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Comparative study on functional and clinical outcomes of distal shaft of tibia fractures treated with suprapatellar and infrapatellar nailing

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Abstract
Introduction: Suprapatellar (SP)-nailing versus infrapatellar (IP)-nailing for distal shaft tibia fractures and post-operative complications like anterior knee pain and sequelae such as malalignment, retropatellar chondropathy and infection, as well as physical functioning and quality of life were the primary objectives of this study.
Methods: Department of Orthopaedics is conducting a study on this topic. Group A (16 cases) underwent Supra Patellar Nail Fixation, while Group B (14 cases) underwent Infra Patellar Nail Fixation in 30 patients with Distal Shaft of Tibia Fractures.
Results: Analyses of the 30 patient study were performed. Anterior knee pain occurred in 25% of patients after SPN and in 35% of patients after IPN, with a 5% malalignment rate following SPN and a 25% malalignment rate following IPN. Complications such as infection and retro patellar chondropathy were not significantly different between the two groups, and neither was physical functionality or postoperative quality of life.
Conclusions: Patients who underwent SPN (group A) had much lower malalignment rates than those who underwent IPN (group B), according to this study. In terms of infection rates, physical functioning, or overall health, this study found no significant difference. The surgeon's expertise should play a major role in determining the best course of action.

Keywords: Tibial shaft fractures, interlocking intramedullary nailing, suprapatellar approach, IKDC

Introduction
Distal tibia fractures, whether or not they have articular involvement, are difficult to treat. The goal of orthopaedic surgery is to restore normal bone structure, repair an epi-metaphyseal block, and prevent complications [1]. These fractures can be treated by open reduction and internal fixation (ORIF), external fixation with or without restricted internal fixation, intramedullary nailing, and, most recently, minimally invasive plate osteosynthesis (MIPO). There is no universal agreement on the best technique to treat these fractures, and each treatment has advantages and disadvantages. Despite advancements in surgical treatments, outcomes are not always favourable, and problems affect a significant portion of the population. Suprapatellar (SP) nailing of the distal shaft of tibia fractures is becoming more popular as an alternative surgical approach as tibia fractures become more common in orthopaedic trauma [2]. According to preliminary study, anterior knee discomfort can be reduced by up to 71 percent when compared to the standard Infrapatellar (IP) approach. The SP-approach may result in iatrogenic knee injury and an increased risk of infection since the nail is injected into the knee superior to the proximal patellar pole and goes through the articular surface. Although the SP-method for tibial intramedullary nailing (IMN) may be preferable, this is still a matter of debate [3]. Anterior knee soreness, precise alignment management, physical functioning, and overall quality of life (QoL) have all been regarded as positive early findings since its introduction [4]. Other trials, however, reported no change in anterior knee discomfort or functional outcomes when compared to IP nailing.

Department of Orthopaedics conducted a study in There is a lack of data on theoretical concerns about retropatellar chondropathy and infection rates following the SP versus IP treatment [5]. Our objectives were (1) Does the SP technique provide less anterior knee pain than the IP strategy? (2) Does the SP versus IP-approach influence the complication rates (retropatellar chondropathy, infection, malalignment, nonunion, and subsequent surgeries).

Materials and Methods

This study included thirty distal tibial shaft fractures that required intramedullary nailing. Multiple traumas, previous tibial surgery, and pathology such as metastatic sickness were among the conditions that were ruled out. Patients were assigned to Group A or Group B by a coin flip as the sole means of randomization, and all patients gave their consent to surgery and follow-up. 16 patients had SPN intramedullary nailing over the 12-month research period, and these cases were compared to our most recently completed IPN intramedullary tibial nailing cases (14 patients). On a designated day, consultants or senior trainees completed all tasks. A consultant was in charge of the trauma list. At the time of induction, all patients were given antibiotic prophylaxis. Patients were placed on a radiolucent operating table for the infrapatellar approach, whereas the suprapatellar technique used a foam wedge in a semi-extended leg stance. A 3 cm incision was made on the medial side of the patellar tendon, and the patellar tendon was retracted to the lateral side to reach the anterior tibia at the junction of the anterior cortex and articular surface for the standard IP approach group. The knee was next bent to roughly 130 degrees with the C-arm to acquire the desired nailing entry point, which was defined as medial to the lateral tibial spine on the anteroposterior view and anterior to the articular edge on the lateral view. A 3 cm incision was made approximately 2 cm proximal to the superior pole of the patella for the SP approach group, after which the quadriceps tendon and articular capsule were split lengthwise and a specialised insertion cannula within a protective sleeve was placed at the desired entry point through the trochlear groove under the patellar. The IP technique was used to define the entry point, which was guided by C-arm. Following that, IMN was inserted using the specific insertion cannula in accordance with protocol. The following stages are conventional IMN implantation surgical methods. Both techniques recorded their intraoperative time separately, including initial positioning and fracture reduction. Intraoperative and/or immediate post-operative radiographs were used to evaluate the nail entrance point in both groups. Both the anteroposterior and lateral views were used to examine the measurements. A blinded observer assessed the nail entry point for both groups and compared it to the optimum entry point photographs, with measurements kept and checked by a second observer.

'Throughout the experiment, a P-value of 0.005 was judged statistically significant using the Shapiro Wilk test for sample characteristics. Shortly after surgery, patients were called and asked to complete a knee trauma-specific outcome score (Lysholm score and IKDC). At one-month and six-month intervals, these ratings were utilised to assess functional results.

Results

A total of 30 patients with Distal Shaft of Tibia fractures were operated through Suprapatellar Nailing (SPN) and Infrapatellar Nailing (IPN) technique. The study is between November 2020 to November 2021. Among 30 patients, left leg was injured in 16 patients and right leg was injured in 14 patients. 28.3 years was the mean age of the patients ranging from 15 to 40 years (Figure 1). RTA was the most common mode of injury in our study accounting for 19 patients (Figure 2). There were 15 males and 15 females in our study. (Figure 3).

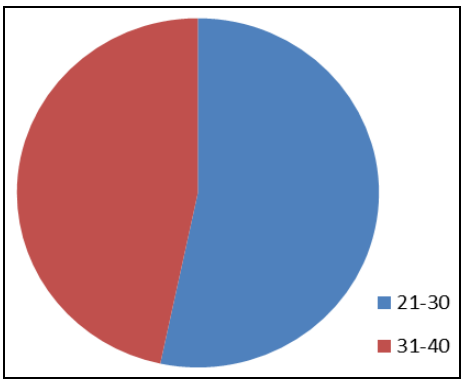

Fig 1: Age Distribution

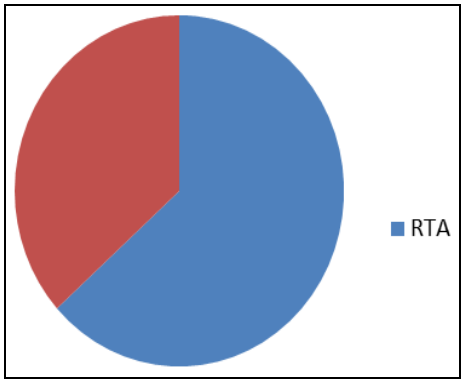

Fig 2: Mode of Injury

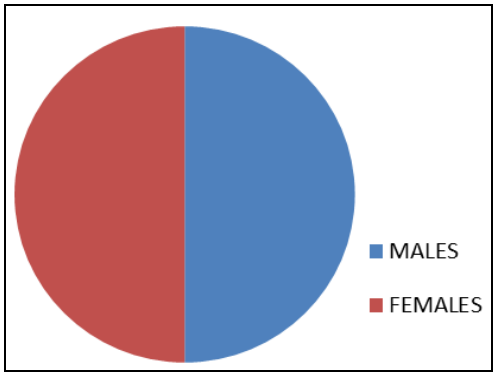

Fig 3: Gender Distribution

Group A (16 patients) underwent surgery through SPN technique and Group B (14 patients) underwent surgery through IPN. Average surgery duration for Group A (SPN) was 93.2 minutes and 106.7 minutes for Group B (IPN). Average blood loss during SPN was 91.5mL and 100.7 mL for IPN. Average hospital stay was 6 days for SPN and 7 days for IPN. Average time for clinical union of fracture was 13 weeks for SPN and 14 weeks for IPN. Average knee ROM attained post-operatively was 115 degree for SPN and 112 degree for IPN. Average IKDC Score 1 month post-op for SPN was 82.6 and was 75.6 for IPN. Average LYSHOLM score for SPN was 77.8 and 70.3 for IPN [Table1]. All patients came back to pre-injury level after 15 weeks with no gait abnormalities. The weighted incidence of anterior knee pain was 30% (9 patients) after SP-nailing and 35% (10patients) after IP-nailing, without reported significance. There was a significant lower rate of malalignment after the SP-approach (4% vs. 20%) with small absolute differences in all planes. There were no other complications such as loss of reduction, screw prominence or screw back out in our study. None of our patients were lost in follow up.

Table 1: Patient data and demographics

S. No	Age	Sex	Side	Mode of injury	Surgery	Surgical time (minutes)	Blood loss (ml)	IKDC (1month Post-Op)	IKDC (6 Months Post-Op)	LYSHOLM (1 Month Post Op)	LYSHOLM (6 Months Post OP)
1	40	M	L	RTA	SPN	95	80	78	82	78	81
2	23	F	L	SI	SPN	96	90	82	84	76	78
3	21	M	R	RTA	IPN	92	110	76	80	70	74
4	29	M	L	RTA	SPN	95	90	84	88	78	81
5	19	M	R	SI	IPN	110	95	80	82	70	74
6	39	F	R	RTA	SPN	100	85	86	88	80	82
7	24	M	L	SI	IPN	115	105	74	78	68	72
8	28	F	R	RTA	SPN	90	100	76	78	70	72
9	36	F	L	RTA	SPN	85	95	86	88	80	82
10	19	M	L	SI	IPN	105	90	76	80	72	76
11	32	F	L	RTA	IPN	110	95	74	76	70	74
12	27	F	R	SI	SPN	90	100	78	80	74	76
13	35	M	R	RTA	IPN	110	110	72	76	68	72
14	21	F	L	SI	SPN	90	90	86	88	82	84
15	31	M	L	RTA	IPN	108	110	76	78	72	76
16	28	M	R	RTA	SPN	97	85	84	86	78	82
17	36	F	R	RTA	IPN	105	100	76	82	70	76
18	40	M	L	RTA	SPN	95	90	84	86	80	82
19	24	F	R	SI	IPN	110	95	82	84	76	80
20	33	M	R	RTA	SPN	85	80	86	88	80	84
21	39	F	R	RTA	SPN	100	85	86	88	80	82
22	24	M	L	SI	IPN	115	105	74	78	68	74
23	28	F	R	RTA	IPN	90	100	76	80	70	76
24	36	F	L	RTA	SPN	85	95	86	88	80	84
25	22	M	L	SI	IPN	105	90	76	80	72	76
26	32	F	L	RTA	IPN	110	95	74	78	70	78
27	27	F	R	SI	SPN	90	100	78	82	74	80
28	35	M	R	RTA	IPN	110	110	72	76	68	74
29	21	F	L	SI	SPN	90	90	86	88	82	86
30	31	M	L	RTA	SPN	108	110	76	80	72	76

SI- Sports Injuries, RTA-Road Traffic Accident, SPN-Supra Patellar Nailing, IPN-Infra Patellar Nailing

Discussion

Using an SP technique rather than an IP technique for IMN of tibial fractures may result in less anterior knee pain. Infection and iatrogenic articular cartilage damage are two possible side effects of the SP technique. This analysis has no limitations in terms of study design, and it provides a complete overview of recent research on a wide variety of outcome metrics when tibia fractures are treated with SP or IP-nailing [6]. This study found no significant reduction in the incidence of anterior knee discomfort using the SP versus IP method (25 percent vs. 35 percent) [7]. Only the rate of malalignment was significantly different in terms of complications, with modest absolute differences favouring the SP-approach (5 percent vs. 25%) in the coronal and sagittal planes [8]. There were no significant differences in risk variables for retropatellar chondropathy, infection, nonunion, or further surgeries. Physical functioning and quality of life were similar in both groups. On average, 25 percent of SP-nailed patients reported anterior knee pain, compared to 35 percent of IP-nailed patients. Despite the fact that IP-nailing had a higher risk of anterior knee pain, no significant differences in results were discovered in trials comparing SP to IP-nailing. Prior to SP-nailing, the incidence of anterior knee pain ranged from 0% to 38%, while after IP-nailing, it ranged from 14% to 46%. There are a multitude of explanations for anterior knee soreness, which could explain the wide range of symptoms. This condition could be caused by iatrogenic injury to the IP nerve, Hoffa's fat pad, periosteal irritation of the entrance point, patellar tendinopathy, or nail prominence. Following nail removal, knee pain can continue up to 60% of the time. The IP-approach is still employed for implant removal after first SP-nailing, which is noteworthy. In order to better comprehend the sensation of pain, greater research into the underlying aetiology of anterior knee discomfort is needed. There is a potential of iatrogenic harm to intra-articular tissues and cartilage as the nail goes through the knee joint. The results of cadaveric research have been contradictory. Only Sanders and Chan reported clinical assessments of retropatellar chondropathy after SP-nailing, with an average follow-up of 16 and 19 months, respectively [9, 10]. According to per-operative arthroscopy and MRI, the SP-nail insertion cannula in the patellofemoral joint did not produce any cartilage damage, gouges, or pressure changes. However, long-term data that could help us better understand this clinical issue is lacking. Infection rates were similar in both the SP and IP techniques, with no obvious differences (12

percent vs. 9 percent) [11]. The majority of infections occurred after SP or IP nailing on open fractures, indicating that open fractures are more essential than nailing technique for infection. The probability of developing knee sepsis following SP-nailing of open fractures was substantially lower than with IP-nailing [12]. SP-nailing does not appear to minimise the rate of malalignment. In the current review, discrepancies in sagittal and coronal plane malalignment favour the SP method [13]. Avilucea, *et al*., who studied distal tibia fractures, found that using SP-nailing could help. While SP-nailing was utilised to treat all fractures in the study by Fu *et al*., there was no comparison to IP-nailing. However, it's worth mentioning that the differences were so minor that they were clinically unimportant. Alignment was measured with radiographs, but CT scans are better at detecting malalignment. No research in this review showed evidence of rotational malalignment using CT measurements [14]. Low-dose CT data on rotational misalignment after a tibial fracture after SP-nailing may be beneficial in the ongoing discussion on SP or IP-nailing, as reported rates of up to 35% after IP-approach after low-dose CT based data on rotational misalignment after a tibial fracture after SP-nailing. Finally, in terms of nonunion, extra surgeries, and impaired range of motion, there is no significant difference in difficulties between the SP-approach and the normal IP-approach, according to this study. There is no definitive proof have that the SP technique is superior to the IP strategy in terms of physical health and well-being. MacDonald *et al* discovered a significant difference between SP and IP-nailing after a year, with an extraordinary SP-group score and a decent IP-group score (93 vs. 84). This study looks at a variety of outcomes, including pain, complications, physical functionality, and overall quality of life (QoL). The second advantage is that the search parameters were not restricted by the type of study (e.g., cohort study, RCT), thus the results cover all relevant outcomes published in the last decade in one place. As a final point, this study gives a clinically question-driven summary of tibial fracture nailing' [15]. Because no heterogeneity was introduced, the findings in this study can be considered validated and statistically credible.

Conclusion

Both the SP and IP approach can be used to treat distal shaft of tibia fractures. This study found no significant reduction in the incidence of anterior knee discomfort using the SP versus IP method (25 percent vs. 35 percent). The SP-approach was found to have lesser risk of malalignment prevalence (5 percent) as compared to IPN (25 percent), with minor variances in the coronal and sagittal planes. There were no significant differences in risk variables for retropatellar chondropathy, infection, nonunion, or further surgeries. Physical functioning and quality of life were similar in both groups. In the end, the surgeon's experience should be the deciding factor.

Conflict of Interest

Not available

Financial Support

Not available

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