Suprapatellar vs. Infrapatellar Intramedullary Nailing for the Treatment of Distal and Diaphyseal Tibial Fractures: Comparative Analysis and Surgical Technique

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ABSTRACT

Introduction: Fractures of the medial and distal tibial segment often occur in young patients with high-energy trauma and older patients with low-energy trauma. The objective of this study is to compare the time of surgery, time of use of fluoroscopy, functional outcomes, and postoperative pain in patients treated with the suprapatellar vs. infrapatellar technique for tibial nailing. **Materials and Methods:** We carried out a retrospective study between March 2018 and October 2019. All the data was collected from the electronic clinical record (ECR). We included patients with diaphyseal and distal tibial fractures. The variables analyzed were: fluoroscopy and surgery time, pain evaluation, and functional outcomes of the patients using the Lysholm score. **Results:** 80 patients met all the inclusion criteria. Sociodemographic data were divided into 2 similar groups. The suprapatellar approach was used in 44 patients and the infrapatellar in 36 of them. A statistical difference was obtained in the analysis for the time of surgery, use of fluoroscopy, and pain evaluation in favor of the suprapatellar technique. **Conclusions:** The results of our study showed shorter surgery and fluoroscopy times with the use of the suprapatellar technique compared with the infrapatellar technique. The suprapatellar technique also yielded better pain results in the visual analog scale.

Key words: Suprapatellar approach; infrapatellar approach; tibial fractures; surgical technique.
Level of Evidence: III

Enclavado endomedular suprarrotuliano vs. infrarrotuliano en el tratamiento de fracturas diafisarias y distales de tibia: análisis comparativo y técnica quirúrgica

RESUMEN

Introducción: Las fracturas diafisarias y distales de tibia son lesiones frecuentes en personas jóvenes que sufren un trauma de alta energía y en ancianos por un trauma de baja energía. El objetivo de este estudio fue comparar el tiempo quirúrgico, el uso de radioscopia, la evaluación funcional y el dolor en el tratamiento de fracturas diafisarias y distales de tibia mediante una técnica suprarrotuliana y una infrarrotuliana. **Materiales y Métodos:** Se realizó un estudio retrospectivo entre marzo 2018 y octubre de 2019. La información de los pacientes se obtuvo de la historia clínica electrónica. Se incluyó a pacientes con fracturas diafisarias y distales de tibia. Se estudiaron y compararon los tiempos de radioscopia y de cirugía. El dolor posoperatorio se evaluó mediante la escala analógica visual y la función, con el puntaje de Lysholm. **Resultados:** Ochenta pacientes cumplían con los criterios de inclusión. Sus datos sociodemográficos fueron pareados en dos grupos similares. Treinta y seis pacientes fueron tratados con la técnica infrarrotuliana y 44, con la técnica suprarrotuliana. Se obtuvieron diferencias estadísticamente significativas en el tiempo de cirugía, el tiempo de radioscopia y en el puntaje de la escala analógica visual para dolor al año. **Conclusiones:** Los resultados mostraron un menor tiempo de cirugía y de radioscopia, y mejores resultados en la escala analógica visual para dolor con la técnica suprarrotuliana para el tratamiento de las fracturas mediodiafisarias y distales de tibia.

Palabras clave: Abordaje suprarrotuliano; fractura de tibia; abordaje infrarrotuliano; técnica quirúrgica.
Nivel de Evidencia: III

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INTRODUCTION

Distal and diaphyseal tibial fractures are frequent injuries in young people who suffer high-energy trauma and in the elderly due to low-energy trauma. The most frequent procedure to treat them is intramedullary nailing of the tibia.[1]

The use of the suprapatellar technique for nailing the tibia in proximal segment fractures has been well studied. Fluoroscopy time, postoperative pain, and functional outcomes have been evaluated with this technique and compared with the infrapatellar approach.[1,2]

On the other hand, the publications on the use of the suprapatellar technique to treat fractures of the tibia in diaphyseal and distal segments are scarcer, and report variable results in terms of postoperative pain, functionality, and clinical evolution.[3-5]

The objective of this study was to compare the surgical time, the evolution of pain, the functional evaluation, and the use of radioscopy in the treatment of diaphyseal and distal fractures of the tibia with the suprapatellar and infrapatellar techniques. In addition, we described the surgical technique and presented a literature review.

MATERIALS AND METHODS

A retrospective cohort study was carried out between March 2018 and October 2019. All patients were treated by the same surgical team, at our institution, a level I trauma center.

The selection of the implant and its approach was not randomized. Both placement systems were available as of the aforementioned date and were selected based on the experience of the surgeon.

Patient information was obtained from the electronic health records. Inclusion criteria were: age 18-70 years, skeletal maturity, involvement of the diaphyseal or distal segment of the tibia, open or closed tibial fracture treatable with intramedullary nailing, isolated tibial fractures, and a minimum postoperative follow-up of 12 months. The exclusion criteria were: proximal tibia fractures, pathological fractures, polytraumatized patients, and skeletally immature patients.

Radioscopy time was evaluated in seconds and surgery time in minutes.

Postoperative pain was determined using the visual analog scale. Functional evaluation was performed with the Lysholm score in the postoperative period, at one year of follow-up.

Statistical analysis

The medians and interquartile ranges between quantitative variables were evaluated with a range of 25-75. The Wilcoxon test was applied for quantitative variables.

The chi-square test was used to compare the qualitative and functional variables of the patients. A p value <0.05 was considered statistically significant.

For the statistical analysis, the Stata 13TM program (Stata Corp., College Station, Texas, USA) was used.

SURGICAL TECHNIQUE

The procedure begins with the patient in the supine position, under regional anesthesia, on a radiolucent surgical table. With radioscopy, it is feasible to evaluate the reduction maneuvers before the surgical procedure, which will be useful during the operation.

After the corresponding asepsis and under surgical conditions, the procedure begins with the placement of a cushion under the hamstring, in such a way as to achieve a semi-extension position to facilitate the procedure of entering the joint. It should be noted that the size of the cushion is not uniform and will depend on the dimensions of the limb to be treated (Figure 1).

Surgical access is then carried out through a skin incision of approximately 3 cm in the longitudinal direction and 2 cm above the superior pole of the patella. It is important to make the incision in a single plane that encompasses the skin tissue, the cellular tissue and finally the quadriceps tendon.

After performing the approach, the entry of the protection cannula can be facilitated with the prior introduction of tissue scissors so that, if there is abundant synovial tissue, an adequate path is achieved (Figure 2).

Once the protection cannula, covered with an external layer of silicone, has been inserted, it is fixed to the femur with a pin and its corresponding guide hole in the cannula, to prevent its expulsion.

Figure 1. Limb in semi-extension, with placement of a cushion in the hamstring and suprapatellar system with guide wire in position.

Figure 2. Cannula system, silicone sheath, and wire guide for the suprapatellar approach.

We then proceed with the search for the entry point under radioscopic vision. Manipulating the protection cannula is necessary to allow access to said point (Figure 3).

After achieving the entry point, which will be penetrated by the guide pin, the drill sleeve is removed and the entry point is subsequently created with a drill bit. Said entry hole can be made manually or with a motor, depending on the characteristics of the bone (Figure 4).

Finally, the drilling guide will be placed, taking special care to avoid expulsion of the tissue protection cannula.

Depending on the fracture pattern, the drilling of the medullary canal will continue, as well as the maneuvers to reduce the fracture line(s).

Finally, and after inserting the intramedullary nail with its corresponding locking guide, we proceed with the locking of the nail and the subsequent removal of the instruments. If the surgeon prefers, the nail closure plug can be placed through the tissue protection cannula.

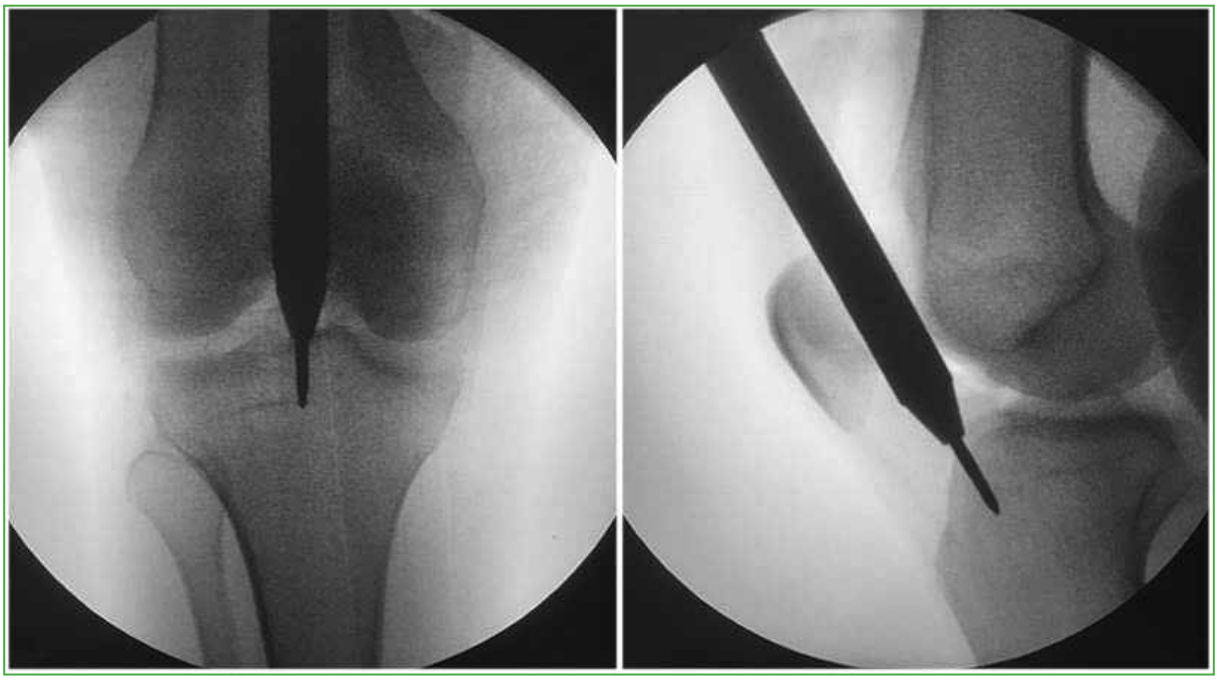

Figure 3. Anteroposterior and lateral fluoroscopic images with the use of the suprapatellar system and placement of the guide wire at the appropriate entry point.

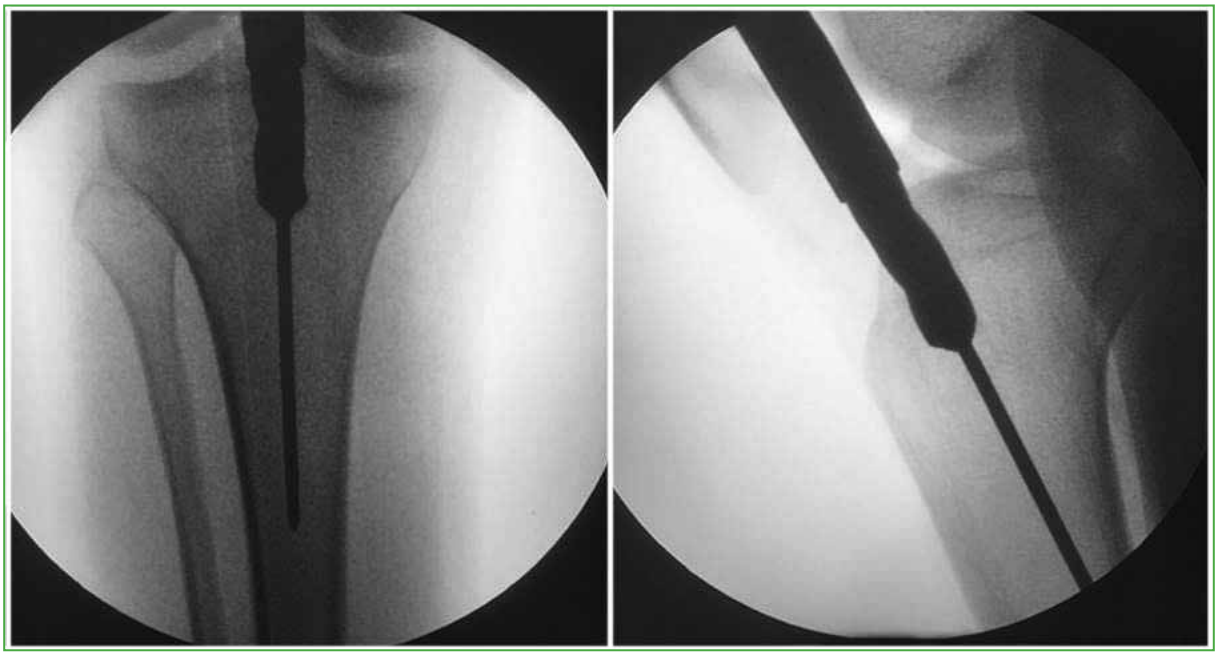

Figure 4. Anteroposterior and lateral fluoroscopic images with the removal of the guide wire sheath and placement of a drill bit to drill the implant entry site.

It is essential to carry out a profuse lavage of the joint in order to remove debris that could have been retained in the joint.

The wound is closed by planes, using a strong suture for the tendinous plane and a smaller suture for the superficial planes.

Finally, skin asepsis and the placement of the appropriate bandage are performed.

RESULTS

Eighty patients met the inclusion criteria. Sociodemographic data were paired in two similar groups. Thirty-six patients were treated with the infrapatellar technique and 44 with the suprapatellar technique. The mean age of the group with the suprapatellar technique was 48 (range 33-64) and that of the other group, 46 (range 32-68). 83% (67 patients) had a midshaft tibial fracture and 17% (13 patients) a distal tibial fracture.

The mean surgery time was 90 min (range 72-107) in patients undergoing the suprapatellar technique (n = 44) and 106 min (range 71-172) in those operated on with the infrapatellar technique (n = 36). . In the corresponding statistical analysis, the difference was significant (p = 0.008).

The fluoroscopy use time was 94.5 s (range 71.5-172.5) for the suprapatellar technique (n = 44) and 204.5 s (range 152.5-262) for the other technique (n = 36), also with a significant difference (p = 0.0001).

Regarding pain assessment at one year of follow-up, the mean visual analog score of patients treated with the suprapatellar technique (n = 44) was 2 (range 1-3), while in the group treated with the infrapatellar technique (n = 36) it was 3 (range 2-5), with a significant difference (p = 0.01).

The Lysholm functional score at one year's follow-up did not show significant differences between both techniques (p = 0.153). Despite this, their absolute values were different, with a mean score of 89 (range 79-96) for the suprapatellar technique (n = 44) and 86.5 (range 77-92) for the infrapatellar technique (n = 36).

DISCUSSION

The results of our study coincide with those of most of the published articles. The shorter fluoroscopy and surgery times with the suprapatellar technique are well documented in the literature.[2,3,6] These results are reflected both in fractures of the proximal tibia, its original indication, as well as in the diaphyseal and distal segments of the tibia.

The functional assessment and the evolution of pain in these patients yielded dissimilar results in the different literature reports.[3-5,7] Some refer that there was no significant difference in knee functionality and range of motion, as reflected in our study. On the other hand, studies such as the one by Cui et al. observed improvements in the range of motion of the knee with the suprapatellar technique compared to the infrapatellar technique.[8] Regarding the evaluation of pain, in our study, the evaluation of the pain one year after surgery revealed significant differences in favor of the infrapatellar technique, as reported largely in the literature. In a large series with a retrospective design and a follow-up of 3.8 years, Isaac et al. reported that they found no difference between both techniques when evaluating postoperative pain.[9]

In all the patients in our cohort, the fracture had consolidated at one year of follow-up, without associated complications. The aforementioned studies did not establish this variable as considerable when determining the selection of the approach, and this was reflected in the absence of said complication among our patients.

The limitations of this study are diverse; the main one is its retrospective cohort design with the disadvantages and biases that this entails compared to a prospective design. In addition, it could be considered that the number of patients evaluated is not one of the largest in the literature; however, having excluded the proximal segment, this value remains considerable and relevant.

CONCLUSION

According to our study, the suprapatellar nailing technique proved to be safe and, in addition, significantly improved surgical and radioscopy times when compared to the infrapatellar technique. Likewise, better outcomes were demonstrated in the visual analog scale for pain.

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

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REFERENCES

1. Franke J, Hohendorff B, Alt V, Thormann U, Schnettler R. Suprapatellar nailing of tibial fractures-Indications and technique. *Injury* 2016;47(2):495-501. https://doi.org/10.1016/j.injury.2015.10.023
2. Williamson M, Iliopoulos E, Williams R, Trompeter A. Intra-operative fluoroscopy time and radiation dose during suprapatellar tibial nailing versus infrapatellar tibial nailing. *Injury* 2018;49(10):1891-4. https://doi.org/10.1016/j.injury.2018.07.004
3. Wang C, Chen E, Ye C, Pan Z. Suprapatellar versus infrapatellar approach for tibia intramedullary nailing: A meta-analysis. *Int J Surg* 2018;51:133-9. https://doi.org/10.1016/j.ijsu.2018.01.026
4. Lu Y, Wang G, Hu B, Ren C, Sun L, Wang Z, et al. Comparison of suprapatellar versus infrapatellar approaches of intramedullary nailing for distal tibia fractures. *J Orthop Surg Res* 2020;15(1):422. https://doi.org/10.1186/s13018-020-01960-8
5. MacDonald DRW, Caba-Doussoux P, Carnegie CA, Escriba I, Forward DP, Graf M, et al. Tibial nailing using a suprapatellar rather than an infrapatellar approach significantly reduces anterior knee pain postoperatively: a multicentre clinical trial. *Bone Joint J* 2019;101-B(9):1138-43. https://doi.org/10.1302/0301-620X.101B9.BJJ-2018-1115.R2
6. Gao Z, Han W, Jia H. Suprapatellar versus infrapatellar intramedullary nailing for tibal shaft fractures: A meta-analysis of randomized controlled trials. *Medicine (Baltimore)* 2018;97(24):e10917. https://doi.org/10.1097/MD.0000000000010917
7. Xu H, Gu F, Xin J, Tian C, Chen F. A meta-analysis of suprapatellar versus infrapatellar intramedullary nailing for the treatment of tibial shaft fractures. *Heliyon* 2019;5(9):e02199. https://doi.org/10.1016/j.heliyon.2019.e02199
8. Cui Y, Hua X, Schmidutz F, Zhou J, Yin Z, Yan SG. Suprapatellar versus infrapatellar approaches in the treatment of tibia intramedullary nailing: a retrospective cohort study. *BMC Musculoskelet Disord* 2019;20(1):573. https://doi.org/10.1186/s12891-019-2961-x
9. Isaac M, O'Toole RV, Udogwu U, Connelly D, Baker M, Lebrun CT, et al. Incidence of knee pain beyond 1 year: suprapatellar versus infrapatellar approach for intramedullary nailing of the tibia. *J Orthop Trauma* 2019;33(9):438-42. https://doi.org/10.1097/BOT.0000000000001504