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Original Research Article **Orthopaedics Surgery**

Suprapatellar vs Infrapatellar Approaches for Intramedullary Nailing of Distal Tibial Fractures: A Prospective Observational Study

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Abstract

***Introduction*:** Intramedullary nailing is a commonly employed procedure for treating distal tibial fractures. The two primary approaches for this procedure include the suprapatellar and infrapatellar techniques. Despite their widespread use, there is ongoing debate about the relative merits and drawbacks of these two approaches. ***Aim of the Study*:** The aim of this study was to assess the comparison between suprapatellar and infrapatellar approaches for intramedullary nailing of distal tibial fractures. ***Methods*:** This cross-sectional study was conducted in Department of Orthopaedics Surgery, Brahmanbaria Medical College Hospital, Brahmanbaria, Bangladesh, during the period from December 2020 to December 2022. Total 120 patients with intramedullary nailing of distal tibial fractures were included in this study. All the patients were divided into two groups; Group A comprised of 60 patients treated by suprapatellar approach and Group B comprised of patients treated by infrapatellar approaches. ***Result*:** For age, the mean age in Group A is 42.3 years (SD± 9.8 years), and in Group B it is 44.7 years (SD±10.3 years). In terms of sex, male predominance was seen in both groups. Surgical characteristics like surgical time (68.5 vs 74.2 mins), blood loss (58.4 vs 63.7 ml), and fluoroscopy number (15.7 vs 18.9) were significantly less in Group A. Post-operatively, Group B reported more pain (VAS score: 27.1 vs 18.7), while Group A had better range of motion (18.3 vs 17.1) and knee functionality (Lysholm score: 84.6 vs 80.9). Group B showed better foot and ankle functionality (AOFAS score: 94.4 vs 91.3). Fracture healing time was similar (24.5 vs 24.7 months). Fewer patients in Group A experienced complications like fracture deformity, malalignment, and surgical site infections. ***Conclusion*:** The suprapatellar approach may be the preferred nailing technique for treating distal tibial fractures compared with infrapatellar approach.

Keywords: Suprapatellar, Infrapatellar, and Intramedullary Nailing of Distal Tibal Fractures.

I INTRODUCTION

Distal tibia fracture is a frequent clinical wound that typically occurs from high-energy accidents [1, 2]. The standard procedure for treating distal tibia fractures is open reduction and internal fixation with plates and screws [3-5]. However, the therapy of these fractures with plates has frequently led to problems such infections, slow or incomplete unions, and implant failures [6-8]. The management of these fractures has evolved significantly over time, with intramedullary nailing (IMN) emerging as the preferred method of fixation, particularly for unstable fractures [9]. The quadriceps muscle power that causes the proximal fracture fragments to shift when the knee is in flexion and the increased likelihood of valgus and procurvatum deformities after tibial nailing make IMN insertion through the infrapatellar (IP) route technically hard [10, 11]. In addition, persistent anterior postoperative knee discomfort is among the most common adverse effects following IMN implantation, with reported incidences ranging from 10 to 80% [12]. In order to address these problems, Tornetta *et al.*, [13] and Cole *et al.*, [14] adapted the semi-extended method for tibial IMN insertion to a suprapatellar (SP) approach employing a midline quadriceps tendon insertion site. The suprapatellar approach for IMN, first described by Tornetta and Collins [15] in 2002, involves the insertion of the nail through a portal in the suprapatellar pouch with the knee flexed at 30 degrees. This approach aligns the tibial and femoral anatomical axes, facilitating nail

insertion and potentially reducing malalignment rates [13, 15]. In contrast, the traditional infrapatellar approach is performed with the knee in a semi-extended position, which can create a lever-arm effect and potentially lead to malreduction [16]. The biggest issue with this method, however, is the risk of patellofemoral articulation injury, which might have an impact on anterior knee discomfort following intramedullary nail fixation and patellofemoral arthritis [17]. Its therapeutic applicability is constrained by the absence of trustworthy data on the prevalence of patellofemoral joint injury. Studies contrasting these two methods have produced conflicting findings. According to the results of a recent randomized controlled study (RCT), the suprapatellar technique to treating tibial shaft fractures was preferable to the infrapatellar approach in terms of functional knee outcomes [18]. Wang Z *et al.*, [15]. reported supra-patellar surgical approach may effectively reduce the incidence of postoperative knee pain, whereas other studies have found no significant differences between the two approaches in terms of alignment, functional outcomes, or complication rates [19, 20]. Moreover, some studies have raised concerns about potential risks associated with the suprapatellar approach, such as intra-articular nail placement or quadriceps tendon injury [19]. Furthermore, patient-related factors such as age, obesity, and comorbidities, as well as fracture characteristics, play a crucial role in the choice of surgical approach. The current study was conducted to compare the suprapatellar and infrapatellar approaches for intramedullary nailing of distal tibial fractures.

II OBJECTIVES

To assess the comparison between suprapatellar and infrapatellar approaches for intramedullary nailing of distal tibial fractures.

III METHODOLOGY & MATERIALS

This cross-sectional study was conducted in Department of Orthopaedics Surgery, Brahmanbaria Medical College Hospital, Brahmanbaria, Bangladesh, during the period from December 2020 to December 2022. Total 120 patients with intramedullary nailing of distal tibial fractures were included in this study. All the patients were divided into two groups; Group A comprised of 60 patients treated by suprapatellar approach and Group B comprised of patients treated by infrapatellar approaches. Consent of the patients and guardians were taken before collecting data. After collection of data, all data were checked and cleaned. After cleaning, the data were entered into computer and statistical analysis of the results being obtained by using windows-based computer software devised with Statistical Packages for Social Sciences version 22. After compilation, data were presented in the form of tables, figures and charts, as necessary. Numerical variables were expressed as mean and standard deviation, whereas categorical variables were count with percentage. Quantitative data among groups were analyzed by exploration of significant difference between all possible paired group means by Bonferroni test. P value of less than 0.05 was considered statistically significant.

IV RESULT

Table-I: Comparison of demographic characteristics among the study groups. For age, the mean age in Group A is 42.3 years (SD± 9.8 years), and in Group B it is 44.7 years (SD±10.3 years). The age range for both groups is between 18 and 65 years. In terms of sex, Group A consists of 32 males (53.3%) and 28 females (46.7%), while Group B has 31 males (51.7%) and 29 females (48.3%). For BMI, Group A has a mean BMI of 25.4 kg/m2 (SD±3.1), and Group B has a mean BMI of 25.7 kg/m2 (SD±3.5). In terms of the side of the body where the fracture is located, Group A has 36 cases (60%) on the right side and 24 cases (40%) on the left side. Group B has 34 cases (56.7%) on the right side and 26 cases (43.3%) on the left side. No demographic characteristics is statistically significant ($p>0.05$). Table-II: Comparison of surgical characteristics between the study groups. For surgical time, Group A has a mean duration of 68.5 minutes with a standard deviation of 10.4 minutes, while Group B has a mean duration of 74.2 minutes with a standard deviation of 11.4 minutes. The difference in surgical time between the two groups is statistically significant, as indicated by a p-value of 0.0050 and the "s" label (which stands for "significant"). Regarding blood loss, Group A has a mean blood loss of 58.4 ml with a standard deviation of 8.6 ml, while Group B has a mean blood loss of 63.7 ml with a standard deviation of 9.3 ml. The difference in blood loss between the two groups is also statistically significant, as indicated by a p-value of 0.0015. For the number of fluoroscopy images taken during surgery, Group A has a mean of 95.7 images with a standard deviation of 3.1, while Group B has a mean of 108.9 images with a standard deviation of 4.8. The difference in the number of fluoroscopy images between the two groups is statistically significant, with a p-value of less than 0.0001. Table-III: Comparison of post-operative characteristics between the study groups. The table presents data on seven post- operative characteristics: follow-up duration (in months), pain score (measured by Visual Analog Scale, or VAS), Hospital for Special Surgery (HSS) score, range of motion score, American Orthopedic Foot and Ankle Society (AOFAS) score, fracture healing time (in months), and Lysholm functional score. For follow-up duration, both groups have a mean of approximately 24 months, with no significant difference between the two groups (p-value = 0.7698). The VAS pain score is significantly higher in Group B, with a mean score of 27.1 compared to Group A's mean score of 18.7 (p-value < 0.0001). This indicates more pain reported in Group B. The HSS score, which measures knee functionality, shows no significant difference between the groups, with means of approximately 97 for both (p-value = 0.7068). The

range of motion score is significantly lower in Group B, with a mean of 17.1, compared to Group A's mean score of 18.3 (p-value = 0.0102). This suggests a better range of motion in Group A. The AOFAS score, which measures foot and ankle functionality, is significantly higher in Group B, with a mean score of 94.4, compared to Group A's mean score of 91.3 (p-value = 0.0007). This suggests better foot and ankle functionality in Group B. The fracture healing time shows no significant difference between the groups, with means of approximately 24.5 months for both (p-value = 0.5327). The Lysholm functional score, which assesses knee functionality, is significantly lower in Group B, with a mean of 80.9, compared to Group A's mean score of 84.6 (p-value=0.0033). This suggests better knee functionality in Group A. For fracture deformity, there is one case in Group A and seven cases in Group B. Figure 1: Complications after operation in the study groups. Malalignment is noted in two cases in Group A and ten cases in Group B. Fracture end hematoma is seen in one case in both Group A and Group B. Surgical site infection is present in two cases in Group A and no cases in Group B. Finally, 54 patients in Group A and 42 patients in Group B did not experience any of the listed complications.

Table I: Comparison of demographic characteristics among the study groups. (N=120)

Characteristics		Group A (n=60)		Group B (n=60)		P value
		No	%	No	%	
Age	Mean ± SD	42.3 ±9.8		44.7 ±10.3		0.1936^{ns}
	Range	18-65		18-65		
Sex	Male	32	53.3	31	51.7	0.8613^{ns}
	Female	28	46.7	29	48.3	
BMI, kg/m^2	Mean ± SD	25.4±3.1		25.7±3.5		0.6201^{ns}
Side	Right	36	60.0	34	56.7	0.7150^{ns}
	Left	24	40.0	26	43.3	

Group A= Patients treated by suprapatellar approach
Group B= Patients treated by infrapatellar approaches
Statistical analysis was done by unpaired Student t-test.
The test of significance was calculated and p values ≤ 0.05 was accepted as level of significance.
s = Significant
ns = Not significant
n = Number of subjects in each group
N = Total number of patients

Table II: Comparison of surgical characteristics between the study groups (N=120)

Characteristics	Group A (n=60)	Group B (n=60)	P-value
Surgical time (Minutes)	68.5±10.4	74.2±11.4	0.0050^{s}
Blood loss (ml)	58.4±8.6	63.7±9.3	0.0015^{s}
Fluoroscopy time	95.7±3.1	108.9±4.8	<0.0001^{s}

Group A= Patients treated by suprapatellar approach
Group B= Patients treated by infrapatellar approaches
Statistical analysis was done by unpaired Student t-test.
The test of significance was calculated and p values ≤ 0.05 was accepted as level of significance.
s = Significant
ns = Not significant
n = Number of subjects in each group
N = Total number of patients

Table III: Comparison of post-operative characteristics between the study groups (N=120)

Characteristics	Group A (n=60)	Group B (n=60)	P-value
Follow up (Months)	24.2±5.5	24.5±5.7	0.7698^{ns}
Pain score (VAS)	18.7±3.5	27.1±4.9	<0.0001^{s}
HSS score	96.9±4.1	97.2±4.6	0.7068^{ns}
Range of motion score	18.3±2.2	17.1±1.8	0.0102^{s}
AOFAS score	91.3±5.1	94.4±4.7	0.0007^{s}
Fracture healing time (Months)	24.5±1.7	24.7±1.8	0.5327^{ns}
Lysholm functional score	84.6±7.1	80.9±6.4	0.0033^{s}

Group A= Patients treated by suprapatellar approach
Group B= Patients treated by infrapatellar approaches
Statistical analysis was done by unpaired Student t-test.

The test of significance was calculated and p values ≤ 0.05 was accepted as level of significance.
s = Significant
ns = Not significant
n = Number of subjects in each group
N = Total number of patients
HSS= Hospital for Special Surgery score,
AOFAS= American Orthopedic Foot and Ankle Society score

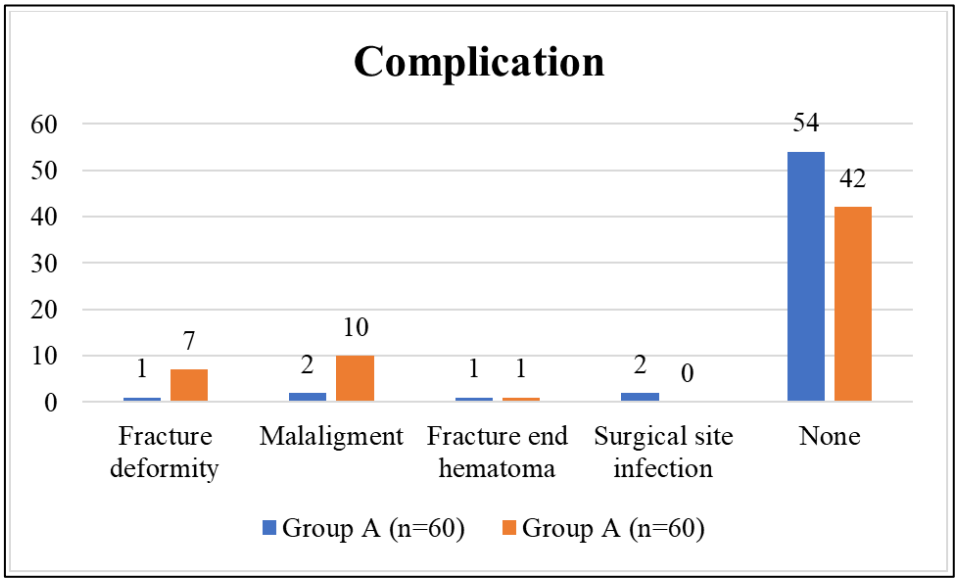

Figure 1: Complications after operation in the study groups (N=120)

V DISCUSSION

The present study was conducted to assess the comparison between suprapatellar and infrapatellar approaches for intramedullary nailing of distal tibial fractures. The comparison between the two groups is of particular importance as these approaches have been widely debated in recent orthopedic literature [21]. In terms of demographic characteristics, our study found no statistically significant differences between Group A (suprapatellar approach) and Group B (infrapatellar approach) ($p>0.05$). Similar findings have been reported in other studies, such as that by and Vallier HA *et al.*, [22] and Sahni G *et al.*, [23] which suggests that the outcomes observed in our study are not influenced by demographic factors. Our study showed that Group A had a significantly shorter surgical time ($p=0.0050$), less blood loss ($p=0.0015$), and less fluoroscopy time ($p<0.0001$) compared to Group B. These findings are in line with those of other studies, such as Sahni G *et al.*, [23] and Cui Y *et al.*, [24] that by who reported that the suprapatellar approach resulted in less operative time and blood loss compared to the infrapatellar approach. Our results support the idea that the suprapatellar approach may offer some advantages in terms of surgical characteristics. In the assessment of post-operative characteristics, our study found significant differences between the groups in pain scores, range of motion scores, AOFAS scores, and Lysholm functional scores. Group A reported less pain (VAS) ($p<0.0001$), better range of motion ($p=0.0102$), and better knee functionality (Lysholm score) ($p=0.0033$) than Group B. However, Group B showed better foot and ankle functionality (AOFAS score) ($p=0.0007$) than Group A. In the study of Cui Y *et al.*, [24], the findings of HSS score, pain score, and range of motion are in line with our study. Another study of Lu Y *et al.*, [25] also found that pain score, Lysholm score, and AOFAS score in suprapatellar approach were better compared to infrapatellar approaches. In the study of Llano L *et al.*, [26] pain score was significantly better in suprapatellar approach but there was no significant difference in Lysholm score among the groups. In contrast, some studies, such as that by Vallier HA *et al.*, [22], have reported no significant differences in functional outcomes between the two groups. This variation in findings may be due to differences in surgical techniques, patient populations, or study designs. Our study also compared complications between the groups, with Group A having fewer instances of fracture deformity and malalignment compared to Group B. These findings align with the results of other studies, such as that by Sun Q *et al.*, [27], which reported fewer complications associated with the suprapatellar approach. The study of Avilucea FR *et al.*, [28] found that the rate of malalignment was lower in suprapatellar approach. Another study of Gao F *et al.*, [29], also found that the rate of complication rate was lower in suprapatellar approach. This might suggest that the suprapatellar approach could provide better clinical outcomes in terms of complications.

In conclusion, our study provides evidence that the suprapatellar approach might offer some advantages over the infrapatellar approach in terms of surgical characteristics, post-operative outcomes, and complications.

Limitations of the Study

In our study, there was small sample size and absence of control for comparison. Study population was selected from one center in Brahmanbaria city, so may not represent wider population. The study was conducted at a short period of time.

VII CONCLUSION AND RECOMMENDATIONS

From the findings of this current study, it can be concluded that, for intramedullary nailing of distal tibia fractures, the suprapatellar approach showed advantages over the infrapatellar approach in less surgical time, range of motion score, AOFAS score, Lysholm functional score, and lower malalignment rate. The suprapatellar approach may be the preferred nailing technique for treating distal tibial fractures compared with infrapatellar approach. Further study with larger sample size is required to have better understanding.

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