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Association of crown discoloration and pulp status in traumatized primary teeth

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Abstract – The aim of the present study was to determine the association of tooth discoloration in traumatized primary teeth with clinical and radiographic signs of pulp necrosis, and pulp status at the time of endodontic access. Clinical and radiographic data from dental reports of the 47 patient charts of the Trauma Patient Care Program were used totaling 55 teeth that underwent endodontic treatment following the protocol of the Federal University of Santa Catarina (Brazil). The following data were collected: gender, age of child at time of trauma; crown discoloration; abscess and/or fistula; periapical bone rarefaction and/or pathological root resorption; and pulp status at the time of endodontic access. The Chi-square test and logistic regression were used in the statistical analysis. The associations between crown discoloration and gender, age, tooth, type of trauma, clinical alteration, and radiographic alteration were not statistically significant. There was a significant association between crown discoloration and pulp necrosis at the time of endodontic access ($\chi^2 = 7.672$; $P < 0.05$). Traumatized primary teeth with crown discoloration had a fivefold greater likelihood of exhibiting pulp necrosis than teeth without crown discoloration (95% CI: 1.5–17.1). Thus, a significant association was found between crown discoloration and pulp necrosis in traumatized primary teeth.

The greatest concern following trauma to primary teeth is how it may affect the permanent dentition. This alteration can occur either during the trauma through the transmission of the force of impact, the direct impact of the primary tooth on germ of the successor or the lasting effects of pulp necrosis and/or inflammation of the traumatized primary tooth. Pediatric dentists have no means of avoiding or intervening in the former two factors. However, the consequences stemming from pulp necrosis and inflammation can be either avoided or minimized (1).

Traumatized primary teeth with necrosis that remain in the oral cavity without treatment can have a negative effect on the permanent successor due to the maintenance of the inflammation of the periapcial tissues (2). The peak prevalence of trauma in the primary dentition is 2.5 years of age (3). Thus, contact between the inflammation and germ of the permanent teeth (when there is no treatment) can be a few years, coinciding with the formation of the successor (2). Moreover, the maintenance of the necrotized primary tooth can lead to the resorption of the tooth and bone tissue, with the loss of the tooth and early eruption of the permanent successor (4).

There is a real difficulty in diagnosing pulp necrosis in both permanent teeth and traumatized primary teeth (5). Pain is one of the associated symptoms to pulpal necrosis, but it is not very frequent in traumatized primary teeth. Signs of pulpal necrosis are symptoms of periapical bone rarefaction, presence of fistula and inflammatory root resorption. Some authors consider crown discoloration an early sign of pulp degeneration (6) and, in many cases, this condition is seen at home by parents/guardians. The term 'crown discoloration' is generically used for any alteration, whether pink, yellow or gray. Often, a single tooth may vary in intensity and coloration (7). A change in crown color is a frequent clinical sign in traumatized primary teeth (3, 8–10). Among other causes, it occurs due to the pulp hemorrhaging stemming from the trauma, in which hemoglobin and erythrocytes are released. The penetration of hemosiderin (pigment originating from hemoglobin) in the dental tissues can lead to a change in crown color (4, 11, 12).

According to some authors, gray crown coloration indicates pulp necrosis (11, 13). Others believe that this statement is not quite true, based on studies describing primary teeth that remained a number of years with a gray color, but with no other clinical or radiographic signs of necrosis (6).

Clinically, gray crown discoloration, even different degrees of gray (14), can recover their original color (9, 12, 15), become yellowed (9, 13, 15) or remain gray with no other sign of necrosis (6, 9). In some case, however, these traumatized primary teeth may develop clinical and radiographic alteration indicative of necrosis of the pulp tissue (16).

The aim of the present study was to determine whether there is an association between crown discoloration and pulp status in traumatized primary teeth.

Materials and methods

The sample was obtained from an analysis of duly filled out charts with data from patients treated at the Trauma Patient Care Program (primary teeth) of the Federal University of Santa Catarina (UFSC, Brazil) between August 1998 and December 2008.

The following data were collected: gender; traumatized tooth (right and left maxillary central incisor teeth); type of trauma (mild – fracture without pulp exposure, concussion, and subluxation; or severe – lateral luxation, intrusion, and extrusion); age of child at the time of the trauma (less than/equal to or more than 18 months); crown discoloration; abscess and/or fistula in clinical examination; periapical lesion or pathological root resorption (loss of root substance combined with loss of adjoining bony substance) in radiographic exam; and pulp status at the time of endodontic access (vital or necrotic).

Among all the charts at the Trauma Patient Care Program (primary teeth), the teeth selected for the sample obeyed the following inclusion criteria: trauma in primary teeth; trauma to right or left maxillary central incisor teeth (most affected teeth); teeth with crown discoloration; and teeth with endodontic treatment initiated. The following were the exclusion criteria: caries or restorations in right and/or left maxillary central incisor teeth; teeth without crown discoloration without endodontic treatment; avulsed and/or replanted teeth (endodontic treatment starts before any signs of pulp necrosis); teeth with crown or root fracture; and data from incomplete charts.

According to The Trauma Patient Program, endodontic treatment of traumatized primary teeth is indicated when the tooth shows one of the following clinical and/or radiographic signals: abscess, fistula, periapical lesion, and root pathological resorption, regardless of crown color alteration.

Data on the dental reports of the teeth during the initial appointment for endodontic treatment as well as data related to the soft tissue were collected from the charts. The following data were collected regarding the soft tissue: absence of signs such as abscess and/or fistula; presence of abscess associated or not to fistula; and presence of fistula. The following data were collected regarding the tooth: absence of crown discoloration; presence of gray crown discoloration; and presence of yellow crown discoloration.

The radiographs attached to the charts were analyzed in a dark environment with the aid of an x-ray viewer and magnifying glass. The following data were collected: absence of signs of pulp necrosis; presence of periapical lesion; presence of pathological root resorption; and presence of periapical lesion associated to pathological root resorption.

Results

Forty-seven charts and respective radiographs involving 55 teeth were examined. Among the 34 with crown discoloration, 21 (61.8%) were grayish, eight (23.5%) were yellowed, and the color of the alteration was not defined in five teeth (14.7%).

Soft tissue alteration was reported during the clinical exam performed on the day of endodontic access. Among the 14 teeth diagnosed with soft tissue alteration, 13 (92.8%) exhibited a fistula and only one (7.2%) exhibited an abscess associated with a fistula. Radiographic alteration also referred to the radiographic exam performed on the day of the endodontic access. Fifty-one teeth exhibited such alteration: 19 (37.3%) teeth with periapical lesion; 23 (45.1%) with pathological root resorption; eight (15.7%) with periapical lesion and pathological root resorption; and one (1.9%) with internal resorption (Table 1).

Associations between tooth discoloration and the other variables, along with the results of the Chi-square test, are displayed in Table 2. Although a non-significant association was found, severe trauma caused a greater frequency of crown discoloration. Regarding pulp status, among the seven vital teeth with discoloration, three (42.8%) were grayish, two (28.6%) were yellowed, and the color of the alteration was not defined in two teeth (28.6%). Among the teeth diagnosed with pulp necrosis and discoloration ($n = 27$), 18 (66.7%) were grayish, six were yellowed (22.2%) and the color of the alteration was not defined in three teeth (11.1%). Another important finding to point out is that, among the 21 teeth with no discoloration, 42.8% ($n = 9$) proved to be necrotic at the moment of root canal access. This finding will be discussed further ahead in the text.

Among the 31 discolored teeth with radiographic alteration, 15 (48.4%) exhibited periapical lesion, 10 (32.3%) exhibited pathological root resorption, five (16.1%) exhibited periapical lesion and pathological root resorption and one (3.2%) exhibited internal

Table 1. Observations and simple frequencies of the variables studied in traumatized primary teeth

Variables	n^1 (%)
Gender	
Male	31 (56.4)
Female	19 (43.6)
Age	
<18 months	12 (21.8)
>18 months	40 (72.7)
Traumatized tooth	
Right maxillary central incisive	26 (47.3)
Left maxillary central incisive	29 (52.7)
Type of trauma	
Mild	41 (74.5)
Severe	12 (21.8)
Crown discolouration	
Absent	21 (38.2)
Present	34 (61.8)
Soft tissue alteration	
Absent	41 (74.5)
Present	14 (25.5)
Pulp status	
Vital	19 (34.5)
Necrotic	36 (65.5)
Radiographic alteration	
Absent	4 (7.3)
Present	51 (92.7)

[1]Number of valid observations.

Table 2. Associations between traumatized primary teeth with and without crown discoloration and explanatory variables

Explanatory variables	Absence of crown discoloration *n* (%)	Presence of crown discoloration *n* (%)	χ^2	*P*
Gender				
Male	11 (35.5)	20 (64.5)	0.219	0.640
Female	10 (41.7)	14 (58.3)		
Age				
<18 months	5 (41.7)	7 (58.3)	0.040	0.842
>18 months	15 (38.5)	24 (61.5)		
Traumatized tooth				
Right maxillary central incisive	8 (30.8)	18 (69.2)	1.148	0.284
Left maxillary central incisive	13 (44.8)	16 (55.2)		
Type of trauma				
Mild	18 (43.9)	23 (56.1)	1.386	0.239
Severe	3 (25.0)	9 (75.0)		
Soft tissue alteration				
Absent	15 (36.6)	26 (63.4)	0.174	0.677
Present	6 (42.9)	8 (57.1)		
Pulp status				
Vital	12 (63.2)	7 (36.8)	7.672	0.006*
Necrotic	9 (25.0)	27 (75.0)		
Radiographic alteration				
Absent	1 (25.0)	3 (75.0)	0.318	0.573
Present	20 (39.2)	31 (60.8)		

*$P < 0.05$.

resorption. Among the teeth with normal crown coloration ($n = 20$), four (20%) exhibited periapical lesion, 13 (65%) exhibited pathological root resorption, and three (15%) exhibited periapical lesion and pathological root resorption (Table 2).

Considering the results of the Chi-square test, the associations between crown discoloration and gender, age, tooth, type of trauma, clinical and radiographic alteration were not statistically significant. However, the association between discoloration and pulp status was significant ($P < 0.05$), suggesting that traumatized deciduous teeth with crown discoloration are more likely to exhibit pulp necrosis (Table 2). Based on the chi-square results, pulp status was included in the non-conditional univariate logistic regression, which revealed that traumatized primary teeth with discoloration were fivefold more likely to exhibit pulp necrosis than teeth with normal coloration (Table 3).

Table 3. Univariate logistic regression analysis of tooth discoloration

	OR[1] (95% CI)	*P*
Pulp status		
0 = vital	10	0.007
1 = necrotic	5.1 (1.5–17.1)	

[1]Non-adjusted value (univariate).

Discussion

More severe trauma causes greater bleeding into the pulp and a greater risk of rupture of the vascular-nerve bundle, making the tooth discoloration permanent (5). However, no significant association was found between these variables, which corroborates the finding described in a previous study (17).

For the precise diagnosis of pulp necrosis in any situation, both clinical and radiographic signs must be analyzed. Children have difficulties reporting symptoms and when they do, their reports often contribute little to the diagnosis (18). Pediatric dentists should always perform a clinical examination observing tooth coloration, mobility, sensitivity to percussion, abscess and/or fistula. A radiographic exam for signs compatible with periapical lesion and/or pathological root resorption is also necessary. The sum of the clinical and radiographic signs facilitates the decision regarding whether or not to perform endodontic treatment for traumatized primary teeth (2).

A number of authors state that discoloration alone does not necessarily indicate pulp necrosis (5, 11–13, 15, 17, 19, 20). A traumatized primary tooth, even with discoloration, may remain asymptomatic until its exfoliation (7, 11, 12, 19, 21), with no need for any invasive treatment other than clinical and radiographic monitoring of the tooth due to the risk of its developing some type of pulp pathology (4, 13).

Unlike findings described by other authors (5, 18, 20), the present study found a statistically significant association between tooth discoloration and pulp status. Therefore, teeth with discoloration should be carefully examined (clinical and radiographic exams) for other signs that may confirm the diagnosis of pulp necrosis (4, 8, 13). In agreement with a number of authors (1, 10, 11, 13, 21–26), the UFSC protocol for the treatment of trauma patients states that root canal treatment or even extraction of teeth with discoloration is only indicated when there is another clinical sign (abscess, excessive mobility or fistula) or radiographic sign (periapical lesion or pathological root resorption). Otherwise, these teeth should be monitored (13, 27). According to Diab and ElBadrawy (5), Soxman et al. (20), Hill (28) and Holan (29), however, when tooth discoloration is diagnosed, root canal treatment should be initiated, even with no other associated signs.

Unlike the findings described in the study by Kenwood and Seow (8), in which pathological alteration were found in the radiographic exam of 50% of crown with discoloration, no statistically significant association between crown discoloration and clinical and radiographic signs of pulp necrosis was found in the present study. This leads to another important discussion: traumatized primary teeth with no discoloration.

As mentioned above, crown discoloration is very much emphasized by both dentists and parents alike for esthetic reasons. Thus, considerable effort is directed toward these teeth, whereas traumatized teeth with no discoloration are overlooked. The percentages of pulp status reported in the present study reveal that nearly half of the teeth with normal coloration had pulp necrosis at the time of

endodontic access. These results stress the need for periodic clinical and radiographic follow-up of all traumatized primary teeth, especially during the 12 months following the trauma, which is when most cases of pulp necrosis are diagnosed (4, 13, 17).

For traumatized primary teeth, discoloration is an important but not decisive factor in the diagnosis of pulp necrosis. Moreover, traumatized teeth without discoloration need to be monitored, as these teeth run the risk of developing pulp necrosis. It is therefore necessary for all traumatized primary teeth to be clinically and radiographically followed up due to the risk of pulp necrosis, and its consequences. When the traumatized tooth exhibits discoloration, the follow-up should have smaller intervals between appointments, especially during the first year after the trauma (30). The decision of treatment must not be taken just because of the presence of discoloration, but it must be taken as a certain probability of the need for treatment. Thus, the decision of endodontic treatment in traumatized primary teeth with crown discoloration should be associated with other signs of pulp necrosis as abscess, fistula, periapical lesion or inflammatory root resorption.

Conclusion

The present study found association between crown discoloration in traumatized primary teeth and pulp necrosis at the time of endodontic access.

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