



Traumatic dental injuries in the primary dentition and sequelae in the permanent dentition: a 7-year retrospective study

Lesões dentárias traumáticas na dentição decídua e sequelas na dentição permanente: um estudo retrospectivo de 7 anos

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ABSTRACT

Objective: Traumatic dental injuries (TDIs) affect the aesthetics and function of primary teeth and can cause sequelae in their permanent successors. This study assessed the distribution of TDIs and sequelae in the primary dentition and the respective permanent dentition in children treated at the Dental Trauma Centre in Brazil.

Material and Methods: This cross-sectional study was conducted by collecting data from 256 dental records over 7 years. Descriptive statistical analyses and the Fisher exact test were used ($p=0.05$). **Results:** Sixty-two patients presented with trauma in the deciduous teeth. TDIs were observed mostly in boys (64.50%) and in the 2 to 4-year age group (44.10%); most injuries occurred from fall from the child's own height (40.30%) and at home (71.20%). The most common type of trauma was subluxation (22.90%). The most prevalent clinical and radiographic sequelae were mobility (45.60%) and periapical lesion (31.80%), respectively. Regarding the permanent dentition, the most frequent sequela was hypomineralization (33.30%). **Conclusion:** According to this study, TDIs in deciduous teeth made up 29.24% of all the cases in the Dental Trauma Program. The major type of trauma in children was subluxation, with sequelae in both dentitions. Follow-up after trauma is important to the maintenance of primary dentition and to prevent and treat possible sequelae in the permanent dentition.

KEYWORDS

Deciduous dentition; Dental health; Injury; Permanent dentition; Sequelae.

RESUMO

Objetivo: Lesões dentárias traumáticas (TDIs) afetam a estética e a função dos dentes decíduos e podem causar sequelas em sucessores permanentes. Este estudo avaliou a distribuição das TDIs e sequelas na dentição decídua e sua respectiva dentição permanente em crianças atendidas no Centro de Trauma Odontológico no Brasil. **Material e Métodos:** Trata-se de um estudo transversal realizado por meio da coleta de dados de 256 prontuários odontológicos ao longo de 7 anos. Foram utilizadas análises estatísticas descritivas e teste exato de Fisher ($p < 0,05$). **Resultados:** Sessenta e dois pacientes apresentaram trauma na dentição decídua. As TDIs foram observadas principalmente em meninos (64,50%) e na faixa etária de 2 a 4 anos (44,10%); a maioria das lesões ocorreu por queda da própria altura (40,30%) e em casa (71,20%). O tipo de trauma mais comum foi a subluxação (22,90%). As sequelas clínicas e radiográficas mais prevalentes foram mobilidade (45,60%) e lesão periapical (31,80%), respectivamente. Em relação à dentição permanente, a sequela mais frequente foi a hipomineralização (33,30%). **Conclusão:** De acordo com este estudo, as TDIs em dentes decíduos foram de 29,24% de todos os casos do Programa de Trauma Dental. O principal tipo de trauma em crianças foi a subluxação, com sequelas em ambas as dentições. O acompanhamento após o trauma é importante para a manutenção da dentição decídua e para prevenir e tratar possíveis sequelas na dentição permanente.

PALAVRAS-CHAVE

Dentição decídua, Saúde bucal, Lesão, Dentição permanente, Sequela.

INTRODUCTION

Traumatic dental injuries (TDIs) are a dental emergency and a worldwide public health problem. Depending on their severity, they can negatively impact quality of life [1,2]. In addition, treatment is often delayed by factors that include the mother's educational level [3], the child's age [4] and the cost of treatment [5].

A referral dental center to treat TDIs plays an important role to minimize their complications. Moreover, depending on the Emergency Hospital, specific treatment of TDIs is not performed since only craniomaxillofacial trauma treatment is done and there are no specialized professionals to manage these conditions, mainly in children.

The prevalence of TDIs has been reported to vary between 20% and 30% according to the studied population [6]. In children, TDI occurs more frequently between 2 and 3 years of age, an age that represents the period when children become more physically active with new motor skills that are not well developed [7]. Defining the diagnosis and performing periodic follow-ups according to the International Association of Dental Traumatology (IADT) guidelines is essential, as not doing so may impair the prevention of damage to both dentitions [7,8].

The present study took place at a medical and dental center in Brasília that serves a wide geographic area in the Federal District, Brazil. Many children have been referred for specialized treatment by other health units in different areas of the Federal District. As a result, the clinic's weekly care program for children and adults affected by dental trauma has become the only local referral center for TDIs from the simplest to the most complex. The dental trauma program has a large number of patients who arrive for their first appointment and are followed up over time to assess the trauma and possible sequelae by volunteer general and pediatric dentists, predoctoral and graduate students, and faculty members.

Delays in the treatment of dental trauma can cause sequelae both in the traumatized tooth and in its successor. Thus, hospitals and health centers must have professionals with specialized knowledge who know how to perform treatments effectively and correctly [9]. Despite numerous studies in this field, questions still remain regarding the profiles of trauma in primary teeth and the

sequelae in permanent teeth, especially in patients who attend a referral dental center. Therefore, this study aimed to evaluate the distribution of TDIs in primary teeth and the sequelae in this dentition and in the respective successor permanent teeth in children attending the dental trauma program of a public university in Brazil, the only free program available in the community.

MATERIAL AND METHODS

Study design and population

A retrospective descriptive study was conducted based on the evaluation of the dental records of patients treated at the Continuous Action and Extension Program: Dental Trauma Prevention and Treatment (PEAC Dental Trauma center) of the University of Brasilia between June 2011 and November 2018. The Research Ethics Committee of the University of Brasilia (Protocol #68744417.0.0000.0030) approved the study. All dental records of children with traumatized primary teeth were included once they had presented complete documentation and the consent form had been signed by a parent or guardian. All records corresponding to permanent teeth were excluded.

Data collection

Data were collected from patient records by two trained evaluators. Data collected included the following: age, sex, date of birth, date of first trauma, date of first visit, time care was sought after the occurrence of trauma, etiology, place of occurrence, type of TDI (classification according to the criteria described by International Association of Dental Traumatology (IADT) guideline [2020]) [10], affected teeth, number of affected teeth, clinical sequelae of the primary teeth (no sequelae, early loss, color change, fistula or edema, mobility, and ectopic position), radiographic sequelae of the primary teeth (no sequelae, pathological root resorption, root resorption, pulp canal obliteration, periapical radiolucency, thickening of the periodontal ligament space, and sequelae of the permanent teeth [no sequelae, hypomineralization, hypoplasia, crown laceration, and root laceration]), and number of teeth with sequelae.

Sequelae were evaluated through an examination and the interpretation of periapical radiographs by two calibrated evaluators,

simultaneously, in an environment with appropriate illumination and by using a radiograph viewer. The radiographs were taken during the follow-up visits based on the protocol of the IADT guidelines [10].

Data analyses

The data collected were stored in a database and analyzed using the Stata version 11.0 program (Stata Corp., College Station, Texas, USA). Descriptive statistical analyses were performed. The association between traumatic events involving hard tooth tissues and support tissues, with characteristics of the children, was tested using the Fisher exact test ($p = .05$).

For data analysis, the TDI was dichotomized into hard tooth tissues (enamel fracture, enamel and dentin fracture, enamel, dentin and pulp fracture, coronoradicular fracture, and root fracture) and supporting tissues (concussion, subluxation, lateral dislocation, intrusive dislocation, extrusive dislocation, and avulsion).

RESULTS

A total of 256 dental records were analyzed. Of these, 150 with trauma to the permanent teeth and 44 with incomplete information on the TDI were excluded. Thus, 62 children (29.24%) with TDI involving the primary teeth, a total of 109 traumatized teeth, were included. According to the characteristics of the study population, TDI was mostly observed in boys (64.50%) and the 2- to 4-year age group (44.10%). The most common cause of trauma was fall from the child's own height (40.30%), followed by falls (26.30%). In addition, injuries occurred more frequently in the family environment (71.20%), and seeking care mostly occurred days after the occurrence of the trauma (80.70%) (Table I).

The most prevalent hard tissue damage was enamel fracture (11.00%). The most prevalent types of trauma involving support tissues were subluxation (22.90%) and lateral luxation (20.20%). Teeth 61 (43.10%) and 51 (34.00%) were the most affected. Clinical and radiographic examinations (45.30%) were the most performed, followed by endodontic treatment (21.90%) (Table II).

In addition, no statistically significant association was found between the type of trauma (involving hard and supporting tissues) and other

Table I - Characteristics of children with dental trauma in primary dentition attended the PEAC Dental Trauma center (n = 62 children)

	n	%
Sex		
Male	40	64.5
Female	22	35.5
Age of child		
<2 years	14	23.7
+2 to 4 years	26	44.1
+ 4 to 10 years	19	32.2
Etiology		
fall from the child's own height	23	40.3
Falls from height	25	26.3
Collision	13	22.8
Car accident	5	8.8
Others	1	1.8
Place		
Home	37	71.2
School	6	11.5
Street	5	9.6
Others	4	7.7
Treatment delays		
< 12 h	5	8.8
12 to 24 h	6	10.5
Days	46	80.7

variables (sex, age, teeth, and treatment delays) of the children ($p > 0.05$) (Table III).

Of the 109 traumatized primary teeth, 32 teeth presented with sequelae (29.35%). The maxillary central incisors were the most affected, with tooth 51 being the most prevalent (46.90%), followed by tooth 61 (34.40%). The most common clinical sequelae after trauma were mobility (45.60%) and color change (38.60%). The radiographic sequelae were periapical lesions (31.80%) and thickening of the periodontal ligament space (27.30%) (Table IV).

A total of 13 teeth presented with sequelae in the permanent dentition after the TDI of their respective predecessors. The most frequent sequela was hypomineralization (33.30%), with teeth 21 (38.50%), 11, and 22 (23.10%) being the most affected. There were TDIs where a tooth had more than one sequela (Table V).

DISCUSSION

A referral dental care center for TDI treatment has been reported to play an important

Table II - Characteristics of dental trauma in the primary dentition of children who attended the PEAC Dental Trauma center (n = 109 traumatized teeth)

	n	%
Traumatic dental injury*		
Enamel fracture	12	11.0
Enamel-dentin fracture	10	9.2
Crown fracture with exposed pulp	10	9.2
Crown-root fracture	3	2.8
Root fracture	2	1.8
Concussion	2	1.8
Subluxation	25	22.9
Intrusive luxation	9	8.3
Extrusive luxation	3	2.7
Lateral luxation	22	20.2
Avulsion	9	8.3
Alveolar fracture	2	1.8
Primary deciduous teeth		
51	37	34.0
61	47	43.1
52	13	11.9
62	10	9.2
71	2	1.8
Treatment		
Observation	29	45.3
Restoration	6	9.4
Endodontic treatment	14	21.9
Extraction	8	12.5
Splint (not rigid)	3	4.7
Others	4	6.2

***Traumatic dental injuries- hard tooth tissues:** enamel fracture; enamel and dentin fracture; enamel, dentin, and pulp fracture; coronoradicular fracture, and root fracture. **Traumatic dental injuries- supporting tissues:** concussion, subluxation, lateral luxation, intrusive luxation, extrusive luxation, and avulsion.

role in minimizing complications. The PEAC Dental Trauma center is a program at a public university in Brazil that provides care to adults and children with TDIs by promoting appropriate treatment and follow-up according to the protocols determined by IADT. This program is a reference center for these patients and is the only one in Brasilia. The treatment offered is free of charge and is supported by the University Hospital of Brasilia, which is part of the National Health System under the administration of the Brazilian Ministry of Health. This study aimed to analyze the distribution of TDIs in the primary dentition, as well as to demonstrate the association between these TDIs, their consequences, and their sequelae in permanent successors, observed over 7 years at the PEAC Dental Trauma center.

Table III - Association between the type of trauma and the children's variables (n = 62 children)

	Hard Tissues		Support Tissue		p
	n	%	n	%	
Sex					
Male	14	60.9	26	66.7	0.64
Female	9	39.1	13	33.3	
Age of child					
< 2 years	7	33.3	7	18.4	0.21
+2 to 4 years	10	47.6	16	42.1	
+4 years to 10 years	4	19.0	15	39.5	
N° traumatized teeth					
1	8	34.8	17	44.7	0.74
2	10	43.5	14	36.8	
3 or more	5	21.7	7	18.4	
Treatment delays					
< 12 h	2	9.5	3	8.3	0.97
12 to 24 h	2	9.5	4	11.1	
Days	17	80.9	29	80.6	

Table IV - Distribution of sequelae in primary dentition (n = 32 teeth)

	n	%
Tooth affected by trauma		
51	15	46.9
61	11	34.4
52	1	3.1
62	4	12.5
71	1	3.1
Clinical sequelae		
Early loss	2	4.5
Fistula	3	6.8
Color change	17	38.6
Ectopic position	-	0.0
Mobility	20	45.6
Others	2	4.5
Radiographic sequelae		
Pathological root resorption	2	9.1
Accelerated root resorption	2	9.1
Pulp obliteration	2	9.1
Periapical lesion	7	31.8
Thickening of the periodontal ligament space	6	27.3
Others	3	13.6

Few studies with large sample sizes have evaluated damage to permanent teeth after TDIs to the deciduous dentition. Study difficulties

Table V - Distribution of sequelae in permanent dentition (n = 13 teeth)

	n	%
Sequelae		
No sequelae	7	38.9
Hypomineralization	6	33.3
Hypoplasia	1	5.6
Coronary dilacerations	1	5.6
Root dilacerations	-	-
Others	3	16.7
Permanent tooth affected		
11	3	23.1
12	2	15.4
21	5	38.5
22	3	23.1

included the need for long-term follow-up between the TDI and the eruption of the successor [11]. In most situations, the patients do not return for clinical and radiographic follow-up, especially when sequelae in the traumatized tooth are absent. The present study also examined a limited number of children assisted in the PEAC Dental Trauma center. However, it was possible to longitudinally analyze 62 patients who received TDIs in the deciduous dentition (with a total of 109 traumatized teeth). Of these, 32 teeth presented with a sequela in the traumatized tooth and 13 in the permanent successor.

Previous studies have reported that the predisposing factors for children with TDIs were sex, age, and type of tooth [1]. Concerning sex, the results of the present study showed a higher prevalence of TDIs in boys [12,13], possibly because Brazilian boys may participate in more aggressive contact sports and outdoor activities than girls. In addition, girls have a more mature and less impetuous behavior than boys [14]. However, recently, there has been a decrease in this difference because girls are predisposed to the same risk factors as boys, especially when it comes to sports [15]. Similar data were found in recent research because, at 5 years of age, children generally tend to participate in the same activities [16]. Since the PEAC Dental Trauma center treats patients with complex TDIs, there may have been a bias regarding sex prevalence.

In this study, children in the 2- to 4-year age group had more TDIs than those in other age groups. This could be explained by the

fact that, at this age, motor coordination is still immature, although the children are physically active. They tend to explore their environment and are unable to fully discern risk. This same age group was reported to be the most prevalent for TDIs in other studies [1,8,13]. Furthermore, for this reason, fall from the child's own height and falls were the most frequent etiology. Children typically stumble and fall before walking as part of their development [13], and often fall from the child's own height is associated with more serious injuries [8].

In the present study, the house was the most common location for the TDI, as the children spend most of their time in the family environment and do not have the same constant supervision as during sports and games [4,8].

Another predisposing factor was tooth type. The maxillary central incisor was the most affected in the present study, with tooth 61 being the most prevalent, followed by tooth 51. This finding was consistent with those of previous studies [1,17-19]. The risk to the maxillary central incisors is mainly because of their prominent location in the dental arch and is associated with factors such as inadequate lip sealing and more pronounced location [1,18].

In general, injuries to the supporting tissue are more severe because, unlike with coronal fractures [20], more force is transferred to the supporting structures, which can cause bone scarring. In addition to severity, soft tissue injuries have a higher prevalence (66.00%), especially in the most prevalent age group found in this study, mostly because the child's bone is still immature, with wide medullary spaces and flexibility. Thus, these characteristics allow the bone to absorb and dissipate the forces during the traumatic impact leading to tooth fracture [1,12,13].

No statistical association was found between the TDI and the variables of sex, age, number of teeth affected, and time of seeking care. Subluxation was found to be the most common TDI, which was consistent with other studies on the deciduous dentition [8,17,21]. Hard tissue injuries, although less frequent in the deciduous dentition, occurred with enamel involvement, also consistent with previous studies [8,21].

Often, there is a long delay between trauma and first aid care. As noted, most caregivers looked for a dentist within days of the

accident [12,21,22]. There is little information on the delayed treatment of children after the traumatic event [23], which may be associated with the lack of perception of the severity of the injury, since most TDIs in children have no bleeding, mobility, or pain. Generally, care is only sought when there is a severe dislocation. In addition, with the perception that deciduous teeth are temporary, parents may not be aware of long-term sequelae after trauma. Also trauma may not be considered a pathology and affordable dental care may be lacking, especially for low-income groups [4,12,24]. The present study found that subluxation was the most common type of trauma, with 29.35% presenting with sequelae. This shows the importance of seeking dental care and follow-up visits after a TDI. Regarding treatment, clinical and radiographic examination (45.30%) was the most performed, which may be directly associated with the fact that subluxation is the most common type of trauma.

The clinical sequelae found in the primary teeth were mobility and color change. Similar results were found where mobility may be justified by bone resilience and root length [25]. The TDI can affect the supporting tissues. The tooth moves but is not dislocated from the socket, and there may be a risk of damage to the pulp neurovascular supply [7]. Color change, ranging from yellow to pink, pink to grey, and grey to black, is also a common finding after trauma and is a result of pulpal bleeding [12].

After deciduous tooth trauma, the objective is not only to avoid consequences to the traumatized tooth but also any damage that may interfere with the development of the germ of the permanent successor [4]. Trauma to primary teeth can damage their successors through direct injury to the permanent germ or indirectly through periapical infection resulting from pulpal necrosis [11]. It is important to analyze the prognosis to decide whether to preserve the primary tooth or to extract it immediately.

Of the 13 permanent teeth with sequelae, most had hypomineralization (33.30%). The most affected teeth were 21, 11, and 22. Although the trauma of the primary tooth had sequelae, no association was observed between the number of them and their respective adjacent teeth, regardless of the type of trauma [22,26].

TDI is a worldwide health problem and requires the implementation of both educational and preventive programs, a correct diagnosis, and an appropriate follow-up to improve the outcome [27,28]. Previous trauma may predict future trauma, as some children are more accident-prone [29]. Thus, public health authorities and doctors should provide individualized treatments as necessary to avoid new episodes [29]. Moreover, consultations with pediatric dentists should be mandatory during prenatal and postnatal care to educate mothers in the management of dental injuries.

The PEAC Dental Trauma center was only implemented 10 years ago. For this reason, the number of patients with a long follow-up period is still low, and care is not exclusively provided to children; adults were excluded from the current study. Nevertheless, the center has been extremely important for the treatment and follow-up of injuries to primary and permanent teeth and for prevention programs in conjunction with the University Hospital of Brasilia to the target population. Treatment should not only prevent sequelae in the primary teeth but also prevent and treat possible sequelae of permanent successors. Studies aimed at identifying patient profiles should be undertaken to plan the service and to predict actions. More public campaigns are necessary to ensure that dentists, the lay population, and those living with children, such as parents or teachers, can identify trauma and seek treatment as soon as possible.

CONCLUSIONS

The presence of clinical sequelae increased with injury severity, and many data from the PEAC Dental Trauma center coincided with later findings: trauma by fall from the child's own height, at home, boys as the most prevalent sex, subluxation as the most common TDI, and sequelae found in both dentitions. Traumatic dental injuries can be considered a public health problem and have a major impact on the esthetics and function of primary teeth. The extension program provides specific care for these events and has been able to meet the high demand by providing high quality care.

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Authors' Contributions

EMT and VPPC conceptualized the ideas, VPPC participated in the methodology, validation and used the software to perform the formal analysis and data curation. PAAK, LVMLR, FCPG and JCFA did the research, resources and original writing. The writing review was done by PAAK and EMT. Visualization, supervision and project administration was done by EMT.

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Conflict of Interest

The authors have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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Regulatory Statement

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