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Clinical effectiveness of lesion sterilization and tissue repair treatment with CTZ paste in primary teeth: a retrospective study

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Abstract

Purpose

To evaluate the clinical effectiveness of lesion sterilization and tissue repair treatment using a paste containing chloramphenicol, tetracycline, zinc oxide, and eugenol (CTZ) in primary teeth, and to examine clinical and sociodemographic factors associated with treatment failure.

Methods

This retrospective observational study analyzed dental records from children treated at the pediatric clinics of the Faculty of Dentistry of the Federal University of Pelotas. Primary molars treated with the CTZ technique were included. Descriptive analyses, Fisher's exact test, multivariate Cox regression, and Kaplan–Meier curves with the Log-Rank test were performed, adopting a 5% significance level.

Results

Seventy-one teeth were evaluated. The annual failure rate was 40.3% (95% CI: 28.6–56.7). Children from families with income < 1.4 minimum wages had a significantly higher risk of failure (HR = 5.65; 95% CI: 1.35–23.72; p = 0.035) compared with those with income ≥ 1.5 minimum wages. Class II restorations also showed a higher failure risk than Class I restorations (HR = 8.21; 95% CI: 1.29–52.35; p = 0.038). The child's behavior during the procedure was classified as cooperative in 95.7% of the treatments.

Conclusion

Although its clinical effectiveness appears limited, the CTZ technique remains a therapeutic possibility for deciduous molars. Family income and restoration class appear to influence the prognosis of CTZ treatment in deciduous teeth.

Introduction

Conventional endodontic treatment of primary teeth with pulpal necrosis or irreversible pulpitis remains one of the major challenges in pediatric dentistry. This difficulty is mainly attributed to the complex morphology of primary root canals and the irregular pattern of physiological root resorption, which increases the risk of instrumenting periodontal tissues and potentially affecting the follicle of the developing permanent tooth. Additionally, young age and behavioral management difficulties further limit the feasibility of performing this treatment. As a result, many children undergo premature extractions (De Deus Moura et al., 2016).

As a simpler, more economical, and faster alternative to pulpectomy, non-instrumental endodontic treatment—also referred to as lesion sterilization and tissue repair (LSTR) therapy—has been proposed (de Oliveira et al., 2021). This conservative technique consists of applying a mixture of antibacterial medications to the pulp chamber floor[5] and the entrances of the root canals, aiming to neutralize the action of the local microbiota without requiring prior chemical–mechanical preparation (Moura et al., 2021). Among the available antibiotic pastes, Chloramphenicol, Tetracycline and Zinc Oxide-Eugenol antibiotic paste (CTZ) was first introduced in 1964 by Cappiello (Cappielo, 1964), who recommended a formulation composed of one part chloramphenicol, one part tetracycline, and two parts zinc oxide mixed with eugenol.

Current literature on the use of this technique in children remains limited, and only a few randomized clinical trials have been published, highlighting the scarcity of high-quality evidence and the need for further clinical investigation (Souza et al., 2025). A systematic review of randomized clinical trials found no significant differences between LSTR and conventional endodontic treatment in primary molars requiring pulpectomy when clinical and radiographic success rates were compared (Chouchene et al., 2024). Another systematic review, which included ten clinical studies—most of them conducted in Brazil—compared CTZ paste with alternative endodontic approaches for necrotic primary molars and demonstrated high success rates, identifying CTZ as a potentially effective and cost-efficient treatment option (Souza et al., 2025). Overall, the available studies suggest that CTZ may serve as an effective therapeutic alternative, emphasizing its reduced treatment time and lower cost compared with conventional endodontic techniques (De Deus Moura et al., 2016; Luengo-Fereira et al., 2019; de Oliveira et al., 2021).

Therefore, this study, based on clinical record data from a pediatric dental service, aims to contribute to the existing literature by evaluating the clinical effectiveness of LSTR therapy using CTZ paste in primary molars, as well as by assessing the association between treatment failures and clinical and sociodemographic variables.

Methods

Design and ethical issues

This retrospective descriptive observational study was approved by the Research Ethics Committee of the Faculty of Dentistry at the Federal University of Pelotas (approval number CEP 7.525.302). The study was conducted in accordance with the STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology) for observational research (von Elm et al., 2014).

Data collection

Data were obtained from the dental records of patients treated at the pediatric dentistry clinics of the Faculty of Dentistry at the Federal University of Pelotas. Clinical care was delivered by fourth- and fifth-

year undergraduate students under the direct supervision of faculty members specialized in pediatric dentistry. This clinic primarily serves children with a high prevalence and severity of dental caries, referred by Basic Health Units from the municipality and surrounding regions. It is considered a reference center and provides free dental services to the community.

The study included dental records of children up to 12 years of age who received non-instrumental endodontic treatment using CTZ paste in one or more primary molars between July 2019 and August 2025, during the period in which CTZ was available as an endodontic therapy option.

Dental records were excluded if the child did not return for at least one follow-up visit within an interval of less than three months, or if no updated treatment plan or dental chart was documented after the procedure.

Information regarding endodontic therapy was collected from the dental chart, treatment plan, and records of procedures performed. The variables extracted included: date of the procedure, child's age at the time of treatment, type of tooth treated (first or second primary molar), restorative material used, class of restoration, the child's behavior during the CTZ appointment. To determine the follow-up period, the date recorded in the most recent treatment plan or dental chart following the procedure was used.

Behavioral assessment during dental care was recorded according to the categories routinely used in the clinic:

- Cooperative: no physical protest, allowing good working conditions; low voice protest (whining or restrained crying) without preventing treatment; fidgety but follows instructions.
- Slightly cooperative: crying; movements of arms, legs, neck, or head; resists but ultimately complies; attempts to interrupt treatment, though treatment is completed effectively.
- Uncooperative: physical restraint by one or more individuals is required; attempts to escape the dental chair or cover the mouth; treatment may need to be interrupted.

Demographic variables included the child's sex and household income, recorded in Brazilian minimum wages (MW). The current Brazilian minimum wage is BRL 1,518, corresponding to approximately USD $290–$300 at current exchange rates. Household income was categorized according to the median as < 1.4 MW or ≥ 1.5 MW.

Radiographic images were not included in the analysis due to inconsistent image quality and storage limitations in the available records.

Outcome

Failure was defined as the study outcome. Teeth presenting clinical signs or symptoms of infection, or with records indicating re-intervention or extraction, were classified as failures. Cases in which only the

restoration failed—while the underlying base material between the CTZ paste and the restoration remained intact and no reapplication of CTZ was required—were not classified as CTZ failures.

Data analysis

The information was tabulated in a Microsoft Excel spreadsheet and subsequently imported into STATA 17.0 for analysis. Descriptive statistics were first performed. Each primary tooth treated with CTZ was considered an independent unit of analysis. The annual failure rate was calculated. Fisher's Exact Test was applied to assess the association between treatment success and clinical and sociodemographic variables. A multivariate Cox regression model was used to identify factors independently associated with endodontic treatment failure. Hazard ratios (HR) and their respective 95% confidence intervals (95% CI) were estimated. The model was adjusted for all independent variables, regardless of statistical significance in the unadjusted analysis, considering their clinical and theoretical relevance to the outcome.

Kaplan–Meier survival curves were generated using follow-up time (in months) as the time variable and clinical failure as the event. The Log-Rank test was used to compare survival curves. A P value < 0.05 was considered statistically significant for all analyses.

Results

Of the 747 pediatric patient records reviewed, 105 documented the use of CTZ paste and were selected for detailed screening. Of these, 61 records met the eligibility criteria and were included in the final analysis; the remaining 44 were excluded for not meeting the study requirements. Among the 61 included children, 10 received CTZ endodontic treatment in two teeth, resulting in a final sample of 71 primary molars. Some variables presented missing data due to inconsistencies in record-keeping, which affected the total number available for analysis of family income, restoration class, and restorative material.

The child's behavior during the procedure was classified as cooperative in 95.7% of the treatments.

The follow-up period ranged from 3 to 37 months, with a mean of 13.8 months (SD = 9.2). The annual failure rate was 40.3% (95% CI: 28.6–56.7). The mean survival time was 13.2 months (SD = 9.1), with a median of 21 months.

As shown in Table 1, of the 71 treated teeth, 38 demonstrated clinical success, while 33 (46.5%) experienced failure. No statistically significant associations were found between treatment failure and the evaluated clinical or sociodemographic variables.

Table 1
Clinical and sociodemographic characteristics of the study sample according clinical success of chloramphenicol, tetracycline and Zinc Oxide-Eugenol antibiotic paste (CTZ)

			Success				
			Yes	(%)	No	(%)	P-value
Variable	**n**	**(%)**					
	71	(100.0)	38	(53.5)	33	(46.5)	
Age in the procedure							0.380**
2–4 years	11	(15.5)	4	(36.4)	7	(63.6)	
5–7 years	42	(59.2)	25	(59.5)	17	(40.5)	
8–10 years	18	(25.3)	9	(50.0)	9	(50.0)	
Household income (in Brazilian minimum wages)*							0.071**
< 1.4	18	(41.9)	7	(38.9)	11	(61.1)	
≥ 1.5	25	(58.1)	17	(68.0)	8	(32.0)	
Tooth							0.099**
First molars	31	43.7	13	(41.9)	18	(58.1)	
Second molars	40	56.3	25	(62.5)	15	(37.5)	
Class of restoration*							0.534**
Class 1	13	21.3	8	(61.5)	5	(38.5)	
Class 2	48	78.6	23	(47.9)	25	(52.1)	
Restorative material*							0.331**
Composite resin	11	16.7	8	(72.7)	3	(27.3)	
Glass ionomer cement	46	69.7	22	(47.8)	24	(52.2)	
Temporary material (coltosol, IRM ou ZOE)	9	13.6	5	(55.6)	4	(44.4)	

*Missed data; **Fisher's exact test, significant at P < 0.05. The minimum monthly wage in Brazil is currently BRL 1,518, which is approximately $290-$300 USD.

In the multivariate analysis (Table 2), family income and restoration class remained significantly associated with treatment success. Teeth from children with a family income of less than 1.4 minimum wages demonstrated a higher risk of failure (HR = 5.65; 95% CI: 1.35–23.72; p = 0.035) compared with

those from families earning ≥ 1.5 minimum wages. Similarly, Class II restorations exhibited a significantly higher risk of failure than Class I restorations (HR = 8.21; 95% CI: 1.29–52.35; p = 0.038).

Table 2
Multivariate analysis of risk factors for overall failure of non-instrumental endodontic treatment with CTZ paste (chloramphenicol, tetracycline, and zinc oxide–eugenol) in deciduous molars, using Cox regression (n = 71)*

Variable	HR	(IC 95%)	P-value
Age in the procedure (ref. 2–4 years)			0.514
4–6 years	2.81	(0.62–12.75)	
8–10 years	1.49	(0.22–9.98)	
Household income (in minimum wages) (ref. ≥1.5)			0.035
< 1.4	5.65	(1.35–23.72)	
Tooth (ref. first molars)			0.163
Second molars	0.30	(0.08–1.20)	
Class of restoration (ref. class I)			0.038
Class II	8.21	(1.29–52.35)	
Restorative material (ref. composite resin)			0.328
Glass ionomer cement	1.63	(0.14–18.31)	
Temporary material	8.44	(041-172.48)	

*Abbreviations used in this table: HR = hazard ratio; IC = confidence interval; Ref. = Reference category for each variable.

The remaining variables (age at the time of the procedure, treated tooth, and restorative material) showed no statistically significant association with treatment failure.

The Kaplan–Meier survival curves (Fig. 1) illustrate the probability of clinical success of CTZ endodontic treatments in primary molars over time. The overall curve (Fig. 1A) demonstrated a progressive reduction in the survival rate throughout the follow-up period. Regarding clinical variables, Class II restorations showed a tendency toward lower survival compared with Class I (Fig. 1B), although this difference did not reach statistical significance (p = 0.075).

Second primary molars exhibited a higher probability of success than first primary molars (Fig. 1C), but this difference was not statistically significant (p = 0.207). Likewise, no significant differences were observed among the various restorative materials used—composite resin, glass ionomer cement, or temporary materials (p = 0.784; Fig. 1D). With respect to age at the time of treatment, survival curves

showed similar behavior for children aged 2–4, 5–7, and 8–10 years (Fig. 1E), with no significant differences among age groups (p = 0.812).

Discussion

This study assessed the clinical effectiveness of non-instrumental endodontic treatment with CTZ paste in deciduous molars and examined whether clinical or sociodemographic factors were associated with treatment outcomes. The findings showed that lower family income and cavities involving proximal surfaces were significantly associated with failure, suggesting that socioeconomic disadvantage and greater lesion complexity may negatively affect the clinical success of this therapy.

Possible explanations for the higher CTZ failure rate observed among children from lower-income families include both biological and contextual factors. Children from socioeconomically disadvantaged backgrounds are more frequently exposed to oral health risk factors, such as inadequate oral hygiene, cariogenic dietary habits, and irregular attendance at follow-up appointments (Lambert, Vanobbergen and Martens, 2017; Yousaf et al., 2022). Socioeconomic adversity may also hinder adherence to postoperative instructions and delay the recognition of early complications, thereby reducing opportunities for timely intervention. This finding is consistent with studies on restorative procedures (Santos, Zare and Mcdermott, 2024), which report reduced longevity among socioeconomically vulnerable populations. In the context of endodontic therapy, a compromised restoration substantially increases the risk of treatment failure, as bacterial infiltration can re-enter the root canal system and initiate inflammatory processes (Olegário et al., 2022).

The lower survival rate observed in teeth treated with this endodontic technique when restored with Class II cavities, compared with Class I cavities, can be explained by both anatomical and technical factors. Class II preparations involve proximal surfaces, requiring the use of matrices and wedges and being positioned closer to the gingival margin, which makes moisture control and adequate marginal sealing more challenging (Alves Dos Santos et al., 2009; Daou, Tavernier and Meyer, 2009). In addition, these cavities require the removal of a greater amount of dental tissue, reducing mechanical retention and increasing the likelihood of restorative failure (Alves Dos Santos et al., 2009). Such restorative compromises can ultimately contribute to endodontic failure by allowing bacterial penetration into the root canal system.

The clinical failure rate observed in this study (46.5%) was approximately three times higher than that reported in a randomized clinical trial that presented failure rates of 13.6% at both the 12- and 36-month follow-up periods (Moura et al., 2021; Castro et al., 2023). However, it is important to note that randomized clinical trials are conducted under highly controlled conditions, with strict inclusion criteria and standardized follow-up protocols. In contrast, the present study reflects the context of a free public reference service that primarily treats individuals referred from Basic Health Units, who often present with a high prevalence of dental caries and more advanced lesions (Rosario et al., 2025). Additionally, treatments in this setting were performed by students, who—although supervised—did not receive the

same level of specific training typically required in controlled clinical trials and were still in a learning process.

Another relevant point is that, in LSTR randomized clinical trials, the most used final restoration was the stainless steel crown (Chouchene et al., 2024), whereas in the service evaluated here, restorations were performed with filling or temporary materials. It is well established that crowns placed on primary molars following pulp treatment reduce the risk of major failure or long-term pain when compared with fillings (Innes et al., 2015). This difference in restorative approach may also have contributed to the higher failure rates observed.

Although tooth type (first or second primary molars) did not significantly influence survival, the survival curves suggested a trend toward better performance in second molars. This could be explained by anatomical differences, as first molars have smaller crowns and therefore less dental structure available for retention (Tafti and Clark, 2023). Furthermore, the greater difficulty in adapting matrices and wedges during the restoration of first molars—both upper and lower—may compromise marginal sealing. Nevertheless, in the present study, no significant difference in failure rates was observed between first and second molars.

Similarly, age at the time of the procedure did not show a significant association with the outcome. It was initially expected that younger children might require more behavioral management, have shorter chair time, and potentially compromise the technical execution of the CTZ procedure. Conversely, older children might experience lower success rates due to more advanced root resorption, which naturally progresses with the child's biological cycle. However, in this study, age did not demonstrate any relationship with CTZ failure.

Another noteworthy finding was that the vast majority of children demonstrated cooperative behavior during the CTZ procedure. Traditionally, CTZ and similar LSTR strategies have been recommended for children with limited cooperation, as they involve fewer clinical steps and shorter chair time (Souza et al., 2025). Our findings suggest that the simplified and minimally invasive nature of the CTZ technique may contribute to greater comfort, improved acceptance, and a more humanized treatment experience. These aspects are particularly important in pediatric dentistry, where treatment success is influenced not only by clinical outcomes but also by the child's behavioral response and overall experience.

As this study analyzed secondary data, several limitations were encountered, which affect the interpretation of the results. Incomplete dental records reduced the total number of cases available for some variables. Additionally, the procedures were performed by students who were still in the learning process, as previously mentioned. Moreover, considering the real clinical practice scenario—where this technique is often used to maintain the tooth in the mouth for a longer period, even in situations where there is no standard indication for endodontic treatment, such as root resorption greater than one-third of the root or extensive coronal destruction that prevents adequate restoration[15]—these factors may also have contributed to the failure rate observed. Furthermore, radiographic evaluation was not included in the present analysis. It is important to highlight that previous studies have demonstrated that clinical

success rates of CTZ-treated teeth tend to be higher than radiographic success rates, with some reports showing marked reduction in clinical signs and symptoms despite persistent or only partially resolved radiolucencies in the furcation area (Siegl et al., 2015; Castro et al., 2023).

Among the strengths of this study, the use of a sample derived from real clinical cases—obtained from the records of a public higher education institution—stands out, as it reflects the applicability of the technique under routine pediatric dental care conditions. Additionally, the use of robust statistical methods, such as Cox regression and Kaplan–Meier survival curves, enabled a detailed analysis of treatment longevity and the influence of different variables on clinical outcomes. Another relevant aspect is the focus on a low-cost and easily performed technique, which is particularly advantageous in resource-limited settings where endodontic files and radiographic equipment may not be available, such as in primary health care services within the Brazilian Unified Health System (SUS). This reinforces the potential of CTZ paste as a viable alternative for the endodontic treatment of primary teeth. Finally, this study contributes to the existing literature, which still lacks sufficient evidence regarding the effectiveness of non-instrumental endodontic therapy.

Conclusion

1. Non-instrumental endodontic treatment with CTZ paste may serve as an alternative option for primary molars with pulpal necrosis or irreversible pulpitis, especially in situations where conventional endodontic techniques cannot be performed.
2. The clinical performance of CTZ appears to be influenced by contextual factors, and clinicians should be aware that children from lower-income families may be at greater risk of treatment failure.
3. Teeth restored with Class II cavities showed a less favorable prognosis, underscoring the importance of careful restorative planning when selecting CTZ as a therapeutic approach.
4. These findings highlight the need for individualized decision-making, considering both the clinical scenario and the child's social context, to optimize the outcomes of non-instrumental endodontic therapy.

Declarations

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Competing Interests

The authors declare no competing interests.

Ethical Approval

This restrospective study was approved by the Research Ethics Committee of the Faculty of Dentistry at the Federal University of Pelotas (approval number CEP 7.525.302).

Informed Consent

Due to the retrospective nature of the study, the requirement for informed consent was waived.

Author Contributions

MSA contributed to study conception and design. Material preparation, data collection, and analysis were performed by MSA and EMP. The first draft of the manuscript was written by EMP, and all authors commented on previous versions. All authors read and approved the final manuscript.

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Figures

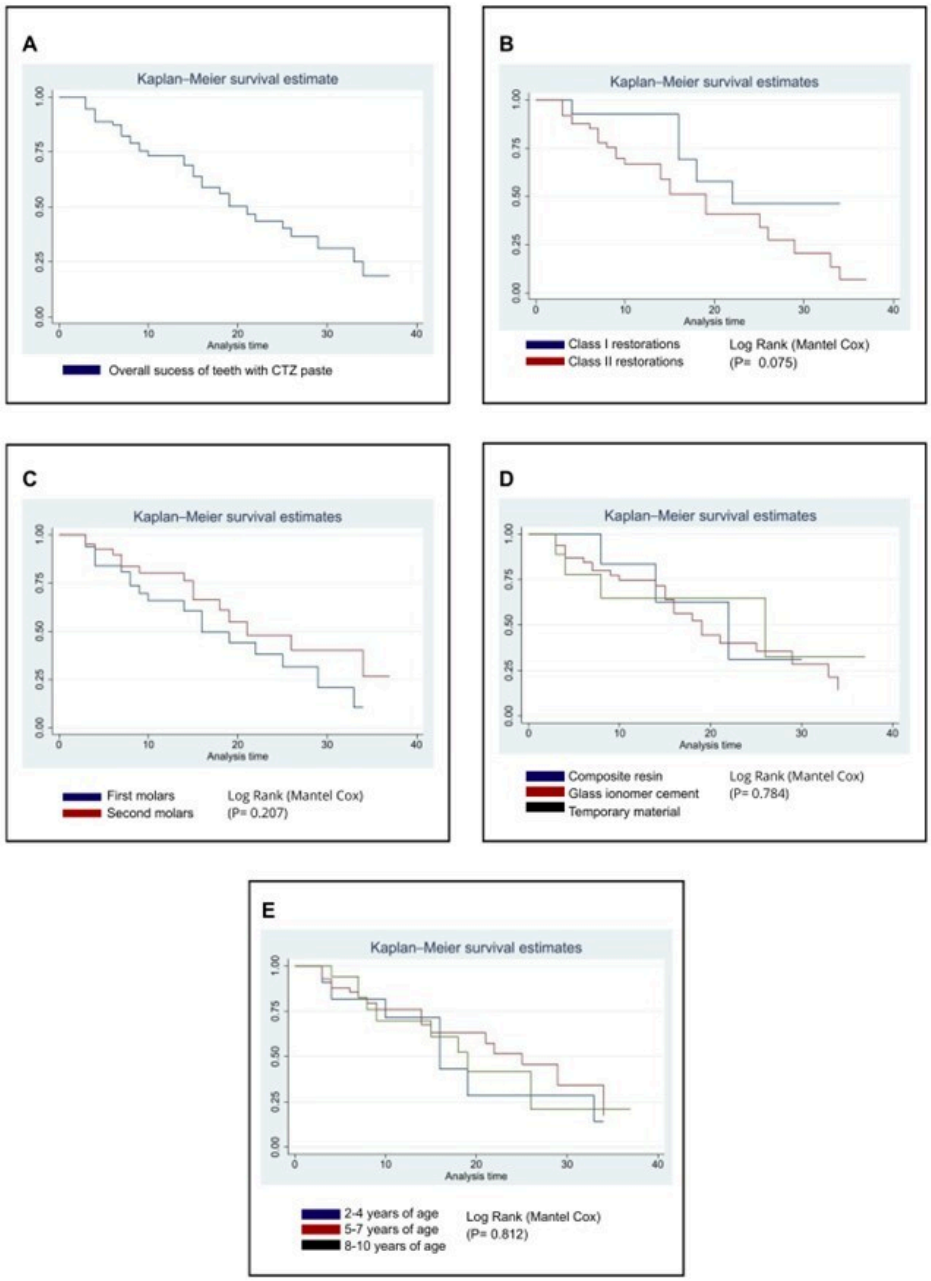


Figure 1. Kaplan-Meier survival analysis. A = Overall success of teeth with chloramphenicol, tetracycline and zinc oxide eugenol paste (CTZ); B = Class of restoration; C = Tooth that underwent the procedure; D = Restorative material used; E = Child's age at the time of the procedure.

Figure 1

See image above for figure legend.