

EFFECT OF DENTIN HYBRIDIZATION ON TOOTH STAINING CAUSED BY FILLING PASTES FOR USE IN PEDIATRIC DENTISTRY

Luciana Fontes de Sousa ¹
Orlando Aguirre Guedes ²

ABSTRACT

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

Keywords: Endodontic cements, tooth discoloration, dentin sealing

INTRODUCTION

The success of endodontic treatment in Pediatric Dentistry depends on the elimination of microorganisms from infected root canals. Individually, bacterial species have low virulence, but collectively, they become pathogenic due to a combination of factors (Bystrom *et al.*, 1985). Apical periodontitis is caused by microbial toxins, enzymes, and their byproducts (Estrela *et al.*, 2003). Certain conditions facilitate the maintenance of polymicrobial infections, such as the supply of nutrients, microbial interactions, and the reduced defense capacity of the host (Estrela *et al.*, 2001ab).

Different intracanal medications have been proposed for use in Pediatric Dentistry (Benfatti e Andrioni, 1969; Tchaou *et al.*, 1995; Bonow *et al.*, 1996; Pabla *et al.*, 1997; Estrela *et al.*, 2001a). However, even after an effective sanitization process, viable bacteria can be recovered from root canals. The difficulties observed in microbial control make the use of filling pastes necessary in endodontic therapy of deciduous teeth (Guedes-Pinto *et al.*, 1981; Costa *et al.*, 1994; Nurko e Garcia-Godoi, 1999; Mani *et al.*, 2000).

Currently, there is great concern with aesthetics, and the expectations of children and their parents regarding dental treatment should be taken into consideration by the dentist when choosing a particular approach (Crystal *et al.*, 2017; Gonçalves *et al.*, 2017; Bagher *et al.*, 2019). The need to prevent possible chromatic changes in the tooth structure has led to the search for different therapeutic alternatives. One alternative that can reduce the negative effects of filling pastes is the protection of the coronal dentin that is exposed through dentin hybridization prior to the start of endodontic therapy.

¹ Acadêmica da Faculdade de Odontologia, Universidade Evangélica de Anápolis - UniEVANGÉLICA, E-mail: fontesluciana01@gmail.com

² Professor do Programa de Pós-Graduação em Odontologia, Universidade Evangélica de Anápolis - UniEVANGÉLICA, E-mail: orlandoaguedes@gmail.com

This protection can be performed 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 after the end of endodontic treatment, using the analysis of methylene blue dye penetration. The authors concluded that specimens that received the resin sealing technique reduced or completely eliminated dye infiltration, compared to specimens that did not receive sealing. De Rose *et al.* (2015) applied a modification of the IDS technique, prior to endodontic treatment, aiming to reduce the negative effects of the sodium hypochlorite irrigating solution. The internal adaptation of the final restorations was evaluated quantitatively with the aid of a scanning electron microscope. The results showed that performing IDS prior to endodontic treatment provided better internal adaptation of the definitive restoration compared to not performing the technique. Khim *et al.* (2018) evaluated the effectiveness of IDS in preventing discoloration caused by filling cements (MTA Fillapex, Sealapex, Zical and Z. O. B seal) used in endodontic therapy of permanent teeth. The authors concluded that applying an adhesive agent to the pulp chamber walls before root canal filling effectively reduced crown discoloration induced by the filling cement.

The literature shows a scarcity of studies that discuss tooth discoloration after endodontic therapy in deciduous teeth. Furthermore, no studies were found that evaluated the influence of IDS on preventing coronal color change caused by root canal filling pastes indicated in Pediatric Dentistry. The objective of the present study was to evaluate the effect of dentin hybridization on staining caused by filling pastes indicated in Pediatric Dentistry

METHODOLOGY

Sample selection and preparation

For the analysis of dentin discoloration, blocks of bovine lower incisor teeth were used, prepared according to the model proposed by Marciano *et al.* (2017).

Two hundred and ten crown blocks (10 mm X 10 mm) were prepared with the aid of 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 and a calibrated cutting speed of 250 rpm. The crowns were glued to an acrylic plate with the aid of cyanoacrylate-based adhesive (Loctite Super Bonder, Henkel Loctite Corporation, USA) and stick wax (Nova DFL, Rio de Janeiro, RJ, Brazil). The blocks were obtained in a single cut ensuring flat surfaces. Cavities with a diameter of 5 mm and approximately 1.5 mm depth were prepared in the center of the lingual face of each specimen with the aid of diamond burs (#4054; KG Sorensen, Cotia, SP, Brazil); a 2 mm thick remnant of dentin and enamel was obtained. The thickness of the remnant was verified with the aid of a thickness gauge (Metalúrgica Fava Indústria Comércio, São Paulo, SP, Brazil).

Then, the specimens were subjected to baths in an ultrasonic tank (Cristófoli Biossegurança, Campo Mourão, PR, Brazil) with 2.5% sodium hypochlorite (Fitofarma, Lt. 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 with distilled water (Farmácia Escola da UFG, Goiânia, GO, Brazil) for 1 minute. Then, after being dried with filter paper (Melitta do Brasil Indústria e Comércio Ltda., Avaré, SP, Brazil), the cavities had their external limit conditioned with 37% phosphoric acid (Condac 37%; FGM Produtos Odontológicos, Joinville, SC, Brazil) for 15 seconds, washed with distilled water (Farmácia Escola da UFG, Goiânia, GO, Brazil) for 1 minute and gently dried with an air syringe for 15 seconds. A layer of adhesive (Adper Single Bond 2; 3M ESPE, Sumaré; SP, Brazil) was applied to the conditioned area and polymerized (Optilight LD Max; Gnatus, Ribeirão Preto, SP, Brazil) for 20 seconds to allow sealing of the interface with resin.

Dentin hybridization

After preparing the blocks, the crowns were randomly distributed into two groups according to whether dentin hybridization was performed (hybridized group; GH) or not (Non-hybridized group; GNH). In the GH group, the specimens underwent hybridization prior to the insertion of the endodontic cements. Dentin hybridization was performed with the Clearfil SE adhesive system (Kuraray, Tokyo, Japan). Application was carried out following the steps indicated by the manufacturer: 1. Primer: application for 30 seconds followed by air jet for 3 seconds at a distance of 15 cm; 2. Adhesive: application for 15 seconds, air jets for 3 seconds (15 cm); 3. Polymerization with LED of 1200 mW/cm² (Radium-cal; SDI, Bayswater, Australia) for 30 seconds. Then a thin layer of flowable composite resin (Filtek Bulk Fill Flow; 3M ESPE, Seefeld, Germany) was applied, polymerized for 15 seconds and final polymerization with glycerin gel for another 15 seconds.

Manipulation and insertion of the filling pastes

At this point, the blocks were again divided among the 5 experimental groups (n= 40) according to the filling paste: 1) Guedes Pinto Paste [composed of 0.30 g of iodoform (K-Dent; Quimidrol, Joinville, SC, Brazil), 0.25 g of Ricofort (Merrel Lepetit, Santo Amaro, SP, Brazil) and 0.1 mL of camphorated paramonochlorophenol]; 2) Zinc oxide and eugenol paste (SS White, Rio de Janeiro, RJ, Brazil); 3) Calcium hydroxide paste, prepared with p.a. calcium hydroxide (Quimis Mallinkrodt, Inc.; St. Louis, MO, USA) and propylene glycol (Natu Phamas, Goiânia, GO, Brazil); 4) Paste containing Chloramphenicol + tetracycline chloride + zinc oxide and eugenol (CTZ; Neo Química, Anápolis, GO, Brazil + Cifarma, Santa Luiza, MG, Brazil + SS White); 5) Vitapex[®] (DiaDent Group International Inc., Burnaby, BC, Canada). The pastes were manipulated to the consistency of a toothpaste and inserted into the cavities with the aid of a #18 dentin spoon (SS White Duflex, Rio de Janeiro, RJ, Brazil). After filling, the cavities were sealed with flow resin (Filtek Bulk Fill Flow; 3M ESPE, Seefeld, Germany) and polymerized with LED light (Valo, Ultradent, South Jordan, USA) for 60 seconds. Five blocks served as a negative control group for the pastes in which the cavities were only restored, and five blocks served as a negative control group for the dentin hybridization technique in which the hybridized cavities were

only restored. After completing the restorations, the specimens were immersed in individual containers containing 2 mL of distilled water (Farmácia Escola da UFG, Goiânia, GO, Brazil) where they remained until the end of the experiment at room temperature.

Evaluation of dentin discoloration after insertion of endodontic cements

Color determination was performed with the aid of a digital spectrophotometer (Vita EasyShade Compact; Vita Zahnfabrik, AG, Bad Sachington, Germany). The equipment was calibrated before measuring each specimen. Measurements were obtained immediately after material placement (reference color 0), after 30 and 60 days. Color parameters were recorded as determined by the International Commission On Illumination (CIE, 1978), considering "L", "a" and "b", where "L" represents the color luminosity values, "a" corresponds to measurement along the red-green axis and "b" is the measurement along the yellow-blue axis. The color change (ΔE) relative to the time intervals was calculated based always on the initial values using the following formula: $\Delta E = [(L_{1\sim} - L_{0\sim})^2 + (a_{1\sim} - a_{0\sim})^2 + (b_{1\sim} - b_{0\sim})^2]^{1/2}$.

Statistical analysis

Data regarding discoloration were tabulated and tested for normality using the Shapiro-Wilk test. Due to a normal distribution, ANOVA and Tukey tests were employed. The influence of dentin hybridization on the discoloration process was also tested, for which Student's t-tests were used. A significance level of 5% ($\alpha = 0.05$) was adopted for all tests.

RESULTS

The studied factors, filling material, hybridization and evaluation period showed a statistical difference in tooth color change ($p < 0.05$) (Table 1).

Tabela 1. Análise da variação da coloração dentária (ΔE) de acordo com a pasta obturadora e período de avaliação investigados (ANOVA com post-hoc Tukey; $\alpha=5\%$).

Grupos	Hibridização	ΔE 7 dias	ΔE 30 dias	ΔE 60 dias
Pasta Guedes Pinto	AUSENTE	18,30 ^c	16,01 ^C	17,51 ^C
	CORONÁRIA	11,50 ^b	11,73 ^b	12,70 ^b
Pasta de Óxido de Zinco e Eugenol	AUSENTE	10,73 ^b	11,48 ^b	11,07 ^b
	CORONÁRIA	9,54 ^b	9,17 ^b	10,02 ^b
Pasta de Hidróxido de Cálcio	AUSENTE	11,75 ^b	9,12 ^b	9,69 ^b
	CORONÁRIA	5,76 ^a	5,37 ^a	7,77 ^b
Pasta CTZ	AUSENTE	11,04 ^b	12,98 ^b	12,63 ^b
	CORONÁRIA	9,07	9,75 ^b	10,81 ^b
Vitapex	AUSENTE	13,60 ^b	12,62 ^b	14,02 ^b
	CORONÁRIA	12,32 ^b	12,51 ^b	12,04 ^b

Controle	-	3,55 ^a	3,19 ^a	3,81 ^a
Valor de p		<0,05	<0,05	<0,05

CONCLUSION

From the above, it is possible to conclude that the filling pastes used in pediatric dentistry induce staining in the tooth structure and that coronal hybridization was not sufficient to prevent tooth staining.

REFERENCES

1. Bagher SM, Sabbagh HJ, AlJohani SM, Alharbi G, Aldajani M, Elkhodary H. Parental acceptance of the utilization of silver diamine fluoride on their child's primary and permanent teeth. *Patient Prefer Adherence*. 2019 May 23;13:829-835.
2. Benfatti SV, Andrioni JN. In vitro study of endodontic medicaments used in primary teeth. *Rev Ass Paul Cirur Dent* 1969;23:213-218.
3. Bonow MLM, Guedes-Pinto AC, Bammann LL. Antimicrobial activity of drugs used in pulp therapy of deciduous teeth. *Braz Endod J* 1996;1:44-48.
4. Bystrom A, Claesson R, Sundqvist G. The antibacterial effect of camphorated paramonochlorophenol, camphorated phenol and calcium hydroxide in the treatment of infected root canals. *Endod Dent Traumatol*. 1985 Oct;1(5):170-5.
5. Costa CAS, Benatti-Neto C, Abdalla RE, Gonzaga HFS, Lia RCC. Preliminary study of the biologic compatibility of a zinc oxide eugenol cement containing antibiotic when implanted in the subcutaneous tissue of rats. *Braz Oral Res* 1994;8:65-70.
6. Costa RCN, Ribeiro CCC, Souza SFC. Avaliação da infiltração apical dos materiais obturadores dos canais radiculares em dentes decíduos. *J Bras Odontopediatr Odontol Bebe*. 2001 jul-ago;4(20):304-8.
7. Crystal YO, Janal MN, Hamilton DS, Niederman R. Parental perceptions and acceptance of silver diamine fluoride staining. *J Am Dent Assoc*. 2017 Jul;148(7):510-518.e4.
8. de Andrade OS, de Goes MF, Montes MA. Marginal adaptation and microtensile bond strength of composite indirect restorations bonded to dentin treated with adhesive and low-viscosity composite. *Dent Mater*. 2007 Mar;23(3):279-87.
9. De Rose L, Krejci I, Bortolotto T. Immediate endodontic access cavity sealing: fundamentals of a new restorative technique. *Odontology*. 2015 Sep;103(3):280-5.
10. Estrela C, Bammann LL, Pimenta FC, Pécora JD. Control of microorganisms in vitro by calcium hydroxide pastes. *Int Endod J*. 2001a Jul;34(5):341-5.
11. Estrela C, Holland R. Calcium hydroxide: study based on scientific evidences. *J Appl Oral Sci*. 2003 Dec;11(4):269-82.
12. Estrela C, Rodrigues de Araújo Estrela C, Bammann LL, Pecora JD. Two methods to evaluate the antimicrobial action of calcium hydroxide paste. *J Endod*. 2001b Dec;27(12):720-3.
13. Fuks AB. Pulp therapy for the primary and young permanent dentitions. *Dent Clin North Am*. 2000 Jul;44(3):571-96, vii.
14. Ghiggi PC, Steiger AK, Marcondes ML, Mota EG, Burnett LH Júnior, Spohr AM. Does immediate dentin sealing influence the polymerization of impression materials? *Eur J Dent*. 2014 Jul;8(3):366-372.
15. Giannini M, Takagaki T, Bacelar-Sá R, Vermelho PM, Ambrosano GM, Sadr A, Nikaido T, Tagami J. Influence of resin coating on bond strength of self-adhesive resin cements to dentin. *Dent Mater J*. 2015;34(6):822-7.
16. Gillen BM, Looney SW, Gu LS, Loushine BA, Weller RN, Loushine RJ, Pashley DH, Tay FR. Impact of the quality of coronal restoration versus the quality of root canal fillings on success of root canal treatment: a systematic review and meta-analysis. *J Endod*. 2011 Jul;37(7):895-902.
17. Gonçalves BM, *et al*. Impact of dental trauma and esthetic impairment on the quality of life of preschool children. *Rev Paul Pediatr*. 2017 Oct-Dec;35(4):448- 455.

18. Grégoire G, Joniot S, Guignes P, Millas A. Dentin permeability: self-etching and one-bottle dentin bonding systems. *J Prosthet Dent.* 2003 Jul;90(1):42-9.
 19. Gresnigt MMM, Cune MS, Schuitemaker J, van der Made SAM, Meisberger EW, Magne P, Özcan M. Performance of ceramic laminate veneers with immediate dentine sealing: An 11 year prospective clinical trial. *Dent Mater.* 2019 Jul;35(7):1042-1052.
 20. Guedes-Pinto AC, Paiva JG, Bozzola JR. Tratamento endodôntico de dentes decíduos com polpa mortificada. *Rev Ass Paul Cirurg Dent* 1981;35:240-245.
 21. Imparato, JCP, et al. **Odontopediatria Clínica:** Integrada e atual. 1a. ed. Nova Odessa - SP - Brasil: Editora Napoleão, 2017. 208 p. v. 3.
 22. Khim TP, Sanggar V, Shan TW, Peng KC, Western JS, Dicksit DD. Prevention of coronal discoloration induced by root canal sealer remnants using Dentin Bonding agent: An *in vitro* study. *J Conserv Dent.* 2018 Sep-Oct;21(5):562-568.
 23. Kopel HM. Root canal therapy for primary teeth. *J Mich State Dent Assoc.* 1970 Feb;52(2):28-33 passim.
 24. Kubota K, Golden BE, Penugonda B. Root canal filling materials for primary teeth: a review of the literature. *ASDC J Dent Child.* 1992 May-Jun;59(3):225-7.
 25. Magne P. IDS: Immediate Dentin Sealing (IDS) for tooth preparations. *J Adhes Dent.* 2014 Dec;16(6):594.
 26. Magne P. Immediate dentin sealing: a fundamental procedure for indirect bonded restorations. *J Esthet Restor Dent.* 2005;17(3):144-54; discussion 155.
 27. Mani SA, Chawla HS, Tewari A, Goyal A. Evaluation of calcium hydroxide and zinc oxide eugenol as root canal filling materials in primary teeth. *ASDC J Dent Child.* 2000 Mar-Apr;67(2):142-7, 83.
 28. Marciano MA, Camilleri J, Costa RM, Matsumoto MA, Guimarães BM, Duarte MAH. Zinc Oxide Inhibits Dental Discoloration Caused by White Mineral Trioxide Aggregate Angelus. *J Endod.* 2017 Jun;43(6):1001-1007.
 29. Maruoka R, Nikaido T, Ikeda M, Ishizuka T, Foxton RM, Tagami J. Coronal leakage inhibition in endodontically treated teeth using resin-coating technique. *Dent Mater J.* 2006 Mar;25(1):97-103.
 30. Nurko C, Garcia-Godoy F. Evaluation of a calcium hydroxide/iodoform paste (Vitapex) in root canal therapy for primary teeth. *J Clin Pediatr Dent.* 1999 Summer;23(4):289-94.
 31. Pabla T, Gulati MS, Mohan U. Evaluation of antimicrobial efficacy of various root canal filling materials for primary teeth. *J Indian Soc Pedod Prev Dent.* 1997 Dec;15(4):134-40.
 32. Qanungo A, Aras MA, Chitre V, Mysore A, Amin B, Daswani SR. Immediate dentin sealing for indirect bonded restorations. *J Prosthodont Res.* 2016 Oct;60(4):240-249.
 33. Sahin C, Cehreli ZC, Yenigul M, Dayangac B. In vitro permeability of etch-and-rinse and self-etch adhesives used for immediate dentin sealing. *Dent Mater J.* 2012;31(3):401-8.
 34. Santos-Daroz CB, Oliveira MT, Góes MF, Nikaido T, Tagami J, Giannini M. Bond strength of a resin cement to dentin using the resin coating technique. *Braz Oral Res.* 2008 Jul-Sep;22(3):198-204.
 35. Tchaou WS, Turng BF, Minah GE, Coll JA. In vitro inhibition of bacteria from root canals of primary teeth by various dental materials. *Pediatr Dent.* 1995 Sep-Oct;17(5):351-5.
-