Pesquisa Brasileira em Odontopediatria e Clínica Integrada 2025; 25:e240099
https://doi.org/10.1590/pboci.2025.065
ISSN 1519-0501 / eISSN 1983-4632

ORIGINAL ARTICLE

Evaluation of Staining Reduction of Teeth Endodontically Treated with CTZ Paste through the Use of Polytetrafluoroethylene Isolation Tape

Lucas de Lima Oliveira Barbosa[1], Jaine Viviane Silva[1], Leopoldo Cosme-Silva[2], Daniela Maria Carvalho Pugliesi[1], Patrícia Batista Lopes do Nascimento[1], Dayse Andrade Romão[1], Priscylla Gonçalves Correia Leite de Marcelos[1], Daniel Pinto de Oliveira[2], Valdeci Elias dos Santos Junior[1]

[1]Department of Pediatric Dentistry, Faculty of Dentistry, Federal University of Alagoas, Maceió, AL, Brazil.
[2]Department of Endodontics, Faculty of Dentistry, Federal University of Alagoas, Maceió, AL, Brazil.

Corresponding author: Valdeci Elias dos Santos Junior **E-mail:** valdeciodonto@gmail.com

Academic Editor: Alessandro Leite Cavalcanti

Received: May 28, 2024 / **Review:** July 30, 2024 / **Accepted:** September 16, 2024

How to cite: Barbosa LLO, Silva JV, Cosme-Silva L, Pugliesi DMC, Nascimento PBL, Romão DA, et al. Evaluation of staining reduction of teeth endodontically treated with CTZ paste using polytetrafluoroethylene isolation tape. Pesqui Bras Odontopediatria Clín Integr. 2025; 25:e240099. https://doi.org/10.1590/pboci.2025.065

ABSTRACT

Objective: To evaluate the level of staining in teeth endodontically treated with CTZ paste with/without the use of polytetrafluoroethylene (PTFE) insulating tape and to identify the restorative material which is the most stable to pigmentation under different rhizolysis conditions. **Material and Methods:** 50 human deciduous incisors were selected. The teeth received CTZ filling and were divided according to whether or not PTFE was used, as well as by the length of the remaining root (1/3 or 2/3 of the root) and by the restorative material (Modified Resin Glass Ionomer Cement or Opus Bulk Resin Fill Flow). Coloration was assessed once a week for six weeks through follow-up photographs. Pearson's chi-square or Fisher's Exact tests were used for intergroup and intragroup comparisons after six follow-up examinations ($p < 0.05$). **Results:** After six weeks of evaluation, it was possible to notice that 100% of the teeth without PTFE had their crowns stained by CTZ. Only 33.33% with PTFE showed staining ($p<0.01$). There was no statistical difference regarding the type of filling material ($p=0.695$) or the residual length of the roots ($p=1.00$). **Conclusion:** Using PTFE is an effective resource in preventing coronal staining in primary teeth endodontically treated with CTZ paste, regardless of the restorative material used to close the endodontic access or even the length of the root remnant.

Keywords: Dental Pulp Necrosis; Pulpectomy; Glass Ionomer Cements; Composite Resins; Esthetics.

Introduction

Several medical approaches have been proposed to promote the cleaning and disinfection of the root canals of primary teeth [1], especially considering that the irregular topography of these canals prevents more straightforward instrumentation [2]. Understanding the changes related to molecular and cellular events during teeth development caused by therapeutic agents during tissue repair of endodontically treated primary teeth offers the opportunity to evaluate the biocompatibility of several therapeutic agents related to this treatment [3].

Based on this premise, the concept of Lesion Sterilization and Tissue Repair (LSTR) has been considered as an alternative for pulp therapy in devitalized primary teeth, a technique that does not require mechanical preparation and is based on the use of combinations of broad-spectrum antimicrobial agents' performance [4,5]. Although LSTR has been practiced and promoted for over 25 years in Japan and Latin America, it was only recently that the AAPD recognized it as a helpful option in endodontics of primary teeth with irreversible pulpitis or necrosis under various diagnostic criteria [6].

Developed by Soller and Cappiello in 1959, CTZ paste comprises chloramphenicol, tetracycline, zinc oxide, and eugenol. It has stood out for its highly reported clinical and radiographic success rate, between 81.8-100% and 63-93%, respectively [1,7]. Its success rate mainly lies in its easy technical execution and reduced clinical time, a condition especially advantageous in non-collaborative patients [8]. Even though CTZ paste is shown to be biocompatible with subcutaneous tissues in experimental models [9], its use has clear limitations, mainly due to the appearance of staining of the crown of deciduous teeth, turning them into a yellow-orange hue due to chloramphenicol and tetracycline impregnation. In this regard, such aesthetic aspect prevents wider application in anterior teeth.

Although not still widely investigated, some studies have recommended the application of sealing CTZ paste over a therapeutic cavity with the use of polytetrafluoroethylene (PTFE) tapes as an attempt to reduce the pigmentation of the crown in primary teeth, preserving their natural color [10,11]. This technique is essential for maintaining self-esteem in children since the pigmentation of anterior deciduous teeth can negatively impact the quality of life [12,13].

Considering the need to avoid such side effects, PTFE tape presents itself as a potential resource for reducing tooth staining by sealing the coronal face of the endodontic access [14]. This tape comprises an inert, ultra-thin, non-porous, and malleable viscoelastic polymer, easily adapted to different teeth contours and cavities [10]. The search for innovative methods and materials in pediatric dentistry has been fundamental for expanding access to safe and effective treatments for children. However, some scientific gaps still prevail regarding the effectiveness of sealing the CTZ paste using PTFE tape, the best indication of restorative material for crown color stability, and the presence of different rhizolysis conditions.

Therefore, this study aims to evaluate the reduction of teeth staining endodontically treated with CTZ paste through polytetrafluoroethylene isolation tape. In addition, this work helps identify the restorative material most stable to pigmentation under different rhizolysis conditions.

Material and Methods

Study Design and Ethical Clearance

This *in vitro* study was reviewed and approved by the research ethics committee of the Federal University of Alagoas (Opinion No. 6.668.063).

Teeth Selection and Preparation

Human deciduous incisors with healthy crowns were selected through the tooth bank of the Faculty of Dentistry. After the initial inspection, teeth with fractures, cracks, and restoration were excluded. Fifty teeth were included in this study. The teeth were cleaned for debris removal and stored in 0.9% saline solution. All teeth were endodontically accessed using 1011 spherical diamond burs (KG Sorensen Indústria e Comércio LTDA, Serra, ES, Brazil) and endo Z drill FG (Microdont Comercio Imp. e Exp. de Produtos Ltda., São Paulo, SP, Brazil) at high speed. Using a 329 carbide drill (KG Sorensen Indústria e Comércio LTDA, Serra, ES, Brazil), the canal entrances were enlarged to an opening of 1mm in diameter and 2mm in depth, thus creating a therapeutic cavity to receive the CTZ paste. After this step, the canal systems were irrigated with saline solution. Subsequently, The CTZ paste was compounded in a compounding pharmacy (A formula, Maceió, AL, Brazil) in proportions 1:1:2 (chloramphenicol, tetracycline, and zinc oxide) in portioned capsule format. To manipulate the paste, three drops of eugenol (approximately 0.15mL) were added to the capsule content (on a glass plate and spatulated with a spatula 26), forming a sandy paste. Subsequently, the CTZ paste was inserted with a spatula and then condensed with a condenser at the entrance of the root canals. All root apices were closed by inserting composite resin to prevent CTZ paste from escaping through the root foramen under the rhizolysis process.

Thereafter, the teeth were randomized into groups according to whether or not they received the isolation tape (TDV Dental, Pomerode, SC, Brazil). Furthermore, the teeth were also randomized according to the remaining root and type of restorative filling material. The restorative materials were Resin-Modified Glass Ionomer Cement (RMGIC; GC Gold label 2LC Light Cured Universal Restorative) or Opus Bulk Fill Flow Resin (FGM Dental Group, Joinville, SC, Brazil) as a filling material for coronary access. Both fill materials were color A2. The palatal face of both groups was restored with a thin layer of composite resin (Vittra APS Unique, FGM Dental Group, Joinville, SC, Brazil), which has chameleon-like properties. Therefore, this study is composed of 8 groups, as defined below:

- G1 (7 Teeth) - 1/3 of root remaining + isolation tape + restoration with Resin-Modified Glass Ionomer Cement as filling material.
- G2 (7 Teeth) - 1/3 of root remaining + isolation tape + restoration with Opus Bulk Fill Flow resin as filling material.
- G3 (6 Teeth) - 2/3 of root remaining + isolation tape + restoration with Resin-Modified Glass Ionomer Cement as filling material.
- G4 (7 Teeth) - 2/3 of root remaining + isolation tape + restoration with Opus Bulk Fill Flow resin as filling material.
- G5 (5 Teeth) - 1/3 of root remaining + without isolation tape + restoration with Resin-Modified Glass Ionomer Cement as filling material.
- G6 (6 Teeth) - 1/3 of root remaining + without isolation tape + restoration with Opus Bulk Fill Flow resin as filling material.
- G7 (6 Teeth) - 2/3 of root remaining + without isolation tape + restoration with Resin-Modified Glass Ionomer Cement as filling material.
- G8 (6 Teeth) - 2/3 of root remaining + without isolation tape + restoration with Opus Bulk Fill Flow resin as filling material.

Afterward, the teeth were inserted into test tubes with 20 mL of saline solution. Coloration was assessed once a week for six weeks. In this regard, a professional camera EOS T7 (Canon Inc., Tokyo, Japan) with a 100

mm macro EF lens and flash equipment was used 30cm from the tooth. The camera was positioned on a tabletop tripod for photographs. Follow-up photographs were constantly compared with the picture taken in the first week to identify any possible color changes in the tooth's crown (Figure 1). Whenever a color change was observed, the outcome was considered as staining. The examinations were performed by a calibrated examiner for visual examination to change the crown's color. Kappa coefficients for the intra-examiner agreement were K = 0.90.

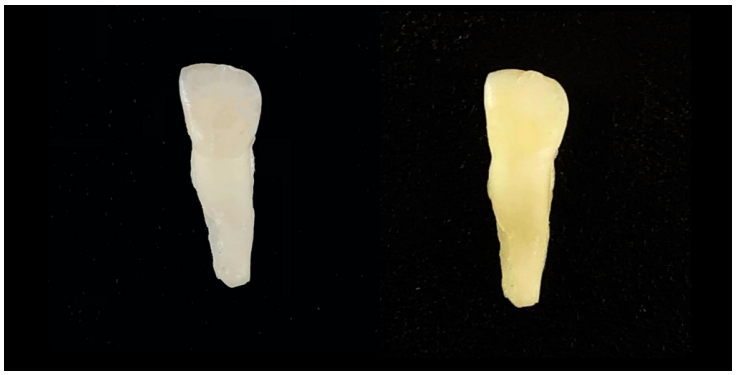

Figure 1. Change in color after six weeks of evaluation. Group without tape, filled with RMGIV and 2/3 of the remaining root.

Data Analysis

After data collection and the categorization of variables, a database was created for statistical analysis using IBM SPSS Statistics for Windows version 17 (IBM Corp., Armonk, NY, USA). The chi-squared or Fisher's exact test was used to test the association between two categorical variables. The margin of error was 5%.

Results

After six weeks of evaluation, it was possible to notice that 100% of the teeth without PTFE insulation had their crowns stained by CTZ (Figure 2). Only 33.33% showed this staining among those who used this insulation. Moreover, a statistically significant difference was verified between these groups ($p<0.001$). The relative risk of staining is 3 times higher in the group that did not use PTFE tape.

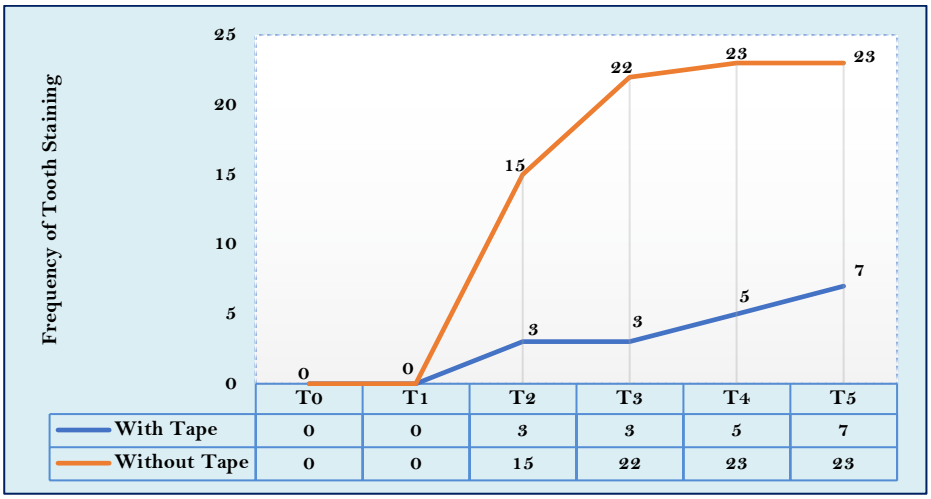

Figure 2. Temporal analysis of the effectiveness of the use of TPFE against tooth staining.

Analyzing the effectiveness of the use of PTFE in terms of reducing staining caused by CTZ showed that there is no statistically significant difference for the use of RMGIC or Bulk Fill Flow resin (p=0.695), nor in terms of the amount of root remnant (p=1.00) in the group where the tape was applied. On the other hand, all teeth in the group without the tape were stained at the end of the six weeks. Therefore, there is no difference in the filling material type or even the amount of root remaining (Table 1).

Table 1. Coronal staining in deciduous teeth after using CTZ paste and its relationship with PTFE tape, restorative material, and root remnants.

Variables	Tooth Staining			p-value	RR (IC 95%)
	No	Yes	Total		
Without PTFE	0	23	23	0.001†*	3 (1.75 to 5.11)
With PTFE	18	9	27		1
Intragroup Analysis - With PTFE					
RMGIC	8	5	13	0.695¥	1
Bulk Fill	10	4	14		1.34 (0.45 to 3.95)
1/3 root remaining	9	5	14	1.00†	1.16 (0.39 to 3.40)
2/3 root remaining	9	4	13		1
Intragroup Analysis - Without PTFE					
RMGIC	0	11	11	**	
Bulk Fill	0	12	12		
1/3 root remaining	0	11	11		
2/3 root remaining	0	12	12	**	

†Chi-square test; ¥Fisher's Exact test; *Statistically significant; **It is not possible to calculate the p-value due to null frequencies.

Discussion

PTFE tape is a material widely used in several fields, including dentistry. However, the relationship between the use of PTFE tape and the reduction of stains on primary teeth after the use of paste based on chloramphenicol, tetracycline, zinc oxide, and eugenol (CTZ) has not been widely explored in the scientific literature [10,14]. Endodontic treatment in primary teeth is essential to preserve oral health and ensure the adequate development of permanent teeth. Therefore, CTZ paste is often used in these procedures due to its antibacterial properties, besides not requiring mechanical instrumentation in the root canals [15-17]. However, one of the side effects of this paste is the potential for tooth stains, an aesthetic inconvenience that occurs in primary anterior teeth, constituting a limitation and contraindication of the technique.

Studies have shown that the composition of CTZ paste, especially the presence of tetracycline, can cause teeth stains, especially in primary teeth. In this context, the search for strategies to reduce or prevent this staining becomes relevant to guarantee the success of endodontic treatment and the aesthetics of children's smiles. This adverse effect becomes evident three weeks after its application, as shown in the present study's findings (Figure 2). In anterior teeth, intense yellowing of the dental crown, such as that caused by CTZ paste, can generate aesthetic discomfort for children and their relatives [12,13]. Although this problem could traditionally be resolved with composite resin veneers or zirconia crowns, this decision would significantly increase costs [18,19] and sessions, leading to iatrogenic events inherent to dental conduct and techniques [20].

From this scenario emerges a simple and low-cost technique related to the isolation of the CTZ paste, limiting it to the root canal. This management is associated with using PTFE tape at the entrance to the root canal, more precisely over the entire therapeutic cavity created for inserting this paste, isolating the root canal from the coronary access region to be filled with restorative material [10,11]. This technique takes advantage of the malleable properties of PTFE tape, which easily adapts to dental contours and is non-porous, preventing contact with different materials used for dental rehabilitation [14]. Although such application is not widespread

and its success is limited to its applications in primary dentition [10,14], this research's results indicate that using such insulating tapes prevents tooth staining caused by the use of CTZ paste. Results show that using PTFE tapes prevented staining in 66.67% of teeth treated with CTZ after six weeks. On the other hand, 100% of the teeth were stained after this period in the group that did not use the tape.

Absorption is the material's ability to incorporate or assimilate another substance or material, entering its constitution. Adsorption is the material's ability to retain another substance or material only on its subsurface [21,22]. Both properties provide the basis for the change in color of the filling materials used in this study (RMGIC and bulk fill flow). However, although they are color-stable materials over time, their use in conjunction with CTZ paste caused pigmentation to occur in these materials, regardless of whether or not PTFE tape was used. Therefore, the choice of material was not a condition that interfered with preventing stains caused by this contact, both in the group with and in the group without using PTFE tape.

A systematic review [23] recommended using LSTR only in teeth with resorbed roots, as with antimicrobial pastes, especially CTZ [17]. As this paste is placed in the therapeutic cavity, located at the entrance to the root canal, it acts across the entire length of the root through diffusion and in both directions, coronal and radicular. In this study, it was possible to verify that, for coronal staining, the length of the root remnant does not influence the prevention of this side effect. Although staining occurred in two groups, using PTFE tape isolates the main communication between CTZ and the pulp chamber, protecting it from staining, similar to the results of the indices presented herein. However, staining may also have occurred due to diffusion by the dentinal tubules, a condition that would not be protected by using the tape alone.

However, it is worth highlighting that *in vitro* laboratory studies have some critical limitations and disadvantages to be considered, such as a controlled environment, which may not reflect interactions with a biological environment; limitations in clinical applicability, as some techniques and results are limited to the effect achieved in the laboratory, leading to results that are not possible to extrapolate for use in humans; as well as possible experimental artifacts and ethical and regulatory limitations. Therefore, although *in vitro* studies are valuable tools for scientific research, it is essential to be aware of their limitations and complement these studies with other approaches, such as randomized clinical trials.

Conclusion

The use of polytetrafluoroethylene tape is an effective resource for preventing coronal staining in primary teeth that have been endodontically treated with CTZ paste, regardless of the restorative material used to close the endodontic access or even the length of the root remnant.

Authors' Contributions

LLOB	https://orcid.org/0009-0008-5607-6473	Methodology, Investigation, Writing - Original Draft and Writing - Review and Editing.
JVS	https://orcid.org/0009-0005-3181-2612	Methodology, Formal Analysis, Investigation, Writing - Original Draft and Visualization.
LCS	https://orcid.org/0000-0002-5755-1933	Methodology, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing and Visualization.
DMCP	https://orcid.org/0000-0002-7854-0416	Conceptualization, Methodology, Formal Analysis, Investigation and Data Curation.
PBLN	https://orcid.org/0000-0002-2355-4810	Conceptualization, Formal Analysis, Investigation, and Data Curation.
DAR	https://orcid.org/0000-0002-7884-1657	Methodology, Formal Analysis, Investigation, and Data Curation.
PGCLM	https://orcid.org/0000-0002-5623-6835	Conceptualization, Validation, Data Curation, Visualization and Supervision.
DPO	https://orcid.org/0000-0003-1992-9920	Validation, Writing - Original Draft, Writing - Review and Editing and Supervision.
VESJ	https://orcid.org/0000-0001-9748-5830	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing, Supervision and Project Administration.

All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

Financial Support

None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

References

[1] Lokade A, Thakur S, Singhal P, Chauhan D, Jayam C. Comparative evaluation of clinical and radiographic success of three different lesion sterilization and tissue repair techniques as treatment options in primary molars requiring pulpectomy: An in vivo study. J Indian Soc Pedod Prev Dent 2019; 37(2):185-191. https://doi.org/10.4103/JISPPD.JISPPD_6_19

[2] Ramos GT, Lucisano MP, Victorio DJB, Ramirez-Sotelo LR, Nelson-Filho P, da Silva RAB, et al. Estimation of root canal conicity of deciduous canines evaluated by nano-CT. Eur Arch Paediatr Dent 2023; 24(3):335-342. https://doi.org/10.1007/s40368-023-00809-y

[3] Moura LFAD, Lima MDM, Lima CCB, Bandeira AVL, Moura MS, Conde Júnior AM, et al. Cellular profile of primary molars with pulp necrosis after treatment with antibiotic paste. Int J Exp Pathol 2018; 99(5):264-268. https://doi.org/10.1111/iep.12292

[4] Tasanarong P, Dechatiwongse Na Ayudhya T, Techanitiswad T, Koontongkaew S. Reduction of viable bacteria in dentinal tubules treated with a novel medicament (Z-Mix). J Dent Sci 2016; 11(4):419-426. https://doi.org/10.1016/j.jds.2016.06.006

[5] Garrocho-Rangel A, Jalomo-Ávila C, Rosales-Berber MÁ, Pozos-Guillén A. Lesion Sterilization Tissue Repair (LSTR) approach of non-vital primary molars with a chloramphenicol-tetracycline-ZOE antibiotic paste: A scoping review. J Clin Pediatr Dent 2021; 45(6):369-375. https://doi.org/10.17796/1053-4625-45.6.1

[6] American Academy of Pediatric Dentistry. Pulp therapy for primary and immature permanent teeth. The Reference Manual of Pediatric Dentistry. Chicago, Ill; American Academy of Pediatric Dentistry; 2020.

[7] Dantas-Neta NB, Moura LF, Cruz PF, Moura MS, Paiva SM, Martins CC, et al. Impact of molar-incisor hypomineralization on oral health-related quality of life in schoolchildren. Braz Oral Res 2016; 30(1):e117. https://doi.org/10.1590/1807-3107BOR-2016.vol30.0117

[8] Santos-Junior VE, Alencar-Filho AV, Leite ACGL, Rosenblatt A. Existe associação entre manchas de esmalte em pré-molares e tratamento endodôntico nos seus antecessores decíduos? Pesqui Bras Odontopediatria Clín Integr 2013; 13(1):17-21. https://doi.org/10.4034/PBOCI.2013.131.03 [In Portuguese].

[9] Lima CC, Conde Júnior AM, Rizzo MS, Moura RD, Moura MS, Lima MD, et al. Biocompatibility of root filling pastes used in primary teeth. Int Endod J 2015; 48(5):405-416. https://doi.org/10.1111/iej.12328

[10] Alkadi M, Alsalleeh F. Ex vivo microbial leakage analysis of polytetrafluoroethylene tape and cotton pellet as endodontic access cavity spacers. J Conserv Dent 2019; 22(4):381-386. https://doi.org/10.4103/JCD.JCD_555_18

[11] Nakornchai S, Banditsing P, Visetratana N. Clinical evaluation of 3Mix and Vitapex as treatment options for pulpally involved primary molars. Int J Paediatr Dent 2010; 20(3):214-221. https://doi.org/10.1111/j.1365-263X.2010.01044.x

[12] Ramos-Jorge J, Sá-Pinto AC, Almeida Pordeus I, Martins Paiva S, Castro Martins C, Ramos-Jorge ML. Effect of dark discolouration and enamel/dentine fracture on the oral health-related quality of life of pre-schoolers. Eur Arch Paediatr Dent 2017; 18(2):83-89. https://doi.org/10.1007/s40368-017-0271-2

[13] Goulart MA, Condessa AM, Hilgert JB, Hugo FN, Celeste RK. Concerns about dental aesthetics are associated with oral health related quality of life in Southern Brazilian adults. Cien Saude Colet 2018; 23(11):3957-3964. https://doi.org/10.1590/1413-8123201823311.24172016

[14] Sattar MM, Patel M, Alani A. Clinical applications of polytetrafluoroethylene (PTFE) tape in restorative dentistry. Br Dent J 2017; 222(3):151-158. https://doi.org/10.1038/sj.bdj.2017.110

[15] Fernandes MLF, Maia CA, Santos AMC, Vilela CR, Araújo FR, Mohallen ML, et al. Antimicrobial photodynamic therapy in the endodontic treatment of deciduous teeth: In vivo pilot study. Pesqui Bras Odontopediatria Clin Integr 2020; 20:e5309. https://doi.org/10.1590/pboci.2020.111

[16] Sain S, J R, S A, George S, S Issac J, A John S. Lesion sterilization and tissue repair-current concepts and practices. Int J Clin Pediatr Dent 2018; 11(5):446-450. https://doi.org/10.5005/jp-journals-10005-1555

[17] Aragão AC, Pintor AVB, Marceliano-Alves M, Primo LG, Silva ASS, Lopes RT, et al. Root canal obturation materials and filling techniques for primary teeth: In vitro evaluation in polymer-based prototyped incisors. Int J Paediatr Dent 2020; 30(3):381-389. https://doi.org/10.1111/ipd.12604

[18] Sousa HCS, Lima MDM, Lima CCB, Moura MS, Bandeira AVL, Deus Moura LFA. Prevalence of enamel defects in premolars whose predecessors were treated with extractions or antibiotic paste. Oral Health Prev Dent 2020; 18(4):793-798. https://doi.org/10.3290/j.ohpd.a45083

[19] Oliveira SCM, Floriano I, Tedesco TK, Gimenez T, Imparato JCP, Calvo AFB. Cost analysis of endodontic treatment in primary teeth: Results from a randomized clinical trial. Braz Oral Res 2021; 35:e126. https://doi.org/10.1590/1807-3107bor-2021.vol35.0126

[20] Freitas RD, Moro BLP, Pontes LRA, Maia HCM, Passaro AL, Oliveira RC, et al. The economic impact of two diagnostic strategies in the management of restorations in primary teeth: A health economic analysis plan for a trial-based economic evaluation. Trials 2021; 22(1):794. https://doi.org/10.1186/s13063-021-05722-7

[21] Öztürk ANS, Harorli OT. Bulk-fill composite in challenging cavities: conversion rate, solubility, and water absorption analysis. Odontology 2024; 112(3):718-728. https://doi.org/10.1007/s10266-023-00873-2

[22] Pieper CM, Zanchi CH, Rodrigues-Junior SA, Moraes RR, Pontes LS, Bueno M. Sealing ability, water sorption, solubility and toothbrushing abrasion resistance of temporary filling materials. Int Endod J 2009; 42(10):893-899. https://doi.org/10.1111/j.1365-2591.2009.01590.x

[23] Coll JA, Dhar V, Vargas K, Chen CY, Crystal YO, AlShamali S, et al. Use of non-vital pulp therapies in primary teeth. Pediatr Dent 2020; 42(5):337-349.