

# Functional Outcomes of Closed Tibial Shaft Fractures Treated with Suprapatellar Intramedullary Nailing – A Prospective Study

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## ABSTRACT

**Background:** Tibial shaft fractures are among the most common long bone fractures with high incidence in young adults. Intramedullary nailing is the gold standard of fixation, and the suprapatellar approach has gained popularity due to technical advantages. Evidence on functional outcomes in closed fractures is still lacking, however. **Objectives:** The aim of this study was to assess the functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing. **Methods & Materials:** This prospective observational study was conducted in the Department of Orthopaedics, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Sher-E-Bangla Nagar, Dhaka, Bangladesh, for one year period from March 2022 to March 2023. Total 33 adult patients with closed tibial shaft fractures were enrolled. **Results:** In this study, mean age was  $38.3 \pm 11.6$  years with male predominance (69.7%). Fractures of AO type 42A were most common (54.5%). The mean knee ROM at last follow-up was  $130.3 \pm 8.6^\circ$ . The majority of patients (72.7%) had fair functional outcomes, 18.2% good, and 9.1% poor. The average VAS was 0.5, and anterior knee pain was complained of by only 15.2%. Lysholm scores improved significantly from 83.1 at 6 months to 93.8 at 12 months ( $p < 0.001$ ). **Conclusion:** Suprapatellar nailing for closed tibial shaft fractures produces good functional outcomes, few complications, and gradual improvement, justifying its use as a safe and effective method of fixation.

**Keywords:** Functional Outcomes of Closed Tibial Shaft Fractures Treated with Suprapatellar Intramedullary Nailing.

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## INTRODUCTION

Fractures of the tibial shaft are among the most common long bone fractures encountered in orthopedic trauma surgery and represent a significant proportion of all fractures operated upon. They have been reported to occur with a frequency of 16.9 per 100,000 person-years in major epidemiological studies with a disproportionate representation among young, active men from mechanisms of injury that involve road traffic

accidents, sporting activities, and falls from height.<sup>[1,2]</sup> Registry-based studies within European populations also confirm that high-energy trauma remains the predominant cause, while socioeconomic cost is substantial, taking into consideration the working young population typically involved.<sup>[3,4]</sup> Not only do these fractures take extended periods to rehabilitate but are also highly likely for morbidity

in the long term, and therefore entail a considerable burden on quality of life and healthcare systems.

The clinical outcomes of tibial shaft fractures extend beyond the acute fracture incident, with malunion, nonunion, infection, and chronic postoperative pain considerably leading to disability and prolonged absence from work and activity. Long-term outcomes following intramedullary fixation tend to highlight anterior knee pain and functional limitation, particularly for kneeling or squatting activities that prevail in the majority of athletic and cultural populations.<sup>[5,6]</sup> Socioeconomically, the collective expense of extended recuperation, lost productivity, and frequent interventions is a huge justification that warrants maximized surgical techniques.

Conventionally, intramedullary nailing (IMN) has emerged as the gold standard for the management of diaphyseal tibial fractures with advantages of biological fixation, load-sharing, and least interference with periosteal blood supply.<sup>[7]</sup> The classic infrapatellar approach with flexion or hyperflexion of the knee has been the traditional method. However, it has been seen to be associated with technical challenges, including failure to achieve and maintain fracture reduction, requirement for multiple fluoroscopic control, and relatively high incidence of anterior knee pain as a result of iatrogenic injury to the patellar fat pad or tendon.<sup>[8,9]</sup>

Overcoming these limitations, the suprapatellar intramedullary nailing (SPN) method has come as a relatively newer development. Performed with a suprapatellar portal with the knee in a semi-extended position, the technique facilitates fracture reduction, particularly in distal and proximal third fractures, and has been shown to reduce operative difficulty by facilitating a more stable leg position during surgery. Moreover, SPN is associated with shorter intraoperative fluoroscopy time, better sagittal and coronal alignment control, and lower malalignment rates compared to the infrapatellar technique.<sup>[10-12]</sup> Recent randomized and observational studies also show excellent radiological and functional outcomes with the suprapatellar technique.<sup>[9]</sup>

Although such theoretical and practical advantages are present, functional outcomes of suprapatellar nailing are still a concern. Anterior knee pain remains a contentious complication with potentially cartilage damage to the patellofemoral joint and irritation of the quadriceps tendon as underlying mechanisms.<sup>[13,14]</sup> Moreover, while several studies have reported on radiographic alignment and union rates as primary outcomes, fewer have looked into long-term functional recovery in terms of pain, mobility, activity level, and quality of life.<sup>[15,16]</sup> The literature is especially sparse regarding prospective analyses confined to closed fractures of the tibial shaft, a large and clinically important subgroup.

This deficit of knowledge points to a need for future research with the functional outcomes as the primary endpoints, since radiographic healing is not equal to recovery as perceived by patients. Therefore, the present study was performed as a prospective evaluation of functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing.

## OBJECTIVES

To assess the functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing.

## METHODS & MATERIALS

This prospective observational study was conducted in the Department of Orthopaedics, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Sher-E-Bangla Nagar, Dhaka, Bangladesh, for one year period from March 2022 to March 2023. Total 33 adult patients aged between 18-60 years having closed tibial shaft fractures treated with surgical fixation using the suprapatellar interlocking intramedullary nailing (SPN) technique were enrolled in this study. Open fractures, pathological fractures, fractures within the proximal or distal 5 cm of the tibia, polytrauma, and history of ipsilateral knee injury or prior surgery were the exclusion criteria. After informed written permission, all the patients underwent extensive clinical and radiological evaluation, and baseline demographic and injury data were recorded.

The surgery was performed under general or spinal anesthesia with the patient in the supine position on a radiolucent table. The affected knee was placed in a semi-extended position with a radiolucent bolster. A 3-4 cm midline suprapatellar incision was done and a protective sleeve was placed under the patella to minimize intra-articular damage. Fracture reduction was achieved by using fluoroscopy and creating an adequate entry point in the canal of the tibia. Reaming was according to canal diameter, and a statically locked intramedullary interlocking nail was then placed and fixed proximally and distally with interlocking screws.

Patients were also followed up and examined postoperatively at 6 weeks, 3 months, 6 months, and 12 months. The Lysholm Knee Scoring Scale and Visual Analogue Scale (VAS) for anterior knee pain were used to assess functional outcome. Radiological union was assessed and noted complications of infection, implant failure, or malunion. Data analysis was done using SPSS version 26.0. Continuous variables were expressed as mean  $\pm$  SD, while categorical variables were given as frequency and percent. Inferential statistics were employed wherever required, and a p-value  $<0.05$  was taken as significant.

## RESULTS

Table I presents the baseline characteristics of the study patients. Among the 33 patients, the mean age was  $38.3 \pm 11.6$  years, with an age range of 21 to 60 years. The majority belonged to the 21-30 year age group (33.3%). There was a clear male predominance, with 23 males (69.7%) compared to 10 females (30.3%). According to the AO classification of fractures, type 42A fractures were most common (54.5%), followed by 42B (24.2%) and 42C (21.2%).

The distribution of patients by side involvement is further illustrated in Figure 1. Regarding the side of injury, the right tibia was involved in 20 patients (60.6%), whereas the left tibia was affected in 13 patients (39.4%).

Findings related to pain scores and complications are summarized in Table II. With respect to anterior knee pain

assessed by the Visual Analogue Scale (VAS), the majority of patients, 28 out of 33 (84.8%), reported no pain (VAS = 0), while 5 patients (15.2%) experienced pain ranging from 1 to 4. The mean VAS score was  $0.5 \pm 1.1$ . In terms of complications, 29 patients (87.9%) had no adverse outcomes. Among the remaining, 2 patients (6.1%) developed delayed union, 1 patient (3%) experienced nonunion, and 1 patient (3%) had a superficial surgical site infection.

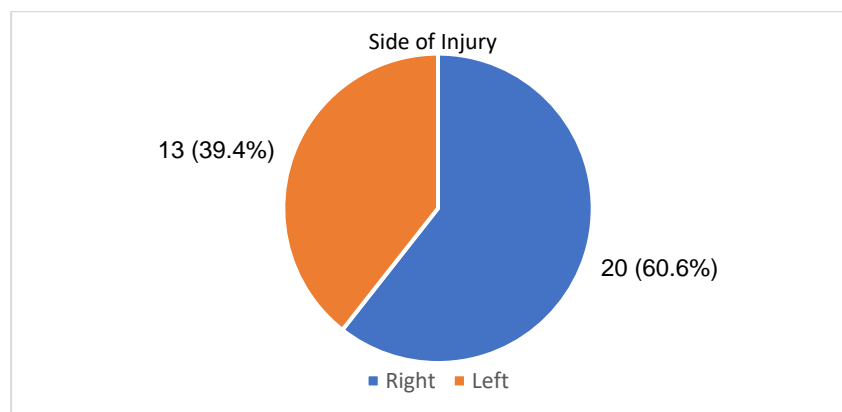
The assessment of functional outcomes at the final follow-up is detailed in Table III. The majority of patients (54.5%) achieved a knee range of motion (ROM) between 130–139°, while 18.2% each had ROM of either 120–129° or a full 140° arc. A smaller proportion, 9.1%, had a more restricted ROM of

110–119°. The mean knee ROM was  $130.3 \pm 8.6^\circ$ , ranging from 110° to 140°. Evaluation of final functional outcome categories showed that 24 patients (72.7%) had fair outcomes, 6 patients (18.2%) achieved good outcomes, and 3 patients (9.1%) were rated as poor.

Progressive improvement in functional recovery is highlighted in Table IV, which outlines the Lysholm Knee Scores at different follow-up intervals. At 6 months, the mean score was  $83.1 \pm 10.8$ , which increased significantly to  $93.8 \pm 8.9$  at 12 months. Statistical analysis using the paired t-test confirmed this improvement to be highly significant ( $p < 0.001$ ).

**Table – I: Baseline characteristics of the study subjects (n=33)**

Characteristics	Number of Patients	Percentage (%)
<b>Age group (in years)</b>		
21-30	11	33.3
31-40	8	24.2
41-50	7	21.2
51-60	7	21.2
Mean	38.3±11.6	
Range	21-60	
<b>Gender</b>		
Male	23	69.7
Female	10	30.3
<b>Type of fracture (AO)</b>		
42A	18	54.5
42B	8	24.2
42C	7	21.2



**Figure – 1: Distribution of the patients by side involvement (n=33)**

**Table – II: Distribution of pain score and complications among the study subjects (n=33)**

Parameters	Number of Patients	Percentage (%)
<b>Ant knee pain (according to VAS)</b>		
0	28	84.8
>0	5	15.2
Mean	0.5±1.1	
Range	0-4	
<b>Complications</b>		
No complication	29	87.9
Delayed union	2	6.1
Nonunion	1	3
Superficial surgical site infection	1	3

Table – III: Outcome variables at last follow up

Outcome variables	Number of Patients	Percentage (%)
<b>ROM of knee (Arc of flexion-extension) (in degree)</b>		
110-119	3	9.1
120-129	6	18.2
130-139	18	54.5
140	6	18.2
Mean	130.3±8.6	
Range	110-140	
<b>Final functional outcome</b>		
Fair	24	72.7
Good	6	18.2
Fair	3	9.1

Range of Motion= ROM

Table – IV: Lysholm knee score at different follow-up (n=33)

Lysholm score	Mean±SD	p value
6 months	83.1±10.8	<0.001
12 months	93.8±8.9	

P-value retrieved from Paired t test

## DISCUSSION

This current study was conducted to assess the functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing. In this prospective study, the demographic profile was that of young to middle-aged adults with an average age of 38.3 years, most of whom were male. This is in keeping with large epidemiological studies that have consistently shown that tibial shaft fractures most frequently happen in young, active males, often due to high-energy trauma such as road traffic accidents and falls.<sup>[1,2]</sup> Our finding that AO type 42A fractures were the most common subtype corroborates earlier prospective series, which also demonstrated simple fracture patterns to be most common in this age group.<sup>[18,19]</sup> Furthermore, the right side was more frequently affected, which also has been observed in earlier registry-based studies.<sup>[3]</sup>

Anterior knee pain following intramedullary nailing has been a long-standing controversial issue. In the present series, anterior knee pain of some degree was experienced by only 15.2% of the patients, with a mean VAS score of 0.5, which is much lower than the incidence described in earlier reports of infrapatellar nailing, where the incidence has ranged from 30% to 60%.<sup>[19]</sup> Ongoing anterior knee pain in a large proportion of patients after infrapatellar fixation was also described by Hussain and Khan<sup>[20]</sup>, with the suggestion that this complication can be avoided with the suprapatellar approach. Systematic reviews also demonstrate lower pain scores with suprapatellar nailing compared to infrapatellar techniques, likely due to decreased iatrogenic trauma to the patellar tendon and surrounding structures.<sup>[6]</sup>

The complication profile was good in this study, and 87.9% of patients were without any adverse events. Delayed union and nonunion were seen in 6.1% and 3% of the cases, respectively, and superficial surgical site infection in 3%. These rates are also similar to other series reported, where nonunion rates have varied between 3% and 10% and infection rates

between 2% and 5%.<sup>[21,22]</sup> The comparatively low rate of complications in our study could be explained by the standardized surgical technique and careful patient selection, as only closed fractures were included.

Functional outcomes at final follow-up in the current study revealed that the average knee ROM was 130.3°, with the majority of the patients experiencing an arc between 130° and 139°. Most of the patients (72.7%) were rated as fair, 18.2% had good outcomes, while 9.1% were rated as poor. These findings are consistent with those of Panda et al.<sup>[9]</sup>, who reported comparable knee ROM and functional scores following both suprapatellar and infrapatellar nailing, with suprapatellar patients mobilizing earlier. Zhu et al.<sup>[23]</sup> also found mean ROM of more than 125° in both groups, with superior ease of reduction and alignment in the suprapatellar group.

Significantly, our study documented progressively rising Lysholm scores from a mean of 83.1 at 6 months to 93.8 at 12 months, and the difference was statistically significant. The trend mirrors the observations of Serbest et al.<sup>[24]</sup>, who also noted persistent improvement in Lysholm scores at 6 and 12 months after suprapatellar nailing. Meta-analyses also support that functional outcomes keep improving between early and late follow-up, with suprapatellar techniques demonstrating slightly superior patient-reported scores than infrapatellar methods.<sup>[8,25]</sup> Long-term follow-up research highlights that these improvements are sustained beyond 12 months, and they emphasize the durability of functional recovery after suprapatellar nailing.<sup>[26]</sup>

Together, our findings add to the body of evidence that suprapatellar intramedullary nailing is a safe and effective treatment for closed tibial shaft fractures with low rates of complication and anterior knee pain and satisfactory functional outcomes.

# CONCLUSION

This current study demonstrates that suprapatellar intramedullary nailing is a safe and effective method for managing closed tibial shaft fractures, with low rates of anterior knee pain and complications. Patients achieved satisfactory knee motion and progressive improvement in functional outcomes, as reflected in significantly rising Lysholm scores over follow-up. These findings support the suprapatellar approach as a reliable technique that enhances functional recovery. Larger multicenter trials with longer follow-up are recommended to validate these results.

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