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Long-term effect of different treatment modalities for traumatized primary incisors presenting dark coronal discoloration with no other signs of injury

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Abstract – The aim was to compare the long-term outcomes of root canal treatment with that of follow-up-only in traumatized primary incisors in which dark discoloration is the only sign of injury. Root canal treatment was performed in 48 dark discolored asymptomatic primary incisors following trauma. Twenty-five of them [root canal treatment (RCT) group] were followed till eruption of their permanent successors. Ninety-seven dark discolored asymptomatic primary incisors were left untreated and invited for periodic clinical and radiographic examination. Of these, 28 [follow-up (FU) group] were followed till eruption of their permanent successors. The parameters examined included early extraction of the traumatized primary incisor, early or delayed eruption of the permanent successors, ectopic eruption of the permanent successor and signs of enamel hypopcalcification or hypoplasia in the permanent successor. Chi-square test was used for statistical analysis. Seven of 25 (28%) of the RCT group and 32% (nine of 28) of the FU group required early extraction. Five of 25 (20%) of the RCT group and 21% (six of 28) of the FU group showed early or delayed eruption of the permanent successors. Sixteen of 25 (64%) of the RCT group and 79% (22 of 28) of the FU group showed ectopic eruption of the permanent successors. Enamel hypopcalcification or hypoplasia in the permanent successors was equally found (36%) in both groups (nine of 25 in the RCT group and 10 of 28 in the FU group). None of differences was statistically significant. Root canal treatment of primary incisors that had change their color into a dark-gray hue following trauma with no other clinical or radiographic symptom is not necessary as it does not result in better outcomes in the primary teeth and their permanent successors.

Gideon Holan

Department of Pediatric Dentistry, The Hebrew University – Hadassah School of Dental Medicine, Founded by the Alpha-Omega Fraternity, Jerusalem, Israel

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Dr Gideon Holan, Department of Pediatric Dentistry, Hadassah School of Dental Medicine, Jerusalem, PO Box 12272, Israel 91120.
Tel.: 972 2 677 6124
Fax: 972 2 643 1747
e-mail: holan@cc.huji.ac.il

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Dark coronal discoloration following trauma is a well-known phenomenon in maxillary primary incisors (1–6). There is, however, a controversy in the dental literature regarding the condition of the pulp of such teeth. While some believe that the pulp of a dark discolored tooth may be vital (1, 7–9), others consider the pulp of such teeth to be necrotic or necrotizing (10–12). The differences may rise from the different time intervals between the injury and the evaluation of the teeth. The dark color may

appear shortly after the injury and persist for a few weeks only after which it fades restoring the original shade or gaining a yellowish hue (8, 13, 14). Follow-up studies of the traumatized primary incisors that start soon after the injury found that in 46–52% of the teeth that became gray, the dark coloration faded (14, 15). As it is believed that the pigments that tint the tooth are absorbed by the pulp, this process gives a strong impression that the pulp in dark discolored teeth is vital. If, however, the study material is limited to teeth with persistent dark discoloration, the findings lead to an opposite conclusion, meaning the pulp in such teeth is necrotic (12, 15). Teeth with persistent dark discoloration may remain asymptomatic for years after the injury with the dark discoloration being the only sign that evidence an injury the tooth had sustained (12, 14–16). It has been hypothesized that dark discolored primary incisors may remain asymptomatic as the necrotic pulp is not infected or if the pulp is infected by low-virulence microorganisms that are suppressed by the host's immune system (12, 14). Occasionally, such teeth develop periapical osteitis; sinus tract and/or external inflammatory root resorption as signs of infection, indicating a necrotic and infected pulp (2, 14).

Disagreement regarding the condition of the pulp and individual attitudes, reflect on the recommended treatment for traumatized asymptomatic dark discolored primary teeth. Some authors suggest extraction or endodontic treatment for such teeth even before they exhibit any other clinical or radiographic pathologic sign (4, 10, 11, 17), while others recommend follow-up with intervention only when necrosis is diagnosed (6, 9, 18–20) or signs of infection appear (21).

It seems reasonable that root canal treatment has a higher success rate when performed in symptomless teeth with no root resorption and/or periapical osteitis than in teeth presenting signs of chronic infection associated with root resorption and destruction of the surrounding supporting tissues. This generates a dilemma to the dentist who faces a young patient with an asymptomatic dark discolored primary incisor. Root canal treatment may have higher success rates if performed at this stage than if postponed till signs of infection appear. Conversely, such endodontic treatment may be unnecessary as there are <50% chances that dark discolored teeth will become infected and require either pulpectomy or extraction (14). In order to answer this question the two treatment options (immediate pulpectomy and follow-up) must be compared.

The purpose of this study was to compare the long-term outcomes of two treatment options (immediate pulpectomy and follow-up) for traumatized dark discolored primary incisors, which are otherwise asymptomatic.

Materials and methods

Study material

Two groups of teeth were included in the study: the root canal treatment (RCT) group and the follow-up (FU) group. Teeth of the RCT group were selected from a group of 48 non-carious primary incisors that had no clinical or radiographic evidence of trauma except for dark coronal discoloration. These teeth underwent endodontic treatment as part of the policy of the department of Pediatric Dentistry at the Hebrew University and Hadassah School of Dental Medicine in Jerusalem during a period of several past years. The endodontic procedure consisted of rubber dam isolation without a clamp, palatal approach to reach the pulp chamber using a no. 330 tungsten bur on a high-speed hand piece with water spray. Local anesthesia was not routinely infiltrated to the mucosa. If the patient complained of pain during insertion of the broach, intrapulpar anesthesia might have been added. The pulp was removed, root canal cleaned, washed with hydrogen peroxide and saline and dried with paper points. A resorbable paste (Kri-1-Pharmachemie AG, CH-8053, Zurich, Switzerland) was used to fill the root canals, and the teeth restored with a composite resin using the acid-etch technique. The children were invited for recall examination to evaluate the treatment outcomes. Twenty-five of the 48 teeth that were available for recall examination close to the time of natural exfoliation and after eruption of the permanent successor comprised the RCT group. Endodontically treated teeth were extracted if, during the follow-up period, had presented sign of infection or risk to the development or eruption of the permanent successor.

Teeth of the FU group were selected from a group of 97 non-carious primary incisors that had no clinical or radiographic evidence of trauma except for dark coronal discoloration. The teeth were left untreated as part of a change in the policy. Teeth that returned to their original bright hue or turned yellowish were excluded from the group, leaving teeth that for a long follow-up period retained a black, gray or brown hue with various intermediate shades. Twenty-eight incisors that were available for recall examination close to the time of natural exfoliation and after eruption of the permanent successor comprised the FU group. Untreated teeth that were subject to early extraction because of the of infection risk to the development or eruption of the permanent successor were also included.

Comparison of teeth of the RCT group with teeth of the FU group

The fate of the affected primary incisors was recorded as: (i) natural self-exfoliation at expected age, (ii) early self-exfoliation, (iii) early extraction because of infection or disturbance to normal development of permanent successor, (iv) late extraction because of over-retention of the primary incisor and eruption of the permanent successor.

The eruption pattern of the permanent successor was recorded as (i) eruption into normal alignment, (ii) ectopic eruption (palatal or labial). The enamel of the permanent teeth was examined and any hypocalcified or hypoplastic defects were recorded.

The data were analyzed using the chi-square test with significance set at $P < 0.05$.

Results

Tables 1 to 4 show the differences between teeth of the RCT group and those of the FU group. Early extraction was required in 28% (seven of 25 teeth) and 32% (nine of 32 teeth) of the RCT and FU groups respectively (chi-square, $P > 0.05$; Table 1). Similarly no statistically significant differences between the groups were found regarding early or delayed eruption of the permanent successor (Table 2); ectopic eruption of the permanent successors (Table 3) and hypocalcification or hypoplasia in permanent successors (Table 4).

Table 1. Distribution of traumatized dark discolored primary incisors with and without root canal treatment according to the need for early extraction

	RCT		FU		Total	
Early extraction	*n*	%	*n*	%	*n*	%
Yes	7	28	9	32	16	30
No	18	72	19	68	37	70
Total	25	100	28	100	53	100

Chi-square $P > 0.05$.

Table 2. Distribution of traumatized dark discolored primary incisors with and without root canal treatment according to early/delayed eruption of permanent successor

	RCT		FU		Total	
Early/delayed eruption	*n*	%	*n*	%	*n*	%
Yes	5	20	6	21	11	21
No	20	80	22	79	42	79
Total	25	100	28	100	53	100

Chi-square $P > 0.05$.

Table 3. Distribution of traumatized dark discolored primary incisors with and without root canal treatment according to ectopic eruption of the permanent successors

	RCT		FU		Total	
Ectopic eruption	*n*	%	*n*	%	*n*	%
Labial	3	12	2	7	5	9
Palatal	5	20	3	11	8	15
Rotation	1	4	1	3	2	4
No	16	64	22	79	38	72
Total	25	100	28	100	53	100

Chi-square $P > 0.05$.

Table 4. Distribution of traumatized dark discolored primary incisors with and without root canal treatment according to hypocalcification/hypoplasia in permanent successors

	RCT		FU		Total	
Enamel defects	*n*	%	*n*	%	*n*	%
Hypoplasia	0	0	2	7	2	4
Hypocalsification	9	36	8	29	17	32
No	16	64	18	64	34	64
Total	25	100	28	100	53	100
Signs in adjacent teeth with no history of trauma	2	8	4	14	6	11

Chi-square $P > 0.05$.

Discussion

Based on the literature (4, 10, 11, 17), the policy of the Department of Pediatric Dentistry at the Hebrew University and Hadassah School of Dental Medicine in Jerusalem advocated endodontic treatment for traumatized primary incisors even if dark-gray coronal discoloration was the only clinical and radiographic sign attributed to trauma. This policy has changed when the author faced several cases in which the above-mentioned conditions lasted for more than 12 months. The old policy has been replaced by periodic clinical and radiographic evaluation of the teeth till eruption of the permanent successors. According to the new policy teeth presenting pathologic changes during the follow-up period are either extracted or pulpectomized. The choice between these two possibilities depends on the conditions found at the follow-up examination. This change served as a unique opportunity to compare the outcomes of two different treatment modalities for teeth presenting the same characteristics without the need for random selection and approval by an institutional committee for studies on human subjects.

The diversity of suggested treatment modalities for traumatized primary incisors with dark coronal discoloration only, as presented in the introduction, is the result of confusion because of uncertainty of

the status of the pulp in such teeth and uncertainty regarding the pattern of late complications that cannot be foreseen.

The findings in the present and a previous study (12) show that traumatized dark discolored primary incisors can remain asymptomatic till natural exfoliation. This makes the status of the pulp irrelevant to the selection of treatment as long as there are no signs of infection. Andreasen and Andreasen (6) stated that 'discoloration of a primary tooth after luxation injury should not be used as the only criterion for interceptive pulpal therapy.

The findings in the present study provide important information regarding the pattern of late complications following two different treatment modalities. The approach of early intervention by endodontic treatment, when the root is radiographically intact, did not guarantee better long-term outcomes compared with the non-intervention approach. It is therefore recommended to adopt the conservative approach in which asymptomatic dark discolored traumatized primary incisors are followed and left untreated as long as there is no clear evidence of infection. Intervention is indicated as soon as swelling, sinus tract, or any other complication, that may risk the development of the permanent incisor or its proper eruption, are detected. At this point the operator should decide which is the most appropriate treatment for the primary tooth.

It has been shown that, during the follow-up period, dark discolored primary incisors may present a variety of radiographic signs such as surface external root resorption and expansion of the follicle of their permanent successors (14). As long as these radiographic signs appear without swelling, sinus tract or increased mobility or sensitivity to percussion, that usually accompany infection, it can be assumed that the teeth are not infected. Moreover, in most cases, these radiographic signs do not interfere with normal development of the dentition (i.e. exfoliation and eruption of the permanent tooth) (Tables 2 and 3).

Conclusion

Root canal treatment of primary incisors that had change their color into a dark-gray hue following trauma with no other clinical or radiographic symptom is not necessary as it does not result in better outcomes in the primary teeth and their permanent successors.

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