Pulp Calcification in Traumatized Primary Teeth – Classification, Clinical And Radiographic Aspects

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Objective: *The aim of this study was to standardize the nomenclature of pulp alteration to pulp calcification (PC) and to classify it according to type, quantity and location, as well as relate it to clinical and radiographic features.* ***Study design:*** *The dental records of 946 patients from the Research and Clinical Center for Dental Trauma in Primary Teeth were studied. Two hundred and fifty PC-traumatized upper deciduous incisors were detected.* ***Results:*** *According to radiographic analysis of the records, 62.5% showed diffuse calcification, 36.3% tube-like calcification, and 1.2% concentric calcification. According to the extension of pulp calcification, the records showed: 80% partial calcification, 17.2% total coronal calcification and partial radicular calcification, and 2.8 % total coronal and radicular calcification. As for location, only 2.4% were on the coronal pulp, 5.2% on the radicular pulp and 92.4% on both radicular and coronal pulp. Regarding coronal discoloration, 54% were yellow and 2% gray. In relation to periradicular changes, 10% showed widened periodontal ligament space, 3.1% internal resorption, 10% external resorption, 10.4% periapical bone rarefaction.* ***Conclusions:*** *Since PC is a general term, it is important to classify it and correlate it to clinical and radiographic changes, in order to establish the correct diagnosis, treatment and prognosis of each case.*

Key words: Dental Pulp Calcification. *Dental Trauma. Radiography, Dental.*

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INTRODUCTION

Pulp calcification[1-4] has been represented in several ways in dental literature: dystrophic calcification[5], calcific metamorphosis[6], calcific degeneration[5], pulp canal obliteration[7-9], diffuse calcification[1, 8], tube-like calcification[8, 10] and pulp nodules[11], among others. It is important to standardize its nomenclature for a better understanding of this type of sequel following traumatic injuries to primary teeth.

There are various patterns of pulp calcification. Mineral deposition may be located along the root canals or pulp chamber, or within the pulpal tissue[5, 12]. Therefore, pulp calcification can be observed on the root and coronal pulp[4, 13, 14]. Pulp calcification may be sub classified as partial or total depending on its extension[5, 15, 16].

Pulp calcification is commonly found in routine X-ray examination or when teeth present clinical manifestations [17, 18]. The process of pulp calcification may be related to clinical changes, such as discoloration of the clinical crown[5, 9, 14, 15, 19]. Radiographically speaking, it may be associated with periapical radiolucency, suggesting pulp necrosis of a sort[5, 13, 20, 21].

It is important to know all kinds of pulp calcification to be able to classify and correlate them to several types of dental trauma and thus predict the clinical outcomes.

In order to obtain more knowledge on pulp calcification in

traumatized primary teeth, the aim of this study was to analyze primary teeth that presented pulp calcification in patients of the Research and Clinical Center for Dental Trauma in Primary Teeth, a subject in Pediatric Dentistry at the Dentistry College of the University of São Paulo (FOUSP), Brazil. Its classification, location and extension will also be described.

MATERIALS AND METHOD

This study was approved by the Ethics and Research Committee of FOUSP (Approval number 204/04). The dental records of 946 patients from the Research and Clinical Center for Dental Trauma in Primary Teeth were studied**.** Dental Trauma in Primary Teeth is a subject in Pediatric Dentistry at the Dentistry College of the University of São Paulo. Only complete files (full medical and dental records, radiographs and photographs) were included. All records from the Clinical Center for Dental Trauma in Primary Teeth follow 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, USA) in the same machine (Spectro 70 X, Dabi Atlante, Ribeirão Preto, Brazil) at 70 kVp and 8 mA. The adult radiographic film was placed between the jaws to obtain a maxillary occlusal radiograph.

For including samples, the criterion was selecting only dental records from patients (age range between 1 and 5 years) with reports of traumatic injuries on maxillary primary incisors with at least half of their roots (confirmed through radiographic examination).

Pulp calcification was analyzed using patients' radiographs, photographs and clinical records. Radiographs were used to classify pulp calcification according to 1) type (pulp canal obliteration or diffuse, tube-like, and concentric), as shown in Figures 1-3; extension (partial or total); and location (coronal pulp, radicular pulp, or both). Tooth crown discoloration was also evaluated (Figures 4a and 4b).

In this study, pulp calcification was classified as pulp canal obliteration or diffuse calcification, tube-like or concentric. The term pulp canal obliteration or diffuse pulp calcification was used when the radicular pulp canal and coronal pulp chamber were

Figure 1- Diffuse pulp calcification in the primary right central incisor

Figure 2- Tube-like pulp calcification in the primary right and left central incisors

Figure 3- Concentric pulp calcification in the primary right central incisor

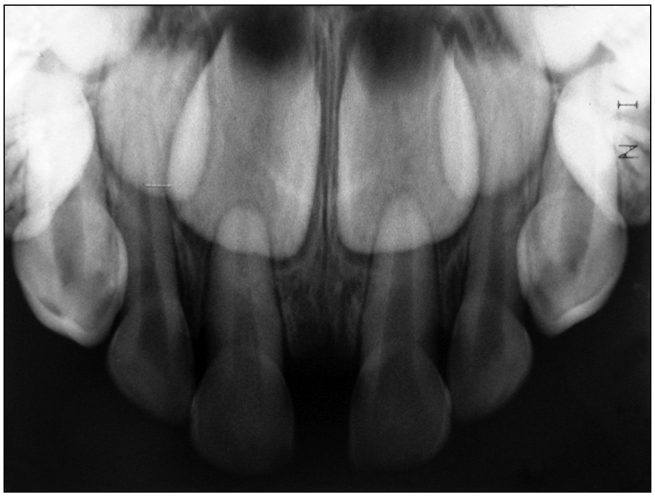

Figure 4a- Primary right central incisor with partial diffuse pulp calcification coronoradicular

Figure 4b- Same tooth showing altered yellowish color.

decreased [5, 12]; the term tube-like was used when radiopaque stripes along the pulpal walls were observed in radiographs[15, 17] and finally concentric calcification when concentric radiopaque images were observed[2, 3, 5, 11].

Pulp calcification was identified in 197 patients. A single, trained and experienced examiner analyzed all records. Examiner training was conducted by using a set of 30 radiographs upon which supervisor and examiner had to jointly agree in relation to each pulp calcification diagnosis. Ten percent of the same samples was also scrutinized by the examiner and the results were submitted to the Kappa test, coefficient = 0.92.

The Research and Clinical Center for Dental Trauma in Primary Teeth was founded in 1999. Up to date, it has treated 1,880 patients suffering from traumatic injuries to primary dentition.

RESULTS

A total of 250 traumatized primary teeth in 197 patients showed pulp calcification.

Table 1 shows the distribution of teeth with pulp calcification according to type. The most common type of pulp calcification was pulp canal obliteration or diffuse calcification (62.5%), followed by tube-like (36.3%) and concentric (1.2%).

Regarding the extension of the pulp calcification, Table 2 shows that most teeth (80%) presented partial coronal and radicular pulp obliteration, followed by total coronal and partial radicular pulp obliteration (17.2%) and total coronal and radicular pulp obliteration (2.8%). No case of total radicular pulp calcification or partial coronal obliteration was found.

Regarding location, Table 3 shows that most teeth presented calcification in both radicular pulp and coronal pulp (92.4%), followed by exclusive radicular pulp calcification (5.2%) and exclusive coronal pulp calcification (2.4%).

Yellowish color change was observed in 54% of the teeth showing pulp calcification. Only five (2%) teeth showed gray crown discoloration, while 110 (44%) traumatized teeth with pulpar calcification did not show any coronal color discoloration at all.

The periradicular changes associated with pulp calcification are described In Table 4. External resorption and widened periodontal ligament space were observed in 26 teeth (10%), whereas internal resorption was the least frequent (3.1%) alteration observed. In most teeth with pulp calcification (66.4%), no periradicular alterations were found.

Table 1. Distribution of teeth according to type of pulp calcification

Diffuse		Concentric		Tube-like	
n	(%)	n	(%)	n	(%)
157	(62.5)	3	(1.2)	91	(36.3)

Type of pulp calcification (n=251)

Teeth may show one or several types of pulp calcification.

Table 2. Distribution of teeth according to quantity of pulp obliteration

Partial		Total		Total coronal and partial radicular		Total radicular and partial coronal	
n	(%)	n	(%)	n	(%)	n	(%)
200	(80.0)	7	(2.8)	43	(17.2)	0	(0)

Quantity of pulp calcification (n=250)

Table 3. Distribution of teeth according to location of pulp calcification

Coronal		Radicular		Coronoradicular	
n	(%)	n	(%)	n	(%)
6	(2.4)	13	(5.2)	231	(92.4)

Location of pulp calcification (n=250)

Table 4. Distribution of teeth according to periradicular alterations

none		Widened periodontal ligament		Internal resorption		External resorption		Periapical rarefaction	
n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
172	(66.4)	26	(10.0)	8	(3.1)	26	(10.0)	27	(10.4)

Periradicular alterations (n=259)

Teeth may show one or several periradicular alterations

DISCUSSION

In another side research conducted by our group, the prevalence of pulp calcification and associated factors were investigated, showing that 197 (20.8%) patients and 250 (14.9%) teeth presented pulp calcification in traumatized primary teeth [22].

Since these results were obtained in our study, we have then adopted the term pulp calcification. This term is normally used to describe the formation of nodules in the pulp. In cases where diffuse calcification of the pulp is present, it may seem strange to affirm that it is a case of pulp calcification and, therefore, some prefer to use the terms narrow pulp cavity or pulp obliteration. However, it is worth mentioning that the pulp tissue is not independent; rather, it must always be considered as the dentin-pulp complex[5]. The etiology of pulp calcification is very diverse and it may occur, for example, due to excessive deposition of dentin by odontoblasts or the calcification of cells within the pulp tissue[4]. Therefore, it is preferable to use the generic term pulp calcification at first, before classifying it

according to type, quantity and location, and before associating it with clinical and radiographic findings.

In this study, pulp calcification was classified as pulp canal obliteration or diffuse calcification, tube-like calcification or concentric calcification. The term diffuse pulp calcification was used when the radicular pulp canal and coronal pulp chamber were decreased[5, 12]; the term tube-like was used when radiopaque stripes along the pulpal walls were observed in radiographs[15, 17] and finally concentric calcification when concentric radiopaque images were observed[2, 3, 5, 11]. Table 1 shows high prevalence of tube-like calcification (36.3%), in contrast to other studies[15, 17].

Regarding the extension of pulp calcification, the present investigation observed high prevalence of partial pulp calcification (80%) contradicting results observed in other studies (Table 2). In the histologic study by Soxman, Nazif and Bouquot[21] , nine teeth (39.1%) showed various stages of pulp calcification, whereas one tooth showed total pulp calcification and the others partial calcification. However, it is worth noticing that these authors studied a small sample, i.e. only 23 traumatized primary teeth[21]. This histologic study showed how rare complete pulp calcification is. In our study, we classified partial and complete pulp calcification based on periapical radiography, aware of the limitations of this method.

Additionally, as some authors assert[3-5, 12, 13], pulp calcification occurs mainly on both coronal and radicular pulp. This study showed the same (Table 3).

Pulp calcification and coronal change of color are reported in scientific literature by some authors[5, 9, 14, 15, 18, 19]. Since enamel is translucent, the white-yellowish dentin is responsible for the color of the tooth. Therefore, the change in tooth color is given by the dentin according to its degree of mineralization, age, endogenous and exogenous pigments[14, 19]. Moreover, Borum and Andreasen[13] related pulp calcification and changes in color to the prevalence of 68.3% of yellowish coronal discoloration, higher than in this study (54%) .

According to Soporowiski, Allred and Needleman[18], 55% of teeth with pulp calcification showed no periradicular changes. In this study, a similar result was observed (66.4%) (Table 4).

As for internal and external resorption, scientific literature describes some cases associated with pulp calcification[6, 13]. Pulp necrosis followed by periapical bone rarefaction was present in 10.4% of the teeth in our study. It may be due to a decrease in size of the pulp cavity[5, 13, 20-22], a congestion in the vascular system of the pulp tissue causing the necrosis thereof or a new trauma or periodontal contamination (Table 4).

The treatment in most cases was clinical together with radiographic control until the calcified tooth exfoliated. Endodontic therapy was performed in teeth that revealed periapical bone rarefaction. However, in some cases, endodontic treatment could be difficult, as access to endodontic cavity may be much limited due to coronal calcification; or radicular calcification may prevent the entry of the file, or if pulp canal obliteration or diffuse, concentric or tube-like calcification is present, it may prevent a complete endodontic treatment. In unfavorable cases, tooth extraction was performed. In the study conducted by Borum and Andreasen [9] , when there was a need for clinical intervention, tooth removal was the only treatment performed.

The presence of carious lesions, restoration and crown fractures were also evaluated; the majority (85.2%) of traumatized primary teeth did not present any of these alterations at all. Therefore, it can be concluded that the irritating stimulus generated in the dentin-pulp complex that led to pulp calcification was related to dental trauma only.

As authors already investigated[9, 19, 22, 23], exfoliation of primary teeth with pulp calcification occurs naturally. This was also observed in our study while monitoring these cases.

Pulp calcification may be the only sign that there was dental trauma in the region. Therefore, the case should be followed until eruption of the permanent successor, as other sequels may occur to these teeth or adjacent ones in both dentitions.

CONCLUSION

It is important to correlate pulp calcification to clinical and radiographic changes. Likewise, knowledge on how to identify this pathology and classify its different kinds may facilitate the follow-up of traumatized teeth with pulpal calcification to provide correct diagnosis and treatment, thus improving the prognosis of such cases.

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