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Suprapatellar versus Infrapatellar Nailing for Tibial Shaft Fractures: a Comparison of Outcomes between Two Approaches

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Abstract

Introduction with Objective: *Tibial shaft fractures are the most prevalent type of tibia fracture. Intramedullary nailing is the standard procedure for surgical treatment of displaced tibial shaft fractures. Tibial nail insertion with suprapatellar approach with the knee in semi extended position which has advantage over infrapatellar approach. The aim of this study is to compare the surgical and clinical outcome of suprapatellar and infrapatellar approach for the tibial intramedullary nailing in patient with tibial shaft fractures.* ***Methods:*** *This Prospective Study was carried out among 48 patients attending at the department of Orthopedics Surgery at Chittagong Medical College Hospital; Chittagong for the treatment tibial fracture within the defined period from May 2022 to April 2023. Total 4 patients were dropped out in the middle of follow up. So follow up was done among 44 patients. All the data were compiled and sorted properly and the quantitative data was analyzed statistically by using Statistical Package for Social Science.* ***Results:*** *Twenty two patients in each group completed the study per protocol and included in the analysis. Both groups are comparable in terms of their age, fracture type and fracture location (P>0.05) .The average time of union was 3.52±0.898 months and 3.36±0.790 months respectively in suprapatellar and infrapatellar approach group (P=0.535). The average duration of operation was 90.04±8.035 and 76.46±9.060 minutes respectively in suprapatellar and infrapatellar approach group (P<0.001). Mean ± SD fsluroscopy time in suprapatellar approach was 115.58 ± 8.387 seconds and in infrapatellar approach was 105.38±9.102 (P<0.001). There was no significant difference among the two groups of nailing according P Value regarding complication like malalignment. Average ROM in suprapatellar approach group was 130.91±1.5 and in infrapatellar approach group was 125.38±1.88 (P<0.001). Suprapatellar approach shows significantly better outcome by mean Lysholm Knee score in comparison to infrapatellar approach according (P Value). The proportion of patients achieved excellent functional outcome was 18(81.8%) and 17(77.3%) in suprapatellar and infrapatellar approach group (P=0.892).* ***Conclusion:*** ***It*** *can be concluded that suprapatellar approach produced better functional outcome than infrapatellar approach in the treatment of tibial shaft fracture when considering mean lysholm knee score, range of motion and rate of malalignment in this present clinical trial.*

Keywords: *Tibial fracture, Suprapatellar approach, infrapatellar approach.*

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Introduction:

Tibial shaft fracture is the most common fracture encountered in orthopaedic practice. The treatment of choice for operative fixation is the insertion of an intramedullary nail (IMN) with interlocking

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screws[1]. IMN has long been the standard procedure for surgical treatment of tibial shaft fracture, allowing for minimally invasive, dynamic fracture fixation and preservation of the extraosseous blood supply by adhering to the concept of biological osteosynthesis and it has the advantages of early mobilization, high union rates, and few wound complications[2,3]. The traditional infrapatellar approach for tibial IMN is a popular surgical procedure. It involves placing the knee in either flexion or hyperflexion and inserting the nail through either a patellar tendon-splitting or patellar tendon-sparing technique. However, quadriceps muscle force often causes proximal fracture fragments displacement with the knee in flexion, resulting in valgus and procurvatum[4,5]. Besides, chronic anterior postoperative knee pain is one of the most frequent complications after IMN insertion, the incidence was reported varying from 10 to 80% and may hamper the functional recovery after tibia IMN[6]. To address the disadvantages of infrapatellar nailing, a suprapatellar technique with the knee in semi-extended position was developed. A semi extended approach for tibial IMN insertion was first described by Tornetta et al., (1996)[7], and later modified to a suprapatellar (SP) approach using a midline quadriceps tendon insertion site by Cole in 2006[8]. This new approach suggests that valgus and procurvatum malalignment can be more easily avoided when the knee is maintained in extension and allows for easier anteroposterior and lateral imaging of the tibia. This approach facilitates fracture reduction, simplifies radiographic imaging, and overcomes the problems of hyperflexion with subsequent malalignment of the fragments[9]. However, the main concern of this approach is the potential for damage to the patellofemoral articulation with a concurrent effect on anterior knee pain after intramedullary nail fixation & patellofemoral arthritis[10].

Materials & Methods:

This Prospective Study was carried out among 48 patients attending at the department of Orthopaedic Surgery at Chittagong Medical College Hospital; Chittagong for the treatment tibial fracture within the defined period from May 2022 to April 2023. Ethical clearance was obtained from the Institutional Review Board (IRB) of CMCH. Purposive sampling was done according to availability of the patients. The collected data were entered into the computer and analyzed by using SPSS (version 20.1) to compare the surgical and clinical outcome of suprapatellar and infrapatellar approach for the tibial intramedullary nailing in patient with tibial shaft fractures. Total 4 patients were dropped out in the middle of follow up. So follow up was done among 44 patients. Functional assessment was done according to Lysholm knee score. Prognosis was described as time taken for radiological union, range of motion and having any malalignment etc. The overall clinical outcomes were categorized according to Lysholm knee score as excellent, satisfactory and poor.

Results:

Table I shows that, the mean age was 35.38 ± 8.747 years in suprapatellar approach group and 38.58 ± 7.541 years in infrapatellar approach group with P value of 0.180 (statistically non-significant).

Table I: Age distribution of the patients (n=48)

Age (years)	Suprapatellar approach	Infrapatellar approach	P value
Mean ± SD	35.38 ± 8.747	38.58 ± 7.541	0.180ns
Range	20-50	28-53	

Statistical analysis was done by student t-test

P value > 0.05 indicates non-significant

ns= non-significant

Table II shows that, Mean ± SD duration of operation in suprapatellar approach was 90.04 ±8.035 minutes and in infrapatellar approach was 76.46 ±9.060 minutes. Mean ± SD fluoroscopy time in suprapatellar approach was 115.58 ±8.387 seconds and in infrapatellar approach was 105.38 ±9.102 seconds. According to P value (<0.001), duration of operation and fluoroscopy time shows statistically highly significant difference between the study groups. Mean ± SD radiological union time in suprapatellar approach was 3.52 ±0.898 month and in infrapatellar approach was 3.36 ±0.790 month (p=0.535).

Table II: Distribution of the patients according to duration of operation, fluoroscopy time and radiological union time with approach of IMN (n=44)

Parameters	Suprapatellar approach	Infrapatellar approach	P value
Duration of operation (minutes)			
Mean ± SD	90.04 ±8.035	76.46 ±9.060	<0.001hs
Range	80-110	60-95	
Fluoroscopy time (seconds)			
Mean ± SD	115.58 ±8.387	105.38 ±9.102	<0.001hs
Range	102-134	90-125	
Radiological union time (month)			
Mean ± SD	3.52 ±0.898	3.36 ±0.790	0.535ns
Range	3-5	3-5	

Statistical analysis was done by student t-test

P value > 0.05 indicates non-significant and < 0.001 indicates highly significant

ns= non-significant ; hs= highly significant

Table III shows, in suprapatellar approach group, 2 (9.1%) patients had suffered with post-operative complication like malalignment and in infrapatellar approach group, 3 patients (13.6%). There was no significant difference in complications among the two groups of nailing according to p value (0.637ns).

Table III: Distribution of the patients according to malalignment with IMN approach (n=44)

Post operative Complication	Suprapatellar approach (n=22)	Infrapatellar approach (n=22)	P value
Malalignment	2 (9.1%)	3 (13.6%)	0.637ns

ns= non-significant

Above table IV shows that, Mean ±SD ROM in suprapatellar

approach group was significantly better than infrapatellar approach group at every follow up according to P value (p<0.001) except after 1 month.

Table IV: Range of motion (ROM) of the patients after 1 month, 3 months, 5 months and 6 months (n=44)

Range of motion ROM (o)	Suprapatellar approach	Infrapatellar approach	P value
After 1 month			
Mean ± SD	110.14 ±3.563	109.86 ±1.670	0.747ns
Range	105-115	107-112	
After 3 months			
Mean ± SD	125.27 ±1.856	116.05 ±2.035	<0.001hs
Range	123-128	113-119	
After 5 months			
Mean ± SD	128.00 ±1.647	120.18 ±1.504	<0.001hs
Range	125-130	118-122	
After 6 months			
Mean ± SD	130.91 ±1.509	125.32 ±1.887	<0.001hs
Range	129-133	123-128	

Table III shows that, average mean ± SD duration of operation was 83.25 ±10.903 minutes (range: 60-110 minutes). Average mean ± SD fluoroscopy time was 110.48 ±10.078 seconds (range: 90-134 seconds). Average mean ± SD radiological union time was 3.44 ±0.841 months (range: 3-5 month) **(Table III)**.

Table III: Distribution of the patients according to duration of operation, fluoroscopy time and radiological union time with approach of intramedullary nailing (n=44)

Lysholm knee score	Suprapatellar approach	Infrapatellar approach	P value
1 month			
Mean ± SD	58.23 ±2.266	56.86 ±2.077	0.044s
Range	56-62	55-61	
3 months			
Mean ± SD	68.64 ±3.430	65.36 ±3.799	0.005s
Range	64-73	60-70	
5 months			
Mean ± SD	79.95 ±6.012	75.05 ±3.184	0.002hs
Range	70-86	70-79	
6 months			
Mean ± SD	89.50 ±5.414	83.77 ±4.058	<0.001hs
Range	75-95	72-87	

Statistical analysis was done by student t-test

P value <0.05 and <0.005 indicates significant and highly significant

s= significant; hs= highly significant

Periodic follow up after 6 months were shown in above table VI. Functional outcome shows that mostly similar result was found in both the study groups. No significant statistical difference was noted according to outcome categories among the groups (p>0.05).

Table VI: Distribution of the patients according to functional outcome after

6 months with IMN approach (n=44)

Functional outcome	Suprapatellar approach	Infrapatellar approach	P value
Poor	2 (9.1%)	2 (9.1%)	0.892ns
Satisfactory	2 (9.1%)	3 (13.6%)	
Excellent	18 (81.8%)	17 (77.3%)	

Statistical analysis was done by Chi-square test

P value > 0.05 indicates non-significant

ns= non-significant

Discussion:

The present study was conducted to compare the functional outcome of suprapatellar and infrapatellar approach for the tibial intramedullary nailing in patient with tibial shaft fractures. Regarding Lysholm knee score, there was significant difference in mean (±SD) Lysholm knee score of the patients between the two study groups at every follow up. Suprapatellar approach shows significantly better outcome in comparison to infrapatellar approach according to P value in present clinical trial. Similar result was found in the study conducted by Sahni et al. (2023), Al-Azzawi et al. (2021) and Lu et al. (2020)[11,12,13]. Functional outcome was subdivided in 03 categories- excellent, satisfactory and poor. In this study, among 44 patients at final follow up after 6 months, 35 (79.05%) patient's functional outcome was excellent and 5 (11.4%) patient's functional outcome was satisfactory. In suprapatellar approach group, 18 (81.8%) patient's functional outcome was excellent and 2 (9.1%) patient's functional outcome was satisfactory and 2 (9.1%) patient's functional outcome was poor. In infrapatellar approach group, 17 (77.3%) patient's functional outcome was excellent and 3 (13.6%) patient's functional outcome was satisfactory and 2 (9.1%) patient's functional outcome was poor. According to P value, functional outcome was better in suprapatellar approach group, but statistically non-significant (p=0.892). Periodic follow up after 1 month, 3 months, 5 months and 6 months for function outcome shows that mostly similar result was found in both the study groups. No significant statistical difference was noted according to outcome categories among the groups (p>0.05). These findings are compared with some studies (Cui et al., 2019; Ringenberg et al., 2022) as they recommend that based on the clinical outcomes of suprapatellar and infrapatellar tibial IMN insertion, the SP and IP approaches can get similar knee functional outcomes in the treatment of tibial shaft fracture[14,15]. In present study, average mean ± SD duration of operation was 83.25 ±10.903 minutes (range: 60-110 minutes). Mean ± SD duration of operation in suprapatellar approach was 90.04 ±8.035 minutes and in infrapatellar approach was 76.46 ±9.060 minutes. These result correspondents to Al-Azzawi et al. (2021) study[12]. Present study shows, average mean ± SD fluoroscopy time was 110.48 ±10.078 seconds (range: 90-134 seconds). Mean ± SD fluoroscopy time in suprapatellar approach was 115.58 ±8.387 seconds and in infrapatellar approach was 105.38 ±9.102 seconds. Fluoroscopy time shows statistically highly significant difference between the study groups (p<0.001). Similarly, Sahni et al. (2023) narrated, the average fluoroscopy time in group A was 94.25±8.66 seconds and in group B was129.40±6.58 seconds

(p-value=0.001)[11]. Average mean ± SD radiological union time was 3.44 ±0.841 months (range: 3-5 months). Mean ± SD radiological union time in suprapatellar approach was 3.52 ±0.898 month and in infrapatellar approach was 3.36 ±0.790 month (p=0.535). Sahni et al. (2023) revealed, average fracture healing time in group A was 90.50±3.32 days and in group B was 90.30± 4.61 days (p-value=0.876)[11]. In suprapatellar approach group, 2 (8.3%) patients had suffered with post-operative complication like malalignment and in infrapatellar approach group, 3 (12.5%). There was no significant difference in complications among the two groups of nailing according to p value (0.637). But a recent study carried by Lu et al. (2020) revealed, the rate of deformity healing was lower in the SP group (3.7% [1/27]) than in the IP group (25% [9/36]) (p= 0.034)[13].

Conclusion:

Based on the clinical results of the suprapatellar and infrapatellar tibial intramedullary nail insertions of this present clinical trial, the results showed that suprapatellar approach produced better functional outcome than the infrapatellar approach in terms of mean Lysholm knee score, range of motion and rate of malalignment. It can be concluded that suprapatellar nailing can be a safe and effective alternative with many advantage for patient.

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