EVALUATION OF DENTAL STAINING CAUSED BY ROOT CANAL FILLING PASTES IN DECIDUOUS TEETH

André Luis Fideles Padilha [1]
Orlando Aguirre Guedes [2]

ABSTRACT
This research project aimed to evaluate tooth discoloration caused by root canal filling pastes used in pediatric dentistry. Blocks from 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 ($p < 0.05$). Root canal filling pastes induce staining in the tooth structure.

Keywords: Pediatric Dentistry, tooth discoloration, dentin adhesives.

INTRODUCTION

Different intracanal medications have been proposed for use in Pediatric Dentistry (Benfatti and Andrioni, 1969; Tchaou *et al.,* 1995; Bonow *et al.,* 1996; Pabla *et al.,* 1997; Estrela *et al.,* 2001a). However, even after effective sanitization, viable bacteria can be recovered from root canals. The difficulties observed in microbial control make the use of root canal filling pastes necessary in endodontic therapy for 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 must be taken into consideration by the dentist when choosing a specific approach (Crystal *et al.,* 2017; Gonçalves *et al.,* 2017; Bagher *et al.,* 2019). One alternative that can reduce the negative effects of root canal filling pastes is the protection of the exposed coronal dentin through dentin hybridization prior to starting endodontic therapy. 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). The objective of the present study was to evaluate tooth discoloration caused by root canal filling pastes indicated in Pediatric Dentistry.

METHODOLOGY

Sample Selection and Preparation

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)

[1] Acadêmico da Faculdade de Odontologia, Universidade Evangélica de Anápolis - UniEVANGÉLICA, E-mail: andrefideles62@gmail.com
[2] Professor do Programa de Pós-Graduação em Odontologia, Universidade Evangélica de Anápolis - UniEVANGÉLICA, E-mail: orlandoaguedes@gmail.com

under water cooling and a calibrated cutting speed of 250 rpm. The crowns were glued to an acrylic plate using cyanoacrylate-based adhesive (Loctite Super Bonder, Henkel Loctite Corporation, USA) and a stick-shaped godiva (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 using 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 using a thickness gauge (Metalúrgica Fava Indústria Comércia, São Paulo, SP, Brazil).

Subsequently, 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 (School Pharmacy of UFG, Goiânia, GO, Brazil) for 1 minute, 17% EDTA (Biodinâmica, Ibiporã, PR, Brazil) for 3 minutes, and again with distilled water (School Pharmacy of UFG, Goiânia, GO, Brazil) for 1 minute. Then, after drying with filter paper (Melitta do Brasil Indústria e Comércio Ltda., Avaré, SP, Brazil), the external limit of the cavities was conditioned with 37% phosphoric acid (Condac 37%; FGM Produtos Odontológicos, Joinville, SC, Brazil) for 15 seconds, washed with distilled water (School Pharmacy of 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.

Handling and Insertion of Root Canal Filling Pastes

At this point, the blocks were again divided into the 5 experimental groups (n= 40) according to the root canal 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, Brasil + SS White); 5) Vitapex® (DiaDent Group International Inc., Burnaly, BC, Canada). The pastes were manipulated to a toothpaste consistency and inserted into the cavities using a #18 dentin spoon (SS White Duflex, Rio de Janeiro, RJ, Brazil). 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 (School Pharmacy of 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 using a digital spectrophotometer (Vita EasyShade Compact; Vita Zahnfabrik, AG, Bad Säckingen, 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 color lightness values, "a" corresponds to measurement along the red-green axis, and "b" is the measurement along the yellow-blue axis. The color change (∆E) relative to the time intervals was calculated based on the initial values using the following formula: $\Delta E = [(L_1-L_0)^2+(a_1-a_0)^2+(b_1-b_0)^2]^{½}$.

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 using Student's t-tests. A significance level of 5% (α = 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 (∆E) de acordo com a pasta obturadora e período de avaliação investigados (ANOVA com post- hoc Tukey; α=5%).

Grupos		∆E 7 dias	∆E 30 dias	∆E 60 dias
Pasta Guedes Pinto		18,30^{C}	16,01^{C}	17,51^{C}
Pasta de Óxido de Zinco e Eugenol		10,73^{b}	11,48^{b}	11,07^{b}
Pasta de Hidróxido de Cálcio		11,75^{b}	9,12^{b}	9,69^{b}
Pasta CTZ		11,04^{b}	12,98^{b}	12,63^{b}
Vitapex		13,60^{b}	12,62^{b}	14,02^{b}
Controle	-	3,55^{a}	3,19^{a}	3,81^{a}
Valor de p		<0,05	<0,05	<0,05

CONCLUSION

Based on the above, it is possible to conclude that the root canal filling pastes used in pediatric dentistry induce staining in the tooth structure.

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 medi- caments 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 deciduos 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 implamted 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.