

Pulp Calcification in Traumatized Primary Teeth: Prevalence and Associated Factors

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Aim: To establish the prevalence of pulp calcifications in 946 patients at the Research and Clinical Center of Dental Trauma in Primary Teeth. **Study Design:** The clinical and radiographic records of 1,675 traumatized primary teeth were evaluated. Statistical analysis was performed using chi-square and univariate logistic regression. **Results:** 197 (20.8%) patients showed pulp calcification (PC). A total of 250 (14.9%) calcified teeth were observed. In most teeth, PC appeared within the first 12 months following trauma. PC prevalence was higher in cases of repeated trauma (29.6%) than in single trauma (16.4%), $p < 0.05$, with a 2.14 chance of showing pulp calcification when a child suffered recurrent trauma. Most teeth showing calcified pulp, suffered trauma to the supportive tissue (67.4%), being statistically significant in relation to the trauma to dental tissue ($p < 0.05$). **Conclusion:** PC is a sequelae in cases of trauma to the primary dentition; teeth that suffered recurrent traumatic injuries show higher risk of presenting.

Keywords: pulp calcification, primary teeth, dental trauma

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INTRODUCTION

Prevalence of trauma to the primary dentition varies from 10 to 36%.¹⁻⁷ Clinical and radiographic follow-ups of traumatized primary teeth and developing permanent teeth must be performed to monitor the emer-

gence of possible complications.⁷⁻⁸ Sequelae of trauma to primary teeth may present as pulp necrosis, internal root resorption, external pathological root resorption, pulp calcification, and loss of supporting tissue, among others. Sequelae depends on the child's individual characteristics and complications during the healing process.⁹⁻¹²

Pulp calcification is a common finding associated with the healing process following traumatic injuries.^{11,13} This may be triggered by cells that are in the process of degeneration and whose cellular membrane can no longer control ion transportation causing excessive accumulation of calcium phosphate crystals within the cells.^{14,15} Another hypothesis,¹⁶ suggests that reduced blood flow in pulpar vessels may result in loss of parasympathetic inhibition and vasoconstriction leading to an uncontrolled sympathetic nervous response. These alterations in the nervous control of the secretory activity of the odontoblasts may result in pulp calcification. Furthermore, these authors report that blood clots formed after the dental injury, may become calcified and trigger calcification of the remaining pulp. However, definite conclusions cannot be drawn based on the few studies published on pulp calcification.

Prevalence of pulp calcification in injured primary teeth that were diagnosed by radiographs varied from 6.1% to 35.9%.^{1, 17-19} Due to the absence of signs and symptoms of teeth with pulp calcification, the prevalence can be greater than those mentioned earlier. Robertson *et al*²⁰ observed pulpal histopathological alterations of 123 primary traumatized teeth under light scanning and transmission electron microscopy and observed pulp calcification in 76% of their sample.

The aim of this study was to evaluate the prevalence of

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Figure 1. Initial radiograph – intrusion of upper central right primary incisor (#51); no pulp calcification observed.



Figure 3. Follow-up radiograph 6 months after intrusion. Notice pulp calcification.

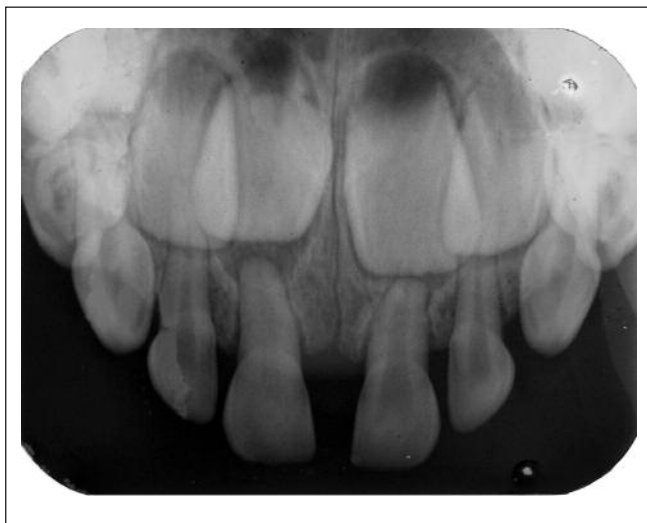


Figure 2. A marked obliteration of the pulp space is observed when compared to the initial radiograph 3 months after intrusion. The intruded tooth has also re-erupted.

pulp calcification in traumatized primary teeth and its relationship to type of trauma, time elapsed since trauma, frequency of traumas and child's age and gender.

MATERIAL AND METHODS

Approval for this study was obtained from the Ethical in Research Committee of the School of Dentistry of the University of São Paulo, Brazil.

The dental records of 1,085 patients from the Research and Clinical Center of Dental Trauma in Primary Teeth, Discipline of Pediatric Dentistry at the School of Dentistry – University of São Paulo. Only files with complete data (medical and dental records; radiographs and photographs) were studied. Since some data were missing, 139 files were excluded from the study. The final sample consisted of 946 files of children who suffered trauma to the upper primary incisors. A single, trained and experienced examiner analyzed all records. The training of the examiner was con-

ducted with 30 radiographs in which the supervisor and the examiner agreed on the diagnosis of the pulp calcification. Ten percent of the same sample was examined and the results were submitted to test Kappa, with Kappa coefficient = 0.92.

The prevalence of pulp calcification and its relationship to age, gender and type of trauma, time elapsed since trauma, and the total number of dental traumas suffered by the patient was evaluated using the patient's clinical records. All records from the Clinical Center of Dental Trauma in Primary Teeth were derived from a systematic collection of data. All modified occlusal radiographs (horizontal view) were taken using adult films (Kodak Insight radiographic films 22 X 35 mm, Eastman Kodak, Rochester, NY/USA) in the same machine (Spectro 70 X, Dabi Atlante, Ribeirão Preto, Brazil) at 70 kVp and 8 mA.

The first analysis of the patient's radiographs evaluated pulp calcification in the traumatized primary teeth. The first (Figure 1) and the last radiograph (Figure 2) obtained from each patient were analyzed. If the radiograph of the evaluated tooth showed less than 1/3 root formation, the radiograph before the last one would be evaluated, and so on. The radiographic images of the first and last radiographs were compared and pulp calcification would be confirmed if a decrease in the size of the pulpal chamber was observed in the latter radiograph.

The second analysis consisted of evaluating the time period necessary to start pulpar calcification after dental trauma. The time period since the child's first dental trauma and the first manifestation of pulp calcification in clinical radiographs were recorded (Figure 3).

Data were tabulated in Microsoft Excel 2007®. Statistical analysis was completed using Chi Square Tests followed by a univariate logistic regression model (Epi-Info 6.0).

RESULTS

From a total 946-patient files studied, 543 were boys and 403 were girls.

Pulp calcification was observed in 197 patients (20.2%): 109 boys (55.3%) and 88 girls (44.7%). No statistical difference was found regarding gender.

Table 1 and 2 show that the 197 patients presenting pulp calcification had a total of 250 calcified primary teeth. The age at which the patient suffered the first dental trauma had no statistical relationship to the presence of pulp calcification ($p>0.05$).

Table 3 shows the relationship between pulp calcification and repeated trauma to the primary dentition. In the group of teeth with pulp calcification, 70.4% suffered only one episode of trauma to the primary dentition, while 29.6% suffered more than one trauma, being statistically different ($p<0.05$). However, the logistic regression showed that teeth that suffered more than one trauma were 2.14 times more likely to develop pulp calcification than teeth that suffered only one trauma ($p<0.05$, OR 2.14 (1.56<OR>2.38)).

The type of dental trauma had a statistically significant effect on pulp calcification. Prevalence and risk factors for pulp calcification were higher among teeth suffering luxation injuries compared to those suffering injury to the dental hard tissue (Table 4) ($p<0.05$; OR 1.35, 1.06<OR>1.71).

Parents of some children—4 from the group with calcified pulp and 17 from the group with no pulp calcification—did not report the type of trauma their child had suffered.

Among 250 teeth showing pulp calcification, this alteration was already present in 113 teeth (45.2%) in the first radiograph taken at the Clinical Center of Dental Trauma. The remaining 137 teeth showed pulp calcification in the follow-up appointments at the Clinical Center of Dental Trauma in Primary Teeth, being that 73 teeth (53.3%) developed this alteration within the first year after the first dental trauma (Table 5).

DISCUSSION

Clinical and radiographic follow-ups are important in order to monitor possible sequelae to the primary and permanent dentition following dental trauma.^{9,12,21} The present study shows that pulp calcification is a sequela of trauma to primary teeth.

Several studies have shown the prevalence of trauma to the primary dentition.¹⁻⁷ However, there are few studies on the sequelae of the primary teeth and their related characteristics. A literature review presented no study comparing the

Table 1. Distribution of patients according to pulp calcification and the age at time of the first injury.

Patients	Age (years)									
	0 — 3		3 — 5		5 — 7		Did not know ¹		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Presence of PC	111	(11.7)	63	(6.6)	14	(1.5)	9	(1.0)	197	(20.8)
Absence of PC	371	(39.2)	262	(27.7)	79	(8.3)	37	(4.0)	749	(79.2)
Total	482	(50.9)	325	(34.3)	93	(9.8)	46	(5.0)	946	(100)

¹The parents did not know the age of the patient at the first trauma
 $p>0.05$

Table 2. Distribution of teeth according to pulp calcification and age at the time of first injury.

Teeth	Patient's Age (years)									
	0 — 3		3 — 5		5 — 7		Did not know ¹		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Presence of PC	134	(8.1)	86	(5.1)	18	(1.0)	12	(0.7)	250	(14.9)
Absence of PC	690	(41.2)	517	(30.8)	156	(9.3)	62	(3.7)	1425	(85.1)
Total	824	(49.3)	603	(35.9)	174	(10.4)	74	(4.4)	1675	(100)

¹The parents did not know the age of the patient at the first trauma
 $p>0.05$

Table 3. Distribution of teeth according to pulp calcification and history of repeated dental injuries.

Teeth	Repeated dental trauma					
	No		Yes		Total	
	n	(%)	n	(%)	n	(%)
Presence of PC	176	(70.4)	74	(29.6)	250	(100)
Absence of PC	1191	(83.6)	234	(16.4)	1425	(100)
Total	1367	(81.6)	308	(18.4)	1675	(100)

$p<0.05$, OR 2.14 (1.56<OR>2.38)
OR: odds ratio

Table 4. Distribution of teeth according to pulp calcification and type of trauma.

Teeth	Type of Trauma ¹					
	Dental tissue		Surrounding tissue		Total	
	n	(%)	n	(%)	n	(%)
Presence of PC	138	(32.6)	285	(67.4)	423	(100)
Absence of PC	413	(26.4)	1151	(73.6)	1564	(100)
Total	551	(27.7)	1436	(72.3)	1987	(100)

¹The same teeth could have more than one type of trauma
($p < 0.05$; OR 1.35, $1.06 < OR < 1.71$)
OR: odds ratio

Table 5. Distribution of teeth according to pulp calcification and time (in months) between injury and first radiographic evidence of pulp calcification.

Radiographic evidence of pulp calcification (n=137) ¹											
0 – 12		12 – 24		24 – 36		36 – 48		48 – 60		Did not know ²	
n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
73	53.3	31	22.6	14	10.2	4	2.9	3	2.2	12	8.8

¹Patients with evidence of pulp calcification at the first appointment were excluded

²The parents did not know the age of the patient at the first trauma

prevalence of pulp calcification among boys and girls. In our study, no difference was found in its prevalence according to gender.

The sample of the present investigation consisted of 946 children who had suffered dental trauma to the primary dentition, and among these, 20.8% showed pulp calcification (Table 1). Comparing these results to the ones obtained by Soporowski *et al*¹⁷ who reported a prevalence of 10.5% among 114 patients, it is clear that our study showed a higher prevalence and had a larger sample.

Pulp calcification was discovered in 14.9% of the total 1,675 teeth studied in the present investigation (Table 2). Other studies on this matter using radiographic evaluation showed a prevalence varying from 6.1% to 35.9% and samples ranging from 69 to 545 teeth.^{1, 18-19} An even higher prevalence (76%) was observed when a histological evaluation of the dental pulp of traumatized primary incisors was performed.²⁰ Furthermore, Milano and Seybold²² reported a 2.1% prevalence of calcified pulp in primary teeth that had no history of dental trauma. Comparing these results to those obtained in our study, we conclude that pulp calcification shows a higher prevalence in traumatized primary teeth.

One of the main functions of the dentin-pulp complex is to respond to hazardous stimuli.⁹ Consequently, it is important to evaluate the response when teeth are submitted to dental trauma more than once. In the current study, a statistically significant difference was observed between pulp calcification and a history of recurrent traumas. Teeth that suffered more than one trauma, showed an odds ratio of 2.4 for pulp calcification when compared to those with only one history of trauma.

Pulp calcification was more frequent in teeth suffering luxation injuries compared to dental hard tissue trauma (Table 4). Soporowski *et al*¹⁷ reported that prevalence of

pulp calcification depends on the type of traumatic injury. If PC occurs on hard tissue injuries, pulpar alterations are rare, whereas in luxation injuries they are more common.⁹ However, when the tooth suffers a hard tissue dental injury, there is also some injury to the supporting tissue. Therefore, when considering traumatized primary teeth, it is of clinical relevance to analyze the overall outcome of all traumatic injuries.^{9, 18,21}

In the present study, pulp calcification was observed in most cases within 12 months after injury, in agreement with the results found by Borum and Andreasen.¹⁸ Kenwood and Seaw¹⁹ observed the first pulp calcification under radiograph exam after the second follow-up assessment that varied from 12 to 110 months. It is difficult to compare our results to those found in other studies since there are no well-established standards for these data in previous investigations. Pulp calcification is one of the sequelae of trauma to the primary dentition. For an adequate diagnosis and treatment, information on prevalence and factors associated with pulp calcification are very important as well as understanding and studying the clinical and radiographic aspects related to this process. Further studies are required to elucidate these complex aspects.

CONCLUSIONS

- Pulp calcification is a sequela of trauma to the primary dentition.
- In cases with a repeated history of traumatic injuries, the chance of pulp calcification doubled compared to a single trauma.
- Occurrence of pulp calcification was greater after luxation injuries.
- Pulp calcification was detected within 12 months after trauma.

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