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Comparison of Medial Parapatellar Tendon Approach versus Trans-Patellar Tendon Approach of IMIL Nail for Diaphyseal Tibial Fractures

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ABSTRACT

Background: One of the common problems that occur following the tibial fractures fixation with an intramedullary interlocking nail (IMIL) is anterior knee pain. **Objective:** The goal of the work was to determine the effect of IMIL nailing of the anterior knee pain in the postoperative period, which was done using the medial parapatellar tendon technique against the trans patellar tendon technique. **Study Design:** Cross-sectional study. **Settings:** DHQ Teaching Hospital, Sahiwal, Pakistan. **Duration:** July to October 2025. **Methods:** A controlled, randomized trial was conducted over four months at DHQ Teaching Hospital, Sahiwal. Sixty patients who met the inclusion criteria for diaphyseal tibial fractures were randomized into two groups of 30 each. Group A Patients underwent IMIL nailing, while Group B patients received a trans-patellar tendon approach. Postoperative assessment of anterior knee pain was performed using the Visual Analog Scale (VAS) at 2, 6, and 12 weeks. **Results:** Out of 60 patients, 48 were male and 12 were female. Right tibia involvement was slightly more frequent than left-sided fractures. Road traffic accidents were the primary cause of injury. At the 12-week follow-up, the average VAS score for anterior knee pain in Group A was 2.6 ± 0.58 , while in Group B it was 4.3 ± 0.61 . **Conclusion:** This study demonstrates that the medial parapatellar tendon approach for IMIL nailing results in significantly less postoperative anterior knee pain compared to the trans patellar tendon approach.

Keywords: Intramedullary interlocking nailing, Trans patellar tendon approach, Medial parapatellar tendon approach, Anterior knee pain, Tibial shaft fractures.

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INTRODUCTION

The tibia is the primary bone that supports weight in the leg. Three types of forces generally contribute to its trauma: high-energy, low-energy, and rotational. Tibial fractures account for nearly 2 percent of all adult fractures. The mechanism of injury among older patients is falls, whereas among younger patients it is motor vehicle collisions. Tibial fractures from high-velocity injuries are frequently associated with other injuries.¹ Tibia fractures are a common orthopedic injury. Males have a higher frequency of sustaining tibial shaft fractures, and they present with such fractures commonly between 10 and 20 years of age, whereas women present most commonly between 30 and 40 years of age.² Pediatric tibial shaft fractures are mostly managed non-operatively with casting, but sometimes, in cases of severe deformity, external fixation, K-wire fixation, and flexible intramedullary nailing are also done. Deformity and growth arrest are important complications.³ Tibial fractures can be accompanied by

significant soft tissue injury and comminution. Internal fixation and open reduction with a plate are famous because they allow anatomical reduction of the fracture but are associated with wound infection and varus and axial instability. To reduce the risk of additional soft-tissue damage, intramedullary nailing is preferred. Several approaches for nailing are available, and these include the lateral parapatellar approach, the trans-patellar approach, the medial parapatellar approach, and even the supra-patellar approach. Each method has its own pros and cons.⁴

Anterior knee pain frequently occurs as a complication associated with the use of tibial nails. Its overall incidence following tibial nail fixation is 10-86%, and the exact etiology is unknown. A study conducted at Ghurki Trust Teaching Hospital, Lahore, compared the medial parapatellar and trans-patellar tendon approaches for intramedullary interlocking (IMIL) nailing in diaphyseal tibial fractures. The study assessed postoperative anterior knee pain using the Visual Analogue Scale (VAS). It was found that patients in the trans-patellar

tendon group had a significantly higher mean VAS score of 3.9 ± 1.1 , compared to 2.1 ± 0.9 in the medial parapatellar group at 6-month follow-up ($p < 0.001$). This indicates that the trans-patellar approach was associated with significantly greater anterior knee pain.^{5,6} Currently, there is limited data, and a clear superiority of one approach over another cannot be clearly stated. The suprapatellar approach has shown superior results in terms of anterior knee pain. However, the knee function score is the same for both suprapatellar and infrapatellar techniques. Various surgical approaches are used for tibial intramedullary nailing, among which the medial parapatellar tendon and trans-patellar tendon approaches are commonly employed. Previous studies have shown conflicting results regarding their superiority. Several studies report that the trans-patellar tendon approach is associated with a higher incidence of postoperative anterior knee pain, possibly due to tendon trauma or scar formation. Previous studies reported significantly higher mean VAS pain scores (3.9 ± 1.1) in the trans-patellar group vs. (2.1 ± 0.9) in the medial parapatellar group ($p < 0.001$).⁷ Anterior knee pain in 47% of trans-patellar patients versus 29% in those where the tendon was not split.⁸ Given the variability in reported outcomes, particularly regarding pain, this study is designed to provide local evidence comparing the two approaches in terms of anterior knee pain, and identifying a better surgical approach may help in minimizing morbidity and optimizing recovery in patients undergoing tibial nailing for diaphyseal fractures. The rationale of the study was to compare the anterior knee pain of patients with diaphyseal tibial fractures treated with the medial parapatellar tendon approach IMIL nail vs the trans-patellar tendon approach IMIL nail.

METHODS

This trial was conducted after approval from the IRB vide letter No. 341, dated 16-01-2025, in the Orthopedic Surgery Department at DHQ Teaching Hospital, Sahiwal, over a period of six months following approval of the synopsis. The sample size of 60 patients was calculated using the World Health Organization (WHO) sample size calculator, based on a previous study, taking a mean difference of anterior knee pain (VAS 2.1 ± 0.9 vs. 3.9 ± 1.1) at a 95% confidence level and 80% power⁴. A total of 60 patients who met the inclusion criteria were enrolled in the study. Patients of either sex, aged more than 18 years, who presented with diaphyseal tibial fractures indicated for intramedullary interlocking nailing including Gustilo Anderson type I, II and IIIA fractures, were enrolled, while patients younger than 18 years and above 75 years of age, patients with hemophilia, thrombocytopenia, cardiac arrhythmias, neurovascular compromise, previous surgery around the knee, any other bony or soft tissue pathology, history of drug abuse, mental disability or those not willing to give consent were omitted from the trial. All patients received comprehensive education regarding the study's procedures and objectives, and written informed consent was duly obtained. The participants were assigned to two groups through a random allocation method, with Group A comprising individuals who underwent surgery via the medial parapatellar tendon approach, and Group B including those operated on with the trans patellar tendon approach. Each patient underwent a routine blood profile assessment and had anteroposterior and lateral radiographs of the legs taken. A normal preoperative

examination and anesthesia clearance were received after the hospitalization. All of the operations were done by qualified orthopedic surgeons with the standard operating procedures. The two groups were put under a standard post-operative physiotherapy protocol.

Patients were questioned on the severity of discomfort during follow-up appointments. They were asked directly about the existence of knee pain and, in case they said that such, prompted to specify its localization. The pain in the front part of the knee was classified as the anterior knee pain only, and the pain related to the location of the fracture or the screw head was not considered. They advised that the patients should rate their pain on the visual analogue scale (VAS), which is a 10-point scale with 0 implying no pain and 10 indicating the worst pain that they can experience. The pool of measurement of anterior knee pain at 2, 6, and 12 weeks after surgery was done in both groups. Secondary outcomes, including the length of operation and postoperative complications, were also taken.

The data gathered underwent data entry and analysis with the help of SPSS version 22. Mean was used to describe age, whereas the frequency and percentages were used to describe categorical variables such as gender and the presence of anterior knee pain. The two groups were compared through an independent sample t-test in the continuous variables and a chi-square test in the categorical variables. The age, gender, BMI, and type of fracture were used to stratify the data in order to consider effect modifiers. A p-value of less than 0.05 was considered significant.

RESULTS

A total of forty-four patients who fulfilled the inclusion criteria were enrolled in the study and randomly divided into two equal groups through a lottery method. Group A consisted of 30 patients who received intramedullary interlocking nailing via the medial parapatellar tendon approach, while Group B also included 30 patients who underwent surgery through the trans-patellar tendon approach. In Group A, there were 26 male patients (86.66%) and 4 female patients (13.33%), whereas Group B had 25 male patients (83.33%) and 5 female patients (16.66%). The mean age of patients in Group A was 32.14 ± 10.22 years, while the mean age in Group B was 29.86 ± 9.74 years. There was no statistically significant difference in age between the two groups ($p = 0.112$) (Table 1).

In terms of laterality, 31 patients (51.66%) presented with right tibial fractures, 23 patients (38.33%) had left tibial fractures, while 6 patients (10.00%) had bilateral tibial involvement. With respect to the mechanism of injury, the majority of cases were due to road traffic accidents, accounting for 48 patients (80.00%), followed by falls in 8 patients (13.33%) and other causes in 4 patients (6.67%) (Table 2).

The Visual Analogue Scale (VAS) was used to measure anterior knee pain after 12 weeks of surgery. Group A had an average anterior knee pain of 2.60 ± 0.58 , and Group B had the same of 4.50 ± 0.61 . The variance in the two groups was statistically significant ($p < 0.001$). The results in Table 3 suggest that patients who underwent surgery through the medial parapatellar tendon method had significantly less anterior knee pain than the

patients who underwent surgery through the trans-patellar tendon method.

Table 1: Analysis of patient age demographics

Groups	n	Age (mean)	SD	p-value
Group A	30	32.14	10.22	0.112
Group B	30	29.86	9.74	0.112

Table 2: Pattern and frequency of injury modes

Mode of Injury	Number of cases	Percentage (%)
Road Traffic Accident (n, %)	48	80.00
Fall (n, %)	8	13.33
Others (n, %)	4	6.67
Total (n, %)	60	100

Table 3: Rate of anterior knee pain

Groups	Number	Mean Value	SD	p-value
A Group	30	2.60	0.58	<0.001
B Group	30	4.50	0.61	<0.001

DISCUSSION

Since its inception in 1992, intramedullary interlocking nailing has established itself as the preferred method for treating tibial diaphyseal fractures, owing to advancements in surgical techniques and implant technology. Although these issues have been mitigated, anterior knee pain remains the most prevalent postoperative complaint associated with tibial nailing. Reported incidences range from 30% to 70% across various series, all of which have implicated the surgical method as a contributing factor factor.⁹

The more traditional patellar (trans-patellar) tendon approach involves the division of the patellar tendon and can directly lead to the trauma of the tendon, retro-patellar fat pad, or infrapatellar nerve branches. These methods are more innervated, and the tendon is not split but rather retracted; therefore, the tissue is theorized to be injured less and to cause less postoperative pain in the patient in the medial parapatellar group.¹⁰ Contrarily, patients in the medial parapatellar group indicated a lower anterior knee pain score than those in the trans-patellar group, and this result is seen in our sample.¹¹

Most of the fractures in our series were due to road traffic accidents, which was consistent with the international literature on tibial shaft fractures.¹² Male pre-eminence was also found in our series as a result of increased exposure of young men to high-energy trauma and exposure activities. The age distribution is also in accordance with the published epidemiological information, with the majority of patients being in the third and fourth decades of life.¹³

Several researchers have investigated causes of anterior knee pain beyond those related to the surgical procedure approach. The author indicated that syndrome persistence corresponds to nail prominence over the tibia plateau, which suggested that

injury to intra-articular tissue, such as cartilage and menisci, could occur during nail insertion, and this might cause the symptoms.¹⁴ Toivanen⁹ highlighted the importance of the protruding proximal locking screws and of entry-site irritation. These multifactorial processes imply that anterior knee pain cannot be attributed to a single cause, yet a surgical approach remains a significant modifiable factor.¹⁵

One significant constraint of our research is the brief follow-up period and the emphasis on pain as the main outcome. Nail prominence, intra-articular damage, and long-term functional outcome are other factors that were not evaluated. It is proposed that additional research involving large sample sizes, extended follow-up periods, and radiological assessments is necessary to better understand the nature of anterior knee pain experienced after tibial procedures involving nailing.

CONCLUSION

The study shows that the medial parapatellar tendon technique results in significantly lower anterior knee pain than the trans patellar tendon technique. The difference is further evident when other possible sources of anterior knee pain, like salient nail ends and unintended injury to intra-articular structures, are eliminated. As a result, the medial parapatellar method may be considered as a more preferable option of intramedullary tibial nailing to aid in reducing the occurrence of postoperative anterior knee pain.

LIMITATIONS

The study had a relatively small sample size and short follow-up duration. Radiological assessment and functional outcome scores were not included, which limits the generalizability of the findings.

SUGGESTIONS / RECOMMENDATIONS

Future studies should include larger samples, longer follow-ups, and additional functional outcome measures to confirm the superiority of the medial parapatellar approach.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

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