

EFFECT OF DENTIN HYBRIDIZATION ON TOOTH STAINING CAUSED BY ROOT CANAL SEALING PASTES FOR PEDIATRIC DENTISTRY

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Abstract

This research project aimed to evaluate dental discoloration caused by root canal sealing pastes used in pediatric dentistry. Blocks of bovine mandibular incisor crowns were prepared. A 2 mm thick enamel and dentin remnant was obtained. The blocks were randomly distributed into two groups according to whether dentin hybridization was performed. After hybridization, the blocks were subdivided into five experimental groups based on the type of endodontic cement: 1) Guedes Pinto Paste; 2) Zinc oxide and eugenol paste; 3) Calcium hydroxide paste, prepared with pure calcium hydroxide and propylene glycol; 4) Paste containing Chloramphenicol + tetracycline chloride + zinc oxide and eugenol; 5) Vitapex®. Color determination was performed using a digital spectrophotometer, with measurements taken 7, 30, and 60 days after material placement. Data on discoloration were tabulated and tested for normality using the Shapiro-Wilk test. ANOVA and Tukey's tests were employed. Root canal paste type and evaluation period showed statistically significant differences in dental color change ($p < 0.05$). The highest staining level was observed with Guedes Pinto Paste ($p < 0.05$). Root canal pastes induce staining in the dental structure. Coronal hybridization was not sufficient to prevent dental staining. The contact time between the obturation material and the dental structure influenced the staining level.

Keywords: Endodontic cements, tooth discoloration, dentin sealing.

INTRODUCTION

Successful endodontic treatment in pediatric dentistry depends on the elimination of microorganisms from infected root canals. While bacterial species individually have low virulence, collectively they become pathogenic due to a combination of factors (Bystrom et al., 1985). Apical periodontitis is caused by microbial toxins, enzymes, and their by-products (Estrela & Holland, 2003). Certain conditions facilitate the maintenance of polymicrobial infections, such as nutrient supply, microbial interactions, and reduced host defense capacity (Estrela et al., 2001ab).

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Various intracanal medications have been proposed for use in pediatric dentistry (Benfatti & Andrioni, 1969; Tchaou et al., 1995; Bonow et al., 1996; Pabla et al., 1997; Estrela et al., 2001a). However, even after an effective disinfection process, viable bacteria can be recovered from root canals. The observed difficulties in microbial control necessitate the use of root canal sealing pastes in endodontic therapy for primary teeth (Guedes-Pinto et al., 1981; Costa et al., 1994; Nurko & Garcia-Godoi, 1999; Mani et al., 2000).

Currently, aesthetics is a major concern, and the expectations of children and their parents regarding dental treatment must be considered by the dentist when selecting a therapeutic approach (Crystal et al., 2017; Gonçalves et al., 2017; Bagher et al., 2019). The need to prevent possible color changes in dental structures has led to the search for different therapeutic alternatives. One alternative that may reduce the negative effects of root canal sealing pastes is protecting the exposed coronal dentin using dentin hybridization prior to endodontic therapy. This protection can be achieved using the immediate dentin sealing (IDS) technique widely used in indirect restorations (Magne et al., 2005; Gillen et al., 2011).

Maruoka et al. (2006) evaluated the inhibition of coronal infiltration through the resin coating technique following endodontic treatment using methylene blue dye penetration analysis. The authors concluded that specimens treated with resin sealing reduced or eliminated dye infiltration compared to untreated specimens. De Rose et al. (2015) applied a modified IDS technique prior to endodontic treatment to minimize the negative effects of sodium hypochlorite irrigating solution. The internal adaptation of the final restorations was quantitatively assessed using a scanning electron microscope. The results showed that IDS performed prior to endodontic treatment provided better internal adaptation of the final restoration compared to not performing the technique. Khim et al. (2018) evaluated the efficacy of IDS in preventing discoloration caused by root canal sealers (MTA Fillapex, Sealapex, Zical, and Z.O.B seal) used in endodontic therapy for permanent teeth. The authors concluded that applying an adhesive agent to the walls of the pulp chamber before root canal filling effectively reduced coronal discoloration induced by the sealer.

The literature shows a lack of studies addressing dental discoloration after endodontic therapy in primary teeth. Furthermore, no studies were found evaluating the influence of IDS on preventing coronal discoloration caused by root canal pastes indicated for pediatric dentistry. The present study aimed to evaluate the effect of dentin hybridization on staining caused by root canal pastes indicated for pediatric dentistry.

METHODOLOGY

Sample Selection and Preparation: For dentin discoloration analysis, blocks of bovine mandibular incisors were prepared according to the model proposed by Marciano et al. (2017).

Two hundred and ten crown blocks (10 mm x 10 mm) were prepared using a double-sided diamond disc (4" x 0.12 x 0.12, Extec, Enfield, CT, USA) mounted on a hard tissue microtome (Isomet 1000, Buehler, Lake Bluff, IL, USA) under water cooling with a cutting speed calibrated at 250 rpm. The crowns were fixed onto an acrylic plate using cyanoacrylate-based adhesive (Loctite Super Bonder, Henkel Loctite Corporation, USA) and stick gutta-percha (Nova DFL, Rio de Janeiro, RJ, Brazil). The blocks were obtained in a single cut ensuring flat surfaces. Cavities 5 mm in diameter and approximately 1.5 mm deep were prepared in the center of the lingual surface of each specimen using diamond burs (#4054; KG Sorensen, Cotia, SP, Brazil); a 2 mm thick enamel and dentin remnant was obtained. The thickness of the remnant was verified with a caliper (Metalúrgica Fava Indústria Comércio, São Paulo, SP, Brazil).

Specimens were then subjected to ultrasonic baths (Cristófoli Biossegurança, Campo Mourão, PR, Brazil) with 2.5% sodium hypochlorite (Fitofarma, Lot 20442, Goiânia, GO, Brazil) for 15 minutes, distilled water (Farmácia Escola da UFG, Goiânia, GO, Brazil) for 1 minute, 17% EDTA (Biodinâmica, Ibiporã, PR, Brazil) for 3 minutes, and again distilled water for 1 minute. After drying with filter paper (Melitta do Brasil Indústria e Comércio Ltda., Avaré, SP, Brazil), the cavity margins were conditioned with 37% phosphoric acid (Condac 37%; FGM Produtos Odontológicos, Joinville, SC, Brazil) for 15 seconds, rinsed with distilled water, and dried gently with an air syringe for 15 seconds. An adhesive layer (Adper Single Bond 2; 3M ESPE, Sumaré, SP,

Brazil) was applied to the conditioned area and light-cured (Optilight LD Max; Gnatus, Ribeirão Preto, SP, Brazil) for 20 seconds to seal the interface with the resin.

Dentin Hybridization: Following specimen preparation, the crowns were randomly distributed into two groups based on whether they underwent hybridization (Hybridized Group; HG) or not (Non-Hybridized Group; NHG). In the HG group, specimens were hybridized before inserting the endodontic cements. Dentin hybridization was performed using the Clearfil SE adhesive system (Kuraray, Tokyo, Japan) following the manufacturer's instructions.

Evaluation of Dentin Discoloration: Color determination was conducted using a digital spectrophotometer (Vita EasyShade Compact; Vita Zahnfabrik, AG, Bad Sachington, Germany), calibrated before each measurement. Measurements were taken immediately after material placement (baseline color), after 30 days, and after 60 days. Color parameters were recorded following the International Commission on Illumination (CIE, 1978) guidelines, measuring "L," "a," and "b" values. Color variation (ΔE) relative to the time intervals was calculated using the formula: $\Delta E = [(L1-L0)^2 + (a1-a0)^2 + (b1-b0)^2]^{1/2}$.

Statistical Analysis: Discoloration data were tabulated and tested for normality using the Shapiro-Wilk test. ANOVA and Tukey tests were employed for data analysis. The influence of dentin hybridization on the discoloration process was tested using Student's t-test. A significance level of 5% ($\alpha = 0.05$) was adopted for all tests.

RESULTS

The studied factors, obturation material, hybridization, and evaluation period presented statistically significant differences in dental color alteration ($p < 0.05$) (Table 1).

Table 1. Analysis of Dental Color Variation (ΔE) According to Obturation Paste and Evaluation Period (ANOVA with post-hoc Tukey; $\alpha=5\%$).

Groups	Hybridization	ΔE days	7 ΔE days	30 ΔE days	60
Guedes Pinto Paste	Absent	18.30c	16.01c	17.51c	
	Coronary	11.50b	11.73b	12.70b	
Zinc Oxide and Eugenol	Absent	10.73b	11.48b	11.07b	
	Coronary	9.54b	9.17b	10.02b	
Calcium Hydroxide Paste	Absent	11.75b	9.12b	9.69b	
	Coronary	5.76a	5.37a	7.77b	
CTZ Paste	Absent	11.04b	12.98b	12.63b	
	Coronary	9.07	9.75b	10.81b	
Vitapex	Absent	13.60b	12.62b	14.02b	
	Coronary	12.32b	12.51b	12.04b	
Control	-	3.55a	3.19a	3.81a	

CONCLUSION

Based on the findings, it can be concluded that the obturation pastes used in pediatric dentistry induce staining in the dental structure and that coronal hybridization was not sufficient to prevent dental discoloration.

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