



# Patterns of Dento-alveolar Fracture in Children

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## ABSTRACT

**OBJECTIVE:** Dento-alveolar fractures are a significant concern in pediatric dentistry, often resulting from falls, sports-related injuries, and motor vehicle accidents. This study aims to identify the specific patterns of dentoalveolar fractures in children at our center, addressing a gap in regional data.

**METHODOLOGY:** This retrospective study analyzed 185 pediatric patients ( $\leq 18$  years) with dento-alveolar fractures. Data on patients' demographic characteristics, etiology, fracture types, radiographic findings, and treatment modalities were evaluated using descriptive and inferential statistical analyses.

**RESULTS:** The mean age of patients was  $10.4 \pm 3.2$  years, with a male predominance (68%). Falls (42%) were the most common cause of injury, followed by sports-related trauma (28%) and motor vehicle accidents (18%). Maxillary anterior teeth were the most frequently affected site (52%), particularly the central incisors (38%). Soft tissue injuries accompanied 74% of cases, with lacerations (55%) and gingival bleeding (45%) being the most frequent. Uncomplicated crown fractures (Ellis Class I: 48%; Ellis Class II: 32%) were the most prevalent injury type, while luxation injuries (20%) and avulsions (8%) were less common. Significant associations were observed between gender and fracture type ( $p = 0.012$ ), as well as between motor vehicle accidents and mandibular fractures ( $p < 0.001$ ). Younger children ( $\leq 10$  years) and sports-related injuries were independent predictors of treatment failure ( $p < 0.05$ ).

**CONCLUSION:** Pediatric dento-alveolar fractures predominantly affect young boys, with falls and sports injuries being the leading causes. The maxillary anterior region, particularly the central incisors, is the most vulnerable. Findings highlight the need for age-specific and gender-targeted preventive measures, including school-based safety programs and the promotion of protective gear in contact sports.

**KEYWORDS:** dento-alveolar fractures, pediatric trauma, maxillary incisors, soft tissue injury, dental trauma epidemiology, fracture management.

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## INTRODUCTION

Dental trauma poses a public health concern, especially among children and adolescents.<sup>1</sup> It is highly prevalent in children under 10 years of age and has long-term potential consequences.<sup>2</sup> Traumatic dental injuries (TDI) can lead to functional impairment, pain, potential aesthetic concerns, and social and psychological distress, thereby affecting a child's overall quality of life.<sup>2</sup> The most injured teeth in TDI are maxillary incisors due to their prominent position in the oral cavity, making them highly susceptible to external impact and injury.<sup>3</sup> Understanding the epidemiology, etiology, and risk factors associated with dentoalveolar fractures is essential for implementing effective preventive and

management strategies.<sup>4</sup> Dento-alveolar Injury is defined as a fracture of the tooth confirmed clinically, characterized by a break in the continuity of the tooth resulting in two or more halves, and a fracture of the supporting bone (tooth socket) confirmed on X-ray showing a breach in the continuity of the alveolar bone.<sup>2</sup> The pattern of dento-alveolar injury is classified according to the Andreasen and Andreasen classification in terms of tooth fracture, tooth displacement, bone fracture, and soft tissue injury.<sup>4</sup>

Traumatic dental injuries (TDI) in children result from various factors, including falls, sports-related activities, road traffic accidents, and physical activities.<sup>5</sup> Previous studies have shown that TDI is the sixth most prevalent type of bodily injury, and the

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highest incidence is among children aged 7 to 12 years.<sup>6</sup> Previous research across different populations demonstrated that boys are more frequently affected than girls due to increased involvement in high-risk activities, and the most commonly injured teeth are the maxillary central incisors, followed by maxillary lateral incisors and mandibular incisors.<sup>7</sup> The most frequently observed type of dental injury in the pediatric population is coronal trauma.<sup>8</sup>

Several risk factors contribute to the increased incidence of dentoalveolar fractures in children.<sup>9</sup> These include involvement in outdoor activities, inadequate parental supervision, and the lack of protective gear, such as mouthguards, during sports.<sup>10</sup> Socioeconomic factors, including parental education level and access to emergency dental care, also influence the frequency and severity of dental trauma. Various studies estimate the prevalence of dentoalveolar injuries in permanent dentition to range between 14.0% and 19.0%, underscoring the urgent need for targeted preventive measures and improved treatment protocols.<sup>11,12</sup>

Although dental care has recently advanced, traumatic dental injuries remain a significant concern due to their potential long-term consequences on oral health and overall well-being. Appropriate and immediate management and intervention of dentoalveolar fractures is crucial to preventing serious complications, including pulp necrosis, tooth loss, and malocclusion. The recent advancements in dental trauma management, such as using bioactive materials, regenerative endodontic procedures, and improved splinting techniques, have improved treatment outcomes.<sup>13</sup> A gap remains in standardized protocols and accessibility to these interventions.

The impact of the COVID-19 pandemic on pediatric fracture patterns is also crucial; recent studies have demonstrated a shift in the mechanism of injury due to lifestyle changes and reduced outdoor activities.<sup>14</sup> All these factors highlight the altered nature of dental trauma epidemiology and the need for continuous surveillance and adaptation of preventive strategies.

This study aims to identify the specific patterns of dentoalveolar fractures in children at our center, addressing a gap in regional data. By analyzing the prevalence, causes, and characteristics of these injuries, our findings will contribute to the existing body of knowledge and aid policymakers in developing targeted preventive and management strategies. This will ultimately help reduce the burden of dental trauma among children and improve overall oral health outcomes.

## METHODOLOGY

This study was designed as a cross-sectional observational

study conducted over six months. The study was conducted at the Oral and Maxillofacial Surgery Department, Bacha Khan College of Dentistry, Mardan, Pakistan. The study was conducted from January 2023 to July 2023.

The sample size was determined using the WHO sample size formula, based on the following parameters: an anticipated frequency of dentoalveolar fracture ( $p$ ) = 14%, a margin of error = 5%, and a confidence level of 95%, resulting in a calculated sample size of 185 participants. A non-probability consecutive sampling technique was employed to recruit study participants.

**Sample Selection Inclusion Criteria:** (1) Patients aged 5 to 14 years. (2) Both genders. (3) Presenting with dentoalveolar fracture of the permanent tooth as per operational definitions.

**Exclusion Criteria:** (1) Congenital dental abnormalities. (2) Spontaneous fracture of the tooth. (3) Patients who could not recall the nature of the injury. (4) Patients with any comorbid disease. The study received ethical approval from the Ethical Review Committee of Bacha Khan College of Dentistry. Approval was granted on 12th January 2022 (Approval No. 13). Patients presenting with dentoalveolar fractures at the Oral and Maxillofacial Surgery Department of Mardan Medical Complex were included in the study based on the inclusion and exclusion criteria. Informed consent was obtained from all patients, ensuring complete confidentiality of their data. A detailed history and clinical examination were conducted using a mouth mirror, dental probe, and tongue depressor under overhead artificial light. Any injuries involving hard facial tissues and teeth were recorded. Radiographic assessments, including orthopantomography, periapical, and occlusal views, were performed as required to confirm the clinical findings and assess the nature of dentoalveolar injuries. The pattern of dentoalveolar injuries was documented as per the operational definitions. All data were recorded by the principal investigator on a specially designed proforma. Statistical analysis was performed using IBM SPSS version 25.

- Mean and standard deviation (or median and interquartile range for skewed data) were calculated for quantitative variables such as age and Body Mass Index (BMI).
- The Shapiro-Wilk test was primarily used to check the normality of the data.
- Frequencies and percentages were computed for qualitative variables, including gender, type of tooth injured, nature of injury, and pattern of injury.
- The pattern of injury was stratified based on age, gender, BMI, nature of injury, and type of tooth.
- Post-stratification, the Chi-square test was applied where applicable, and Fisher's exact test was used for small sample sizes (expected cell count <5).

- If the data for age and BMI were not normally distributed, the Mann-Whitney U test (for two groups) or Kruskal-Wallis test (for multiple groups) was used instead of a t-test.
- A p-value of  $\leq 0.05$  was considered statistically significant.
- Data results were presented in the form of tables and charts for clarity.

## RESULTS

This study included 185 pediatric patients (aged  $\leq 18$  years) diagnosed with dento-alveolar fractures. The mean age was  $10.4 \pm 3.2$  years, with a male predominance (68%). Falls were the most common cause of injury (42%), followed by sports-related trauma (28%) and motor vehicle accidents (18%). The most frequently affected site was the maxillary anterior region (52%), especially the central incisors (38%).

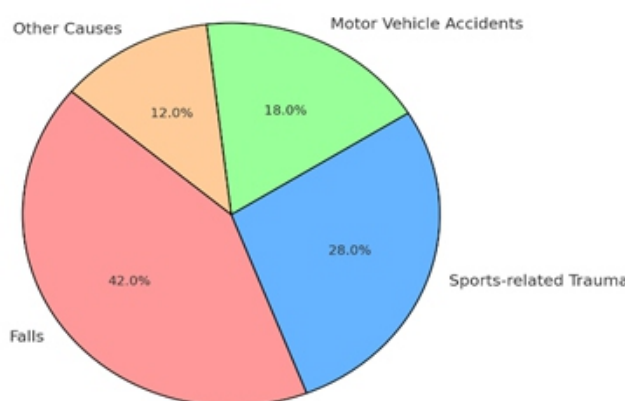
Soft tissue injuries were present in most cases (74%), primarily lacerations and gingival bleeding. Uncomplicated crown fractures (Ellis Class I and II) were the most prevalent, while luxation and avulsion injuries were less frequent.

Radiographic evaluations commonly utilized periapical X-rays (65%), and alveolar bone fractures were observed in 42% of the cases. Most patients were treated with splinting (58%) and repositioning (36%); surgical intervention was required in 15%.

Statistical analysis revealed significant associations between gender and fracture type ( $p = 0.012$ ), with males more frequently sustaining maxillary fractures. Motor vehicle accidents were strongly associated with mandibular fractures ( $OR = 2.45$ ,  $p < 0.001$ ).

Children aged 6–12 years sustained more extensive injuries, with a median of four teeth involved versus three in adolescents ( $p = 0.018$ ). Luxation injuries had the highest rate of pulp necrosis among all fracture types, showing a significant association with complications ( $p = 0.007$ ).

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Predictor Variable	Odds Ratio (OR)	95% CI	p-value
Age $\leq 10$ years	1.89	1.05 - 3.40	0.030*
Sports-related injuries	2.12	1.18 - 3.81	0.010*
Motor vehicle accidents	2.45	1.56 - 3.85	<0.001*
Luxation injuries (versus Crown Fracture)	1.75	0.92 - 3.30	0.087

Statistically significant ( $p \leq 0.05$ )

Table 1: Risk Factors for Severe Fractures (Binary Logistic Regression)

Fracture Type	Pulp Necrosis (%)	Infection (%)	Need for Reintervention (%)	p-value
Uncomplicated Crown Fractures (Ellis I & II)	12%	8%	5%	0.007*
Luxation Injuries	28%	15%	18%	
Avulsions	25%	22%	21%	

Table 2: Complication Rates by Fracture Type

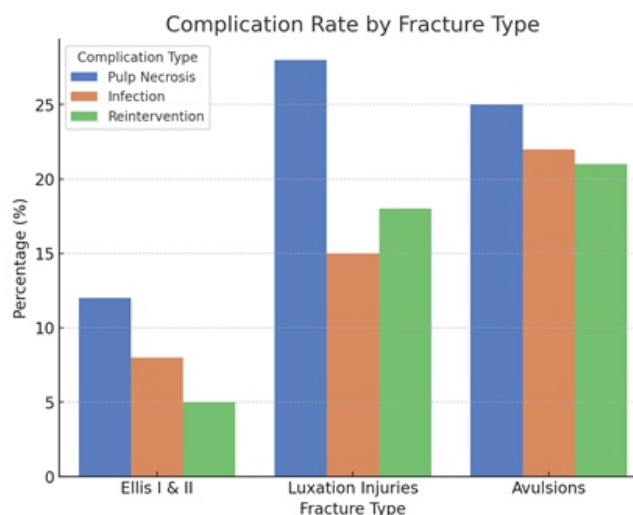


Figure 2: Complication rate by fracture type

Binary logistic regression identified age  $\leq 10$  years ( $OR = 1.89$ ,  $p = 0.030$ ) and sports-related injuries ( $OR = 2.12$ ,  $p = 0.010$ ) as independent predictors of treatment failure.

These findings emphasize the significant impact of age, gender, and injury mechanism on fracture pattern and treatment outcomes in pediatric dento-alveolar trauma.

## DISCUSSION

The findings of our study align with previous research on pediatric dental trauma, reinforcing the role of gender and age as key predisposing factors.<sup>14</sup> Similar to other retrospective and cross-sectional studies conducted globally, our data indicate a higher prevalence of dento-alveolar fractures in boys (68%),

likely due to greater engagement in high-risk physical activities. Additionally, we observed a peak incidence around 10 years, slightly later than the commonly reported age of 8 years, which may be attributed to variations in study populations and behavioral patterns.<sup>15</sup> Falls emerged as the leading cause of injury (42%), consistent with existing literature identifying simple falls as the primary etiology of dental trauma in children.<sup>16</sup> Furthermore, our study corroborates previous findings that maxillary central incisors are the most frequently affected teeth (38%), underscoring their anatomical vulnerability during facial impact.<sup>17</sup> These parallels with global research highlight the need for targeted prevention strategies, including school-based education programs and protective measures during play and sports activities.<sup>18</sup>

Our study's findings regarding the higher prevalence of dento-alveolar fractures in boys are consistent with previous research, which has reported male-to-female ratios ranging from 1.38 to 3:1.<sup>19</sup> The predominance of male patients (68%) in our study falls within this spectrum, suggesting that boys are more susceptible to dental trauma due to increased participation in outdoor activities and contact sports, similar to findings by Al-Jundi et al.<sup>20</sup> In contrast, Shayegan et al. reported a less pronounced gender difference (1.38:1) in a younger cohort (mean age: 5.3 years), indicating that gender disparities in trauma incidence may become more apparent with age.<sup>21</sup> Our data further support this trend, as older children exhibited more severe fractures, emphasizing the role of behavioral factors in trauma risk. These variations across studies underscore the need for region-specific preventive strategies, such as promoting the use of protective gear during sports and increasing awareness about pediatric dental trauma.

Our study aligns with previous research in identifying the maxillary incisors as the most frequently affected teeth in dento-alveolar trauma, which can be attributed to their prominent position in the dental arch and limited structural support.<sup>22</sup> Similar to the findings of previous studies, our data confirm that the maxillary central incisors (38%) are the most vulnerable, while mandibular anterior teeth are less frequently affected due to the flexibility of the mandible absorbing impact forces. Additionally, proclination of the maxillary incisors and increased overjet may further predispose these teeth to trauma. While some studies have reported a higher involvement of the maxillary left central incisor in single-tooth injuries and the right central incisor in multiple-tooth injuries, our study did not specifically analyze this variation. However, the presence of multiple-tooth involvement in more severe cases within our dataset supports previous findings that single-tooth injuries are more common, yet multiple-tooth injuries are prevalent in certain trauma mechanisms.<sup>23</sup> These findings reinforce the importance of early orthodontic assessment and preventive

measures, such as mouthguards, to minimize dental trauma risk in at-risk children. Our study also observed age-related variations in the pattern of dento-alveolar fractures, reinforcing findings from previous research. While we did not specifically assess the location of injuries, the peak incidence of trauma in children aged 6-12 years suggests that many of these injuries likely occurred in school settings, as reported in other studies. The higher prevalence of falls (42%) and sports-related injuries (28%) in our study further supports the importance of safe school environments and supervised play. Given that younger children are more prone to sustaining injuries at home, parental education on childproofing household spaces is crucial. Similarly, school teachers and caregivers should be trained to recognize and manage dental trauma promptly. The implementation of protective strategies, such as ensuring safe playground surfaces and promoting the use of mouthguards in contact sports, is essential for reducing the risk of dento-alveolar injuries in pediatric populations.

### Limitations

Despite the comprehensive analysis of dento-alveolar fractures in pediatric patients, this study has several limitations. First, the retrospective nature of the study may introduce selection and information bias, as data were collected from medical records rather than direct clinical observation.

Second, the study did not assess long-term treatment outcomes, such as the success of different management strategies or complications like pulp necrosis and tooth loss over time. A longitudinal follow-up would be beneficial in understanding the prognosis of dento-alveolar fractures and refining treatment protocols.

This study was conducted in a hospital-based setting, which may not fully reflect the epidemiology of dento-alveolar fractures in the general population, particularly in children who do not seek hospital care for minor injuries. Future studies should incorporate community-based data to provide a more representative picture of pediatric dental trauma.

## CONCLUSION

This study provides a comprehensive analysis of dento-alveolar fractures in pediatric patients, highlighting key epidemiological patterns and risk factors. Our findings confirm that boys are more frequently affected than girls, with a peak incidence occurring in children aged 6-12 years. Falls and sports-related trauma emerged as the leading causes of injury, with maxillary anterior teeth—particularly the central incisors—being the most commonly affected due to their prominent position in the dental arch. Soft tissue injuries were a frequent accompaniment, emphasizing the complex nature of dental trauma. The severity and pattern of fractures varied significantly



with age, gender, and mechanism of injury, reinforcing the need for targeted preventive strategies.

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### Conflict Of Interest

The authors declare no conflict of interest.

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#### CONFLICT OF INTEREST

Author declare no conflict of interest.

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#### AUTHORS CONTRIBUTIONS

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**AK:** Conception, Design of the work, Acquisition, Data Analysis, and Drafting, Reviewed, Final approval, Agreement to be accountable.

**MH:** Conception, Design of the work, Interpretation of data for the work, and Drafting, Final approval, Agreement to be accountable.

**KZ:** Conception, Design of the work, Final approval, Agreement to be accountable.

**SU:** Conception, Design of the work, Reviewed, Final approval, Agreement to be accountable.

**UB:** Conception, Design of the work, Data analysis, and Drafting, Reviewed, Final approval, Agreement to be accountable

#### DATA SHARING POLICY

The data that support the findings of this study are available from the corresponding author upon reasonable request



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