

# Indications for Surgical Treatment of Tibial Fractures in Children.

Isadora Mantovani Freitas <sup>a</sup>, Gabriela Lopes Peruchi <sup>b</sup>.

<sup>a</sup> Higher School of Sciences of the Santa Casa de Misericórdia de Vitória, Espírito Santo, Brazil, [isadora.freitas@edu.emescam.br](mailto:isadora.freitas@edu.emescam.br).

<sup>b</sup> Higher School of Sciences of the Santa Casa de Misericórdia de Vitória, Espírito Santo, Brazil, [gabriela.peruchi@edu.emescam.br](mailto:gabriela.peruchi@edu.emescam.br).

**Abstract.** Tibial fractures are among the most common orthopedic injuries in children and adolescents, often resulting from falls, sports, and other traumas, and they pose significant challenges for healthcare providers due to their potential long-term impacts on growth and development. Effective treatment is crucial to ensure proper healing and prevent complications like deformity and chronic pain. Despite substantial literature on adult fracture treatment, surgical approaches for pediatrics lack standardization, with methods such as elastic stable intramedullary nailing (ESIN) and open reduction and internal fixation (ORIF) varying based on factors like fracture type and surgeon expertise. An integrative review of seven studies highlights the frequent recommendation for surgical intervention, showing that ESIN offers high union rates and low complication risks, particularly for unstable fractures. Comparative analyses indicate that both open reduction and circular external fixation yield similar functional outcomes for tibial plateau fractures, promoting the need for personalized treatment plans. In addition, evolving trends in surgical management have sparked discussions on adapting strategies to meet the unique characteristics of younger patients. Notably, the review identifies gaps in research, such as small sample sizes and variable methodologies, emphasizing the necessity for high-quality controlled studies that examine long-term outcomes and refine clinical guidelines. Ultimately, the synthesis underscores the importance of evidence-based surgical practices to optimize recovery and inform future research directions in pediatric orthopedic care, aiming to enhance functional outcomes for young patients with tibial fractures.

**Keywords.** Tibial Fractures, Fracture Fixation, internal, Child.

## 1. Introduction

Tibial fractures in children and adolescents are one of the most common types of childhood orthopedic injuries and represent a significant clinical challenge for healthcare professionals. These fractures can occur due to a variety of causes, including falls, sports accidents, and household trauma, and have the potential to negatively impact the growth and functional development of young patients. Effective treatment of these fractures is crucial not only to ensure proper healing but also to prevent long-term complications, such as deformity and chronic pain. [1]

Understanding the epidemiological characteristics of tibial fractures in children and adolescents is essential to inform clinical practice and establish

prevention strategies. The current global scenario indicates a bimodal distribution of proximal tibial fractures, with extra-articular fractures presenting a peak incidence at age 3, while tibial tubercle and intra-articular fractures increase significantly from age 15 onwards. The annual incidence of these fractures has been estimated at 3.8 per 100,000 children, with a high rate of 21 per 100,000 among adolescents aged 13 to 16 years. Although high-energy traumas, such as those associated with sporting activities, are becoming more prevalent, the majority of fractures still occur due to low-intensity injuries, reflecting children's behavior and daily activities. Furthermore, associated complications, such as compartment syndrome, have been reported at low frequencies, highlighting the importance of a careful approach in managing these injuries. [2]

Although there is a large body of literature on the treatment of fractures in adults, the surgical approach in children and adolescents still lacks clear standardization. Different techniques, such as elastic stable intramedullary nailing (ESIN) and open reduction and internal fixation (ORIF), have been used, but the choice of method may vary depending on the nature of the fracture, the age of the patient, and the experience of the surgeon. The decision on which technique to use, therefore, becomes a critical aspect of clinical management. [2]

The analysis of indications for surgical interventions in tibial fractures is especially relevant, since inadequate management can result in complications that extend into adulthood. For example, poorly treated or inadequately healed fractures can lead to persistent functional problems and a reduced quality of life. Given the importance of adequate treatment, this integrative review seeks to synthesize the available evidence on the best surgical practices for these fractures. [3]

This study focuses on a review of seven scientific articles that address different aspects of surgical treatment for tibial fractures in children and adolescents. The review will allow a comparative analysis of surgical approaches and their outcomes, not only in the pediatric population, but also in comparison with approaches used in adults. This will enrich the understanding of clinical guidelines and promote discussions on how to improve surgical outcomes and long-term recovery. [4]

The aim of this review is therefore to critically evaluate the available evidence to determine the appropriate indications for surgical treatment of tibial fractures in young people, identifying not only the most effective methods but also the gaps in knowledge that still need to be explored. Through this analysis, we hope to contribute to the formation of a solid evidence base that supports clinical practice and, consequently, improve the outcomes for young patients suffering from these injuries. [5]

## 2. Research Methods

This literature review was conducted through a search of the Pubmed, CAPES and Virtual Health Library (BVS) databases during the month of September 2024, using the descriptors “Tibial Fractures” AND “Fracture Fixation, internal” AND “Child”, according to the Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH).

The inclusion criteria used took into account the publication date between 2019 and 2024, in English, Portuguese and Spanish, fully available and limited to humans. Duplicate articles or those that were not in accordance with the intended theme for this research were excluded, analyzed according to the determination of the indication of the surgical approach in children with tibial fractures.

## 3. Results

After searching the Pubmed, CAPES and Virtual Health Library (BVS) databases, this study selected 1.595 articles to prepare an integrative literature review on the indications for surgical interventions in tibial fractures in children.

The application of the inclusion and exclusion criteria described in the method resulted in a second sample of 137 articles suitable for use in accordance with the objectives of this research. After reading the titles, abstracts and full texts of the pre-selected articles, another 130 works were excluded from the final selection. The final sample for this study was of 7 articles.

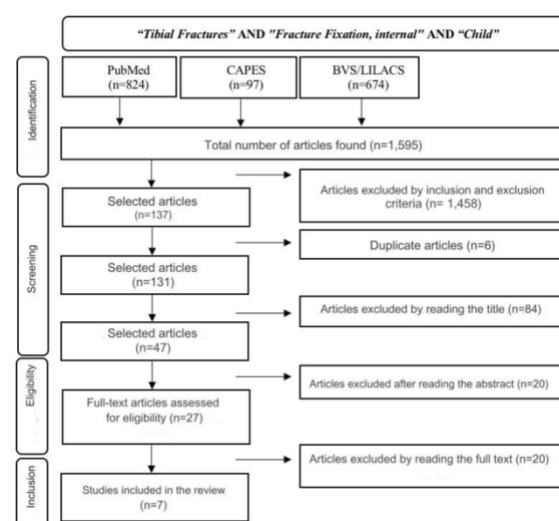


Figure 1 – Flowchart of article search and selection

## 4. Discussion of the results

The results indicate that surgical approach is frequently recommended for tibial fractures in children and adolescents. The study conducted by Frei et al on elastic intramedullary nailing (ESIN) demonstrates a high union rate and a low incidence of complications, which makes it a reliable technique for the treatment of femoral shaft fractures in young people. The research emphasizes that the choice of this approach is particularly valid for unstable fractures, reinforcing the need to consider the specific clinical condition when deciding the treatment. [2]

In the study conducted by Li et al, the comparison between open reduction with internal fixation and circular external fixation for tibial plateau fractures in adolescents revealed no significant differences in terms of functional recovery. This analysis suggests that, although both methods are effective, the choice between them may be guided by factors such as fracture severity and surgeon experience, and

reinforces the importance of personalized treatment protocols. [3]

The information given by Koivisto et al provides a comprehensive overview of the epidemiology and management of proximal tibial fractures, pointing to an increase in the incidence of surgically treated fractures. This study highlights the evolution in surgical practices and the need for appropriate management that considers the specific characteristics of the pediatric population, emphasizing that inadequate treatment can lead to long-term complications. [1]

In the Kothari et al work, the classification and management of tibial tubercle avulsion fractures demonstrates that specific surgical approaches are effective in correcting deformity and restoring function. The results suggest that surgical treatment in cases of significant avulsion not only promotes bone healing but also improves functional outcomes, especially in active adolescents who require rapid recovery. [6]

Shermetaro et al addresses the management of supination-inversion injuries involving the distal tibia and suggests that surgical treatment in complex cases can lead to significant improvements in function. The research indicates that appropriate interventions are essential to prevent long-term complications and restore functional capacity in affected children, showing that surgical management can be beneficial when indicated. [7]

In the study conducted by Vestergaard et al, an analysis of distal fracture trends over 20 years reveals changes in treatment practices, indicating that surgical approaches have become more common for certain fractures. This study highlights the need to adapt treatment strategies to emerging trends and the demographic profile of the pediatric population, highlighting the importance of longitudinal data to guide clinical practice. [4]

Finally, Ali Al-Ashhab et al analyzes the treatment of Tillaux fractures in adolescents, highlighting that surgery can result in better functional outcomes compared to conservative approaches. The data reinforce the idea that surgical intervention is crucial for displaced fractures, as it promotes more effective and faster recovery, especially in young athletes, where functionality is a primary concern. [5]

The analysis of different surgical approaches for tibial fractures in children and adolescents reveals a growing consensus in the literature about the effectiveness and the need for individualization in treatment. The reviewed studies demonstrate that techniques such as elastic intramedullary nailing and circular external fixation not only ensure high union rates, but also minimize complications, especially in cases of unstable and complex fractures. The research by Li et al. emphasizes the importance of the surgeon's experience and the severity of the fracture as determining factors in the choice of method, reflecting a personalized approach that is becoming

increasingly relevant in the pediatric context. Furthermore, the evolution of surgical practices, highlighted by Koivisto et al., highlights the need to rigorously manage fractures in the pediatric population, as inappropriate interventions can result in long-term consequences.

Limitations of the studies include small sample sizes and variable methodologies that make generalization of the results difficult. The review also identifies gaps, such as the need for more studies focused on long-term functional outcomes and more standardized interventions. Priorities for future research include randomized controlled trials that evaluate direct comparisons between surgical and conservative approaches.

## 5. Conclusions

The synthesis of results suggests that surgical approaches for tibial fractures in children and adolescents are empirically supported, but often lack definitive guidelines. Analysis of the seven studies reveals the relevance of surgical interventions, but also highlights the need for more high-quality controlled studies to support clinical recommendations. In short, the interrelationship between fracture severity, patient specificities and surgeon experience must be carefully considered to optimize functional results. Thus, the review of the evidence suggests that, although there are multiple effective techniques, the adequacy and personalization of surgical treatment are essential to ensure rapid and effective recovery, especially in active adolescents who require immediate return to their daily activities.

The interrelationship between studies indicates the need for more comprehensive research that integrates different methodologies and designs treatment protocols that minimize complications and improve the recovery of young patients. Implications for medical practice include a better understanding of the most effective surgical methods and identification of areas requiring additional exploration to optimize pediatric orthopedic care.

## 6. Acknowledgement

This study was conducted as a fundamental part of the UNIGOU Training Program for the year 2024, promoted by the Institute of Czech-Brazilian Academic Cooperation (INCBAC Institute), with the aim of promoting the engagement and integration of Brazilian students in international scientific spaces.

## 7. References

- [1] Koivisto ST, Laaksonen T, Ahola JA, Helenius I, Stenroos A. *Epidemiology and management of proximal tibia fractures in children and adolescents: a population-based study based on the Kids' Fracture Tool*. Acta Orthopaedica. 2022

Oct 20;93:826–30.

- [2] Frei B, Mayr J, de Bernardis G, Camathias C, Holland-Cunz S, Rutz E. *Elastic stabile intramedullary nailing (ESIN) of diaphyseal femur fractures in children and adolescents*. *Medicine*. 2019 Apr;98(14):e15085.
- [3] Li Z, Wang P, Li L, Li C, Lu H, Ou C. *Comparison between open reduction with internal fixation to circular external fixation for tibial plateau fractures: A systematic review and meta-analysis*. Farouk O, editor. *PLOS ONE*. 2020 Sep 17;15(9):e0232911.
- [4] Vestergaard V, Pedersen AB, Tengberg PT, Troelsen A, Schrøder HM. *20-year trends of distal femoral, patellar, and proximal tibial fractures: a Danish nationwide cohort study of 60,823 patients*. *Acta Orthopaedica*. 2019 Dec 4;91(1):109–14.
- [5] Ali Al-Ashhab ME, Mahmoud Mohamed AA. *Treatment for displaced Tillaux fractures in adolescent age group*. *Foot and Ankle Surgery*. 2020 Apr;26(3):295–8.
- [6] Kothari V, Park C, Anshul Sobti, Hulme A, Ng S. *Classification and management of tibial tubercle avulsion fractures in children*. *British journal of hospital medicine*. 2024 Jul 16;1–7.
- [7] 1.Shermetaro J, Sosnoski D, Ramalingam W, Tamai J. *Management of Pediatric Supination-inversion Ankle Injuries Involving Distal Tibia and Intraepiphyseal Distal Fibula Fractures*. *JAAOS Global Research & Reviews [Internet]*. 2024 May 1 [cited 2024 Aug 1];8(5):e23.00284.