

Comparative Study of Knee Function and Pain Between the Suprapatellar and Medial Parapatellar Approaches After Intramedullary Nailing of a Tibial Fracture

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ABSTRACT

Introduction: Anterior knee pain is the most frequent cause of reoperation after intramedullary nailing of a tibial fracture. In recent years, semi-extension approaches have simplified the surgical technique, but postoperative pain continues to be the most frequent complication. The aim of this study is to compare the medial parapatellar approach (PPM) vs the suprapatellar approach (SP) with respect to knee pain and postoperative function after intramedullary tibial nailing. **Materials and Methods:** We retrospectively formed 2 groups of patients with tibial fractures treated with intramedullary nailing through the PPM (n:33) and SP (n:17) approaches. We evaluated postoperative knee pain with the VAS and Lysholm score; and function with the SF-12. They were clinically evaluated at 1, 3, 6 and 12 months. **Results:** The mean age of the groups was 41.5 years (29-76) for the PPM group and 40.4 years (23-90) for the SP group. Pain and knee function were significantly better in the group of patients operated through the SP approach. **Conclusion:** The suprapatellar approach is associated with less knee pain and better postoperative function after intramedullary nailing of a tibial fracture. However, prospective studies should validate these results.

Key words: Tibia fracture; tibia nailing; semi-extended approach; suprapatellar approach; parapatellar approach.

Level of Evidence: III

Estudio comparativo de la función y el dolor de la rodilla entre el abordaje suprarrotuliano y pararrotuliano medial luego del enclavado endomedular de una fractura de tibia

RESUMEN

Introducción: El dolor anterior de rodilla es la causa más frecuente de reoperaciones luego del enclavado endomedular de una fractura de tibia. En los últimos años, los abordajes en semiextensión han facilitado la técnica quirúrgica; sin embargo, el dolor posoperatorio sigue siendo la complicación más frecuente. El objetivo de este estudio fue comparar el abordaje pararrotuliano medial con el suprarrotuliano en cuanto al dolor de rodilla y la función posoperatoria luego del enclavo endomedular de tibia.

Materiales y Métodos: Se conformaron retrospectivamente 2 grupos de pacientes con fracturas de tibia tratados con clavo endomedular a través del abordaje pararrotuliano medial (n = 33) y suprarrotuliano (n = 17). Se evaluaron el dolor de rodilla posoperatorio con las escalas analógica visual y de Lysholm, y la función con el SF-12, al mes 1, 3, 6 y 12. **Resultados:** La edad promedio era de 41.5 años (rango 29-76) para el grupo con abordaje pararrotuliano y de 40.4 años (rango 23-90) para el otro grupo. Los resultados respecto del dolor y la función de la rodilla fueron significativamente mejores en el grupo operado con el abordaje suprarrotuliano. **Conclusiones:** El abordaje suprarrotuliano se asocia con menor dolor de rodilla y mejor función posoperatoria luego del enclavado endomedular de una fractura de tibia. Sin embargo, estudios prospectivos deberán validar estos resultados.

Palabras clave: Fractura de tibia; clavo de tibia; abordaje en semiextensión; abordaje suprarrotuliano; abordaje pararrotuliano.

Nivel de Evidencia: III

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INTRODUCTION

Tibial fracture is one of the most frequent long bone fractures.¹ Intramedullary nailing is the treatment of choice since, in most cases, it achieves excellent consolidation outcomes with a low rate of complications.² However, anterior knee pain is a frequent cause of disability in patients and is responsible for reoperation rates of up to 29.8%.³ Although the cause of anterior knee pain after tibial intramedullary nailing is multifactorial, the surgical approach has been identified as one of the main causes.⁴

In the last decade, modifications in nail design and the development of different approaches in the semi-extension position have made it possible to extend the indication for intramedullary nailing to all segments, facilitating the surgical technique.⁵ However, they have not been able to reduce postoperative knee pain.⁶⁻⁸

Initially used for metaphyseal fractures and then for all tibial fractures, we have adopted the semi-extension position technique through the medial parapatellar approach (MPP) for tibial intramedullary nailing. However, due to the most recent advent of the suprapatellar technique (SP), we began to incorporate it within the possibilities of approaches. For this reason, we propose to carry out a comparative study between both techniques to evaluate the functional outcomes and postoperative knee pain. Our hypothesis is that there are no significant differences between both approaches regarding postoperative pain and function of the knee.

MATERIALS AND METHODS

The study was approved by the Ethics Committee of the Institution. We retrospectively evaluated 85 tibial fractures treated with intramedullary nailing at our institution between January 2017 and January 2020. We included skeletally mature patients treated with an MPP or SP approach with a minimum follow-up of one year. In the first period (January 2016-December 2017), all patients underwent an MPP approach, while in the second period (January 2018-June 2020), the choice of the approach was based on the availability of the implant.

We excluded patients with fractures associated with a fracture of the ipsilateral femur (floating knee), pathological fractures, pre-existing knee disease, fractures that progressed to nonunion or developed infection, and those unable to walk.

After incorporation, two groups were formed according to the approach used: MPP (n = 33) and SP (n = 17). We collected data on age, sex, side, type of fracture according to the AO/OTA classification, open vs. closed, and follow-up time.

Anterior knee pain was assessed with the visual analog scale and with the pain section of the Tegner-Lysholm scale.⁹ The functional assessment was performed with the SF-12 questionnaire.¹⁰ Knee pain and function records were made in clinical controls at one month, and at 3, 6, and 12 months. All data collected were compared between the two groups.

In the statistical analysis, the chi-square or Fisher test was used for categorical variables, depending on whether they met assumptions. For continuous variables, since the distribution was not normal, the summary measure was the median with its interquartile range and the Wilcoxon or Mann-Whitney tests were used. A p value <0.005 was considered statistically significant.

RESULTS

The mean age was 41.5 years (range 29-76) for the MPP approach group and 40.4 years (range 23-90) for the SP technique group (p >0.05). Four fractures from the MPP approach group and two from the other group were open (p >0.05). However, there were significant differences in the type of fracture between both groups. In the group with the MPP technique, metaphyseal fractures were more frequent (4.1/4.3) (Table 1).

The evaluation of anterior knee pain with the visual analog scale showed a significant difference in favor of the group with the SP approach at one month, and at 3 and 6 months after surgery.

When the Tegner-Lysholm scale was applied to assess knee pain, there were also significant differences in favor of the group with the SP technique at one month, and at 3, 6, and 12 months of follow-up (p <0.05) (Table 2).

The knee function analysis also showed significant differences in favor of patients operated on with the SP approach. However, these differences were only significant in the remote evaluation at 6 and 12 months (p < 0.05) (Table 2).

Table 1. Demographics, side, classification, and percentage of open fractures

	Medial parapatellar approach (n = 33)	Suprapatellar approach (n = 17)	p
Sex (male)	22 (66.67%)	9 (52.94%)	0.344
Age (years)	35 (IQR 33-48)	38 (26-43)	0.310
Side (left)	16 (48.48%)	10 (58.82%)	0.488
OTA/AO Classification			0.016
4.1	0 (0%)	4 (23.53%)	
4.2	15 (45.45%)	7 (41.18%)	
4.3	18 (54.55%)	6 (35.29%)	
Open			NS

NS = not significant. IQR = interquartile range.

Table 2. Postoperative pain and functional outcomes

	Medial parapatellar approach	Suprapatellar approach	p
VAS 1 month	5 (4-6)	2 (2-3)	0.001
VAS 3 months	3 (3-4)	1 (1-2)	0.001
VAS 6 months	2 (2-3)	0 (0-1)	0.001
VAS 12 months	1 (0-1)	0 (0-1)	0.07
Lysholm 1 month	15 (15-20)	20 (20-20)	0.017
Lysholm 3 months	20 (15-20)	20 (20-25)	0.013
Lysholm 6 months	25 (20-25)	25 (25-25)	0.048
Lysholm 12 months	25 (20-25)	25 (25-25)	0.004
SF-12 1 month	70 (65-72)	70 (70-73)	0.1142
SF-12 3 months	72 (70-75)	75 (73-75)	0.0745
SF-12 6 months	75 (72-80)	80 (80-85)	0.0003
SF-12 12 months	78 (75-80)	85 (80-85)	0.0004

VAS = visual analog scale, Lysholm = Tegner-Lysholm scale, SF-12 = SF-12 questionnaire.

DISCUSSION

The analysis of the results of this study has refuted the initial hypothesis, since we have found a significant difference in functional outcomes and postoperative knee pain between the MPP and SP approaches after intramedullary nailing of a tibial fracture.

A first consideration that explains the significant difference in the type of fracture between both groups is that the first cases in this series correspond to patients with metaphyseal fractures in whom we began to use the semi-extension technique exclusively through the MPP approach. In the following years, we extended it to all tibial fractures with an indication for intramedullary nailing, and we incorporated the SP approach.

In different studies, knee pain continues to be reported as the most frequent complication after tibial intramedullary nailing.^{3,4} Several factors responsible for postoperative knee pain have been pointed out.⁴ Most of them are related to the skin incision,^{11,12} tendon injury,¹³ nail protrusion,¹⁴ and injury to structures caused by making the entry point.^{15,16}

Although, in recent years, the development of approaches in the semi-extended position has introduced some advantages over the infrapatellar technique,¹⁷ the shift of the approach from the patellar tendon area has not been accompanied by a decrease in postoperative knee pain.⁶⁻⁸ Although both approaches move the incision away from the patellar tendon area, especially the SP, there is no conclusive evidence that this is associated with less postoperative knee pain.⁶⁻⁸ The intra-articular entry of both approaches poses an associated risk of injuring intraarticular structures that could be responsible for postoperative knee pain. Although the management of the patella with both approaches is different and one could assume that the SP access would cause a chondral injury responsible for postoperative pain, especially over the patellofemoral joint, cadaveric and biomechanical studies have not found a direct relationship between eventual joint damage and knee pain.^{15,16}

In a cadaveric study that sought to determine the damage of intra-articular structures between the SP vs parapatellar technique, Zamora et al. reported that intermeniscal ligament injuries occurred in three out of ten specimens in each group. Regarding the risk of chondral damage, they detected a cartilage injury in the patellofemoral joint in three of 10 cases in the SP approach group, while in the parapatellar approach group, a lesion occurred in the lateral aspect of the lateral condyle in one of 10 cases. Consequently, the authors concluded that, despite the fact that the risk of soft tissue injury is the same in both groups, the risk of chondral injury should be considered with the SP technique.¹⁶ In a cadaveric study, Gelbke et al. showed that the pressure received by the cartilage of the patellofemoral joint is significantly higher with the SP technique than with the traditional infrapatellar technique.¹⁸ However, they clarified that the level of pressure generated is below that necessary to produce an irreversible injury to the chondrocyte.

For the evaluation of knee pain, we used scales used in other studies, such as the Tanger-Lysholm scale and the visual analog scale. In the case of the Tanger-Lysholm scale, we decided to use the segment aimed at evaluating only knee pain and thus avoid other responses that might not be directly related to the surgical technique of nail insertion. For the functional evaluation, we used the SF-12 questionnaire because it is a widely used score to evaluate traumatic pathology.

Most studies that evaluated knee function and pain after tibial intramedullary nailing have focused on comparing the SP or parapatellar technique with the traditional infrapatellar hyperflexion technique.^{6-8,15-17} Although recently some authors have reported less pain with the SP technique,¹⁷ most have not found significant differences between the different approaches.⁶⁻⁸ Our study is novel as it compares two of the three approaches described for intramedullary nailing of the tibia in semi-extension; to our knowledge, there are no studies comparing the different approaches available.

We are aware of some limitations of the study that force us to take the results obtained with caution. First of all, this is not a prospective, randomized study; therefore, the first cases of the series correspond to those operated with the MPP technique, so some factors related to the learning curve with the semi-extension position may have influenced the results. Secondly, our study lacks an analysis of knee pain regarding its location. Although anterior knee pain is the most common after tibial intramedullary nailing, there are other locations that were not analyzed and are not included in the scales used and could influence the rate of knee pain reported. Lastly, the number of the series is low considering the frequency of the pathology and, therefore, studies with a larger sample should validate these results.

CONCLUSION

Based on the results of this study, the SP approach is associated with less pain and better knee function than the MPP approach after tibial intramedullary nailing. However, these results must be validated by studies with a larger number of patients and prospective designs.

Conflict of interest: The authors declare no conflicts of interest.

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