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ORIGINAL RESEARCH

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Epidemiological and clinical characteristics of traumatic dental injuries in pediatric patients aged 0–14 years: a retrospective study

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Abstract

Background: This study investigated the epidemiological and clinical characteristics of traumatic dental injuries (TDIs) in children, focusing on etiology, injury type, treatment, prognosis, and follow-up compliance to inform preventive and therapeutic strategies. **Methods**: A retrospective cross-sectional analysis was conducted using records of 138 pediatric patients aged 0–14 years who presented with TDIs to the Department of Pediatric Dentistry at Mersin University between March 2024 and March 2025. Patient- and tooth-related variables were examined. **Results**: TDIs occurred most frequently among 8-year-olds (16.7%). Falls were the most common cause (58.0%), and maxillary incisors were the most affected teeth (tooth 21: 39.2%; tooth 11: 32.2%). The most frequent treatment was repositioning, splinting, and pulpectomy (25.1%), followed by restoration (24.2%). At follow-up, 91.6% of traumatized teeth survived, while 3.5% required additional treatment. **Conclusions**: TDIs are a significant pediatric public health issue. Falls are the leading cause, and maxillary incisors are the most often injured. Early treatment and regular follow-ups improve outcomes; however, timely presentation remains low. Raising public awareness, educating parents and caregivers, and enhancing emergency access to pediatric dental care may improve prognosis and reduce TDI burden.

Keywords

Traumatic dental injury; Pediatric patients; Retrospective analysis

1. Introduction

Traumatic dental injuries (TDIs) are a prevalent oral health problem affecting both primary and permanent dentitions, particularly in children. Pediatric patients are more susceptible to these injuries due to their underdeveloped motor coordination and limited ability to perceive potential risks [1]. Falls and collisions are the most common causes of TDIs, especially during the toddler stage when children are learning to crawl, walk, and run [2]. The incidence of dental trauma is highest in children up to 12 years of age and gradually decreases thereafter [2]. Furthermore, boys are more frequently affected than girls, highlighting a notable gender disparity in TDI prevalence [3].

Several studies have identified increased overjet, incompetent lip closure, and Class II occlusal relationships as significant risk factors for anterior dental trauma [4, 5].

Approximately 30% of traumatic dental injuries occur in the primary dentition, while around 20% affect the permanent dentition [6]. Beyond the teeth themselves, TDIs may compromise surrounding soft tissues, alveolar bone, and the psychosocial well-being of the child. Inadequate management can lead to complications, such as infection, pulp necrosis, premature tooth loss, esthetic concerns, and psychological trauma, that adversely affect a child's quality of life. In addition, treatment costs and the burden on healthcare systems underscore the importance of early and effective intervention [7, 8]. Epidemiological studies have demonstrated that the prevalence of TDIs varies worldwide depending on etiological factors, age groups, gender differences, and occlusal risk factors. However, regional investigations remain critical for identifying local risk determinants, raising community awareness, and developing targeted preventive strategies [9]. Educational initiatives and awareness campaigns are vital for informing parents, teachers, and healthcare professionals about dental trauma risks and the importance of prompt emergency management. Such efforts can help reduce trauma incidence and improve treatment outcomes [8].

Southern Turkiye represents a significant region for such investigations due to its distinctive socioeconomic, cultural, and environmental characteristics. The relatively high proportion of children, extended outdoor activity time, and the prevalence of seasonal recreational activities (*e.g.*, cycling, street games, swimming, and football) contribute to a heightened risk of dental trauma [10]. Furthermore, widespread participation in sports, limited use of protective equipment, and insufficient

parental knowledge of dental trauma increase both the frequency of these injuries and the risk of complications [10]. Regional disparities in healthcare access may further affect treatment outcomes. Data obtained from Southern Turkiye can, therefore, contribute not only to regional health policy planning, but also serve as a reference for areas with similar socioeconomic and cultural contexts.

Accordingly, the present study aimed to evaluate the distribution of trauma-related factors in pediatric patients with TDIs who presented to the Department of Pediatric Dentistry at Mersin University. Specifically, patient-related variables (age, gender, trauma etiology, time elapsed before presentation, soft tissue involvement, history of recurrent trauma, and compliance with follow-up) and tooth-related variables (tooth number, dentition type, diagnosis, prognosis, and treatment methods) were analyzed.

2. Material and methods

This retrospective study analyzed the records of pediatric patients aged 0–14 years who presented with a history of dental trauma to the Pediatric Dentistry Clinic at Mersin University, located in the southern region of Turkey, between March 2024 and March 2025. Patients who presented either immediately after the traumatic event or at a later time following trauma were included in the study.

Ethical approval was obtained from the Mersin University Clinical Research Ethics Committee (Approval No: 2025/366).

2.1 Eligibility criteria

2.1.1 Inclusion criteria

Patients were included if they met all of the following criteria:

• Aged between 0 and 14 years at the time of traumatic injury.

• Presence of a clinically and/or radiographically confirmed traumatic dental injury (TDI) involving primary or permanent teeth and/or associated soft tissues.

• Presentation to the clinic during the study period, either immediately after trauma or at a later time.

• Availability of complete clinical records, including at least one documented follow-up visit or a final clinical status assessment.

2.1.2 Exclusion criteria

Patients were excluded if they met any of the following criteria:

• Presence of hard tissue disorders unrelated to trauma (*e.g.*, dental caries, developmental enamel defects).

• Incomplete or inadequate records (missing data regarding type of injury, affected tooth, trauma-to-visit interval, or treatment applied).

• Cases treated exclusively at another healthcare facility without documentation in our clinic records.

• Records restricted for medico-legal reasons.

To minimize selection bias, all patients presenting with dental trauma during the study period who met the inclusion criteria were evaluated. Cases with incomplete records were excluded. Information bias was reduced by relying on both clinical and radiographic documentation.

2.2 Data collection and variables

Data were extracted from electronic patient records (Nucleus v9.40.220). The following variables were recorded:

• Demographic data (age, sex).

• Time interval between trauma and hospital admission.

• Etiology of trauma (falls, sports injuries, bicycle accidents, fights, traffic accidents, being hit by an object, collision with another person).

• Type of traumatic dental injury.

• Presence of soft tissue and supporting bone injuries.

• History of recurrent trauma.

• Need for emergency treatment.

• Follow-up attendance.

• Prognostic outcome.

Traumatic dental injuries were classified into:

• Hard tissue injuries: uncomplicated crown fracture, complicated crown fracture, complicated crown-root fracture, root fracture, alveolar fracture.

• Periodontal tissue injuries: concussion, subluxation, extrusive luxation, lateral luxation, intrusive luxation, and avulsion.

All TDIs were classified according to Andreasen's criteria to ensure consistency [11].

2.3 Calibration and reliability

Data extraction was performed independently by two calibrated researchers using predefined criteria. Inter-rater agreement was assessed on a subset of 20 randomly selected patient records. Discrepancies were resolved through discussion and consensus.

2.4 Treatment modalities

Treatment approaches included observation, extraction, repositioning and splinting, repositioning with splinting and pulpectomy, pulpotomy, restoration, apexification, regenerative endodontic procedures (REP), Cvek pulpotomy, and direct pulp capping.

2.5 Prognostic outcome assessment

Prognosis was categorized into three outcome groups:

• Survived:

• Teeth that remained asymptomatic, showed age-appropriate mobility, normal percussion response, and, in permanent teeth, a positive vitality test, with no evidence of pathological root resorption or periapical lesions on radiographs.

• Need for further treatment:

• Teeth requiring additional intervention due to pain, swelling, sinus tract formation, pulp necrosis, inflammatory or replacement resorption, progressive periapical radiolucency, or excessive mobility.

• Missed (lost):

• Teeth that were extracted as a consequence of trauma-related complications or that could not be followed up.

For permanent teeth, survival was defined as the tooth remaining in the oral cavity without extraction due to trauma-related causes.

For primary teeth, survival was defined as retention of the tooth until natural exfoliation, with loss occurring only upon the physiological eruption of the permanent successor.

2.6 Statistical analysis

A trained researcher entered the data into an Excel database (Microsoft 365, Microsoft Inc., Redmond, WA, USA). Data from 138 patients were statistically analyzed using IBM SPSS Statistics for Windows (Version 22.0; IBM Corp., Chicago, IL, USA).

Descriptive statistics and frequency analyses were used to summarize demographic characteristics, trauma etiology, trauma types, tooth distribution, treatment modalities, and prognostic outcomes. Data were analyzed at both the patient level and the tooth level. Tooth-level variables (type of injury, treatment modality, prognosis, and survival) were recorded separately for each affected tooth, whereas patient-level data included trauma etiology, epidemiological characteristics, time of presentation, history of recurrent trauma, and adherence to follow-up appointments.

The chi-square test was applied to evaluate the association between age groups and trauma etiology. A p-value of < 0.05 was considered statistically significant.

3. Results

A total of 138 pediatric patients with traumatic dental injuries were included in the study, comprising 86 males (62.3%) and 52 females (37.7%). The majority of patients were in the 6–11-year age group (n = 83, 60.1%), followed by the 12–14-year group (n = 41, 29.7%) and the 0–5-year group (n = 14, 10.1%) (Table 1).

Regarding the time interval between trauma and presentation to the clinic, most patients presented more than 7 days after the injury (n = 60, 43.5%). Only 16 patients (11.6%) sought care within the first 3 hours following trauma, while 17 patients (12.3%) presented between 3 and 24 hours and 45 patients (32.6%) between 1 and 7 days after the traumatic event (Table 1).

Falls were the most common etiological factor, accounting for 58.0% (n = 80) of all injuries, followed by being hit by an object (n = 27, 19.6%) and sports-related injuries (n = 8, 5.8%). Less frequent causes included bicycle accidents (4.3%), fights or battles (4.3%), traffic accidents (2.2%), collision with another person (2.9%), and other causes (2.9%) (Table 2).

When trauma etiology was analyzed according to age groups, falls were the predominant cause in all age categories, but were especially frequent in children aged 0–5 years (78.6%). In the 6–11-year group, falls (63.9%) and being hit by an object (15.7%) were the most common etiological factors. In contrast, in the 12–14-year group, falls (39.0%) remained the leading cause, followed by being hit by an object (29.3%) and sports-related injuries (9.8%). These findings indicate a shift from predominantly fall-related injuries in early childhood toward more activity- and environment-related trauma mechanisms in older children (Table 2).

TABLE 1. Demographic characteristics and time interval between trauma and presentation to the clinic among pediatric patients with traumatic dental injuries (n = 138).

Variable	Category	n	%
Age group (yr)			
	0–5	14	10.1
	6–11	83	60.1
	12–14	41	29.7
Gender			
	Female	52	37.7
	Male	86	62.3
Time interval between trauma and presentation			
	≤3 h	16	11.6
	3–24 h	17	12.3
	1–7 d	45	32.6
	>7 d	60	43.5

Values are presented as number (n) and percentage (%). h: hour; d: day.

A total of 227 traumatized teeth were recorded in the 138 patients. Maxillary central incisors were the most frequently affected teeth (n = 162, 71.4%), followed by primary incisors (n = 31, 13.7%) and mandibular incisors (n = 17, 7.5%). Maxillary lateral incisors accounted for 6.6% of all affected teeth, while other teeth were rarely involved (0.9%) (Table 3).

With respect to the type of traumatic dental injuries, the most commonly observed injuries were uncomplicated crown fractures (n = 68, 30.0%), complicated crown fractures (n = 52, 22.9%), and subluxations (n = 28, 12.3%). Intrusive luxations accounted for 11.5% (n = 26) of all injuries, whereas avulsions were observed in 7.5% (n = 17) of cases. Other injury types, including root fractures, lateral luxations, and alveolar fractures, were less frequently encountered (Table 2).

The most frequently applied treatment modalities were repositioning with splinting and pulpectomy (n = 57, 25.1%), restoration (n = 55, 24.2%), and observation (n = 48, 21.1%). Less commonly used treatments included repositioning and splinting alone (7.5%), Cvek pulpotomy (7.5%), apexification (5.3%), regenerative endodontic procedures (4.0%), extraction (3.5%), pulpotomy (1.3%), and direct pulp capping (0.4%) (Table 3).

Regarding prognostic outcomes based on a tooth-level analysis, 208 teeth (91.6%) survived during the follow-up period. Eight teeth (3.5%) required further treatment due to post-traumatic complications, while 11 teeth (4.8%) were lost or extracted as a consequence of trauma-related sequelae (Table 3).

Recurrent trauma was observed in 8 patients (5.8%). Follow-up attendance was recorded in 104 patients (75.4%), whereas 34 patients (24.6%) did not attend scheduled follow-up visits (Table 3).

TABLE 2. Distribution of traumatic dental injuries according to etiology, trauma type, and age group (n = 138).

Variable	Category	0–5 years n (%)	6–11 years n (%)	12–14 years n (%)	Total n (%)
Etiology					
	Falls	11 (78.6)	53 (63.9)	16 (39.0)	80 (58.0)
	Sports injuries	0 (0.0)	4 (4.8)	4 (9.8)	8 (5.8)
	Bicycle accidents	1 (7.1)	3 (3.6)	2 (4.9)	6 (4.3)
	Fights/battles	0 (0.0)	3 (3.6)	3 (7.3)	6 (4.3)
	Traffic accidents	0 (0.0)	2 (2.4)	1 (2.4)	3 (2.2)
	Hit by an object	2 (14.3)	13 (15.7)	12 (29.3)	27 (19.6)
	Collision with another person	0 (0.0)	3 (3.6)	1 (2.4)	4 (2.9)
	Other*	0 (0.0)	2 (2.4)	2 (4.9)	4 (2.9)
	Total	14 (100)	83 (100)	41 (100)	138 (100)
		Total n	(%)		
Trauma type					
	Uncomplicated crown fracture	68	30.0		
	Complicated crown fracture	52	22.9		
	Complicated crown-root fracture	6	2.6		
	Root fracture	9	4.0		
	Alveolar fracture	1	0.4		
	Concussion	5	2.2		
	Subluxation	28	12.3		
	Extrusive luxation	4	1.8		
	Lateral luxation	11	4.8		
	Intrusive luxation	26	11.5		
	Avulsion	17	7.5		
	Total	227	100		

Values are presented as number (n) and percentage (%). Percentages in age-group columns are calculated within each age group. Age groups were defined as follows: 0–5 years (early childhood), 6–11 years (middle childhood), and 12–14 years (adolescence). The "other" category comprised rare and heterogeneous trauma mechanisms, including playground-related injuries, door-related accidents, and accidental blows at home, each occurring in fewer than two cases.*

3.1 Relationship between age group and trauma etiology

To assess whether the cause of dental trauma (etiology) differs across developmental stages, patients were categorized into three age groups:

- 0–5 years: Early childhood;
- 6–11 years: Middle childhood;
- 12+ years: Adolescence and beyond.

A Chi-Square test of independence revealed no statistically significant association between age group and trauma etiology ($\chi^2(14) = 15.874$, $p = 0.3211$). Although certain etiologies (*e.g.*, falls, collisions) appeared more frequent in middle childhood, the overall distribution did not demonstrate a consistent or meaningful variation across age groups.

3.2 Trauma etiology and gender

The relationship between trauma etiology and gender was also assessed using the Chi-Square test. The analysis showed no statistically significant association between the variables ($\chi^2(7) = 11.540$, $p = 0.1167$). This suggests that trauma causes were distributed similarly among male and female patients.

3.3 Gender and time to seek care

A Mann-Whitney U test was conducted to compare the time elapsed between trauma and hospital arrival across genders.

The results indicated no significant difference between male and female patients in terms of time to presentation ($U = 2341.0$, $p = 0.4333$).

3.4 Soft tissue involvement and time to seek care

Similarly, the relationship between soft tissue injury and the time to seek care was evaluated.

The analysis showed no statistically significant difference between patients with and without soft tissue involvement ($U = 1794.0$, $p = 0.1709$).

TABLE 3. Tooth distribution, treatment modalities, prognostic outcomes, and follow-up characteristics of traumatic dental injuries.

Variable	Category	n	%
Tooth distribution			
	Maxillary central incisors (11, 21)	162	71.4
	Maxillary lateral incisors (12, 22)	15	6.6
	Mandibular incisors (31, 32, 41, 42)	17	7.5
	Primary incisors (51, 52, 61, 62, 63)	31	13.7
	Other teeth	2	0.9
	Total	227	100
Treatment modalities			
	Observation	48	21.1
	Restoration	55	24.2
	Direct pulp capping	1	0.4
	Cvek partial pulpotomy	17	7.5
	Pulpotomy	3	1.3
	Repositioning and splinting	17	7.5
	Repositioning, splinting, and pulpectomy	57	25.1
	Apexification	12	5.3
	Regenerative endodontic procedure (REP)	9	4.0
	Extraction	8	3.5
	Total	227	100
Prognostic outcomes			
	Survived	208	91.6
	Need for further treatment	8	3.5
	Missed (lost/extracted)	11	4.8
	Total	227	100
Recurrence and follow-up			
	Recurrent trauma (Yes)	8	5.8
	Recurrent trauma (No)	130	94.2
	Follow-up attendance (Yes)	104	75.4
	Follow-up attendance (No)	34	24.6

Values are presented as number (n) and percentage (%). REP: regenerative endodontic procedure. Prognostic outcomes were assessed on a tooth basis. Recurrence and follow-up attendance were assessed on a patient basis.

3.5 Trauma diagnosis and dentition type

A statistically significant association was found between trauma diagnosis and dentition type ($\chi^2(10) = 75.607$, $p < 0.001$).

This finding indicates that certain types of dental trauma are more commonly observed in either primary or permanent dentition. Specifically:

• Uncomplicated crown fractures and Complicated crown fractures were markedly more frequent in permanent teeth.

• Avulsion and Root fractures also predominantly affected permanent dentition.

• In contrast, Concussion, Subluxation, and Lateral luxation occurred more often in primary teeth, although they were also observed in permanent teeth to a lesser extent.

These results emphasize the importance of considering dentition status in trauma diagnosis and management planning. The distribution of trauma diagnoses by dentition type is presented in Fig. 1.

The relationship between diagnosis and prognosis in primary dentition was evaluated using the Pearson chi-square test. The analysis revealed a statistically significant association between diagnosis and prognosis ($\chi^2 = 17.371$, $df = 6$, $p = 0.008$). In permanent dentition, the relationship between diagnosis and prognosis was also assessed using the Pearson chi-square test. However, no statistically significant association was found between diagnosis and prognosis ($\chi^2 = 20.806$, $df = 20$, $p = 0.409$). The relationship between diagnosis and prognosis in primary and permanent teeth is presented in Figs. 2,3.

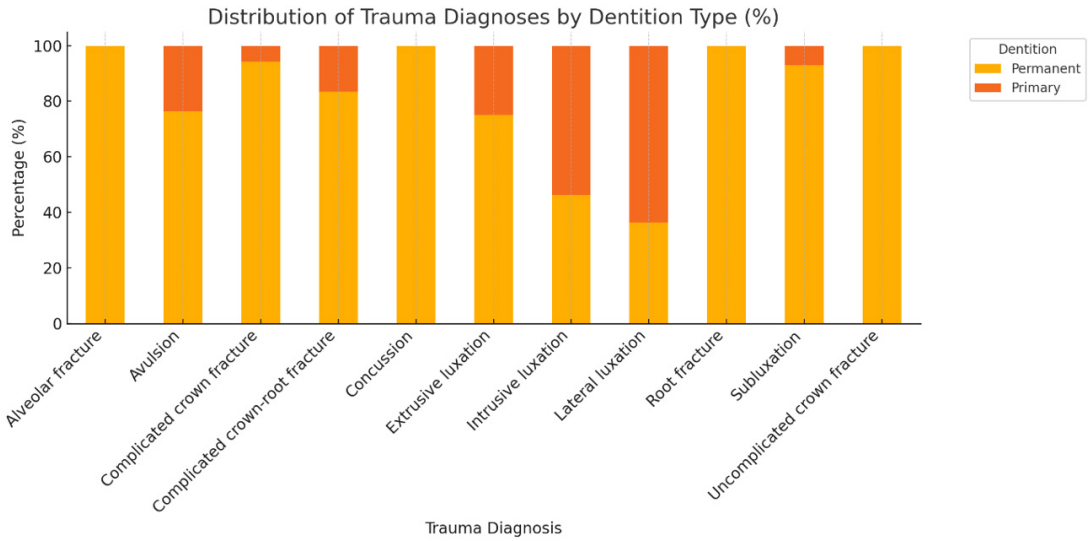

FIGURE 1. Distribution of trauma diagnoses by dentition type.

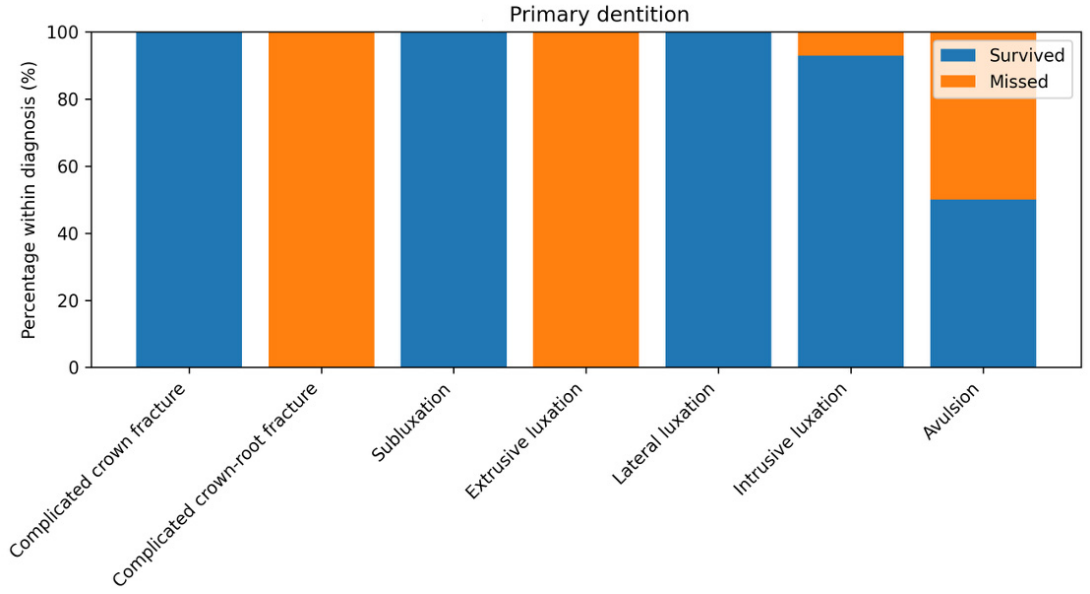

FIGURE 2. The relationship between diagnosis and prognosis in primary dentition.

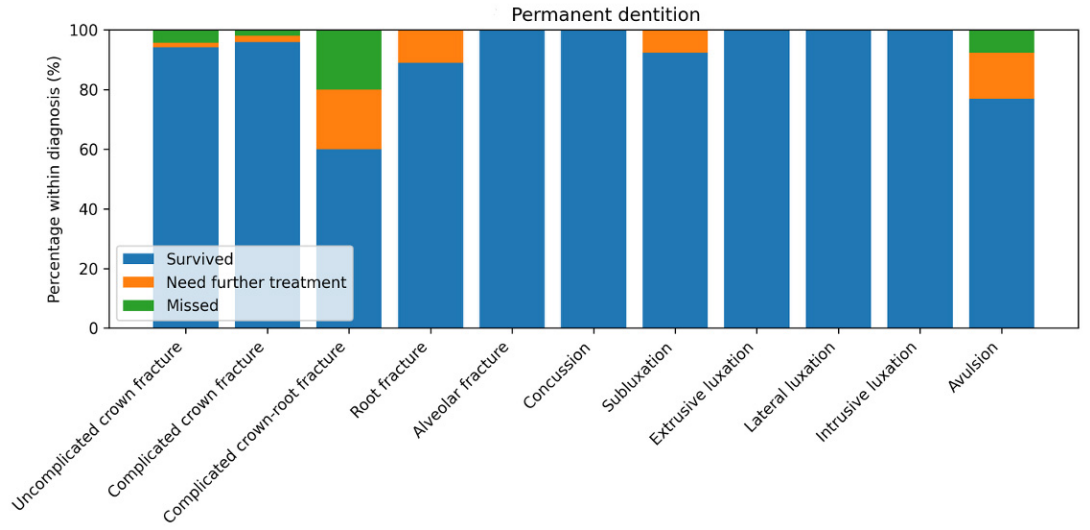

FIGURE 3. The relationship between diagnosis and prognosis in permanent dentition.

4. Discussion

While dental traumas can occur at any age, they are particularly prevalent during childhood [12]. Examining and treating young children who have experienced trauma is often challenging due to fear and anxiety. However, untreated TDIs can lead to poor prognoses, such as early tooth loss, which may negatively impact a child's functional and psychological well-being [11].

The frequent occurrence of dental injuries among children and adolescents can be linked to numerous predisposing factors, including gender, age, and a history of previous trauma. Prompt and accurate management of TDIs by caregivers and healthcare professionals is of great importance for the long-term prognosis of the affected teeth. The aim of this study was to determine the characteristics, types, treatment methods, prognoses, and follow-up attendance of TDIs in pediatric patients, in order to enrich epidemiological knowledge and contribute to the improvement of treatment, prevention, and education related to TDIs [13]. In this context, the present study aimed to evaluate the demographic characteristics, etiological factors, trauma types, treatment modalities, prognostic outcomes, and follow-up attendance of traumatic dental injuries in pediatric patients [13].

In this study, males demonstrated a higher susceptibility to dental trauma compared to females, a trend that aligns with findings from numerous epidemiological studies across different pediatric age groups [13, 14].

This gender disparity may be explained by behavioral and physiological factors; males are generally more engaged in outdoor and high-impact physical activities, which increases the risk of injury [15, 16]. Furthermore, sex-related differences in physiological responses to stress have been reported in the literature. However, the underlying neurobiological mechanisms and their potential association with risk-taking behaviors or susceptibility to traumatic incidents remain unclear [17, 18].

The etiology of TDIs in both primary and permanent dentitions has been extensively documented in the literature, with common causes including falls, bicycle-related accidents, traffic collisions, and instances of child abuse [19–21].

In the three-year retrospective analysis of traumatic dental injuries in primary teeth conducted by Özgür *et al.* [14] in Columbus, Ohio, USA, the most common cause of primary tooth injury was reported to be "fall accidents" (82%). Our study similarly identified falls as the predominant cause of dental trauma among pediatric patients. This finding also aligns with epidemiological data reported in other studies conducted within our country. Understanding these etiological factors is crucial for developing targeted prevention strategies and informing public health policies aimed at reducing the incidence of such injuries [19, 22].

One of the most critical factors affecting the prognosis of traumatized teeth is the time interval between the trauma and the presentation to a healthcare facility. In our study, when evaluating the time elapsed before seeking care, the majority of cases presented within 2–7 days, followed by presentations within 24–48 hours. Only 7.4% of patients sought care within the first 1–2 hours after trauma. These findings indicate that early intervention rates following trauma remain relatively low. In a study conducted by Eyuboglu *et al.* [22] in the Eastern Anatolia Region of Turkey, it was reported that most patients with severe dental trauma visited the pediatric dentistry clinic within the first three days, while 41% sought dental care three weeks post-injury. The authors attributed this delay to harsh winter conditions in the region, which limit easy access to pediatric dental clinics. Conversely, Gümüş *et al.* [19] found that 47.2% of patients presented to the pediatric dentistry department within the first 24 hours after trauma, while Šimunović *et al.* [23] observed that only 35.38% of patients sought dental treatment within the crucial first 24 hours following a traumatic dental injury.

Despite milder climate conditions and easier transportation access in our region, only 24.2% of patients presented within the first 24 hours, further highlighting the low rates of early intervention and the prevalence of delayed presentations.

Correct and timely post-trauma intervention is essential in dental injuries, as prognosis heavily depends on it. Delayed treatment often necessitates more complicated and costly procedures. Unfortunately, parental awareness regarding the urgency of seeking immediate dental care after trauma remains considerably low.

Previous studies have reported that TDIs are more common in the permanent dentition [24, 25]. Consistent with these findings, our study demonstrated a higher prevalence of dental trauma in permanent teeth compared with primary teeth. This difference may be attributed to the lower participation of young children in physical activities, thereby reducing their risk of trauma [26].

When examining the types of injuries, the most common TDI in our study was uncomplicated crown fracture (30.0%). This finding is consistent with the results of Díaz *et al.* [25], who reported that uncomplicated crown fractures were the most frequent hard tissue injury in permanent dentition (32.9%) among children and adolescents attending a public hospital in Temuco, Chile. However, it contrasts with the findings of Sari *et al.* [27], who indicated that enamel fractures were the most common fractures in permanent teeth. Other frequently observed injuries in our study included complicated crown fractures (22.9%), subluxation (12.3%), intrusion (11.5%), and avulsion (7.5%). The least common injury was alveolar fracture, accounting for only 0.4% and recorded in a single case. Other rare injuries included extrusion (1.8%), concussion (2.2%), complicated crown-root fracture (2.6%), root fracture (4.0%), and lateral luxation (4.8%).

In recent years, there has been increasing emphasis on conservative vital pulp therapies for the management of complicated crown fractures in immature permanent teeth, with the primary aim of preserving pulp vitality and allowing continued root development. Mineral trioxide aggregate (MTA) has been widely advocated as a bioactive material that promotes dentin bridge formation and supports apexogenesis in young permanent incisors [28].

A recent case report by Dubey and Rathore demonstrated successful apexogenesis following MTA application in a young permanent incisor with a complicated crown fracture, highlighting the potential of conservative vital pulp therapy to achieve favorable long-term prognostic outcomes. These

findings support the use of vital pulp therapies, such as partial pulpotomy and direct pulp capping, as viable treatment options in appropriately selected cases of traumatic dental injuries in pediatric patients [28].

Consistent with Dang *et al.* [29] and Frankenhaeuser *et al.* [17], subluxation was identified as the most common periodontal tissue injury in our study. Sae-Lim *et al.* [30] reported that 45% of TDIs were accompanied by soft tissue injuries, often involving multiple teeth. Similarly, in our study, soft tissue trauma was present in 34.1% of patients, with lesions most commonly observed on the lips, cheeks, and gingiva.

These findings highlight the diverse spectrum of TDIs in the pediatric population, emphasizing the need for tailored diagnostic and treatment approaches according to injury type and severity. Given that injuries such as complicated crown fractures and luxations often require more complex management and carry a higher risk of long-term complications, prompt and accurate diagnosis is crucial. Furthermore, the notable prevalence of soft tissue injuries alongside hard tissue trauma underscores the importance of comprehensive clinical evaluation to address all aspects of trauma and optimize patient outcomes.

There is a consensus in the literature that the maxillary incisors are the most commonly affected teeth by trauma in both primary and permanent dentitions, with no significant difference between the sides of the mouth. Similarly, in our study, the upper teeth were significantly more frequently affected by trauma compared with the lower teeth. This higher susceptibility is attributed to the prominent and exposed position of the maxillary teeth in the oral cavity, making them more vulnerable to fractures than the mandibular teeth [31]. Given the critical role of maxillary incisors in both esthetics and function, trauma to these teeth can have significant psychological and social impacts on pediatric patients, further emphasizing the importance of early diagnosis and management [11]. Delayed presentation often limits the possibility of conservative approaches, making more invasive procedures necessary. These treatment options also require careful follow-up to monitor healing, detect potential complications, such as root resorption or periapical pathology, and ensure long-term tooth preservation.

Another factor that may negatively affect the prognosis of TDIs is the occurrence of repeated trauma. If the etiological factors triggering the initial trauma remain unchanged and the patient or caregivers are not adequately informed to prevent recurrence, secondary trauma is highly likely. The frequency of multiple dental trauma episodes has been reported to be as high as 49% in patients with TDIs, with repeated injuries to the same teeth ranging between 8% and 45% [32–34].

In our study, the rate of repeated trauma was relatively low, which may be attributed to the fact that our hospital was newly established and the data collection period was limited to one year. We anticipate that this rate would increase in studies with longer follow-up periods.

Glendor *et al.* [35] found that the interval between trauma episodes tends to decrease with each subsequent event. Pissiotis *et al.* [36] also observed that patients with multiple dental traumas were significantly younger than those who experienced only a single episode—reporting an average age of 6 years for the former, compared with 9 years for the latter. Furthermore, Glendor *et al.* [32] demonstrated that nearly half of the patients who suffered multiple traumas had already injured at least one tooth previously, and that when the first injury occurred at age 9, the risk of subsequent injuries was 8.4 times higher compared with cases where the first trauma occurred at age 12. These findings underline the importance of targeted education and preventive strategies for patients with a history of dental trauma, in order to minimize the risk of recurrence and improve long-term outcomes.

Successful management of dental trauma depends on long-term follow-up and periodic clinical and radiographic evaluations in accordance with the guidelines set by the International Association of Dental Traumatology (IADT) [37–39]. Ritwik *et al.* [24] reported that only 42% of children returned for follow-up care. In contrast, 75.4% of patients in our study attended their scheduled follow-up appointments. This relatively high compliance may be attributed to the fact that, unlike in many other countries, most healthcare services in Turkey are publicly funded, reducing financial barriers to follow-up care.

However, patient compliance tends to decline over time, making it challenging to adhere to trauma guidelines that recommend annual evaluations for up to five years, particularly in severe cases. Parents should be informed that traumatized teeth are often asymptomatic and that regular follow-ups are essential to detect complications early [24]. The high success rate and favorable prognosis observed in this study may be linked to the high level of adherence to follow-up appointments.

Timely and accurate intervention following trauma is critical. However, many parents only seek dental care when their child experiences pain or visible esthetic problems [16, 21]. A lack of awareness about the potential consequences of dental trauma may also contribute to delayed treatment-seeking behavior. The results of this study, thus, highlight the need to emphasize the importance of timely dental care to prevent more severe outcomes.

Although the data were collected from a single center located in a single city in Turkey, which may limit the generalizability of the findings, this study still represents a minor, but meaningful step toward enriching the national epidemiological data on dental trauma. Future multicenter studies involving different regions of the country are warranted to improve the external validity and generalizability of these findings.

Previous retrospective and prospective studies on traumatic dental injuries have reported findings broadly consistent with our results regarding gender distribution, etiological factors, trauma types, and treatment approaches. Male predominance and the high frequency of falls and play-related injuries observed in our cohort are in line with existing literature and likely reflect increased physical activity and risk-taking behavior in boys during childhood.

Despite the relatively short study period, our findings provide region-specific epidemiological data that contribute to the understanding of pediatric TDIs in a real-world clinical setting. Notably, the high proportion of delayed presentations observed in this study underscores a critical gap in parental awareness and access to timely emergency dental care. Similar delays

have been reported in developing and middle-income countries, suggesting that this issue is not solely center-specific, but reflects broader systemic and educational challenges.

An important observation of this study is the relatively high adherence to follow-up visits compared with some international reports. This may be attributable to the tertiary care setting and the structured recall system of our institution. However, it should be noted that although follow-up attendance was documented, the relatively short and variable follow-up duration limited the assessment of long-term outcomes, particularly for complications such as root resorption or pulp necrosis.

The comprehensive evaluation of both hard and soft tissue injuries represents a further strength of the study, as soft tissue trauma is frequently underreported despite its clinical relevance. This integrated approach allows for a more holistic interpretation of trauma severity and management needs. Nevertheless, the lack of consistent long-term outcome data prevented meaningful analysis of the relationship between treatment modalities and prognosis.

Several limitations should be considered when interpreting the results. The retrospective, single-center design and modest sample size restrict the generalizability of the findings. In addition, the absence of socioeconomic and educational variables precluded analysis of family-related factors that may influence injury risk, care-seeking behavior, and treatment compliance. Seasonal variation may also have influenced injury patterns, as data collection was limited to a 12-month period.

Future research should prioritize multicenter, long-term prospective studies with larger cohorts to validate and expand upon these findings. Incorporating socioeconomic indicators, parental knowledge assessments, and access-to-care variables would allow a more comprehensive evaluation of prognostic determinants. Moreover, interventional studies focusing on parental education, school-based prevention programs, and standardized follow-up protocols may play a crucial role in reducing the incidence and long-term burden of traumatic dental injuries in the pediatric population.

5. Conclusions

This retrospective study evaluated traumatic dental injuries in 138 pediatric patients and demonstrated that males were more frequently affected than females, with falls being the most common etiological factor. Uncomplicated and complicated crown fractures were the most prevalent trauma types, and maxillary central incisors were the most commonly involved teeth. The most frequently applied treatment modalities were repositioning with splinting and pulpectomy, restoration, and observation.

Overall, the majority of traumatized teeth showed favorable prognostic outcomes, with a high survival rate during the follow-up period. These findings provide epidemiological data on traumatic dental injuries in children and may contribute to improving early management and follow-up strategies in pediatric dental trauma care.

AVAILABILITY OF DATA AND MATERIALS

All data analysed during this study are included in this article.

AUTHOR CONTRIBUTIONS

OPG—performed the research. MS—analyzed the data. OPG and MS—designed the research study; wrote the manuscript. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for this study was obtained from the Mersin University Clinical Research Ethics Committee (Approval number: 2025/366). Due to the retrospective nature of the study, the requirement for informed consent was waived by the Ethics Committee.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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