USE OF IRRIGATING SOLUTIONS IN PULPECTOMY OF DECIDUOUS TEETH: LITERATURE REVIEW

USO DE SOLUÇÕES IRRIGADORAS NA PULPECTOMIA DE DENTES DECÍDUOS: REVISÃO DE LITERATURA

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Resumo

A limpeza dos canais radiculares se apresenta como uma etapa crucial para o sucesso do tratamento endodôntico. Por essa razão, a busca por soluções irrigadoras eficazes na terapia endodôntica de dentes decíduos é frequente nas pesquisas e demonstra a necessidade de encontrar substâncias com menor toxicidade e maior eficiência. Sendo assim, o objetivo do presente estudo é analisar as diferentes soluções e protocolos de irrigação no tratamento endodôntico de dentes decíduos, a fim de construir uma conduta clínica. Para isso, foi realizada uma busca na literatura nas bases de dados PubMed/MEDLINE, Cochrane Library, SCIELO, Portal de Periódicos CAPES e BVS utilizando a combinação dos termos "deciduous tooth", "root canal irrigants", "pulpectomy" e seus derivados, associados entre si pelo operador booleano "AND" e adaptados para cada base de dados. As buscas foram realizadas no período de Julho à Agosto de 2020. Foi encontrado o total de 192 resultados. Após uma leitura crítica, foram selecionados 8 estudos. A revisão incluiu estudos que abordassem as soluções irrigantes mais usuais: hipoclorito de sódio, digluconato de clorexidina, ácido cítrico e ácido etilenodiaminotetracético (EDTA) na terapia endodôntica de dentes decíduos. O EDTA e digluconato de clorexidina apresentam baixa toxicidade e o hipoclorito de sódio 1% combinado com ácido cítrico 6% apresentam a combinação mais próspera. A associação das duas substâncias mostrou ser mais eficiente na limpeza dos canais radiculares e na remoção da smear layer. Porém, mais estudos são necessários, principalmente clínicos, para confirmação do melhor protocolo de irrigação para o tratamento endodôntico de dentes decíduos.

Palavras-chave: Pulpectomia. Dente decíduo. Irrigantes do Canal Radicular.

Abstract

Cleaning of root canals is a crucial step for a successful endodontic treatment. For this reason, the search for effective irrigating solutions in endodontic therapy of deciduous teeth is frequent in research and it demonstrates the need to find substances with lower toxicity and greater efficiency. Thus, this study aims to analyze the different irrigating solutions and protocols in the endodontic treatment of deciduous teeth, in order to build a clinical approach. For this, a literature search was performed in the Databases PubMed/MEDLINE, Cochrane Library, SCIELO, Portal de Periódicos CAPES and VHL using the combination of the terms "deciduous tooth," "root canal irrigants," "pulpectomy" and their derivatives, associated with each other by the Boolean operator "AND" and adapted for each database. The searches were carried out from July to August 2020. In total, 192 results were found. After a critical reading, eight studies were selected. The review included studies addressing the most common irrigating solutions: sodium hypochlorite, chlorhexidine digluconate, citric acid, and ethylenediaminetetraacetic acid (EDTA) in endodontic therapy of deciduous teeth. EDTA and chlorhexidine digluconate have low toxicity and the 1% sodium hypochlorite combined with 6% citric acid have the most prosperous combination. The association of these two substances proved to be more efficient in cleaning root canals and removing the smear layer. However, more studies are necessary, mainly clinical ones, to confirm the best irrigating protocol for the endodontic treatment of deciduous teeth.

Keywords: *Pulpectomy. Deciduous tooth. Root Canal Irrigators.*

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INTRODUCTION

Oral diseases remain a challenge to public health worldwide. Untreated caries in deciduous dentition is the 10th most prevalent condition in the world and it often culminates in the early loss of several teeth (1). Another significant factor that may compromise deciduous dentition are frequent dentoalveolar traumas in the infant population (2,3). When an injury to dental tissues because of caries or dental trauma occurs, there may be the development of irreversible pulp inflammation or necrosis of this tissue, and radical endodontic treatment is indicated, depending on the periradicular conditions of the affected teeth (4). This procedure – also called pulpectomy – aims to maintain the health of oral tissues, prevent damage to the dental germ and enable the preservation of this dental element until its physiological time of exfoliation (5).

The success of endodontic treatment depends on steps and processes that must be carefully executed. The instrumentation of the channels made mechanically with the use of files – whether manual or rotational – should be combined with an irrigating solution used in abundance (6), because only mechanical instrumentation is unable to achieve the necessary disinfection, considering the root resorption process and the complex internal anatomy of the deciduous tooth (7). Other stages of treatment, such as the use of intracanal medication and a satisfactory root filling, which contributes to an adequate sealing after the chemical-mechanical instrumentation process, are essential for a successful endodontic treatment.

The use of non-inert irrigating solutions is essential for pulpectomy, and even more in deciduous teeth, due to the existence of many branches and accessory channels in its anatomy (8). These solutions will ensure satisfactory disinfection of the tooth channel system, as well as increased dentin permeability and removal of the smear layer (SL) resulting from mechanical preparation. SL is composed of necrotic remnants of the dental pulp, infected dentin scrapings and bacteria. The presence of SL impairs the diffusion of intra-channel medications and the adaptation of the palatal obturator, due to the obliteration of the dentinal tubules (9).

Some studies in deciduous teeth evaluate the efficacy and toxicity of irrigating solutions used in Endodontics at different times and concentrations, in addition to the need and efficacy of SL removal in achieving clinical success of endodontic treatment (9,10). Among the substances, sodium hypochlorite (NaOCl), chlorhexidine diluconate (CHG), citric acid (CA), and ethylenediaminotetraacetic acid (EDTA) stand out. NaOCl is one of the most used substances in Endodontics because of its antimicrobial action and dissolution of organic tissue (11,13). CHG is another substance used, which has properties such as substantiality, antimicrobial effectiveness, and low toxicity (14). The effectiveness of chelators – such as CA and EDTA for final irrigation and SL removal – have shown good results in the literature. The CA has antimicrobial properties, positive reaction when in contact with calcium ions as well as low cytotoxicity (15). The EDTA promotes a disinfection of the root canal system, better penetration of the medication into the dentinal tubules and adaptation of the palatal obturator (16).

Considering the significance of irrigating solutions in the endodontic treatment of deciduous teeth, we should make use of the solution or combination of solutions that have the best benefit to pulpectomy, considering aspects such as antibacterial efficiency, substantiality, and low toxicity to the body. This literature review aims to analyze different irrigating solutions and protocols in the endodontic treatment of deciduous teeth, based on current evidence.

LITERATURE REVIEW

The literature review followed the precepts of the descriptive study via a bibliographical search in scientific articles on the subject. The search was conducted with the Databases PubMed/MEDLINE, Virtual Health Library (VHL), CAPES Portal of Journal, Scientific Electronic Library Online (SCIELO), and Cochrane Library, comprising the last 20 years, in order to comprehensively evaluate the scientific evidence on irrigation of deciduous teeth in endodontic treatment. All searches were performed by a single researcher, from July to August 2020. In vitro or in vivo studies (clinical trial) and systematic reviews presenting irrigating solutions (CHG, NaOCl, EDTA,

and CA) in pulpectomy of deciduous teeth were considered eligible for literature review. Studies with different forms of measurement of success of endodontic treatment were accepted, without language restriction. Studies with permanent dentition, case reports, in addition to other substances that have not yet attested their efficacy, unpublished data, articles not found in full or that are outside the stipulated period, were not eligible for the study.

The descriptors indexed by MeSH/DeCS that were used in the PubMed/MEDLINE, Cochrane Library, SCIELO, CAPES journal portal and VHL included the combination of the terms "deciduous tooth," "root canal irrigants," "pulpectomy" and their derivatives, adapted for each database and for each language (English, Spanish, and Portuguese) using the Boolean operators "AND" and "OR." The studies were first selected by titles and abstracts independently, following the inclusion criteria. Duplicates were eliminated. After this stage, the researcher performed an exploratory reading of all articles found in full, recording pertinent information presented in a chart containing title, author, year, journal, irrigating substances used in each research and the studies' conclusion. The flowchart (Figure 1) presented describes the number of articles found and excluded by the eligibility criteria until reaching the articles included in the literature review. The selection following the criteria was fundamental for the better reliability and power of generalization of the conclusions of this study.

After a critical reading of titles and abstracts – in addition to the application of the inclusion and exclusion criteria – out of the 192 studies found, eight articles were selected for literature review: six in vitro and two in vivo (clinical trials). The characteristics of the selected studies are presented in Chart 1, which shows the totality of publications in international journals. Furthermore, four of the eight articles found evaluated CA and EDTA, most of them had a control group (saline solution) and favorable results for all irrigating solutions tested.

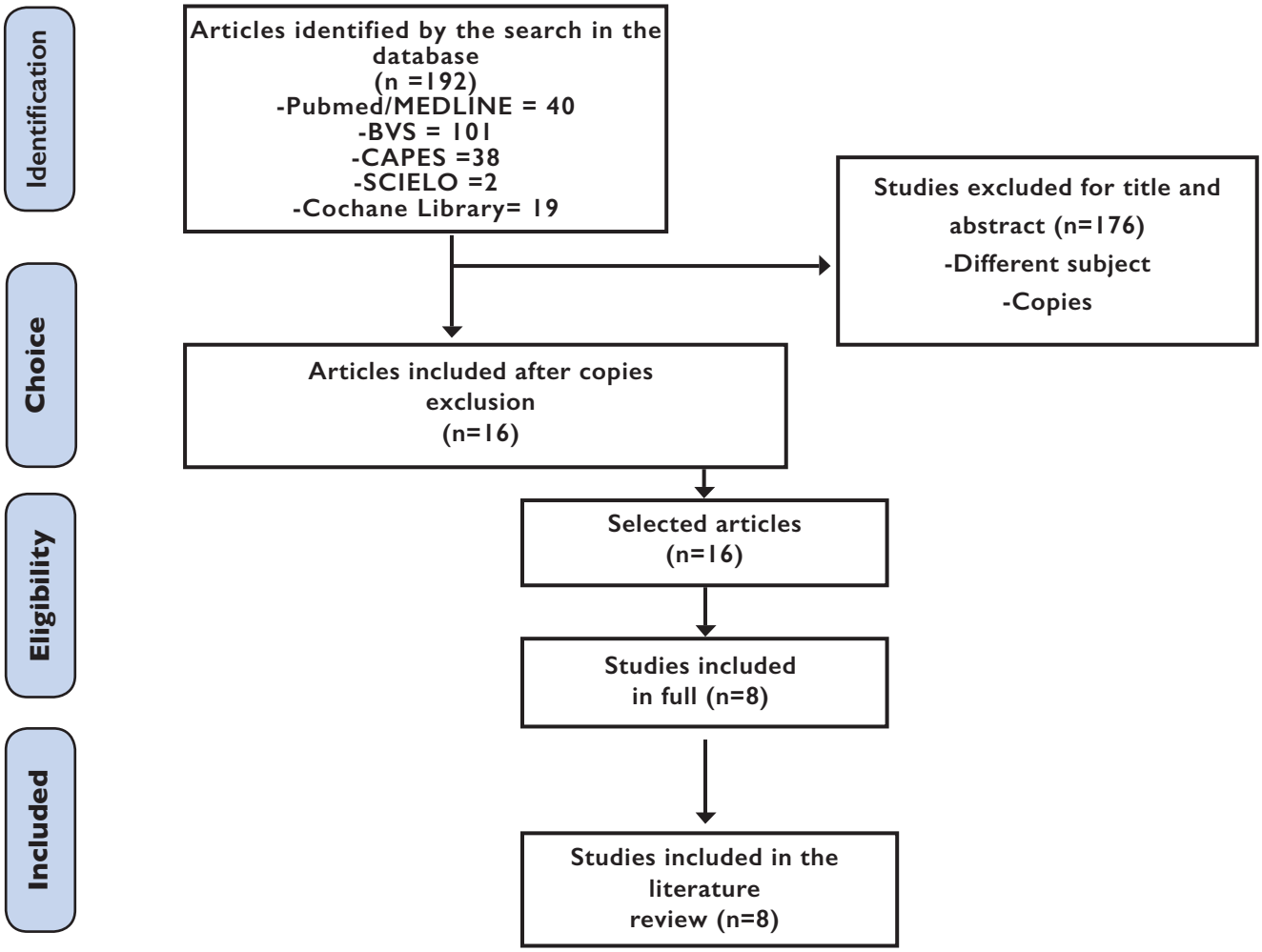

Figure 1 - Flowchart of the studies assigned in the literature review.
Source: Own authorship, 2020.

Chart 1 - Detailed analysis of the publications regarding title, author, year of publication, journal, irrigating substances evaluated, and conclusion.

Title	Author	Year	Journal	Irrigating substances evaluated	Conclusion
Effect of the sodium hypochlorite and citric acid association on smear layer removal of primary molars	Götze, G et al.	2005	Brazilian Oral Research	Experimental Group: AC 4% + NaOCl 1%; AC 6%; AC 6% +NaOCl 1%; AC 8% + NaOCl 1%; AC 10% + NaOcl 1%	6% citric acid associated with 1% sodium hypochlorite is suggested as an auxiliar chemical substance in deciduous teeth irrigation.
The influence of smear layer removal on primary tooth pulpectomy outcome: a 24-month, double-blind, randomized and controlled clinical trial evaluation	Barcelos, R et al.	2011	International Journal of Paediatric Dentistry	Grupo Experimental: AC 6% Grupo Controle: solução salina normal 0,9%	At the end of the 24 months period, it can be demonstrated that teeth which received an additional substance (6% CA), presented a higher rate of success (91.2%) when compared with the group without removal (70%).
Reduction in bacterial loading using 2% chlorhexidine gluconate as an irrigant in pulpectomized primary teeth: a preliminary report	Ruiz-Esparza, C et al.	2011	The Journal of Clinical Pediatric Dentistry	Experimental Group: 2% CHG – Control Group: Sterile saline solution	Chlorhexidine digluconate is suggested as an alternative for the pulpectomy treatment of necrotic deciduous teeth.
Toxicity of irrigating solutions and pharmacological associations used in pulpectomy of primary teeth	Botton, G et al.	2015	International Endodontic Journal	Experimental Group: 1% NaOCl; 2.5% NaOCl; 2% CHG; 6% CA; 17% EDTA; 1% NaOCl + 6% CA; 1% NaOCl + 17% EDTA; 2.5% NaOCl + 17% EDTA; 2% CHG + 6% CA; 2%CHG + 17% EDTA – Control Group: 0.9% normal saline solution	Among the main reasons, the chlorhexidine digluconate presented the lowest cytotoxic potential. EDTA was the least cytotoxic auxiliar irrigating substance, and the association of the two solutions presented the lowest toxic potential of all groups.
Application of 17% EDTA Enhances Diffusion of (45) Calabeled OH(-) and Ca(2+) in Primary Tooth Root Canal	Ximenes, M et al.	2016	The Bulletin of Tokyo Dental College	Experimental Group: 17% EDTA; 1% NaOCl – Control Group: No irrigation	17% EDTA use in deciduous tooth increased the diffusion of OH(-) and Ca (2+)
Comparison of removal of endodontic smear layer using ethylene glycol bis (beta-amino ethyl ether)-N, N, N´, N´- tetraacetic acid and citric acid in primary teeth: A scanning electron microscopic study	Hegde J; Bapna K	2016	Contemporary Clinical Dentistry	Experimental Group: 17% EDTA; 6% CA – Control Group:0.9% normal saline solution	The results attest that the sequential irrigation of the pulpal canal wall with 17% EDTA followed by 5% NaOCl created efficient root canal walls without smearing.
The effect of different irrigation protocols on smear layer removal in root canals of primary teeth: a SEM study	Demirel, A et al.	2019	Acta Odontologica Scandinavica	Experimental Group: 1% NaOCl; 10% EDTA + 1% NaOCl; 6% CA + 1% NaOCl – Control Group: 0.9% normal saline solution	6% CA and 1% NaOCl can be recommended with irrigating protocol in deciduous teeth.
The effects of various irrigation protocols on root canal wall adaptation and apical microleakage in primary teeth	Yüksel, B et al.	2020	Acta Odontologica Scandinavica	Experimental Group: 1% NaOCl; 10% EDTA + 1% NaOCl; 6% CA + 1% NaOCl – Control Group: 0.9% normal saline solution	6% CA and 1% NaOCl can be recommended with irrigating protocol in deciduous teeth.

DISCUSSION

The cleaning of root canals – as well as the enlargement and modeling of them – are the stages of chemical-mechanical preparation aimed to promote the dissolution of living or necrotic organic tissues, the elimination or maximum reduction of microorganisms, lubrication, the chelation of calcium ions and the suspension of debris originating from instrumentation (17). Many of the irrigating solutions are used throughout the process (NaOCl and CHG), whereas other solutions are only used in the final stage, such as the chelators solutions (EDTA and CA).

Among the irrigating solutions used in Endodontics, NaOCl is the auxiliary solution for root canal instrumentation most commonly used by dentists worldwide due to its highly desirable properties, such as a broad antimicrobial spectrum and the ability to dissolve organic tissue (18). The concentrations used during endodontic therapy range from 1.0% to 5.25%, with the antimicrobial potential proportional to the concentration employed; however, the more concentrated solutions present higher cytotoxicity to periapic tissues and, consequently, lower biocompatibility (4).

According to Leonardo and Leonardo, the action of NaOCl on the fatty acids of tissues promotes a lubricating action, assisting in the process of mechanical instrumentation inside the channels (4). Moreover, the antimicrobial efficiency of the substance is related to biosynthetic changes in cell metabolism and phospholipid destruction of the cell membrane of bacteria (19). On the other hand, the inappropriate use of the substance may cause

some complications, such as extravasation of the solution in the periapical region, causing ecchymosis, hematomas, subcutaneous emphysema, damage to the patient's vision or clothing discoloration, reinforcing the significance of performing the correct protocol of the use of NaOCl safely and effectively.

Developed more than 50 years ago, the CHG has some remarkable characteristics such as broad-spectrum antimicrobial action (acting against Gram-positive and Gram-negative bacteria, as well as against yeasts), biocompatibility, substantiality, cleaning capacity, surface tension, enabling this substance to be used as an irrigating substance during biomechanical preparation, as well as in the drug phase (18). However, because it is not able to dissolute tissue and to present cytotoxicity to tissues, the indication of that substance becomes limited.

Chelator agents, such as CA and EDTA, are used during endodontic treatment. These compounds improve the penetration ability of antibacterial agents, removing SL and favoring the adhering of the palatal obturator, used after the completion of the chemical-mechanical preparation. Although not chemically active, they indirectly reduce the amount of microorganisms in intraradicular dentin (21-23).The EDTA began to be used in Endodontics in 1957 (4), and the solution at 17% and 10 ml considered the therapeutic concentration (24). The compound has a low surface tension, increasing dentin wetting and improving the penetration of irrigators or cements into the canal walls (23).

Citric acid is another chelator agent effective in removing smear layer.The compound presents chemical stability, lower cytotoxicity, and greater antimicrobial effect against facultative and obligate anaerobes when compared to EDTA (25-27). Solution concentrations range from 1% to 50% (28), with the lowest (6-10%) recommended for endodontic treatment, in order to avoid undesirable (peritubular and intertubular) erosions in the dentin of the root canal, due to its ability to reduce the microhardness of this tissue (29).

Among the studies found in the literature review, none individually evaluated the NaOCl solution, and it can be attributed to characteristics such as irrigating already being consolidated in the literature, such as a broad antimicrobial spectrum, high efficacy of bacteria organized in biofilms, avoiding the formation of SL during instrumentation. However, the absence of substantiality, presence of some cytotoxicity, and potential allergen make up the need to seek alternatives to this irrigator (30, 31).

Regarding the effectiveness of 2% CHG solution, Ruiz-Esparza et al. conducted a randomized clinical trial with 40 necrotic deciduous teeth, 20 of them irrigated with CHG and the other half with saline solution. Two sample collections were performed for microscopic evaluation at different times – after channel opening and after complete mechanical instrumentation. The 2% CHG showed a reduction in intracanal bacterial load, evidencing itself as a potentially beneficial compound for endodontic therapy in deciduous teeth (14).

Regarding the performance of the CA, Barcelos et al. conducted a randomized, double-blind clinical study lasting 24 months to assess the real need for smear layer removal for successful endodontic treatment in deciduous teeth. After chemical-mechanical preparation, the smear layer of the first group was removed using 6% CA (40 teeth) and no additional chelator agent was used in other group (42 teeth). At the end of the period, it can be demonstrated the teeth that received the additional substance (6% CA) had a higher success rate (91.2%) when compared to the group without removal (70%). Therefore, the protocol using 6% CA demonstrated better results and long-term clinical success in endodontic therapy of deciduous teeth (9).

Furthermore, studies evaluated the associated use of NaOCl and CA aiming to disinfect the channels concomitantly with the removal of SL in deciduous molars. The in vitro study of Götze, G et al. microscopically analyzed the presence of smear layer in samples where NaOCl was used at the concentration of 1% and CA at different concentrations (4%, 6%, 8%, and 10%). All CA concentrations used after NaOCl were able to remove SL, with no statistically significant difference between the tested groups. However, 8% and 10% CA

destroyed the peritubular dentin and 4% CA showed a higher number of samples with dense SL. Although the association of 6% CA and 1% NaOCl presented better results regarding the SL removal, further in vivo studies are still necessary to evaluate the performance of this association in order to enable its clinical use (32).

With the results of Götze et al., Hegde and Bapna analyzed the ability to remove the SL of the substances 17% EDTA, 6% CA, and saline solution as control. The study used 30 deciduous teeth, dividing them equally among the irrigating solutions. After mechanical instrumentation and irrigation, the teeth were examined by scanning electron microscopy. The results argue that sequential irrigation of root canal walls with 17% EDTA followed by 5% NaOCl causes greater removal of mechanical instrumentation-related debris (33).

In addition to being effective, the substance used as an irrigator should also be biocompatible in order to avoid damage to the patient's body. The study by Bottonet al. evaluated the toxicity (cytotoxicity and genotoxicity) of the use of NaOCl (1% and 2.5%), 2% CHG, 6% AC, 17% EDTA and its associations. All groups indicated some level of toxicity. Among the solutions, CHG and EDTA presented lower cytotoxic potential individually, and the association of these two solutions exhibited the lowest toxicity potential among all groups. Therefore, when thinking about biological safety for the infant patient, the association between CHG and EDTA is the best choice (16).

More recent studies included in the literature review compared the use of 1% NaOCl, 10% EDTA, 6% CA, and 0.9% saline solution. Hegde and Bapna et al. conducted their study with 40 extracted deciduous upper incisors, dividing them into four groups: 1% NaOCl, 10% EDTA + 1% NaOCl, 6% CA + 1% NaOCl and saline solution. After irrigation, the canal walls were evaluated and compared by scanning electron microscopy. Smear layer removal was more effective in the 10% EDTA + 1% NaOCl and 6% CA + 1% NaOCl groups. The two combinations can be suggested as recommended for pulpectomy of deciduous teeth. However, due to the absence of erosive dentinal alterations, the use of 6% CA + 1% NaOCl (33) is recommended.

With the findings of Hegde and Bapna et al. (33), Yüksel et al. evaluated the same groups of solutions in relation to canal wall adaptation and apical microinfiltration using a total of 90 extracted unirradicular deciduous teeth. The association of 6% CA + 1% NaOCl was considered the most successful irrigation protocol in providing the evaluated characteristics. Due to the ability to provide appropriate changes in root canal walls – in order to perform a well-adapted and leak-proof filling – 6% CA + 1% NaOCl can be recommended as an irrigation protocol in deciduous teeth (34).

CONCLUSION

This review presents a synthesis of the literature that analyzes the different irrigating solutions and protocols in the endodontic treatment of deciduous teeth. There is still no consensus in the literature regarding the best irrigating solution for this purpose. According to the analyzed articles, the success of smear layer removal or reduction of microbial load is strictly related to the type of compound or association of compounds used, as well as their concentration. The most prosperous substance presented was the combination of 6% CA + 1% NaOCl, which proved to be more efficient in cleaning root canals and removing SL. Furthermore, the substances EDTA and CHG showed low cytotoxicity and good properties, showing themselves as alternatives of root canal irrigators. However, caution is needed to read the results, as the studies differed regarding the design (in vivo and in vitro) and the outcomes (reduction of microbial load and success of therapy).

Further studies in the area are necessary, considering the relevance and the clinical frequency with which endodontic treatment in deciduous teeth is necessary. The maintenance of these dental elements until their physiological age of exfoliation is proven to be a determining factor for permanent dentition to have its adequate occlusion and alignment. Thus, pulpectomy performed following the protocols recommended by current scientific evidence is efficient for the preservation of deciduous teeth

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