sarmiento⁶ and Plumarom et al.¹⁰ Superficial infections were effectively managed with antibiotics, which is consistent with the management protocols suggested by these studies.

Our findings are also in line with a study by Taitsman et al. which identified risk factors for infection in high-energy tibial fractures treated with intramedullary nailing, emphasizing the importance of early intervention and meticulous surgical technique to minimize complications.¹²

Moreover, the role of early mobilization in improving outcomes has been well-documented. Davis and Weiss demonstrated that early weight-bearing and rehabilitation can significantly enhance recovery times and functional outcomes, which is consistent with our findings.¹³ Similarly, Bokyo et al. discussed the positive impact of mechanical stability provided by intramedullary nails on the biological processes of fracture healing.¹⁴

The socioeconomic context of our study population also plays a critical role in the outcomes observed. Peter et al. highlighted the challenges faced by patients in developing countries, including limited access to healthcare and rehabilitation services, which can affect recovery.¹⁵ Our study's setting in a developing country underscores the effectiveness of intramedullary nailing in resource-limited environments. A similar study conducted in southern Nepal consisting of 53 patients had findings similar to ours and had recommended for high union rate and low infection rate, recommended closed interlocking nailing as the best modality of treatment for diaphyseal tibial fractures.¹⁶

One of the strengths of our study is the comprehensive follow-up and consistent assessment using the modified Johner and Wruh criteria. This standardized evaluation method allows for a reliable comparison with other studies and adds robustness to our findings. However, the limitations include the relatively small sample size and single-center design, which may affect the generalizability of the results.

Future research should focus on larger multi-center trials to validate these findings and further explore the role of intramedullary nailing in various socioeconomic settings. Additionally, investigating the long-term functional outcomes and quality of life of patients treated with intramedullary nails would provide valuable insights into the overall effectiveness of this treatment modality.

Conclusion

Tibial IMIL nail can be employed with excellent and good results in closed, Gustilo I, and II tibial diaphyseal fractures. These enable early mobilization, quicker union, few problems, and an early resumption of activities done prior to the injury.

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