

Incidence of Open Tibial Fractures in Children and Adolescents: An Observational Retrospective Study

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Abstract

Background: Tibial fractures in children are a common orthopedic injury that can lead to significant morbidity and functional impairment. This study aimed to investigate the incidence, associated factors, treatment methods, and post-treatment complications of open and closed tibial fractures in children within a Bangladesh population. **Subjects and Methods:** This retrospective observational study was conducted at the Department of Orthopedics, DSK Hospital, Dhaka, Bangladesh, including 500 valid hospital records of pediatric tibial fractures treated between 2019 and 2021. The study itself was completed within 1 year, from January to December of 2022. Data was collected and analyzed using SPSS version 25 software. **Results:** Closed fractures were more common than open fractures (91.46% vs. 8.54%). The incidence of fractures was highest in the 13-18 years age group. Road traffic accidents were the most common cause of open fractures (58.70%), while falls from height were the predominant cause of closed fractures (60.13%). Surgical treatment was more frequent in open fractures (95.65%) compared to closed fractures (72.25%). Open fractures had a higher incidence of wound infection (6.52%) and delayed union (17.39%) compared to closed fractures (2.64% and 7.71%, respectively). **Conclusion:** This study highlights the importance of timely intervention and appropriate management of pediatric tibial fractures, particularly in the case of open fractures, to minimize complications and improve patient outcomes. Further research and prevention strategies are needed to reduce the incidence of pediatric tibial fractures and improve long-term outcomes.

Keywords: Pediatric, Orthopedic, Tibial, Fracture.

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Introduction

Tibial fractures are among the most common long-bone injuries in children, accounting for up to 15% of all pediatric fractures.^[1] The overall prevalence of pediatric fractures is estimated to be 300-400 fractures per 10,000 children per year.^[2] Open tibial fractures, although less common than closed fractures, pose a significant challenge to the healthcare system and the patients' well-being, especially in developing countries like Bangladesh, where access to healthcare facilities is often limited.^[3,4] The present study aimed to investigate the incidence of open tibial fractures in children in Bangladesh and provide insights into their management and complications. Pediatric fractures are a significant public health concern due to their potential impact on a child's daily life, growth, and development.^[5] Fracture incidence varies with age, as children's bones undergo a dynamic process of growth and remodeling. It has been reported that the risk of fractures increases with age, particularly during the adolescent growth spurt.^[6] Additionally, gender differences in fracture incidence have been reported, with boys experiencing fractures more frequently than girls.^[7] In Bangladesh, the prevalence of pediatric fractures remains underreported, with limited data available on the subject. Understanding the incidence of open tibial fractures in the Bangladeshi pediatric population will

contribute to the development of targeted prevention and treatment strategies. Tibial fractures can be classified into open and closed fractures. Open fractures occur when the bone breaks through the skin, creating an open wound, whereas closed fractures involve a broken bone without a breach in the skin. Open fractures are of particular concern due to their increased risk of complications, such as infection, nonunion, and delayed healing.^[8] Prompt and appropriate management of open tibial fractures is crucial in minimizing these complications and ensuring optimal outcomes for the child. Understanding the incidence and treatment of pediatric fractures in low- and middle-income nations has attracted increasing attention in recent years (LMICs). The management of open tibial fractures might be particularly difficult in these countries because of scarce resources and the limitations of the healthcare systems.^[9] This study seeks to address this knowledge gap by providing valuable insights into the incidence and management of open tibial fractures in Bangladesh, an LMIC with a high burden of pediatric fractures. Treatment approaches for open tibial fractures in children may vary depending on factors such as the severity of the injury, the presence of accompanying soft tissue damage, and the child's age. Initial management typically involves wound debridement, irrigation, and stabilization of the fracture using external fixation, casts, or intramedullary nails.^[10,11] Subsequent treatment may include bone grafting, wound closure, or soft tissue coverage procedures.^[12] The

management of closed tibial fractures, in contrast, is generally more straightforward, involving reduction and immobilization through casting or splinting.^[13,14] It is essential to note that the management of pediatric fractures may differ from that of adults due to the unique characteristics of growing bones, such as their increased healing capacity and the presence of growth plates.^[15] Therefore, understanding the specific challenges and considerations in treating open tibial fractures in children is crucial for improving patient outcomes. In conclusion, this retrospective observational study aims to provide valuable information on the incidence of open tibial fractures in children in Bangladesh. By understanding the prevalence and contributing factors to these injuries, healthcare providers can develop targeted strategies for prevention and treatment. Furthermore, this study will shed light on the challenges faced in managing open tibial fractures in a developing country, highlighting the need for improved healthcare infrastructure and access to specialized care.

Subjects and Methods

This retrospective observational study was conducted at the Department of Orthopedics, DSK Hospital, Dhaka, Bangladesh. The study duration was 1 year, from January 2022 to December 2022. During this period, a total of 500 valid hospital records of tibial fractures that were treated at the study hospital for the last 3 years (2019-2021) were included for the study. Ethical approval regarding the study was obtained before the data collection. Only completed records of any participants 18 years or younger presenting with open or close tibial fractures were included in the study, while patients older than 18 years and patients with incomplete hospital records were excluded from the study. Patients with fractures other than Tibial fractures were excluded if they had no tibial fractures as well. Data was collected using a pre-made data sheet and entered into an Excel sheet. Collected data was analyzed using SPSS V.25 software.

Results

Of the 500 tibial fractures, 46 (8.54%) were classified as open fractures, while the remaining 454 (91.46%) were categorized as closed fractures.

Among the 46 patients with open fractures, the age distribution was as follows: 10 (21.74%) were aged 0-6 years, 12 (26.09%) were aged 7-12 years, and 24 (52.17%) were aged 13-18 years. In the closed fracture group (n=454), the age distribution included 104 (22.91%) aged 0-6 years, 146 (32.16%) aged 7-12 years, and 205 (45.15%) aged 13-18 years. No significant difference was observed in age distribution between the two groups ($p > 0.05$). Regarding gender distribution, 33 (71.74%) of the open fracture patients were male, and 13 (28.26%) were female. In the closed fracture group, 337 (74.23%) were male, and 117 (25.77%) were female. The difference in gender distribution was not statistically significant between the two groups ($p > 0.05$).

The cause of injury differed significantly between the open and closed fracture groups ($p < 0.001$). In the open fracture group, road traffic accidents accounted for 27 (58.70%) cases, falls from height for 10 (21.74%) cases, sports injuries for 8 (17.39%) cases, and other causes for 1 (2.17%) case. Conversely, in the closed fracture group, road traffic accidents accounted for 131 (28.85%) cases, falls from height for 273 (60.13%) cases, sports injuries for 29 (6.39%) cases, and other causes for 21 (4.63%) cases. The only exception was the "Others" category, where the difference in the cause of injury was not statistically significant between the two groups ($p > 0.05$). [Table 1]

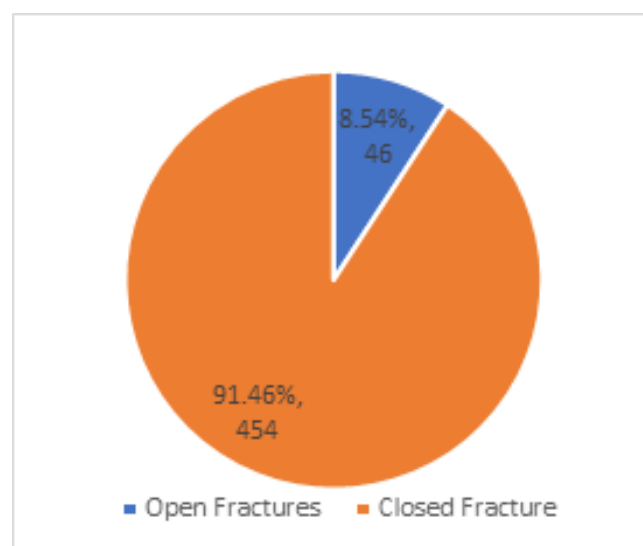


Figure 1: Distribution of participants by type of fracture (n=500)

In the open fracture group (n=46), lower limb fractures were found in 20 (43.48%) patients, upper limb fractures in 17 (36.96%), craniofacial fractures in 3 (6.52%), and multiple fractures in 6 (13.04%). No spinal or rib and sternum fractures were observed in this group. In comparison, the closed fracture group (n=454) had lower limb fractures in 137 (30.18%) patients, upper limb fractures in 178 (39.21%), craniofacial fractures in 85 (18.72%), spinal fractures in 16 (3.52%), fractures of the rib and sternum in 2 (0.44%), and multiple fractures in 37 (8.15%) patients. Statistical analysis revealed significant differences between the open and closed fracture groups in the distribution of associated fractures for lower limb fractures ($p < 0.001$), craniofacial fractures ($p < 0.001$), and multiple fractures ($p < 0.05$). However, no significant difference was observed between the two groups concerning upper limb fractures ($p > 0.05$), spinal fractures ($p < 0.05$), and fractures of the rib and sternum ($p > 0.05$). [Table 2]

Among the 46 patients with open fractures, surgical treatment was the primary intervention in 44 (95.65%) cases, while conservative treatment was applied in only 2 (4.35%) cases. In contrast, among the 454 patients with closed fractures, surgical treatment was utilized in 328 (72.25%) cases, and conservative treatment was employed in 126 (27.75%) cases. The difference in the treatment approach

between the open and closed fracture groups was statistically significant ($p < 0.001$), with a higher proportion of surgical interventions in the open fracture group compared to the closed fracture group. [Table 3]

In the open fracture group ($n=46$), the observed complications included wound infection in 3 (6.52%) patients, non-union in 3 (6.52%) patients, and delayed union in 8 (17.39%) patients, while malunion occurred in 3 (6.52%) patients. Among the open fracture patients, 42 (91.30%) experienced no complications following treatment. In the closed fracture group ($n=454$), the post-treatment

complications were as follows: wound infection in 12 (2.64%) patients, non-union in 15 (3.30%) patients, delayed union in 35 (7.71%) patients, and malunion in 37 (8.15%) patients. No complications were reported in 417 (91.85%) of the closed fracture patients. Statistical analysis revealed significant differences between the open and closed fracture groups in terms of wound infection ($p < 0.05$) and delayed union ($p < 0.001$). For non-union ($p > 0.05$), malunion ($p > 0.05$), and the lack of complications ($p > 0.05$), no significant differences were seen between the two groups. [Table 4]

Table 1: Distribution of participants by baseline characteristics (n=500).

| Variables | Open Fracture (n=46) | | Closed Fracture (n=454) | | p-value |
|-----------------------|----------------------|------------|-------------------------|------------|---------|
| | Frequency | Percentage | Frequency | Percentage | |
| Age | | | | | |
| 0-6 years | 10 | 21.74% | 104 | 22.91% | >0.05 |
| 7-12 years | 12 | 26.09% | 146 | 32.16% | |
| 13-18 years | 24 | 52.17% | 205 | 45.15% | |
| Gender | | | | | |
| Male | 33 | 71.74% | 337 | 74.23% | >0.05 |
| Female | 13 | 28.26% | 117 | 25.77% | |
| Cause of Injury | | | | | |
| Road Traffic Accident | 27 | 58.70% | 131 | 28.85% | <0.001 |
| Fall from height | 10 | 21.74% | 273 | 60.13% | <0.001 |
| Sports injury | 8 | 17.39% | 29 | 6.39% | <0.001 |
| Others | 1 | 2.17% | 21 | 4.63% | >0.05 |

Table 2: Distribution of participants by associated fractures alongside tibial fractures (n=500).

| Associated Fractures | Open Fracture (n=46) | | Closed Fracture (n=454) | | p-value |
|------------------------------|----------------------|------------|-------------------------|------------|---------|
| | Frequency | Percentage | Frequency | Percentage | |
| Lower Limb Fractures | 20 | 43.48% | 137 | 30.18% | <0.001 |
| Upper Limb Fracture | 17 | 36.96% | 178 | 39.21% | >0.05 |
| Craniofacial Fractures | 3 | 6.52% | 85 | 18.72% | <0.001 |
| Spinal Fractures | 0 | 0.00% | 16 | 3.52% | <0.05 |
| Fractures of Rib and Sternum | 0 | 0.00% | 2 | 0.44% | >0.05 |
| Multiple Fractures | 6 | 13.04% | 37 | 8.15% | <0.05 |

Table 3: Distribution of participants by treatment method (n=500).

| Treatment Method | Open Fracture (n=46) | | Closed Fracture (n=454) | | p-value |
|------------------------|----------------------|------------|-------------------------|------------|---------|
| | Frequency | Percentage | Frequency | Percentage | |
| Surgical Treatment | 44 | 95.65% | 328 | 72.25% | <0.001 |
| Conservative Treatment | 2 | 4.35% | 126 | 27.75% | |

Table 4: Distribution of participants by post-treatment complications (n=500)

| Post Treatment Complications | Open Fracture (n=46) | | Closed Fracture (n=454) | | p-value |
|------------------------------|----------------------|------------|-------------------------|------------|---------|
| | Frequency | Percentage | Frequency | Percentage | |
| Wound Infection | 3 | 6.52% | 12 | 2.64% | <0.05 |
| Non-Union | 3 | 6.52% | 15 | 3.30% | >0.05 |
| Delayed Union | 8 | 17.39% | 35 | 7.71% | <0.001 |
| Malunion | 3 | 6.52% | 37 | 8.15% | >0.05 |
| No Complications | 42 | 91.30% | 417 | 91.85% | >0.05 |

Discussion

The present study aimed to investigate the incidence of open and closed tibial fractures in children, their associated factors, treatment methods, and post-treatment complications in a Bangladesh population. Our findings indicate that closed fractures were more common than open fractures (91.46% vs. 8.54%), which is in line with previous research that reported a higher prevalence of closed fractures in pediatric populations.^[9] Regarding age distribution, our study found

that the incidence of fractures was highest in the 13-18 years age group for both open (52.17%) and closed (45.15%) fractures. This was consistent with previous studies that have suggested a higher risk of fractures in adolescents due to increased physical activity, involvement in sports, and risk-taking behaviors.^[1,7] However, the age distribution between open and closed fractures in our study did not reveal any significant differences ($p > 0.05$). The cause of injury showed significant differences between open and closed fracture groups, with road traffic accidents being the most common

cause for open fractures (58.70%), while falls from height were the predominant cause for closed fractures (60.13%). This finding is consistent with a 2017 study, which reported that road traffic accidents were the leading cause of open fractures in children.^[12] The greater energy impacts commonly associated with these events may be the cause of the increased frequency of open fractures from road traffic accidents. Our study also analyzed associated fractures alongside tibial fractures. We found a significant difference in the distribution of associated lower limb fractures ($p < 0.001$) and craniofacial fractures ($p < 0.001$) between the open and closed fracture groups. This finding highlights the importance of thoroughly assessing patients with open fractures for additional injuries, as these patients may have sustained multiple traumas due to the high-energy nature of their accidents.^[14] The treatment methods used for open and closed fractures in our study revealed a significant difference ($p < 0.001$), with a higher proportion of surgical interventions in the open fracture group (95.65%) compared to the closed fracture group (72.25%). This is expected, as open fractures often require surgical intervention to manage the associated soft tissue damage and reduce the risk of infection.^[8] In terms of post-treatment complications, our study found a significantly higher incidence of wound infection ($p < 0.05$) and delayed union ($p < 0.001$) in the open fracture group compared to the closed fracture group. These results are consistent with previous literature, which has reported a higher risk of infection and delayed union in open fractures due to the complexity of these injuries and their susceptibility to contamination.^[10,16] In conclusion, our study provides valuable insights into the epidemiology, treatment, and complications of pediatric tibial fractures in Bangladesh. The findings highlight the importance of timely intervention, particularly in the case of open fractures, to minimize the risk of complications and improve patient outcomes. Further research is needed to explore the long-term outcomes of pediatric tibial fractures and identify strategies to prevent these injuries in children.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community. The retrospective design of the study had further limited the variables possible to collect.

Conclusion

This retrospective study has provided essential insights into the incidence, associated factors, treatment methods, and post-treatment complications of open and closed tibial fractures in children within a Bangladesh population. Our findings showed a higher prevalence of closed fractures compared to open fractures and highlighted the significant differences in causes of injury and treatment approaches between the two groups. Moreover, the study demonstrated a higher incidence of wound infection and delayed union in open fractures, emphasizing the importance of prompt and appropriate management to minimize complications and

improve patient outcomes.

Recommendation

Based on the findings of this study, the following recommendations can be made to improve the prevention, management, and long-term outcomes of pediatric tibial fractures:

1. To decrease the prevalence of tibial fractures caused by traffic accidents and height falls, increase public awareness and educational programs on injury prevention and road safety, focusing on both parents and children.
2. Develop and implement guidelines for the early assessment and management of pediatric tibial fractures, with particular emphasis on timely intervention for open fractures to minimize complications and promote healing.
3. Encourage multidisciplinary collaboration between pediatric orthopedic surgeons, emergency physicians, and other healthcare professionals to optimize patient care and ensure the best possible treatment outcomes for children with tibial fractures.
4. Establish a national registry of pediatric tibial fractures to facilitate ongoing research, monitoring, and evaluation of fracture management, including long-term follow-up to assess functional outcomes and quality of life in affected children.
5. Conduct further research on the factors contributing to the development of complications in pediatric tibial fractures, with the aim of identifying modifiable risk factors and developing targeted interventions to prevent complications and improve patient outcomes.

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