

## LONGITUDINAL STUDY OF SEVERE TRAUMATISMS ON PRIMARY TEETH: CLINICAL AND RADIOGRAPHIC COMPLICATIONS

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**ABSTRACT:** The objective is to evaluate the frequency of trauma in primary teeth, the sequelae resulting from injuries involving the supporting tissues, as well as the association of these injuries with clinical and radiographic sequelae. This was a longitudinal clinical study, in which 342 traumatized teeth, assisted at the dental service of a public institution, were evaluated after the trauma and after 24 months. The data were submitted to a descriptive analysis and the Chi-square test ( $p \leq 0.05$ ). The highest frequency of trauma occurred at age 24-35 months, the main etiological factor being the decrease of height (77.8%), male gender (59.5%), dental arch (96.5%), tooth 51 (43.1%); 70.6% had more than one affected tooth and 8.2% had a history of trauma; the most prevalent injury was lateral luxation (33.6%). In the preservation, there was an association between type of injury to the supporting tissue with the presence of radiographic sequelae ( $p = 0.02$ ) and early loss ( $p = 0.01$ ). In conclusion, the main sequelae observed were tooth crown discoloration and inflammatory root resorption and there was a significant association between the type of support tissue injury and the presence of radiographic sequelae and the early loss of the traumatized deciduous tooth.

**KEY WORDS:** Tooth injuries; Deciduous teeth; Complications.

### ESTUDO LONGITUDINAL DOS TRAUMATISMOS SEVEROS EM DENTES DECÍDUOS: COMPLICAÇÕES CLÍNICAS E RADIOGRÁFICAS

**RESUMO:** O objetivo é avaliar a frequência dos traumatismos em dentes decíduos, as sequelas advindas das injúrias envolvendo os tecidos de sustentação, bem como a associação destas injúrias às sequelas clínicas e radiográficas. Trata-se de um estudo clínico longitudinal, no qual foram avaliados 342 dentes traumatizados, atendidas no serviço odontológico de uma instituição pública, as avaliações foram realizadas após o traumatismo e decorrido 24 meses. Os dados foram submetidos a uma análise descritiva e ao teste Qui-quadrado ( $p \leq 0,05$ ). A maior frequência de traumas ocorreu na idade 24-35 meses, o principal fator etiológico à queda da própria altura (77,8%), gênero masculino (59,5%), arco dentário o superior (96,5%), dente 51 (43,1%); 70,6% possuíam mais de um dente afetado e 8,2% histórico de trauma; a injúria mais prevalente foi a luxação lateral (33,6%). Na preservação, houve associação entre tipo de injúria ao tecido de suporte com a presença de sequelas radiográficas ( $p=0,02$ ) e perda precoce ( $p=0,01$ ). Conclui-se que as principais sequelas observadas foram a descoloração coronária e reabsorção radicular inflamatória e houve associação significativa entre as variáveis tipo de injúria ao tecido de sustentação com a presença de sequelas radiográficas e a perda precoce do dente decíduo traumatizado.

**PALAVRAS-CHAVE:** Traumatismos dentários; Dente decíduo; Complicações.

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## INTRODUCTION

Scientific literature points out that traumatic injuries to primary teeth are among the main causes of demand for pediatric dentists<sup>1</sup>. These injuries prevalence varies in the studies, according to Costa et al.<sup>2</sup> the incidence of trauma in the primary teeth dentition is between 9 and 62%, but according to Assunção et al.<sup>3</sup> it is between 4 and 30%. This difference is given mainly due to the criteria in the selection and size of sample. The traumatic injury can generate emotional consequences for the child, as well as for their family, besides clinical and radiographical sequelae in both dentitions<sup>1,4,5</sup>. The most prevalent phase is between one and a half and three years old, when children are learning how to walk<sup>6-8</sup>, the lack of motor coordination prevents the child from avoiding falling and self-protection<sup>5,9-11</sup>. Falling from their own height is the most frequent cause of injuries<sup>11</sup>. The most affected teeth are the upper central incisors<sup>1,6,12</sup>, regarding the type of injury the ones to supporting tissues are the most frequent, the main one being luxation<sup>12-14</sup>.

The right mediated or immediate clinical care according to the injury severity, as well as the involvement of family members to adhere to follow-up consultations, as a way to prevent and treat possible clinical and radiographic sequelae, both for primary teeth and permanent teeth are fundamental<sup>2,5,6,12,15-17</sup>. Scientific studies point to crown discoloration, pulp necrosis, ankylosis, premature loss, pulp hyperemia and abnormal position in the dental arch as the main clinical sequelae in primary teeth<sup>3,7,8,11,18-20</sup>. The inflammatory resorption, pulp obliteration and periapical lesion are shown as the radiographic sequelae<sup>1,2,11,12,21</sup>. In permanent successors, in the crown, hypoplasia or hypocalcification of the enamel and laceration may occur, in the root, laceration, duplication, stopping its partial or total formation; in addition to the abnormal position of the germ, odontomas or changes in the rash process<sup>1,4,8,13,14,22</sup>.

According to the International Association of Dental Traumatology (IADT) guidelines, a traumatized tooth must be monitored until its exfoliation<sup>11</sup>. During this period, the clinical and radiographic examinations must be carried out following these deadlines: one week, three to four weeks, six to eight weeks, six months, one

year and, during each subsequent year<sup>11</sup>. Qassem et al.<sup>23</sup> concluded in their study that it takes more than 180 days for sequelae to be diagnosed in the primary teeth involved in the trauma. So maintaining a protocol for monitoring traumatized teeth is extremely relevant, however, post-traumatic sequelae can be diagnosed even after more than four years of follow-up.

Bearing in mind that the severity of the trauma is an important factor for the prognosis of the traumatized tooth and that the possible sequelae of the different types of trauma need to be known to be prevented, the objective of this study is to evaluate the frequency of trauma in primary teeth, and the associations of injuries to the supporting tissue with clinical and radiographic sequelae, in children assisted in the emergency department of the Dental Clinic of the State University of Maringá-PR, between 2011 and 2017.

## METHODOLOGY

This research was submitted to the Standing Committee for Ethics in Research Involving Human Beings at the State University of Maringá, number 24562 (CAAE 01635512.4.0000.0104).

This is a longitudinal clinical study, in which the follow-up of infant patients seen in the emergency department of the dental clinic of the State University of Maringá - Paraná, Brazil was carried out, with a history of dental trauma involving primary teeth, in the period corresponding to the years from 2011 to 2017.

Sampling was made up of 201 children, who received emergency treatment at the dental clinic, totaling 342 deciduous teeth evaluated. The variables necessary for the study, referring to the child's data at the time of the trauma, such as age, etiological factor, gender, affected dental arch, teeth involved, most prevalent hemiarch, number of traumatized teeth, history of previous trauma, type of traumatic injury and treatment performed at the first visit were collected from the patient's medical record. At the first consultation, the guardians signed the Free and Informed Consent Form for minors and were instructed about the importance of teeth preservation with a previous history of trauma, and then the patient was scheduled for post-trauma evaluation. The initial and

all subsequent evaluations were performed by a single properly calibrated dental surgeon with extensive clinical experience.

In the post-traumatic reevaluation consultation in each patient, prior to the examination, they were submitted to a dental prophylaxis with prophylactic toothpaste and Robson toothbrushes, or cleaning with 0.12% chlorhexidine and, then, a detailed clinical inspection of the teeth involved in the trauma was performed, palpation and percussion tests, followed by radiographic examination of the traumatized region. The reassessment appointments were scheduled after one week of the trauma, three to four weeks, six to eight weeks, six months, one year and, during each subsequent year, until the eruption of the permanent tooth, following the proposal by Malmgrem et al. (2012)<sup>11</sup>.

All clinical and radiographic sequelae observed in the reevaluation consultations were recorded in specific clinical records for this purpose, as well as the treatment performed.

The classification of injuries and clinical and radiographic sequelae of deciduous and permanent teeth were properly analyzed according to what was proposed by Andreasen, Andreasen and Andersson<sup>24</sup> considering the following aspects: clinical signs: absence of clinical signs; discoloration of the crown, abscess and fistula; radiographic signs: absence of radiographic alteration, periapical lesion, inflammatory resorption, pulp calcification, ankylosis. For the analysis of clinical and radiographic sequelae in permanent teeth, the following clinical signs were considered: crown discoloration, hypoplastic enamel, laceration of the tooth crown; radiographic signs: tearing of the tooth root, odontomas, root duplication, incomplete root development, poor position of the permanent tooth, eruption disorders. For cases where pathological changes in primary or permanent teeth were diagnosed, patients were referred to the Pediatric Residency Program at the State University of Maringá, where they received the appropriate clinical treatment.

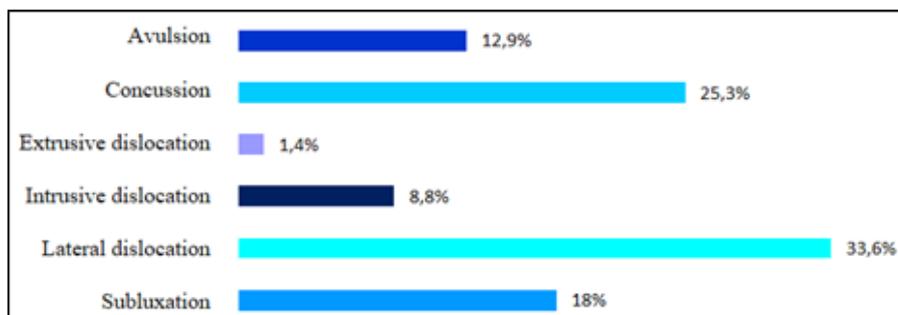
The quantitative data were analyzed through the program Statistical Package for the Social Sciences (SPSS for Windows, versão 15.0, SPSS® Inc, Chicago, III), obtaining the relative frequency (%) of the previously mentioned

variables and association between the following: type of injury to the supporting tissue with clinical, radiographic sequelae, and early loss of the traumatized tooth; age at the moment of trauma with clinical and radiographic sequelae through the Chi-squared test ( $p \leq 0,05$ ).

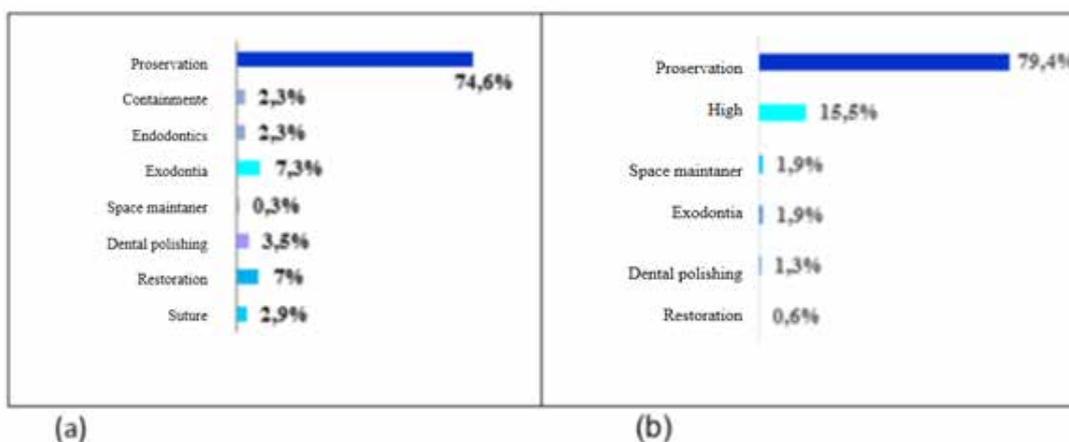
## RESULTS

201 patients with a history of dental trauma in primary teeth were evaluated, totaling 342 traumatized teeth. The age of the children at the time of the trauma ranged from one to six years old, with the most prevalent age between 24 -35 months (35.5%) and falling from own height being the main etiological factor (77.8%). The male gender was the most affected with 59.5%. The most affected dental arch was the upper one (96.5%), the upper central incisors were the most traumatized teeth, tooth 51 (43.1%) and 61 (41.1%); the right and left sides were equally affected and 70.6% of the patients had more than one tooth involved. In addition, 8.2% of children had already had a history of dental trauma.

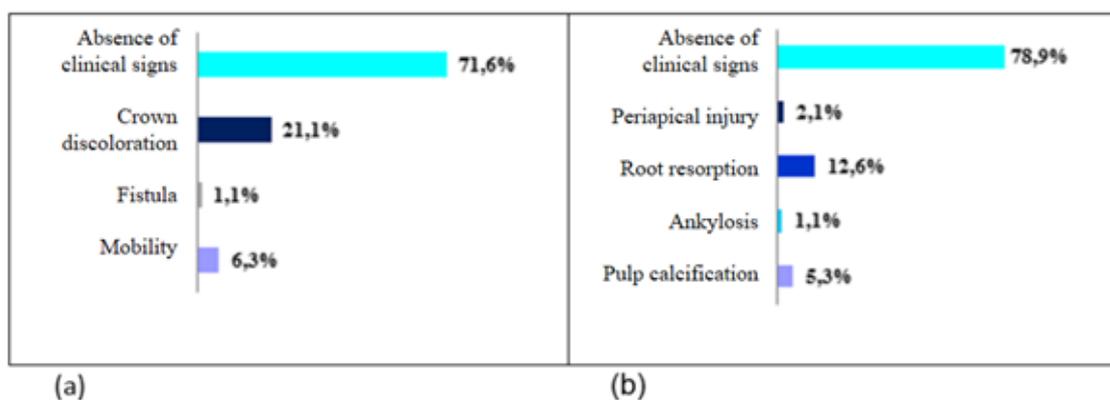
When analyzing the type of trauma, it was observed that 64.7% had injuries to the supporting tissues and 35.3% to the dental tissues.



**Figure 1.** Distribution of the frequency of traumatic injuries to supporting tissues, at the moment of trauma, according to its severity.



**Figure 2.** Description of the type of treatment performed on traumatized primary teeth, (a) at the moment of trauma; (b) 24-month reevaluation.



**Figure 3.** Distribution of the frequency of clinical and radiographic sequelae to primary teeth of the injuries to supporting tissue, after 24 months (a-Clinical sequelae and b-Radiographic sequelae).

A Figura 1 expressa os dados coletados referentes à frequência das injúrias ao tecido de sustentação, de acordo com sua severidade.

Ainda no momento do trauma, avaliaram-se dados referentes à primeira intervenção realizada para o tratamento das injúrias traumáticas, relatados na Figura 2(a). Decorridos 24 meses, ainda houve necessidade de intervenções clínicas nos dentes traumatizados conforme mostra a Figura 2(b).

Nas consultas de acompanhamento, decorridos 24 meses do traumatismo, 57% dos dentes foram reavaliados, destes, 17% foram perdidos precocemente e houve o diagnóstico da presença de sequelas clínicas e radiográficas, nos dentes decíduos traumatizados, como ilustrado na Figura 3.

Analisando-se a associação entre a variáveis (Tabelas 1 a 3) as associações significantes foram o tipo de injúria ao tecido de sustentação com a presença de sequelas radiográficas em dentes decíduos, na preservação de 24 meses ( $p=0,02$ ) sendo a reabsorção radicular inflamatória a mais presente.

E a variável tipo de injúria ao tecido de sustentação com perda precoce do dente decíduo ( $p=0,01$ ), mostrando que depois da avulsão, a luxação lateral foi o tipo de injúria que mais levou a perda precoce do dente decíduo.

**Table 1.** Associations between previous trauma history with early loss, clinical and radiographic sequelae

VARIABLE	PREVIOUS HISTORY OF TRAUMATISM		
	No	Yes	Value of p
Early loss of primary tooth			
No	117	2	0,975
Yes	10	24	
Clinical Sequelae			
No	63	25	0,993
Yes	5	2	
Radiographic Sequelae			
No	69	20	0,993
Yes	7	0	

**Table 2.** Associations between Injuries to supporting tissue with radiographic, clinical sequelae and early loss

VARIABLE	RADIOGRAPHIC SEQUELAE ON THE DECIDUOUS TOOTH				
	Absence of signals	Pulp calcification	Inflammatory root resorption	Ankylosis	Value of p
Injuries to the supporting tissue					
Concussion	10	0	4	0	0,022
Subluxation	8	1	1	0	
Intrusive Luxation	2	0	0	1	
Lateral Luxation	18	1	5	0	
	CLINICAL SEQUELAE TO DECIDUOUS TOOTH				
Injuries to supporting tissue	Absence of signals	Tooth crown discoloration	Mobility		
Concussion	12	1	1		0,129
Subluxation	7	3	0		
Intrusive Luxation	1	2	0		
Lateral Luxation	15	4	5		
	EARLY LOSS OF DECIDUOUS TOOTH				
Injuries to supporting tissue	No	Yes			
Concussio	23	0			0,010
Subluxation	14	1			
Intrusive Luxation	5	1			
Extrusive Luxation	1	2			
Lateral Luxation	28	7			
Avulsion	2	11			

**Table 3.** Association between age at the moment of trauma with clinical and radiographic sequelae

VARIABLE	AGE AT THE MOMENT OF TRAUMA (MONTHS)					Value of <i>p</i>
	< 12	12-23	24-35	36-47	48 e +	
<b>Absence of signals</b>						
Tooth crown discoloration	2	16	24	10	16	0,468
Fistula	0	4	8	1	1	
Mobility	0	0	1	0	0	
Mobilidade	1	1	4	0	0	
<b>Radiographic sequelae</b>						
Absence of signals	2	20	27	9	17	0,533
Periapical injury	0	0	1	0	1	
Pulpar calcification	0	0	2	2	1	
Inflammatory root resorption	1	1	7	0	3	
Ankylosis	0	0	0	0	1	

## DISCUSSION

Trauma are frequent events in the primary dentition; currently, after tooth decay, it is the most common cause for parents to seek specialized care<sup>1</sup>. As it is an aesthetic, functional and also psychological problem, it is considered an urgent situation, and it must be conducted in such a way that the dentist, able to perform the care, calms down the child and especially those responsible for them, in order to diagnose correctly and to plan a safe and effective treatment, in an attempt to reduce the clinical and radiographic sequelae of traumatized teeth and their permanent successors<sup>7,8</sup>.

Reviewing the scientific literature, with respect to the frequency of dental trauma, it was observed in relation to gender that there is no unanimity among the authors, since studies report that there is no statistical difference between gender in primary dentition<sup>3,9,16</sup>, in line with the present study, and another group where it was observed that the male gender is the most involved in traumatic injuries<sup>2,14-16,22</sup>. According to Goettems et al.<sup>22</sup>, boys are more prone to injuries than girls, although this difference has been decreasing, due to behavioral changes in childhood.

Regarding the child's age at the time of the trauma, this study found a higher frequency between <sup>24-35</sup> months, followed by 48 months, data similar to the studies by Jesus et al.<sup>5</sup> that attributed the fact to the immaturity of the motor coordination systems, balance and also

the child's independence, associated with the fact that children are unable to protect themselves. The study by Rocha et al.<sup>16</sup> also reports the most common age range of one to four years, with a peak in both years. The study by Kramer et al.<sup>15</sup> differs from these findings, pointing out the most affected age group of 36-48 months.

When the etiological factor is analyzed, the scientific literature <sup>5,6,10,15,16</sup> is unanimous in pointing out falls as the most common etiological factor of dental injuries, in agreement with the findings of this study, since the upper arch was the most affected, the upper central incisors are the most affected teeth, the left side being more involved in the trauma, confirming the reports of scientific research <sup>2,3,5,10,15,19,21</sup>.

Another important fact verified, checked during the anamnesis was that 8.2% of the children studied here had already had a previous history of trauma, similar to the data pointed out by Amorim et al.<sup>10</sup>, in which 16.9% of the participants had a history of recurrence of the trauma. Although there are no scientific studies in the literature that report the recurrence of trauma in primary teeth, clinical practice shows that there is a predisposition for recurrent trauma to the appearance of sequelae, which justifies a more careful monitoring of these cases. Checking this variable in this study, there was no association between the variables previous history of trauma with early tooth loss, presence of clinical and radiographic sequelae in primary teeth, which may be attributed to the decrease in the sample, since 43 % of traumatized teeth were not

reassessed in the 24-month postoperative period. In this sense, Amorin et al.<sup>10</sup> point out the importance of future studies to identify risk factors and methods of preventing recurrent trauma. The study by Goettems et al.<sup>22</sup> points out that children who have suffered trauma to the primary dentition are more likely to have permanent dentition trauma. According to Malmgren et al.<sup>11</sup> recurrent traumas cause early loss of the deciduous tooth, and this loss can affect aesthetics, quality of life, nutrition, arch integrity, development and eruption of permanent successors. Lauridsen et al.<sup>13</sup> consider as early loss the tooth that was lost more than four months before its contralateral exfoliates. In the present study, premature loss appeared in 17% of patients, data similar to the work by Rocha et al.<sup>16</sup>, who point out that many of them are lost at the time of trauma or in the post-trauma period, Lauridsen et al.<sup>13</sup> report that in intrusive luxation, teeth are lost early due to pulp necrosis or accelerated physiological resorption, with a higher incidence in the first year after trauma. There was an association between the type of injury to the supporting tissue and the early loss of the primary tooth, showing that the most severe trauma such as luxation generate more severe consequences for the primary tooth. This alert is for the professional to guide the parents for return visits, since the dental arch needs to be rehabilitated in cases of premature loss of the deciduous tooth.

As for the type of traumatic injury to the supporting tissues, it was found in this study that lateral dislocation was the most prevalent one (33.6%), followed by concussion and subluxation, similar in the studies by Jesus et al.<sup>5</sup> and Lauridsen et al.<sup>4</sup> however, other researchers point to a higher prevalence of subluxation<sup>1,10,20</sup> and extrusive luxation 16. According to Mendoza-Mendoza et al.<sup>1</sup>, intrusive luxation had the highest prevalence compared to avulsion, diverging from this study in which intrusive luxation had (8.8%) and avulsion (12.9%). Qassem et al.<sup>20</sup> point out that the prevalence of luxation decreases with the child's age, since this type of injury is associated with the resilience of the alveolar bone and support structures.

Another point studied was the treatment received for the trauma, at the time of the trauma, noting that most children, after clinical and radiographic examination,

the diagnosis pointed to the need for only control and monitoring, although some patients needed interventions such as tooth extractions, restorations, dental polishing, endodontics and containment. This type of intervention was maintained in the 24-month evaluation, however other interventions were still necessary, among them the performance of extractions, installation of maintainers, such as Denari prosthesis, polishing and restorations. It was also observed that 23.2% of the patients had their permanent successor in the oral cavity and that 15.5% of them were discharged, since the permanent incisors had already completed their eruption, without any changes.

During post-trauma reevaluation consultations, as well as in other studies, the appearance of clinical and radiographic sequelae in primary teeth was identified<sup>3,5,16</sup>. This study diagnosed an association between the variables type of injury to the supporting tissue and the presence of radiographic sequelae in deciduous teeth ( $p = 0.02$ ), observing that the lateral luxation generated more cases of inflammatory root resorption. Mendoza-Mendoza et al.<sup>1</sup>, concluded that the intrusive luxation causes a greater number of sequelae, with the most frequent pathological resorption, with or without necrosis associated with the pulp. On the other hand, in the study by Lauridsen et al.<sup>13</sup> and similarly to the diagnosis of this research, resorption in cases of intrusion is rare in primary teeth, which may be related to the difficulty in detecting the initial stages of radiological physiological resorption on radiographs, however, as resorption takes place, the root decreases and bacteria have easier access to the pulp<sup>4</sup>. Yet, in cases of displacement injury, rupture of gingival insertion may occur, facilitating the infiltration of bacteria into the tissues, thus the damaged tissue stimulates an inflammatory reaction that stimulates osteoclast activation factors<sup>4</sup>. Therefore, it is expected that inflammatory root resorption is more common in teeth that have suffered luxation<sup>17</sup>. Costa et al.<sup>2</sup> mention that teeth that have undergone extrusive luxation or concussion and a re-implanted avulsion tooth have a 10% greater chance of developing accelerated root resorption, and the replantation of a deciduous tooth is contraindicated in the vast majority of cases of avulsion as it is a procedure which involves very specific conditions for its success and

the possibility of injury to the permanent germ, if the clot is forced into the alveolus<sup>17</sup>.

Another sequel pointed out in this study was the discoloration of the crown. Holan, Needleman<sup>19</sup> and Qassem et al.<sup>20</sup>, describe the discoloration of the crown in traumatized incisors as the most common clinical sequel, and in many cases the trauma is only noticed by the aesthetic change of the tooth color. The results of the present study confirm these reports, since 21.1% of the reassessed teeth had a color change, especially the teeth that suffered concussion, subluxation and lateral luxation. Cardoso, Rocha<sup>9</sup> reinforce that sequelae such as mobility and discoloration are more prevalent in the first visit, and in follow-up consultations there is a significant reversal, which can be explained by transient discoloration. Holan<sup>18</sup> states that darkened teeth can remain asymptomatic until their natural exfoliation, which shows that discoloration of the crown cannot be a sole criterion in the diagnosis for treatment. Some authors suggest the extraction or endodontic treatment for these teeth, even before showing any other pathological clinical or radiographic sign, while others, similar to our conduct, recommend follow-up with intervention only when necrosis is diagnosed or signs of infection appear<sup>14,18,20</sup>.

In the age association of the occurrence of the trauma with the presence of clinical sequelae in primary teeth with the presence of radiographic sequelae, they did not show significance. However, reports by Costa et al.<sup>2</sup> children aged 37-42 months had a higher frequency of clinical sequelae and children aged 43-60 months had a higher frequency of radiographic sequelae, explained by the excellent vascular supply and greater resilience of the alveolar bone in younger children, in contrast, in older children, physiological resorption can cause pulp degeneration. Qassem et al.<sup>20</sup> investigated the level of root maturity of primary teeth at the time of trauma in relation to possible sequelae, and resulted in the occurrence of sequelae being determined by root maturity at the time of injury.

Given the above, knowing the risks of clinical and radiographic sequelae in traumatized primary teeth remains the objective of research in future longitudinal works, and one of the challenges will be the expansion of the sample size and the commitment of family members

to take children to visits of post-trauma control, this being one of the limitations of this study, since even though guidance is given to family members on the importance of monitoring the injured tooth to prevent sequelae to primary and permanent teeth, there was still no possibility of reassessing all the children who had been assisted, compromising the analysis of statistical data and associations between the studied variables.

## CONCLUSION

The present study pointed out that trauma to primary teeth is frequent, with injuries to the supporting tissues being the most prevalent, especially lateral luxation. After 24 months, the main clinical and radiographic sequelae observed were tooth crown discoloration and inflammatory root resorption, respectively. There was a significant association between the variables type of injury to the supporting tissue with the presence of radiographic sequelae and the early loss of the traumatized deciduous tooth.

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