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Therapeutic approach to pulpotomy in deciduous teeth with chloramphenicol, tetracycline, and zinc-oxide paste

Abordagem terapêutica da pulpotomia em dentes decíduos com pasta cloranfenicol, tetraciclina e óxido de zinco

Abordaje terapéutico de la pulpotomía en dientes temporales con pasta de cloranfenicol, tetraciclina y óxido de zinc

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Abstract:
Objective: to evaluate the effectiveness of chloramphenicol, tetracycline, and zinc oxide-eugenol paste in the pulpotomy of deciduous teeth in children, considering its clinical, radiographic, and biological outcomes. **Methods:** an integrative review was conducted in 2025, considering the years 2020 to 2025, using the combination of the descriptors "Pulpotomy," "Deciduous Tooth," and "CTZ Paste" in the US National Library of Medicine, Virtual Health Library, and the CAPES Journal Portal. The data were organized into tables and figures for analysis and interpretation of evidence from the collected publications. **Results:** from the initial 37 studies, 10 were considered. It was found that the chloramphenicol, tetracycline, and zinc oxide-eugenol paste provides a significant reduction in both operative time and operational costs; High clinical (90 to 100%) and radiographic (72 to 100%) success rates, coupled with satisfactory biocompatibility. **Conclusion:** although the findings are satisfactory, further research is needed to consolidate the efficacy and safety of chloramphenicol, tetracycline, and zinc oxide-eugenol paste in pulpotomies of deciduous teeth in children.
Keywords: Tooth, deciduous; Pediatric dentistry; Pulpotomy.

Resumo:
Objetivo: avaliar a eficácia da pasta de Cloranfenicol, Tetraciclina e Óxido de Zinco-Eugenol na pulpotomia de dentes decíduos em crianças, considerando seus efeitos clínicos, radiográficos e biológicos. **Método**: revisão integrativa, realizada em 2025 considerando os anos de 2020 a 2025, utilizando-se a combinação dos descritores, "Pulpotomia", "Dente Decíduo" e "Pasta CTZ", nas bases *US National Library of Medicine*, Biblioteca Virtual em Saúde e o Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior. Os dados foram organizados em tabelas e figuras para análise e interpretação de evidencias trazidas nas produções levantadas. **Resultados**: De 37 estudos iniciais, 10 foram considerados. Verificou-se que a pasta cloranfenicol, tetraciclina e óxido de zinco-eugenol proporciona redução significativa tanto do tempo operatório quanto dos custos operacionais; altas taxas de sucesso clínico (90 a 100%) e radiográfico (72 a 100%), aliadas a uma biocompatibilidade satisfatória. **Conclusão**: apesar dos achados serem satisfatórios são necessárias mais pesquisas para consolidar a eficácia e segurança da pasta cloranfenicol, tetraciclina e óxido de zinco-eugenol em pulpotomias de dentes decíduos em crianças.
Palavras-chave: Dente decíduo; Odontopediatria; Pulpotomia.

Resumen:
Objetivo: evaluar la eficacia de la pasta de Cloranfenicol, Tetraciclina y Óxido de Zinc-Eugenol en la pulpotomía de dientes temporales en niños, considerando sus efectos clínicos, radiográficos y biológicos. **Método**: revisión integradora, realizada en 2025 considerando los años de 2020 a 2025, utilizándose la combinación de los descriptores "*Pulpotomia*" (Pulpotomía), "*Dente Decíduo*" (Diente temporal) y "Pasta CTZ", en las bases *US National Library of Medicine*, Biblioteca Virtual en Salud y el Portal de Revistas Científicas de la Coordinación de Perfeccionamiento del Personal de Nivel Superior. Los datos fueron organizados en tablas y figuras para el análisis e interpretación de las evidencias aportadas en las publicaciones recopiladas. **Resultados**: de 37 estudios iniciales, 10 fueron considerados. Se verificó que la pasta de cloranfenicol, tetraciclina y óxido de zinc-eugenol proporciona una reducción significativa tanto del tiempo operatorio como de los costes operativos; altas tasas de éxito clínico (90 a 100%) y radiográfico (72 a 100%), junto con una biocompatibilidad satisfactoria. **Conclusión**: aunque los hallazgos son satisfactorios, son necesarias más investigaciones para consolidar la eficacia y seguridad de la pasta de cloranfenicol, tetraciclina y óxido de zinc-eugenol en pulpotomías de dientes temporales en niños.
Palabras clave: Diente primário; Odontología pediátrica; Pulpotomía.

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INTRODUCTION

Dental caries is one of the most common chronic conditions in childhood, with a significant impact on the oral health of children worldwide. In Brazil, data from the National Oral Health Survey show a high prevalence of the disease, especially in five-year-old children in the North (57.97%), Midwest (52.03%), and Northeast (47.27%) regions, reflecting an important public health problem[1].

It is a multifactorial disease associated with the interaction between cariogenic microorganisms, frequent sugar consumption, and poor oral hygiene. In deciduous teeth, the progression of carious lesions occurs more rapidly due to the thinner enamel and dentin, which can result in pain, infections, and premature tooth loss, with functional impacts and impacts on the child's development[2].

The selection of appropriate therapeutic approaches is essential, considering not only the extent of the lesion, but also factors such as age, child behavior, and clinical conditions[3]. Pulp therapy is a conservative alternative, aimed at maintaining the vitality or function of affected deciduous teeth, preventing their premature loss[4-6].

In this context, pulpotomy consists of removing the coronal portion of the dental pulp, followed by the application of materials capable of promoting the maintenance of the health of the remaining tissues. Several materials have been used, such as calcium hydroxide (HC), mineral trioxide aggregate (MTA), Biodentine, zinc oxide-eugenol (ZOE), Guedes-Pinto paste (PGP), 3Mix-MP paste (ciprofloxacin, metronidazole and minocillin) and chloramphenicol, tetracycline and zinc oxide-eugenol paste (CTZ). However, despite the range of available options, the literature does not present a consensus regarding the ideal material, particularly in terms of long-term clinical efficacy, biocompatibility, cost-effectiveness, and standardization of clinical protocols[7-9].

CTZ antibiotic paste has emerged as a therapeutic option, due to its antimicrobial action, ease of application, and potential for use in a single treatment. Introduced by Cappiello in 1964, CTZ has been investigated in different studies, showing promising clinical and radiographic outcomes[9-10]. However, its use remains controversial, particularly regarding the biological safety of the antibiotics present in its composition, the lack of standardized protocols, and the limited number of long-term clinical studies.

The high prevalence of caries in the Brazilian pediatric population and the difficulties in accessing specialized dental treatments justify the investigation of therapeutic approaches that are both clinically effective and low-cost, while requiring shorter operative time. Pulpotomy with CTZ paste may represent a viable alternative, especially in primary care settings and in the

care of pediatric patients with low cooperation[10]. Thus, this study aims to evaluate the efficacy of chloramphenicol, tetracycline, and zinc oxide-eugenol paste in the pulpotomy of deciduous teeth in children, considering its clinical, radiographic, and biological effects.

METHODS

This is an integrative review based on the analysis of scientific productions on a given topic, aiming to synthesize findings from independent studies addressing the same subject[11].

The methodological approach followed the six steps described by Dantas *et al*[12]: (1) identification of the topic and formulation of the research question; (2) literature search and sampling in databases; (3) data extraction and categorization; (4) critical analysis of the included studies; (5) interpretation of the data; and (6) presentation of the integrative review.

The guiding question of the study was developed according to the PICO strategy, which is an acronym for population (P), intervention (I), comparison (C) and outcome (O), widely used in the elaboration of questions in integrative reviews. Thus, it was defined: P - pediatric patients; I - pulpotomy with CTZ paste; C - conventional techniques/endodontic materials; and O - clinical, radiographic and biological efficacy. Based on this strategy, the following research question was formulated: "*What are the benefits of the pulpotomy procedure using Chloramphenicol, Tetracycline, and Zinc Oxide-Eugenol paste in deciduous teeth?*"

The search was conducted from July to October 2025 in the PubMed (US National Library of Medicine), Virtual Health Library (VHL), and the CAPES (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior)* Journal Portal databases. The search strings were used through the following descriptors: "*Pulpotomia*", "Pulpotomy", "*Dente Decíduo*", and "Deciduous Tooth", associated with the Boolean operator "AND". In addition, given the specificity of the topic, a keyword that was not on the Health Sciences Descriptors (DeCS) website, but which was essential to the topic addressed, was also included: "*Pasta CTZ*" and "CTZ paste".

Eligibility criteria included: articles published between 2020 and 2025; available in English, Portuguese, and Spanish; full-text access; free availability; and relevance to the research question. Exclusion criteria included: paywalled studies; review articles; duplicates; abstracts; studies not addressing the topic; and publications outside the defined time frame. To ensure methodological rigor, the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[13] guidelines were followed.

Data analysis followed the steps of data organization, including pre-analysis, material exploration, treatment, and interpretation of results[14]. Subsequently, extracted data were

organized and categorized according to the benefits of pulpotomy in deciduous teeth with CTZ paste, considering clinical, biological, and radiographic outcomes.

The synthesis of the findings was performed descriptively, supported by tables and figures that detailed the study design, search strategies, results from the databases, and a flowchart illustrating the identification, screening, eligibility, and inclusion process, in accordance with PRISMA 2020 recommendations.

RESULTS

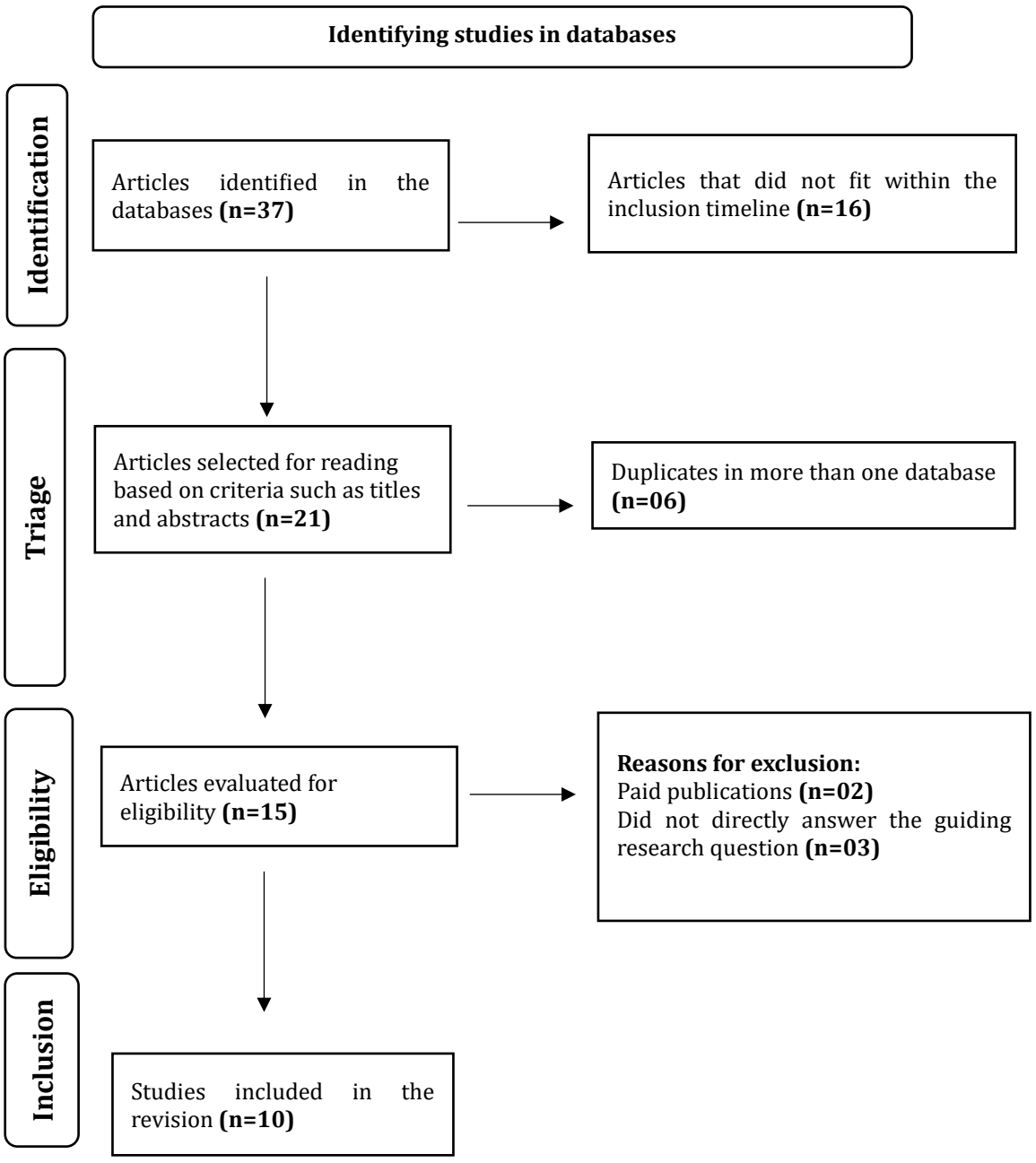
Table 1 presents the information according to the databases, the search strategy used, and the number of studies identified in each database, as well as the number of publications after applying the language and publication period filters. The initial search identified 37 studies in the PubMed, Virtual Health Library, and CAPES Journal Portal databases. After applying the inclusion and exclusion criteria, 16 of the 37 studies were excluded because they did not fit within the established publication period. Subsequently, during the screening process, 21 articles were selected for further analysis following a careful review of titles and abstracts.

Table 1. Databases consulted, search strategies, and studies identified initially and after applying language and publication period filters. Cabedelo/PB, Brazil, 2025.

Database consulted	Search strategy	Initial search	Articles considered after applying filters
PUBMED	(Pulpotomy) AND (Tooth, Deciduous) AND (Paste CTZ)	01	00
PUBMED	(Tooth, Deciduous)) AND (CTZ paste)	11	06
VHL	(*Pasta CTZ*) AND (*Dente Decíduo*)	17	08
CAPES	(*Pasta CTZ*) AND (*Dente Decíduo*) AND (*Pulpotomia*)	04	03
CAPES	(Tooth, Deciduous)) AND (CTZ paste)	04	04
Total		37	21

Of the 21 articles, 6 were excluded due to duplication. Subsequently, 15 publications were assessed in full for eligibility, of which 5 were excluded because they were paywalled and did not directly address the guiding research question. Thus, 10 studies were included in the final sample. The processes of identification, screening, eligibility, and inclusion were illustrated in a flow diagram developed in accordance with the PRISMA 2020 guidelines and presented in Figure 1.

Figure 1. Identification, screening, eligibility and inclusion of studies. Cabedelo/PB, Brazil, 2025.



The characteristics of the included studies are presented in Chart 1, which includes information on first author, year of publication, study objective, country, study design, and main results. The selected studies were published between 2021 and 2025 and comprised different methodological designs, including randomized clinical trials, systematic reviews, narrative reviews, scoping reviews, and case reports, with a predominance of studies conducted in Brazil.

Chart 1. Articles considered and main findings, first author, objective, country, type of study and main results. Cabedelo/PB, Brazil, 2025.

Author/ Year	Objective	Country	Type	Main results
Castro (2023)[15]	To compare the effectiveness of the LSTR (lesion sterilization and tissue repair) technique with CTZ paste (chloramphenicol, tetracycline, zinc oxide, and eugenol) and pulpectomy with ZOE paste (zinc oxide-eugenol) in the treatment of deciduous molars with pulp necrosis.	Brazil	Randomized clinical trial	Regarding clinical success, the ZOE paste showed approximately 3% greater success than the CTZ paste. Radiographic success was equivalent between the two options. Finally, the success rate of the ZOE paste was approximately 2% higher when compared to the CTZ paste. Even so, after 6 months the efficacy was similar.
Moura (2021)[16]	To compare the efficacy of a lesion sterilization and tissue repair (LSTR) antibiotic paste composed of chloramphenicol, tetracycline, and zinc oxide-eugenol (CTZ) versus pulpectomy with zinc oxide-eugenol (ZOE) in the treatment of deciduous molars with pulp necrosis.	Brazil	Randomized clinical trial	When comparing the techniques with ZOE paste and CTZ paste, after a period of 12 months, clinical success and overall success were greater for ZOE paste, and radiographic success was greater for CTZ paste. Regarding procedure time, the CTZ paste technique was 84 minutes faster.
Silva (2022)[17]	To present a clinical case report in which different endodontic approaches were performed on traumatized and necrotic homologous teeth.	Brazil	Case report	The use of CTZ paste showed satisfactory results, similar to traditional therapy in the short term, in the case report presented.
Oliveira (2021)[18]	Evaluate the cost of this treatment, comparing it to the instrumented technique using iodoform paste.	Brazil	Randomized clinical trial	The execution cost was 58.33% lower with the CTZ paste. Specifically, the instrumented technique cost US$16.15, while the CTZ paste cost US$6.73. Therefore, the main benefits of the technique were shorter time and lower cost.
Souza (2025)[19]	To evaluate the effectiveness of the disinfection and tissue repair technique using chloramphenicol-tetracycline-zinc oxide-eugenol (CTZ) paste in the pulp therapy of deciduous teeth.	Brazil	Systemic review	The review identified that CTZ paste has a high clinical success rate (90% to 100%) and a high radiographic success rate (72% to 100%). The main benefits found were: reduced post-procedure pain, lower cost, and practicality.
Sobral (2023)[20]	To conduct a randomized controlled clinical trial to compare the efficacy of (NIET) in deciduous teeth associated with the use of two obturation pastes.	Brazil	Randomized clinical trial	The use of non-instrumental techniques, such as CTZ paste, offers advantages such as shorter chair time and less complexity than the conventional technique involving root canal instrumentation.
Dias (2021)[21]	To suggest a clinical protocol model for the systematization and standardization of endodontic treatment of deciduous teeth with CTZ paste.	Brazil	Case report	The use of CTZ paste is a simple, viable, and satisfactory alternative that should be considered, especially in the public healthcare system. It has proven to be clinically and radiographically effective in all treated teeth during a 180-day follow-up.
Uribe (2023)[22]	To report the use of CTZ paste in a deciduous molar diagnosed with pulp necrosis and acute periodontal abscess.	Colombia	Case report	The technique was described as a positive and effective alternative in a clinical case. Even considering the information on biocompatibility, CTZ paste should be considered as an option during dental treatment of deciduous teeth.
Zeno (2022)[23]	To present recent literature on CTZ antibiotic paste in relation to its antimicrobial activity, biocompatibility, and clinical and radiographic success rate.	Colombia	Narrative review	The review highlighted studies that indicated clinical success rates for CTZ paste ranging from 37% to 100% and radiographic success rates from 29.7% to 97.4%. Biocompatibility was considered good.
Garrocho-Rangel (2021)[24]	To conduct a scoping systematic review to explore the real-world clinical applications of chloramphenicol-tetracycline-ZOE (CTZ) antibiotic paste as a therapeutic agent for lesion sterilization tissue repair (LSTR).	México	Scope review	The CTZ paste demonstrated high clinical success rates and good radiographic results. However, there was no difference compared to conventional pulpectomy. The study also mentions that biocompatibility has been questioned.

DISCUSSION

According to a randomized clinical trial, the main benefits of CTZ paste includes a less invasive procedure, reduced clinical time and low discomfort for children, as well as lower cost for dentists[15]. Another randomized clinical trial study reported promising results for reducing clinical time, as the conventional pulpotomy procedure had an average execution time of 145 minutes, while the use of CTZ paste resulted in an average time of only 61 minutes, a difference of about 84 minutes (1 hour and 24 minutes)[16]. In a pediatric case report, there was regression of periapical lesions, absence of pain, abscess and fistula, as well as restoration of the tooth's natural color[17].

In another study conducted in 2023, also highlighted the lower cost associated with the procedure[15]. Complementarily, a 2021 study comparing CTZ paste with an instrumented technique using iodoform paste reported that CTZ presented an execution cost of 58.33% relative to the comparator, considering capital costs, dental materials, and professional labor. This reduction was also associated with the non-use of rubber dam isolation, instrumentation, and root canal obturation procedures[18].

The lower cost of the technique is associated with the advantages in the practicality of using CTZ paste and the reduction of postoperative pain[19]. This technique is characterized as a promising option for children who are not cooperative and for environments with fewer resources[20]. In view of this, in a clinical case, the importance of implementing this paste in the public network was reported[21].

The instrument-free technique represents a beneficial option for children, as endodontic procedures are often associated with fear and anxiety, and the absence of instrumentation in the operative field may reduce these emotional responses[25].

Regarding the CTZ pulpotomy protocol, a study conducted in 2023 describes the following steps: access to the pulp chamber and removal of coronal necrotic tissue, light irrigation with sterile saline solution, application of CTZ paste directly to the canal entrances, and coronal sealing with temporary restorative cement, followed by definitive restoration with composite resin[16].

A 2021 study proposed a modified protocol including irrigation with 20 mL of sterile 0.9% saline solution with aspiration, drying of the pulp chamber with sterile cotton, insertion of CTZ paste using an endodontic explorer (No. 47), followed by light condensation with sterile cotton. The paste was prepared chairside (1 capsule in a 1:1:2 proportion with two drops of eugenol). A thin layer of gutta-percha was placed, followed by cleaning with 70% alcohol and restoration with resin-modified glass ionomer cement[1][18].

A case report detailed another protocol beginning with local anesthesia using 2% lidocaine with 1:80,000 epinephrine, followed by irrigation with saline solution. CTZ paste (125 mg chloramphenicol, 125 mg tetracycline, and 250 mg zinc oxide) was mixed with eugenol and inserted into the pulp chamber, isolated with gutta-percha (Maillefer, Switzerland), and restored with high-viscosity glass ionomer cement, with follow-up every two months[22].

The guidelines in the book "*Anúario de Odontopediatria Clínica: integrada e atual*" detail the clinical protocol for the use of CTZ paste10:93:

> *Coronal opening; Locating the canal entrances with an exploratory probe; Irrigation with 2% chlorhexidine and aspiration; [...] Preparation of CTZ paste (post-CTZ + eugenol); Firm spatulation to eliminate granularity; Insertion of CTZ paste into the root canal entrances and the pulp chamber floor; [...] Light compression of the paste with sterile cotton pellets; Insertion of the temporary obturation material into the pulp chamber; Light compression of the temporary obturation material using sterile cotton pellets, followed by cleaning of excess material on the surrounding walls; Insertion and adaptation of the chosen restoration material.*

In another clinical case, a protocol is highlighted, consisting of the following steps: anesthesia with 2% lidocaine with 1:100000 epinephrine, coronal opening with removal of the pulp chamber roof without instrumentation, followed by irrigation with saline solution and restoration with resin-modified glass ionomer cement[17].

Regarding the clinical and radiographic efficacy of the material, a randomized clinical trial conducted in 2023 compared groups treated with CTZ and zinc oxide-eugenol (ZOE) pastes[15]. In general terms, the results demonstrated a superiority in clinical aspect of the ZOE paste, while radiographic success reached 43.2% in both samples. Furthermore, the reassessment conducted after 36 months did not demonstrate any statistically significant difference, which indicates equivalent efficacy between the techniques in the long term. In contrast, a narrative review showed reduced rates of clinical (37%) and radiographic (29.7%) success[23].

Conversely, a randomized clinical trial conducted in 2021 compared the use of CTZ paste to the conventional ZOE procedure over a 12-month follow-up, in which CTZ showed better results in radiographic success (75%) and established itself as an effective technique[16]. As well as in a case report, clinical success rates between 90% and 100% and radiographic success rates in the range of 72% to 100% were observed[19]. These results suggest an increase in the reported effectiveness of the material in relation to the chronological advancement of scientific investigations[19].

Regarding tissue repair, the technique of sterilizing lesions with CTZ paste constitutes a valid alternative to traditional ZOE pulpectomy in primary teeth with pulp necrosis, mainly from a clinical point of view, as it offers similar results over time[15,19,24]. However, despite its proven effectiveness, another study highlights the need for caution regarding the biocompatibility of the material[24].

The term biocompatibility refers to the ability of a material to be "acceptable" by the body, without generating inflammatory responses, irritations, or rejections. Thus, it is necessary to investigate the biocompatibility of CTZ paste in contact with the oral mucosa[26].

Although the aforementioned limitations exist, the clinical benefits resulting from CTZ paste are evident. Due to this proven efficacy, the material is considered a good alternative during treatment[21,24]. In this regard, a study conducted in 2022 corroborates this view by demonstrating that the biocompatibility of the material is satisfactory[23]. Thus, CTZ paste represents a viable and low-cost alternative, characterized by reduced clinical time and high applicability in pediatric dental care.

CONCLUSION

CTZ paste (chloramphenicol, tetracycline, zinc oxide-eugenol) has shown relevant biological effects on pulp tissues in the studies reviewed, highlighting its antimicrobial, anti-inflammatory, and analgesic properties, which favor its application in pulpotomies in deciduous teeth. The studies analyzed demonstrate high rates of clinical (90% to 100%) and radiographic (72% to 100%) success, in addition to advantages such as low cost, reduced operating time, less postoperative pain, less fear and anxiety among children, and greater practicality.

The findings of this review suggest that CTZ paste may represent a viable alternative in pediatric dental care, especially in public services, by enabling faster and lower-cost procedures. However, limitations include the scarcity of studies and the lack of publications in Portuguese on the subject, making it necessary to conduct further clinical research to expand the scientific evidence on its effectiveness, with an emphasis on publications in Portuguese.

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