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# Pulp polyp in traumatized primary teeth – a case–control study

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Pulp polyp, also called hyperplastic pulpitis, is an open, chronic irreversible pulp inflammation (1-4). It is also described as a hyperplastic growth of the pulp, which projects itself out of the pulp chamber with a reddish mucosa-like structure (3, 4). It usually occurs in children and young adults due to great pulp exposures, traumatic fractures, or caries. It usually takes place mainly in primary or recently erupted permanent teeth, in which the root apex is not completely formed (1, 5, 6).

The dental pulp in young teeth can evolve into a hyperplasia and resists necrosis due to the excellent blood supply, the ample apex foramen, and the communication between the pulp chamber and the oral cavity. This behavior can be also associated with the resistance and reactivity that the pulp tissue has against bacterial infection (1-7).

Most studies in literature have focused on the occurrence of pulp polyps in permanent teeth formed mainly due to extensive caries lesions (1-3, 6) or specifically on the histology of these polyps (1-3, 8). In primary teeth, few studies described this pulp condition (9), and to the best of our knowledge, no previous studies have investigated the associated factors with the occurrence of pulp polyp in traumatized primary teeth. Furthermore, the impact of presenting pulp polyp after traumatic injuries has not also been reported.

Abstract - Aim: To assess clinical characteristics and other factors associated with the occurrence of pulp polyp in traumatized primary teeth as well to evaluate the impact of pulp polyp occurrence on clinical decisionmaking after traumatic injuries. Material and methods: This study was divided into three phases. First, occurrence and clinical characteristics of pulp polyp were assessed followed by a descriptive analysis and categorical tests of association. Secondly, a case-control design was used, and the occurrence of pulp polyp was set as the outcome. In third phase, the occurrence of pulp polyp after fracture with pulp exposure was investigated as a variable possibly associated with clinical decision-making (dental extraction/endodontic treatment). Logistic regression analyses were used, and odds ratios and 95% confidence interval (OR; 95% CI) were calculated in second and third phases. Results: Occurrence of pulp polyp in traumatized primary teeth was of 2.3%. Hyperplastic tissue color and proliferation size were not associated with the time to seek treatment after injury (P > 0.05). Children up to 2 years of age had more chance of having pulp polyp in comparison with older children (3.15; 1.15–8.64). Teeth with crown-root fracture had more chance of dental extraction in the therapeutic approach than the teeth with only crown fracture (4.36; 1.10–17.32). Presence of pulp polyp was not associated with the treatment carried out. *Conclusions*: Occurrence of pulp polyp in traumatized primary teeth is not frequent and is associated with the age when traumatic dental injury occurs but does not interfere directly with the therapeutic approach.

> Therefore, the purpose of this study was to assess the clinical characteristics and other factors associated with the occurrence of pulp polyp in traumatized primary teeth. Furthermore, we investigated factors related to the therapeutic approach adopted after pulp exposure-fractured teeth to assess the impact of the presence of pulp polyp on clinical decision-making.

# Material and methods

This study was approved by the Ethics in Research Committee of the School of Dentistry of the University of São Paulo.

# First phase

Initially, 1864 files of patients who sought treatment, from 1998 to 2009, at the Research and Clinical Center of Dental Trauma in Primary Teeth, Discipline of Pediatric Dentistry at the School of Dentistry – University of São Paulo, were evaluated to verify the occurrence of pulp polyp in this population. Data were collected by a single trained examiner who analyzed photographs, radiographs, and information contained in the clinical files.

With regard to the clinical characteristics of pulp polyp, the examiner assessed the following: type of tooth (primary upper central incisor, primary upper lateral incisor, primary upper canine); fracture type (crown fracture, crown-root fracture, root fracture); clinical appearance of the polyp (reddish, whitish); size of the proliferation (same size as the crown, greater than crown size); number of mobile fragments including crown and root fragments (1, 2 or more); and time taken to seek treatment in the Center of Trauma (less to 30 days or more than 30 days).

Chi-square and Fisher's exact tests were performed to evaluate the association between color/size of the pulp polyp and the time taken to seek treatment after traumatic injury.

## Second phase

The second phase was a case–control study. The outcome chosen was the presence of pulp polyp in traumatized primary upper incisors with pulp exposure.

The case group consisted of 40 primary upper incisors of 40 children who presented pulp polyp after pulp exposure fracture. The control group consisted of 40 teeth that had presented pulp exposure fracture, but not the pulp polyp. Children for control group were randomly chosen among the 1864 files of Center of Trauma. No child was being followed in our center previous to dental trauma. Children were registered as soon as they sought dental treatment, and at that moment, all information about traumatism was collected and included in children's files.

Patient files with incomplete data, files that did not record traumatism in primary upper incisors, and files containing records of previous pulp exposure due to a fracture(s) other than crown or crown/root were excluded from the sample. When the same subject presented two traumatized teeth (both in case or control groups), only one tooth was randomly selected for analysis.

The following explanatory variables were chosen: gender (girls or boys); age when trauma occurred ( $\leq 2$ or >2 years); type of tooth (central incisor or lateral incisor); type of fracture (crown fracture or crown-root fracture); and time taken to seek treatment (less to 30 days or more than 30 days).

Logistic regression analysis was used to investigate the association between each one of these variables and the outcome. Univariate analyses were initially performed. The level of significance was adjusted at 0.05. Subsequently, multiple logistic regression was performed using a forward stepwise approach. We considered a level of 0.20 for entry into the model and a level of 0.05 to retain the variable in the model. We also checked the possible interactions and, if necessary, some variables were maintained in multiple models only for adjustment.

#### Third phase

Using data collected during the second phase, another analysis was performed to investigate factors associated with the therapeutic approach adopted after pulp exposures to assess the impact of occurrence of pulp polyp on clinical decision-making. Dental extraction and endodontic treatment were set as possible categories for this outcome.

In this analysis, we considered 80 primary upper incisors with pulp exposure after traumatic injury, among which 39 had been treated endodontically and 41 had been extracted. All teeth included in the second phase were maintained for this analysis. Therefore, inclusion and exclusion criteria were the same as previously described.

The explanatory variables for this analysis were the following: gender (girls or boys); age when trauma occurred ( $\leq 2$  or >2 years); type of tooth (central incisor or lateral incisor); type of fracture (crown fracture or crown–root fracture); presence of pulp polyp (yes or no); and time taken to seek treatment (less to 30 days or more than 30 days).

Logistic regression analysis was used to investigate the association between these variables and the therapeutic decision on fractured teeth presenting pulp exposure. The same methodology of analysis in second phase was adopted at this stage.

#### Results

From 1864 clinical records, 43 children presented pulp polyp in primary teeth due to traumatic dental injury (2.3%). Only two children had two teeth with this pulp condition, and therefore, 45 teeth with pulp polyp were recorded.

Primary upper central incisors were the most affected teeth by pulp polyp (95.5%). The crown-root fracture was the main cause of pulp exposure that led to pulp polyp (84.4%; Table 1), and in most cases, the crown fractured into two parts presented only one mobile fragment (64.4%). The time taken between the trauma and seeking for treatment in the Center of Trauma varied from 1 day to 12 months.

The hyperplastic tissue color was frequently reddish (78.0%). Moreover, the color was not associated with the time to seek treatment (P = 0.08; Table 2). The proliferation size greater than crown size was the commonest (78.0%), but the proliferation size was not also associated with the time to seek treatment (P = 0.70; Table 3). There were no records of color and size of pulp polyps in four children's files.

*Table 1.* Distribution of fracture type and primary tooth affected by pulp polyps

	Fracture type			
Tooth	Crown–root fracture n (%)	Crown fracture n (%)	Root fracture n (%)	Total n (%)
Central incisor	36 (83.7)	6 (13.9)	1 (2.4)	43 (100)
Lateral incisor	1 (100)	0 (0)	0 (0)	1 (100)
Canine Total	1 (100) 38 (84.4)	0 (0) 6 (13.3)	0 (0) 1 (2.2)	1 (100) 45 (100)

Table 2. Distribution of hyperplastic tissue color and time to seek treatment

	Hyperplastic tiss	ue color	
Time	Reddish	Whitish	Total
	n (%)	n (%)	n (%)
<30 days	20 (69.0)	9 (31.0)	29 (100)
>30 days	12 (100.0)	0 (0.0)	12 (100)
Total	32 (78.0)	9 (22.0)	41 (100)

Table 3. Distribution of proliferation size and time to seek treatment

	Proliferation size			
Time	Greater than the crown n (%)	Size of the crown n (%)	Total <i>n</i> (%)	
<30 days >30 days Total	22 (88.0) 10 (62.5) 32 (78.0)	7 (12.0) 2 (37.5) 9 (22.0)	25 (100) 16 (100) 41 (100)	

In the case–control study, the adjusted multiple logistic regression analysis showed that children up to 2 years of age had more chance of presenting pulp polyp than the elders (OR = 3.15; 95% CI = 1.15– 8.64). Long time to seek treatment in the Center of Trauma (more than 30 days) was negatively associated with the pulp polyps growth (OR = 0.37; 95% CI = 0.14–0.98; Table 4).

After trauma involving dental fractures, crown-root-fractured teeth had more chance of being extracted in the therapeutic approach than the crown-fractured teeth (OR = 4.36; 95% CI = 1.10-17.32). However, the presence of pulp polyp was not associated with the treatment carried out after dental fractures (Table 5).

## Discussion

This protocol is the first to study factors associated with pulp polyp in traumatized primary teeth. It is comprehensible that the occurrence of this pulp response has been low as pulp involvement in traumatized primary teeth has been reported not exceeding 5-6% in different countries (10–17). On the other hand, it is important to study this pulp response to improve on diagnosis and treatment.

In contrast with polyps in carious teeth (1, 2, 6), polyps after traumatic injuries were more frequently found in the primary upper central incisors, which are also the most affected teeth in these cases (18). Although the crown–root fracture has been found in most cases with a pulp polyp, the type of tooth fracture was not associated to pulp polyp occurrence, as showed in the case–control study.

Considering clinical features, several slight variations in color of pulp polyps have been reported (3–5). Most pulp polyps in fractured primary teeth were reddish, probably due to neoformation of blood vessels (1, 2). Some authors suggest, in permanent teeth, new polyps are often more purplish and bleed more easily, while older polyps tend to be paler and less hemorrhagic (3, 4). Conversely, pulp polyp color was not associated with time to seek treatment. We hypothesize that the masticatory stimulation on permanent molar pulp polyps can promote their epithelialization and keratinization, resulting in the whitish appearance. The same may not occur for anterior teeth, where we observed the most traumatic injuries.

The evaluation of the colors in photographs, as we conducted, can be subjective and should be considered as a limitation of this study. To minimize this limitation, we considered only two very distinct colors for evaluations: reddish and whitish. We believe this choice probably made this assessment easier and more accurate.

Table 4. Distribution, univariate and multiple regression analyses of association between pulp polyp occurrence and independent variables in traumatized primary teeth

Variable	Case group n (%)	Control group n (%)	Crude OR (95% CI)	Ρ	Adjusted OR (95% CI)	Ρ
Gender						
Girls	11 (39.3)	17 (60.7)	1.94 (0.76-4.96)	0.16	*	*
Boys	29 (55.8)	23 (44.2)				
Age when TDI occurred						
>2 years old	20 (69.0)	9 (31.0)	3.44 (1.31-9.05)	0.01	3.15 (1.15-8.64)	0.02
$\leq$ 2 years old	20 (39.2)	31 (60.8)				
Type of tooth						
Central incisor	39 (50.6)	38 (49.4)	0.49 (0.04-5.59)	0.56	**	**
Lateral incisor	1 (47.6)	2 (52.4)				
Type of fracture						
Crown fracture	6 (46.1)	7 (53.9)	1.20 (0.37-3.96)	0.76	**	**
Crown-root fracture	34 (50.7)	33 (49.3)				
Time to seek treatment						
Less to 30 days	28 (60.9)	18 (39.1)	0.35 (0.14-0.88)	0.03	0.37 (0.14-0.98)	0.05
More than 30 days	12 (35.3)	22 (64.7)				

OR, odds ratio; CI, confidence interval.

\*Variable used for final model adjustment, despite its level of significance.

\*\*Variable that did not enter into the multiple model.

Numbers in bold means variables significantly associated with pulp polyp occurrence.

Variable	Endodontic treatment n (%)	Dental extraction n (%)	Crude OR (95% CI)	Р	Adjusted OR (95% CI)	Ρ
Gender						
Girls	16 (57.1)	12 (42.9)	1.68 (0.67-4.24)	0.27	*	*
Boys	23 (44.2)	29 (55.8)				
Age when TDI occurred						
>2 years old	15 (51.7)	14 (48.3)	0.83 (0.33-2.07)	0.69	*	*
$\leq$ 2 years old	24 (47.0)	27 (53.0)				
Type of tooth						
Central incisor	37 (48.0)	40 (52.0)	0.46 (0.04-5.32)	0.54	*	*
Lateral incisor	2 (52.4)	1 (47.6)				
Type of fracture						
Crown fracture	10 (76.9)	3 (23.1)	4.36 (1.10-17.32)	0.04	4.36 (1.10-17.32)	0.04
Crown-root fracture	29 (43.3)	38 (56.7)				
Pulp polyp						
No	20 (50.0)	20 (50.0)	0.90 (0.37-2.17)	0.82	*	*
Yes	19 (47.5)	21 (52.5)				
Time to seek treatment						
Less to 30 days	23 (50.0)	23 (50.0)	1.13 (0.46-2.73)	0.79	*	*
More than 30 days	16 (47.0)	18 (52.9)				

Table 5. Distribution, univariate and multiple analyses of association between therapeutic clinical decision-making after fracture with pulp exposure and independent variables in primary teeth

OR, odds ratio; CI, confidence interval.

\*Variable that did not enter in the multiple model.

Numbers in bold means variables significantly associated with therapeutic clinical decision-making.

A high occurrence of large polyps (size greater than the crown) was observed in this study. Nevertheless, the polyp size was not associated with a greater time to seek treatment. It seems that the time the pulp polyp is exposed to the oral environment does not interfere with its growth. Other factors should influence on this growth such as an allergic reaction (19) or external stimuli.

Probably, more important than the pulp exposure duration may be the potential for pulp proliferation. Younger children ( $\leq 2$  years of age) had more chance of presenting pulp polyp than elders. Rich blood supply allows pulp to resist bacterial infection, and this reaction is probably favored in teeth whose crowns and roots are completely destroyed. A more severe hyperplastic response of the pulp in primary teeth among younger children may be indicative of a favorable pulpal reactivity and defense. This is probably due to the open root apical foramen found in this age, which contributes to an excellent blood supply and a high level of bacterial resistance (1-3, 5, 20). Therefore, it is advantageous the pulp polyp occurs in children, especially the younger children, as this clinical sign suggests absence of necrosis. The occurrence of pulp necrosis could, in more advanced stages, lead to early primary tooth loss or further permanent tooth complications (21 - 24).

Longer time to seek treatment after occurrence of traumatic dental injuries was negatively associated with pulp polyp occurrence. Probably, children who had pulp polyps sought treatment more quickly than those who did not, as the pulp hyperplasia can be interpreted by parents as a negative aspect or some condition that could require more attention. Usually, the hyperplasia has no symptoms, except during mastication, when the pressure may cause discomfort due to movement of fractured crown fragments. This fact could explain why some children took up to 1 year to seek treatment.

The pulp polyp could also influence on dentist's clinical decision-making, as it is a rare event, and many professionals may be unaware of treatment alternatives. Facing the complexity in diagnosis and the association with dental fracture, many clinicians could frequently opt for dental extraction in these cases. Our center has adopted a highly conservative approach for treating primary teeth after traumatic injuries for many years. The endodontic treatment is often the first option instead of early primary tooth extraction. We also evaluated whether the presence of polyp could interfere in the initial clinical decision-making for traumatized primary teeth. However, this study showed that the presence of pulp polyps did not influence the treatment decision-making in traumatized primary teeth. Therefore, we corroborate that the presence of a pulp polyp does not lead to early primary tooth loss as observed in some stages of necrosis process (21-24).

On the other hand, the presence of a crown-root fracture can increase the need of tooth extraction, despite the pulp polyp formation. This type of fracture compromises the tooth root and can extend under gingival tissue, which may strongly complicate endodontic or restorative treatments.

As the radicular pulpal tissue in teeth with pulp polyps has been shown to remain normal as assessed by histological studies (1, 2, 5), we believe that conservative treatment (pulp treatment) would be the best option (3–5), except for fractures in which future rehabilitation treatments would not be possible. Further studies should be conducted to verify the longevity and cost-effectiveness of endodontically treated teeth that had previously presented with a pulp polyp.

In conclusion, the occurrence of pulp polyp is not frequent, but it has greater chance to occur in children up to 2 years of age. In addition, pulp polyp formation does not seem to interfere directly in the therapeutic clinical decision-making even among highly conservative professionals.

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