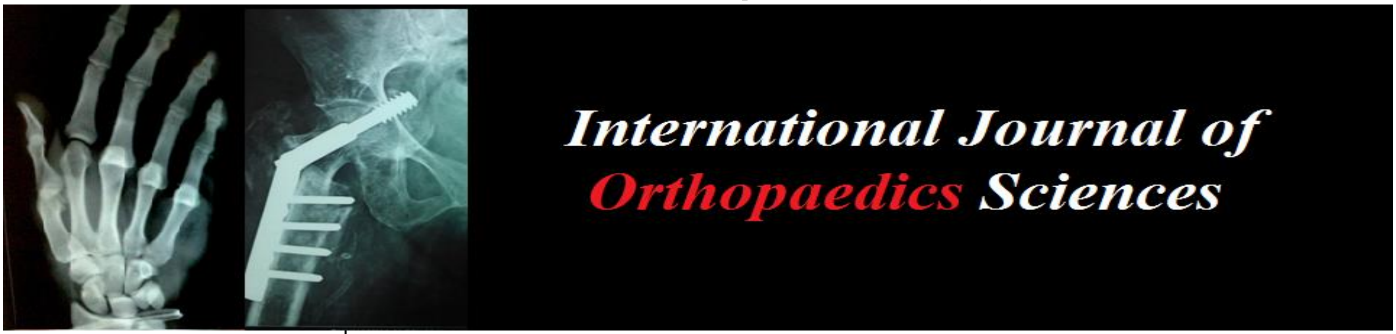

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A comparative analysis of the infrapatellar and suprapatellar approaches for intramedullary nail fixation in tibia fractures

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Abstract
Objective: Intramedullary nailing is a commonly used method for fixing tibia fractures due to its benefits. However, it can lead to complications such as malalignment and knee pain. The traditional infrapatellar approach is associated with higher malalignment rates, while a suprapatellar approach has shown lower rates. Knee pain, particularly at the site of nail insertion, is a common issue reported by patients. Different approaches have been compared, but no significant difference has been found in terms of chronic knee pain. To assess clinical, radiographic, and functional outcomes after intramedullary nail (IMN) fixation of tibia fractures with an infrapatellar approach compared to a suprapatellar approach.
Methods: Retrospective study: Level 1 trauma centre. Patients with 30 tibia fractures were treated with intramedullary nailing between 2022 and 2023. A retrospective chart review of tibia fractures was conducted. The clinical and functional outcomes of tibia fractures treated with IMN were compared between groups treated with an infrapatellar approach versus a suprapatellar approach. Multivariate models were created to control for confounding demographic, comorbidity, and injury-related confounders.
Results: Outcome measures included non-union, malunion, and infection. Subjective functional patient outcomes were assessed using pain interference (Pi) and physical function (PF) Patient-Reported Outcome Measurements Systems scores (PROMIS). There were 14 patients treated with infrapatellar nailing (46%) and 16 patients treated with suprapatellar nailing (54%). On multivariate analysis, suprapatellar nailing was independently associated with decreased risk of malunion and decreased risk of postoperative knee pain. There was no difference in the rate of non-union infection or Patient Reported Outcome Measurements Systems pain interference or physical function scores.
Conclusion: Suprapatellar IMN fixation of tibial shaft fractures is independently associated with a lower risk of malunion and postoperative knee pain compared to the infrapatellar approach. However, there are no functional differences between approaches.

Keywords: Tibia, suprapatellar, non-union, malunion, promise.

Introduction

Despite the implementation of operative fixation, the successful healing of tibia fractures remains challenging due to complications such as infection, malunion, and non-union [1, 2]. To address these challenges, intramedullary nailing has gained popularity as a preferred method of fixation for tibia fractures, offering benefits like soft tissue preservation, early definitive fixation, and weight-bearing capacity [3]. However, there have been reports of high malunion rates associated with intramedullary nail (IMN) fixation using the traditional infrapatellar approach, particularly in distal tibia fractures, with reported malalignment rates as high as 23% [4-5]. The exact cause of malalignment related to the infrapatellar approach remains somewhat unclear. Factors that may contribute include the knee being in a hyper-flexed position during nail insertion and intraoperative imaging, difficulties in maintaining a reduction in proximal and distal fractures while in a flexed position, and suboptimal nail fit in metaphysical regions [6]. Some studies have reported a significantly lower incidence of malalignment when utilizing a suprapatellar approach.

While traditionally used for proximal tibia fractures, the suprapatellar approach has also shown benefits in distal fractures by eliminating the need for hyper flexion and constant manipulation of the leg during positioning required for infrapatellar nailing [7, 8]. This allows the extremity to remain stable in the semi-extended position throughout the entire fixation process.

Additionally, knee pain is a common complaint following intramedullary nailing of tibia fractures, particularly anterior knee pain at the site of nail insertion. This represents the most frequently reported complication by patients. Previous studies have compared different approaches, such as trans patellar tendon and paratendinous approaches, for intramedullary nailing of tibia fractures, but no significant differences have been found in terms of chronic anterior knee pain between these approaches [9, 10]. Moreover, studies evaluating the incidence of subjective postoperative knee pain at the time of radiographic union after different approaches have reported no significant differences in pain levels based on the approach used. Currently, there is limited literature providing a comprehensive comparison of radiographic union, complications, and patient-reported outcomes between the infrapatellar and suprapatellar approaches for IMN fixation of tibia fractures. The objective of this study is to review all tibia fractures treated with intramedullary fixation and compare clinical and radiographic outcomes, including malunion, non-union, infection rates, and patient-reported outcomes, between the infrapatellar and suprapatellar approaches. Based on the semi-extended position used in the suprapatellar approach, it is hypothesized that this approach will result in lower rates of malunion and subsequent non-union, with no significant difference in the rate of infection [11-13]. Additionally, it is expected that patient-reported outcomes will be more favourable regarding knee pain with the suprapatellar approach, while no difference in function is anticipated.

Methods and Materials

This is a prospective study of 30 patients with fracture of the tibia shaft fractures who presented to our hospital between May 2022-May 2023. This study was approved by the ethical committee of our institution. All patients with fractures of the tibia shaft willing for surgery and follow-up were included in our study while patients with the proximal tibia, compound injuries, pathological fracture, previous injury/surgery to ankle or leg and patients with localised or systemic infection were excluded. At the time of admission, all patients were subjected to a thorough clinical and radiological evaluation. The limb was immobilized with a above-knee pop slab and the neurovascular status of the limb was evaluated and the findings were documented in the case records. Any associated fractures were also evaluated and documented. The patients were randomly allocated into two groups while group 1 consisted of the suprapatellar approach and group 2 infrapatellar approach.

Standard anteroposterior and lateral radiographs of the tibia were taken and the fracture type and pattern were noted. The fractures were classified according to the AD classification into 3 types where type A was simple spiral, transverse and oblique fractures, type B included spiral, bending and Fragmented fractures while type C Included complex fractures of the tibia shaft. Routine blood investigations were done and the patients were evaluated for fitness for surgery. Any associated comorbid conditions were noted and documented in the case records. After obtaining informed and written consent for surgery, the patients were taken up for the procedure. The surgery was performed under spinal anaesthesia Injection cefazolin 1 gm was given intravenously at the time of induction of anaesthesia and was continued for a minimum of 3 days in the postoperative period. In group 1, patients with a suprapatellar approach was used in all cases. The patients were placed in the supine position on a radiolucent table and the injured leg is positioned with a roll under the knee joint so that it is Flexed 20-30 degrees. The C-arm is placed on the opposite side and if the table allows split leg. A 1.5cm to 2 cm incision longitudinal skin incision is made 1 cm above the base of the patella.

The quadriceps tendon is exposed by blunt dissection and a longitudinal midline split is performed in the tendon. The Ideal entry point seen on AP view is located 9 mm in the lateral direction from the centre of the tibial plateau and slightly lateral to the tibial tubercle. On the lateral view, the entry point is anterior to the anterior articular tibial medullary canal, the guide wire must be directed towards the central position in both planes.

When the correct position of the guide wire is verified by radiographic imaging in both anteroposterior and lateral views, the protection sleeve is inserted (Figure 8). With a blunt trocar, the sleeve can be carefully rolled over the guide wire and in under the patella to the top of the tibia. It is important to ensure under fluoroscopy that the sleeve "sits" on top of the tibia to prevent iatrogenic damage to the knee joint. In some systems, it is possible to fix the sleeve with additional Kirschner wires to the tibia plateau (Figure 9), which is an advantage because without fixation the sleeve can be easily pulled upwards during reaming. If the sleeve is not fixed, it is important that its location is regularly checked during the reaming process. Through the sleeve over the guide wire, the medullary canal is now opened to a depth of 4-6 cm in the proximal tibia with a short reamer. If the guide wire is not centred in the canal or the reaming is too far down, there is a risk of penetrating the posterior cortex. Next, the ball-tip guide can be inserted into the medullary canal and advanced past the fracture level and down to the distal tibia. Verify by radiographic imaging in both planes that the wire is within the medullary canal. In meta-diaphyseal fractures, it is important to centre the wire in the distal fragment in both the anteroposterior and lateral views.

Now the length of the nail is determined (or after the reaming process) using the proper measuring guide. Be careful not to overestimate the length. It is much easier to mount a longer end cap than to remove a nail protruding into the knee joint. If guide systems are used for placement of the distal locking screws, it is then necessary for the probe that the nail is first locked distally, and in cases in which the fracture can be compressed further, there is a risk that the nail will migrate into the knee joint. Before reaming, the fracture is reduced in the usual manner. A percutaneous reduction clamp might be useful in reducing oblique fractures to an anatomic or near-anatomic position during the reaming process. Positioning with the legs stretched makes it much simpler to reposition and fix until the nail is inserted. It is essential that the reaming is performed through the protection sleeve, and it is recommended that the correct position of the sleeve is checked radiographically several times during the process to avoid intraarticular damage. Be aware that, depending on the length of the tibia, there will typically be a need to use a reamer at the suprapatellar entry that is longer than the infrapatellar entry. The reaming then takes place as usual to a diameter that is 1 mm to 1.5 mm larger than the diameter of the nail. Depending on the manufacturer of the nail, it will now often be necessary to remove the inner part of the sleeve protector before the nail is inserted. Ordinarily, it should be possible, if necessary, before inserting the nail to place blocking screws in both planes, which can reposition and improve the stability of the fracture. The nail is locked proximally through the system's targeting device and distally by freehand technique a proper end cap is inserted and under fluoroscopy, it is then ensured in both planes that the nail does not protrude into the knee joint. With a finger in the knee joint, an additional digital check is made that the nail cannot be felt, and simultaneously the cartilage on the patella and the femur can be checked for damage. The knee joint is flushed with saline to ensure that debris and blood is removed from the joint Infra patellar approach flex knee over radiolucent triangle and mark out inferior pole of patella, borders of patellar tendon, joint line, tibial tubercle make incision from inferior pole of patella distally 2.5cm towards tibial tubercle along medial 1/3 of patellar tendon spread down to dissect Parthenon, identify medial edge of patellar tendon and incise retract patellar tendon laterally and spread down to guidewire starting point insert self-retaining retractor such as a Gelpi to maintain access Guidewire Insertion guide pin start point just medial to the lateral tibial spine on the AP radiograph on anterior cortical downslope on lateral view guide pin should be placed parallel with canal on AP view and just posterior to parallel on lateral view use soft tissue protector over guide wire use cannulated starting point reamer to open canal (drill to metaphysical bone remove starting pin and reamer, place ball tip guidewire in canal with T-handle place gentle bend at tip of wire, manually push in to distal aspect of fracture site on C-arm Fracture Reduction reduce fracture by pulling traction over triangle can use small blue towel bump behind leg as a bump use mallet to hold pressure over fracture site can use intramedullary finger reduction tool and/or pointed reduction clamps through skin incisions once fracture reduced, manually push guidewire past fracture site to distal physeal scar check biplanar imaging to ensure wire is in canal measure nail length with ruler Traveling Traction if working alone or with untrained assistant, or if reduction assistance is needed, apply traveling "box" traction before knee incision can use femoral distractor over pins as an alternate to external fixator bars insert pins through posterior distal tibia and posterior proximal tibia (just anterior to fibular head but in posterior proximal tibia) Reaming start with size 9mm reamer, then ream up 0.5-1.0 mm with each reamer push down through starting hole into bone before starting reamer this prevents eccentric reaming of your starting point can use step stool to get better body position for reaming if needed check chatter from reamer feedback and diaphyseal fit on C-arm imaging minimal to no reaming at fracture site to minimize eccentric reaming ream 1.0 above size of final nail (i.e. size 12 mm reamer head for size 11mm nail)ream on full speed, slowly and deliberately, don't stop reamer in canal (avoids reamer head from becoming incarcerated)if a distal fracture, don't ream the distal tibia unless the guidewire is in perfect position Blocking Screws if coronal or sagittal malalignment is noted, blocking screws are placed on the concavity of the deformity most commonly placed posterior or lateral to the guide wire in the proximal segment in proximal 1/3 fractures these screws serve as a pseudo-cortex to guide the nail these screws also serve to increase construct stiffness Nail Insertion build nail on back table and make sure targeting guide lines up with holes in nail insert nail over guidewire and push into place manually as much as possible advance to fracture site and minimize mallet use at fracture site to minimize iatrogenic comminution insert nail fully and check lateral C-arm view at the knee to ensure the nail is sunk at or below the edge of the bone rotation of the nail should align with 2nd metatarsal if compression is needed across fracture site, insert distal interlocking screws via perfect circles technique then backslap distal fragment into proximal fragment must sink nail into proximal segment enough to allow backslapping remove guidewire before placing interlocking screws

Patients in both groups were made weight-bearing walking on the 1st postoperative day Patients in both groups received iv antibiotics for a period of 3 days. Wound inspection was done on the third and fifth postoperative day and the sutures were removed on day 12. Postoperative radiographs were taken to evaluate the quality of fracture reduction and fixation. At the time of discharge, the patients were advised to continue active mobilization of the knee. They were asked to review at a time frame of 6 weeks, 3 months and 6 months and at yearly intervals following that. At the time of review, the patients were evaluated radiologically to assess the status of fracture union and functional assessment was done using PROMIS score. All the follow-up data and the scoring were documented in the patient case reports. Statistical analysis was done with SPSS software. Mann-Whitney test was used to assess continuous variables and the Chi-square test was used in the comparison of categorical variables. A P value < 0.05 was taken to be statistically significant.

Results

30 patients with fractures of the tibia shaft who presented between January 2022 to January 2023 were managed by surgical means and were followed up for a minimum period of 1 year. They were randomly allocated into 2 groups. There were 16 patients who underwent suprapatellar and 14 infrapatellar (Figure 1).

Group 1: Patients managed by Suprapatellar approach (N=15). The mean age of the patients was 36.93±7.4 years ranging from 21 to 56 years. There were 10 males and 5 females in this group with the right side being more commonly involved as seen in 9 of the patients. According to the AO fracture classification, type A was the most common one seen followed by type B and C. RTA was the most commonly mode of injury as seen in 9 patients followed by slip and fall in 6 patients. The suprapatellar approach was performed through the intramedullary interlocking nail. The average time from presentation to surgery was 3.5 days while the mean duration of surgery was 90+/-8 minutes ranging from 82 to 98 minutes. Fluoroscopy was not used in any of the cases hence there was no radiation exposure. The average blood loss was 180±10.4 ml ranging from 170 to 190 ml. The average duration of hospital stay was 5.4 days. The mean duration of follow-up was 6 months ranging from 4 to 8 months. The average time to fracture union was 16.1 weeks ranging from 13 to 18 weeks. All fractures united well at the end of 30 weeks. The mean DASH score at 3 months was 21.4-28.2 while it was 8.9-6.4 at the end of the 6 months (Figure 2). There was no change in the score after 6 month period. There was a superficial skin infection seen in 2 patients which settled down well with antibiotics. There were no complications such as nonunion, malunion or loss of fixation or reduction or implant failure encountered in this group. None of the patients were lost to follow-up (Table 1).

Group 2: Patients managed by Infrapatellar approach (N=15). The mean age of the patients was 37.53+8.1 years ranging from 20 to 56 years. There were 9 males and 6 females in this group with the right side being more commonly involved as seen in 8 of the patients. According to the AO fracture classification, type A was the most common one seen followed by type B and C. RTA was the most commonly mode of injury as seen in 11 patients followed by slip and fall in 4 patients. Infrapatellar approach was done using intramedullary interlocking nail. The average time from presentation to surgery was 3.6 days while the mean duration of surgery was 90.7±8.1 minutes ranging from 82 to 98 minutes. Fluoroscopy was not used in any of the cases hence there was no radiation exposure. The average blood loss was 182±10.3 ml ranging from 170 to 190 ml. The average duration of hospital stay was 5.7 days. The mean duration of follow-up was 6 months ranging from 5 to 7 months. The average time to fracture union was 15.5 weeks ranging from 14 to 17.1 weeks. All fractures united well at the end of 30 weeks. The mean DASH score at 3 months was 19.5±27.4 while it was 8.3+5.8 at the end of 6 months. There was no change in the score after 6 month period. 1 case was noted with infection and was treated with iv antibiotics and the infection settled well. No complications were encountered in this group and none of the patients were lost to follow up.

Discussion

Regardless of the location, tibia fractures pose difficulties in achieving optimal healing due to issues such as infection, malunion, and non-union, even with operative fixation. However, the utilization of intramedullary nailing has gained popularity as a preferred method of fixation in tibia fractures. This approach offers several advantages, including the preservation of soft tissues, enabling earlier definitive fixation, and facilitating weight-bearing. We found nail entry point in the Suprapatellar nailing approach was more accurate on both AP and lateral radiographs which is consistent with a similar study by Jones, *et al*. The importance of a more accurate nail entry point is demonstrated by improved fracture reduction and less risk of Damage to the intra-articular surface thus leading to reduced pain, better function and potential to minimise post-traumatic Osteoarthritis. Sun, *et al*. demonstrated that radiation time was reduced in the Suprapatellar compared to the infrapatellar approach in 162 tibial nails and another supporting study by Williamson, *et al*. who also compared radiation time and exposure between the two techniques in 90 tibial nails" also demonstrated this [5, 6]. However, in the first study didn't look at the radiation dose and the later study compared only the fluoroscopy difference between the two techniques, unlike our study where we compared multiple factors. However, this has been studied by Valsamis, *et al*. and they demonstrated that in the hands of experienced trauma surgeons there is no significant impact of the learning curve and thus no increased radiation dose exposure as compared to the more traditional technique of the Infrapatellar tibial nail approach [7]. In our study fewer patients reported anterior knee pain in the Suprapatellar approach group compared to the infrapatellar approach group which may be due to the accuracy of the femoral trocar protection sleeve which helps with the positioning of the guide wire, reducing iatrogenic soft tissue trauma or could be a by-product of a distant entry incision from the proximal tibia, this is consistent with findings from a study by Courtney, *et al*. [16]. Who reasoned that during the Suprapatellar approach, the infrapatellar nerve is distant from the incision compared to the infrapatellar approach. A further meta-analysis by Xu, *et al*. supports our finding of a lower incidence of anterior knee pain following suprapatellar tibial nailing. Longer-term sequelae of suprapatellar tibial nailing have been an ongoing concern and are well discussed in the literature. Various studies have compared intra-articular injuries between the two techniques looking at secondary iatrogenic damage to the cartilage surface of the Patellofemoral joint or other intra-articular structures such as the footprint of the anterior cruciate ligament, the meniscus and the intermeniscal ligament. While we acknowledge this concern, as demonstrated by Tornetta, *et al*. on cadaveric knees, this can be avoided by following simple steps to aim for the 'safe zone' in the nail entry point which, as described above, is slightly lateral to the centre of the tibial tubercles and by using the specifically designed silicone protection sleeve which is a standard part of the Suprapatellar nailing instruments [11]. Indeed, Leary, *et al*. found there is no evidence of damage to the knee structures on both insertion and extraction of the suprapatellar tibial nail in a cadaveric knee study using a standard suprapatellar technique and instruments. The comparison between infrapatellar and suprapatellar approaches for intramedullary nailing (IMN) fixation of tibial fractures remains a topic of debate. Limited literature exists that directly compares the two techniques in terms of clinical, radiographic, and functional outcomes. In this retrospective case-control study, the suprapatellar approach was found to be independently associated with a reduced risk of malunion and postoperative knee pain. There were no significant differences between the two groups in terms of non-union, infection rates, or PROMIS PI or PF scores (Figure 2). The study revealed that the suprapatellar approach independently lowered the risk of malunion by 84% compared to the infrapatellar approach for tibia fractures. The incidence of malunion in the suprapatellar group (5%) resembled the rates reported for distal tibia fractures treated with open reduction internal fixation. Notably, this study included all tibia fractures and accounted for fibular fixation in the multivariate model, distinguishing it from previous research that focused solely on distal tibia fractures. Several factors were proposed to explain the association between the infrapatellar approach and increased malalignment. These included the requirement for hyper-flexed positioning during surgery, which can be challenging to maintain and may result in the heel coming into contact with the operating table, compromising reduction. In contrast, the suprapatellar approach allows for a more stable leg position after reduction, reducing the risk of mal reduction and subsequent malunion (Table 1). Regarding non-union, the outcomes were comparable between the two approaches, indicating that both techniques yielded satisfactory results. The study also addressed concerns about fibular fixation as a reduction aid, stating that it did not increase the rate of non-union, and its influence was controlled for in the analysis. The incidence of surgical site infection did not significantly differ between the infrapatellar and suprapatellar groups. The infection rate aligned with previous literature on intramedullary fixation of tibia fractures. Despite previous suggestions of an increased risk of septic arthritis with the suprapatellar approach, such findings were not supported by this study. To evaluate subjective patient outcomes, the study incorporated assessments of knee pain and utilized PROMIS PF and PI scores during the final follow-up. Importantly, there were no significant differences in PROMIS PF or PI scores between the infrapatellar and suprapatellar groups, indicating that the suprapatellar approach did not result in inferior subjective outcomes. It should be noted that the PROMIS PF scores were generally low, likely influenced by the patient's overall physical function. Various studies have compared knee pain after using different approaches (suprapatellar and infrapatellar) for tibia fractures. However, there is no consensus on whether either approach causes increased anterior knee pain. Some studies suggest that patients who undergo the suprapatellar approach experience less anterior knee pain after surgery. Interestingly, a cadaveric study reported a lower incidence of articular injury with the suprapatellar approach compared to the infrapatellar approach. However, due to differences in outcome measurements, sample sizes, and postoperative protocols among studies, it is difficult to draw definitive conclusions about anterior knee pain. Another factor to consider is the potential bias when evaluating subjective knee pain after surgery since patients who have a successful recovery may be discharged earlier, leading to a bias in the results. The current study aimed to provide a comprehensive comparison of the suprapatellar and infrapatellar approaches for tibia fractures. It assessed complications such as malunion, non-union, and infection, as well as patient subjective outcomes using PROMIS scores. The results demonstrated the effectiveness of the suprapatellar approach in reducing malunion in tibia fractures treated with intramedullary nailing (IMN). Furthermore, patients who underwent the suprapatellar approach reported equivalent or improved subjective outcomes, possibly due to a lower incidence of postoperative anterior knee pain. However, it is important to consider the limitations of the study. The analysis was retrospective, introducing inherent bias. Surgeon preferences during and after surgery, variations in fracture types, weight-bearing status, intra-articular involvement, concomitant fibular fixation, and patient comorbidities were not directly evaluated but could have influenced the outcomes. Although the study included subjective outcome scores and evaluations of postoperative knee pain from approximately 40% of patients at the final follow-up, a larger sample size would have been preferable. Additionally, while the inclusion of non-trauma-trained surgeons in the study increased its generalizability, it may have introduced additional variability. In summary, the study found that the infrapatellar and suprapatellar approaches resulted in comparable outcomes, with no significant differences observed in the mentioned factors. However, it is important to interpret the findings cautiously, taking into account the limitations and potential biases associated with the study design.

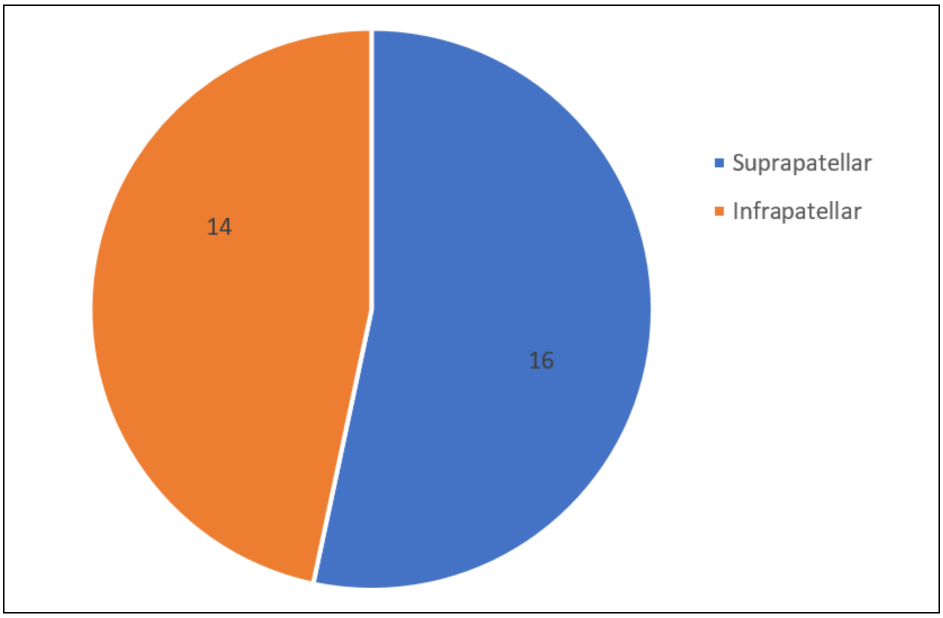

Fig 1: Type of approaches for nailing

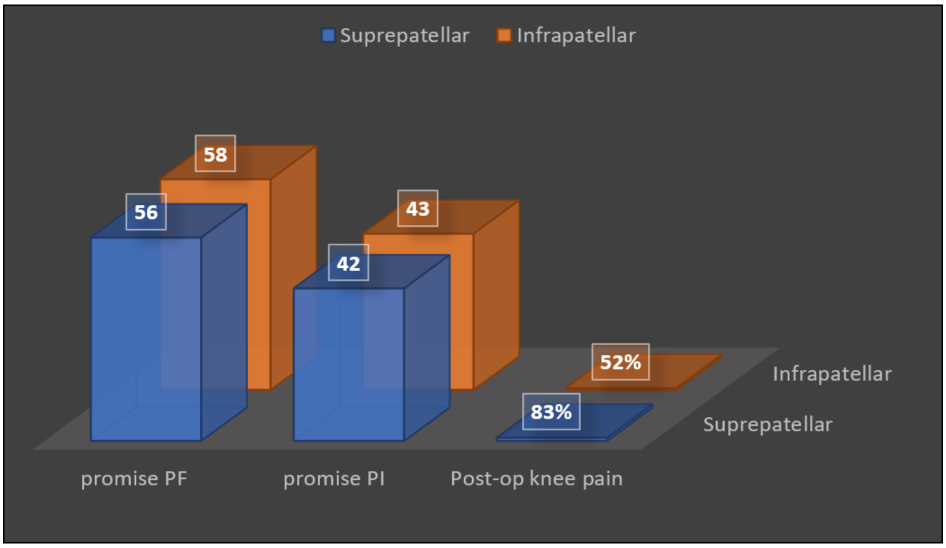

Fig 2: Comparison of scores

Table 1: Patient demographics and data

S. No	Age/sex	Mode of injury	Comorbidities	Unilateral/bilateral	Surgical time	Approach
1	25/M	RTA	Nil	Right	2 hrs.	Infrapatellar
2	47/M	RTA	DM2, HTN	Right	1 hr. 35 min	Infrapatellar
3	68/F	Slip and fall	DM2	Left	1 hr. 30 min	Suprapatellar
4	21/M	RTA	Nil	Right	1 hr. 10 min	Infrapatellar
5	32/M	RTA	Nil	Left	2 hrs.	Suprapatellar
6	70/F	RTA	DM2	Left	1 hr. 25 min	Suprapatellar
7	18/M	RTA	Nil	Right	2 hrs.	Infrapatellar
8	23/F	RTA	Nil	Left	1 hr. 35 min	Infrapatellar
9	31/M	Workplace injury	Nil	Right	1 hr. 35 min	Suprapatellar
10	40/M	RTA	DM2	Left	1 hr. 25 min	Suprapatellar
11	35/M	Workplace injury	Nil	Right	1 hr. 15 min	Suprapatellar
12	45/M	RTA	Nil	Left	1 hr. 30 min	Suprapatellar
13	36/M	RTA	DM2	Right	1 hr. 10 min	Infrapatellar
14	38/ F	RTA	DM2	Right	2 hrs.	Infrapatellar
15	39/M	RTA	Nil	Left	1 hr. 25 min	Suprapatellar
16	41/M	RTA	Nil	Right	1 hr. 20 min	Suprapatellar
17	44/M	Workplace injury	Nil	Right	1 hr. 15 min	Suprapatellar
18	53/M	Workplace injury	DM2	Left	2 hr.	Infrapatellar
19	54/ F	RTA	Nil	Left	1 hr. 15 min	Infrapatellar
20	58/ F	RTA	DM2	Right	1 hr. 30 min	Infrapatellar
21	41/M	RTA	Nil	Right	2 hr.	Suprapatellar
22	44/M	RTA	DM2	Right	1 hr. 20 min	Suprapatellar
23	40/M	RTA	Nil	Left	1 hr. 15 min	Suprapatellar
24	30/M	RTA	Nil	Left	1 hr. 10 min	Infrapatellar
25	33/F	RTA	Nil	Right	1 hr. 40 min	Infrapatellar
26	35/F	Workplace injury	Nil	Right	2 hr.	Suprapatellar
27	56/ M	Slip and fall	Nil	Right	1 hr. 30 min	Suprapatellar
28	65/ M	Slip and fall	HTN	Left	1 hr. 45 min	Infrapatellar
29	55/ M	Slip and fall	HTN	Right	1 hr. 30 min	Infrapatellar
30	44/ M	Slip and fall	HTN	Right	1 hr. 30 min	Suprapatellar

Conclusion

Suprapatellar IMN fixation of tibial shaft fractures is independently associated with a lower risk of malunion and postoperative knee pain compared to the infrapatellar approach. However, there are no functional differences between approaches.

Declarations

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Conflict of interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval: Not required

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