

CTZ (chloramphenicol, tetracycline and zinc oxide) obturator paste for primary teeth: An important approach in pediatric dentistry



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ABSTRACT

The maintenance of the deciduous dentition in the oral cavity until the moment of its physiological exfoliation is extremely important, and the performance of pulp therapy is indicated when the cariogenic process is installed in a broad and advanced way, reaching the pulp tissue of the dental element. The most common treatment in these cases is pulpectomy, where the filling of primary teeth is performed using obturator pastes. The objective of this study is to review and discuss the literature on the antibiotic obturator paste based on tetracycline, chloramphenicol and zinc oxide and eugenol, called CTZ. This is a paste whose treatment does not require instrumentation of the root canals, being a procedure of tissue repair and sterilization of lesions (known as LSTR). The PubMed and Scielo databases were consulted using the keywords: "endodontic treatment" AND "LSTR". The 10 most current articles and also the articles considered most relevant were used. It has been observed that CTZ paste is not yet widely used, despite not being a new paste. Due to the practicality of the technique without instrumentation indicated for necrotic deciduous teeth, its use has grown, as well as scientific studies on it. In conclusion, the technique of using the CTZ paste is very effective, conferring great advantage in the treatment of non-cooperative patients, as it is easy, simple, and can be performed in a single session, presenting antibacterial power.

Keywords: Endodontics, Root canal filling, Primary tooth.

1 INTRODUCTION

The main goal of pulp therapy in primary teeth is to maintain the integrity and health of the teeth and supporting tissues while maintaining space, function, and aesthetics. The indications and types of pulp therapies depend on the pulp diagnosis, which can be classified as: normal pulp (symptomatology-free and responsive to vitality tests), reversible pulpitis (mild pulp inflammation,



but recoverable), irreversible pulpitis (the pulp has inflammation unable to regenerate), and necrotic pulp (AAPD, 2022).

The procedure of tissue repair and sterilization of lesions, called LSTR, is known as an endodontic treatment in which there is no instrumentation of the root canals and has been discussed since 1990 (Hoshino *et al.*, 1996). Instead, a paste based on different antibiotics is used only in the pulp chamber, which is intended to disinfect the root canals (Coll *et al.*, 2020a; Coll *et al.*, 2020b). This method has been used as an option to potentially replace traditional pulpectomy, as it is simpler and faster to perform and does not require multiple visits, even for teeth with periapical lesions (TAKUSHIGE T *et al.*, 2004).

In endodontic pastes, the antibacterial activity is essential, and several other properties are desirable, such as biocompatibility, radiopacity, absence of tooth discoloration or aggression to the successor permanent tooth germ, degradation similar to the physiological process of resorption of the deciduous tooth, low solubility in water, among others. (SEGATO RAB *et al.*, 2016).

Among the antibiotic pastes used with the LSTR technique, the paste consisting of chloramphenicol, tetracycline and zinc oxide and eugenol, called CTZ, has been reported in the literature as a promising option (MOURA J *et al.*, 2021).

In view of the diversity of endodontically treating deciduous teeth, and in view of the possibility of using a pulp treatment with less time, which is extremely important for the management of infant behavior, this study aims to describe the use of CTZ paste (Chloramphenicol, Tetracycline and Zinc Oxide and Eugenol), in order to bring knowledge to dentists about this option.

2 METHODOLOGY

The present work is a literature review, with a bibliographic search based on scientific articles on endodontic treatment of deciduous teeth with CTZ paste. The search tools were online databases, such as PubMed (www.pubmed.org) and Scielo (<https://scielo.org>). The search strategy included the following keywords: "*endodontic treatment*" AND "*LSTR*" and was conducted in February 2023. The most relevant articles published in the last 10 years were selected for bibliographic research, as well as classic articles that the authors considered pertinent.

When the complete study was not available in the databases, the search was used through the Portal de Periódico/CAPES (www.periodicos.capes.gov.br) platform. A descriptive analysis of the articles was performed and the data were organized in such a way as to provide relevant information about the use and benefits of the CTZ folder.

After a broad reading of the articles of choice, the main information was selected in order to organize the references for the complete development of the objective proposed to the present work.



3 LITERATURE REVIEW

Pulp therapy in primary teeth has been suggested since 1932 as a method for maintaining these teeth, which would otherwise be lost (KUBOTA, GOLDEN, PENUGONDA, 1992). Pulpectomy in primary teeth is an approach that requires more time in the chair and, when it comes to dental treatment for children, resources that spend less time have a greater interest in pediatric dentistry. There is a major impact of pulpectomy on behavior management in the pediatric population and uncertainties about the effects of root canal filling materials on the development of the successor permanent tooth (HOLAN & FUKS AB, 1993).

A technique that has been gaining more visibility over time is lesion sterilization and tissue repair (LSTR), which has been proposed as an alternative approach that seeks to facilitate the disinfection of carious dentin lesions, pulp infections, and periapical lesions in primary teeth (HOSHINO *et al.*, 1989), with the advantage of being simpler and faster. LSTR has been proposed as an option to potentially replace conventional pulpectomy, as it is simpler and faster to perform and does not require multiple visits, even for teeth with periapical lesions (TAKUSHIGE *et al.*, 2004). LSTR is also known as non-instrumental endodontic treatment (NIET) and consists of non-mechanical disinfection of root canals and the use of a paste made of a mixture of antibiotics, placed at the entrance of root canals (NAKORNCHAI, BANDITSING, VISETRATANA, 2010).

Cappiello *et al.* in 1964 developed a paste for filling/filling root canals in primary teeth. The paste is composed of chloramphenicol, tetracycline and zinc oxide, compounded with eugenol as an aqueous carrier and is currently known as CTZ paste (powder base obtained by compounding pharmacy, in ratios of 1:1:2, chloramphenicol/tetracycline/zinc oxide, respectively). This method avoids the need for canal instrumentation, which can reduce the child's time in the chair, in order to facilitate the management of child behavior (CAPPIELLO, 1964). The folder follows the same principles as the LSTR. This paste consists of broad-spectrum and bacteriostatic antibiotics (GAETTI *et al.*, 2014). Zinc oxide has a low absorption rate when used in pastes to fill the root canals of primary teeth, and eugenol also has antimicrobial action (HARINI, BHAT, HEGDE, 2010).

The technique of applying the CTZ paste is considered easy, simple and can be performed in a single session, it has antibacterial power, promoting the stabilization of bone resorption and not causing tissue sensitivity. In addition, it does not require prior root canal instrumentation, regardless of the pulp diagnosis, offering a great advantage in the treatment of uncooperative patients, facilitating the management of pediatric patient behavior and, consequently, reducing operative time (FERREIRA *et al.*, 2019).

Pastes containing antibiotics have shown great clinical relevance. In a research cited by the article by Moura *et al.* in 2021, CTZ paste was used, which in its composition two antibiotics were inserted: tetracycline and chloramphenicol. The first drug is an antimicrobial that acts against a large



number of bacteria, as well as aerobic, facultative anaerobic and spirochete bacteria, it acts against Gram (+) and Gram (-) microorganisms (GONÇALVES & SILVEIRA, 2010). The second is a broad-spectrum bacteriostatic antibiotic, which can also be bactericidal in high concentrations or when used against highly sensitive microorganisms. It is active against several gram-negative bacteria, has excellent activity against all anaerobic microorganisms that can develop in the channels (ANDRADE, 2008).

Another component of the paste is zinc oxide and eugenol, its activity is mainly a result of the potent antibacterial action of eugenol, and it has analgesic properties extracted from cloves. When released in the paste, it has therapeutic effects on dentin and pulp and is considered to be the component of essential oils that best reduces the bacterial activity of species such as *Staphylococci*, *Micrococci*, *Bacilli* and *Enterobacteria* for more than 30 days (GONÇALVES & SILVEIRA, 2010).

According to studies carried out by Freire et al. (2021), CTZ caused a yellowish color in the solution, which became even more intense over time. This is probably due to the presence of tetracycline, which gives such a coloration to the CTZ paste. The release of pigments by CTZ in an aqueous medium may strengthen the theory described in the literature that the material represents a risk factor for color change in successor permanent teeth, causing yellowish or brownish stains due to the impregnation of tetracycline with dental tissues (BOAST, CURTIS, GWEE, 2016). However, there is no strong evidence on this effect, and the occurrence of defects in the enamel of permanent teeth seems to be more related to the inflammatory process in the periapical region of the deciduous tooth (COSTA *et al.*, 2017).

In 2015, Lima and collaborators developed a study with mice to observe the biocompatibility of CTZ paste. A study group of 54 mice received subcutaneous tissue implants from polyethylene tubes containing CTZ (manipulated paste) or calcium hydroxide-based paste (Biodynamic® brand powder plus distilled water) or, as a negative control, empty tubes. Biocompatibility was evaluated on days 7, 21 and 63, totaling nine groups of six animals each. After the experimental intervals, the implant areas were removed and submitted to histological processing. After 7 days, all groups had severe acute inflammatory infiltrates. Inflammation was reduced over the 21 days in the CTZ paste group. Mild chronic inflammatory infiltrates were observed after 63 days in the CTZ group and in the calcium hydroxide paste group. From then on, this study concluded that CTZ and calcium hydroxide pastes demonstrated similar biocompatibility with subcutaneous tissue in this experimental animal model.

Successful endodontic treatment of teeth with pulp necrosis requires the reduction or elimination of infection within the root canal system. Drugs used in pulp therapy of primary teeth must have antimicrobial activity and be biocompatible, particularly given the proximity of contact in the furcation and periapical regions (SILVA *et al.*, 2010, FIDALGO *et al.*, 2011).



In 2016, the author Lúcia de Deus Moura et al. published a study evaluating children who had their primary first molars with necrotic pulp treated endodontically with CTZ paste (MOURA et al., 2016). The study was conducted with children attended by the Pediatric Dentistry Clinic of the Federal University of Piauí (UFPI), from 2010 to 2014. In total, 28 children aged between 4 and 10 years were included, and 38 first deciduous molars diagnosed with pulp necrosis were used. The treatment protocol was: initial periapical x-ray, anesthesia, absolute isolation with a rubber dam, coronary opening and removal of dental caries, location of the root canals, irrigation of the pulp chamber with saline solution, drying with sterile cotton, insertion of the CTZ paste at the entrance of the root canals, isolation of the CTZ with a thin layer of gutta-percha, Restoration with non-provisional restorative material available on the day and final periapical x-ray. The patients' teeth were evaluated clinically and radiographically over 36 months. Clinical success was considered when there was no abscess and tooth mobility was compatible with its chronological age. Radiographic success was considered when there was an absence of radiolucent region in the apical region and in the furcation region. The researchers found 100% clinical success and 93% radiographic success and suggested CTZ paste as a therapy for necrotic primary first molars.

Another Brazilian study evaluated the clinical and radiographic results of endodontic treatments in 36 deciduous teeth treated with CTZ antibiotic paste, performed from 2008 to 2010. Of the 36 deciduous teeth analyzed, 15 (41.6%) presented clinical and radiographic alterations. Clinically, color changes were observed in 2 incisors, 2 maxillary molars, and 6 mandibular molars; 3 cases of pain and 2 cases with the presence of fistula in the lower molar group. Enamel hypoplasia was the only clinical alteration observed in permanent successor teeth (30.0%). As for the permanent successor teeth, enamel hypoplasia was the only clinical finding observed. Of the 10 permanent successor teeth evaluated, only 1 incisor and 2 maxillary premolars revealed this finding. These premolars were successors of deciduous molars with expressive external root and bone resorption, as observed on diagnostic radiographs.

4 DICUSSION

The term "lesion sterilization and tissue repair" (LSTR) is used to refer to endodontic therapies using drug combinations to eliminate or minimize the amount of microorganisms present in the root canal system of the tooth with necrotic pulps without prior chemical-mechanical preparation (TAKUSHIGE et al., 2004). Despite this, the author Maysa Lannes Duarte and collaborators in 2020 mentioned that deciduous teeth with pulp necrosis, especially those with periapical lesions, certainly improve the clinical prognosis when using a combination of irrigation solutions, despite the fact that the treatment of LSTR does not employ irrigation.



A major challenge faced by pediatric dentistry is to develop biomaterials that have antimicrobial, as well as biocompatible and resorbable properties, for deciduous teeth with necrotic pulp (Silva et al. 2010, Barja-Fidalgo et al. 2011, Queiroz et al. 2011). CTZ paste has great potential as a treatment option for endodontically compromised primary teeth in young children, especially those with difficulties in behavior management. One application for the CTZ folder is for users of public health services due to the large patient load in such facilities and the ease with which general practitioners can perform these procedures due to technical simplicity, good clinical outcomes, and cost-effectiveness (CAPIELLO, 1964). Another factor that is very relevant to SUS is the fact that they have low-cost components in their composition (OLIVEIRA *et al.*, 2013).

In 2016, Lúcia de Deus Moura et al. published a study evaluating children who had their primary first molars with necrotic pulp endodontically treated with CTZ paste. Patients evaluated in this case report showed no adverse signs or symptoms after completion of treatment with CTZ paste. When clinical evaluation was associated with radiography, there was a high percentage of success. (MOURA *et al.*, 2016). However, studies conducted by Lokade et al. in 2019, CTZ paste is used in group III (pulp chamber filled with CTZ paste) and failure was observed in one month of follow-up. Considering that at 6 months of clinical life, as well as the radiological follow-up, there was a 90.9% success rate. The failure was due to pain, gingival swelling, formation of the sinus tract, clinically and radiologically, there was an increase in the periodontal ligament (DPL), increased interradicular radiolucency, internal resorption, and discontinuity of the dura mater lamina in both cases. At twelve months of clinical and radiographic follow-up, there were 81.8% and 63.6% success rates, respectively. Clinically, the main reasons for clinical failure were pain, gingival edema and sinus tract formation in all four teeth and radiologically four teeth presented with internal resorption, along with increased interradicular radiolucency and another four teeth showed increased PDL, increased interradicular radiolucency and discontinuity of the lamina dura. The twelve-month success rate of CTZ in this study was lower compared to that of Deus Moura (100% clinical and 93% radiographic). This may be due to the difference in evaluation criteria (LOKADE *et al.*, 2019).

Biocompatibility is the ability of a material to promote an appropriate biological response in a given application. That is, although a biocompatible material may not be inert, the reaction caused by a test material should not pose an unacceptable physiological risk when compared to other scientifically approved materials (Peters, 2013). In the 2015 study by Lima et al., samples taken from mice containing CTZ paste showed progressive darkening over time, which may have been caused by the tetracycline component. CTZ paste was associated with an intense initial inflammatory response during the first few days of the experiment. At the end of the experiment, a mild chronic inflammatory process was observed, with a qualitative and quantitative decrease in collagen fiber density and tissue thickness. This finding suggests that CTZ was biocompatible and had therapeutic properties.



The use of tetracycline in the treatment is questionable, as it can cause tooth staining, the ingestion of this antibiotic during the period of odontogenesis causes darkening (LACERDA *et al.*, 2012). Because of this, its use is not indicated for anterior teeth due to the risk of aesthetic damage, as well as during odontogenesis, which ends around 7-8 years of age (LIMA *et al.*, 2021). However, in 2020, Sousa *et al.* found a higher percentage of enamel defects in teeth with a predecessor extracted by necrosis without endodontic treatment than in teeth treated with CTZ (SOUSA *et al.*, 2020). According to Freire *et al.* in 2021, defects in the enamel of the successor tooth may be more related to the inflammatory process in the periapical region of the deciduous tooth, resulting from the carious process, without the material being a determining factor (FREIRE *et al.*, 2021). In 2016, Reis *et al.* conducted a study to evaluate the incidence of enamel stains in 180 premolars and endodontic treatment in their deciduous predecessors, and it was identified that the appearance of stains occurred, however, without statistically significant difference, suggesting that tetracycline does not act locally and that any staining that may occur would be due to inflammation in the periapical region generated by pulp involvement of the deciduous predecessor (REIS *et al.*, 2016).

Although the CTZ paste is not a new discovery, it is still little used in dentistry courses in Brazil, about only 2.4% (Costa *et al.*, 2012). This resistance is probably due to the care in the use of the drugs of its composition, more precisely tetracycline, which poses the risk of staining the crown of the permanent successor. It is worth emphasizing that enamel hypoplasia can be a consequence of systemic, traumatic, environmental or genetic events that occur during the development of teeth, interfering with the normal formation of the enamel matrix, causing defects and irregularities on its surface. In general, it can be stated that any nutritional deficiency or serious systemic disease may be capable of producing enamel hypoplasia, since ameloblasts constitute one of the most sensitive groups of cells in the body, with regard to metabolic function (Ribas and Czlusniak, 2004). Therefore, it cannot be stated that the occurrence of enamel hypoplasia in permanent teeth that preceded deciduous teeth treated with CTZ is due to endodontic treatment using this paste.

5 CONCLUSION

In view of the information presented in the review, it is concluded that the technique of using CTZ paste is easy, simple, can be performed in a single session, has antibacterial power, promotes stabilization of bone resorption and does not cause sensitivity to tissues. In addition, it does not require instrumentation of the root canals, before or after disinfection, which confers a great advantage in the treatment of non-cooperative patients. However, care should be taken in view of the disadvantage of crown pigmentation of the treated primary tooth.



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