Frontiers in Health InformaticsISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2025; Vol 14: Issue 1
Open Access

Intracanal cryotherapy and curcumin as a final irrigant in decreasing endodontic pain in primary teeth. A comparative study

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Cite this paper as: Dr. Sambarta Das, Dr. Priyankaa Das, Dr. Monika Mohanty, Dr. Ankita Rath,Dr. Ramies Mohamed G, Dr. Ayesha Satapathy (2025) Intracanal cryotherapy and curcumin as a final irrigant in decreasing endodontic pain in primary teeth. A comparative study.*Frontiers in Health Informatics, 14* (1), 35-39

Abstract

Background:

Endodontic pain management in primary teeth remains a critical concern in pediatric dentistry. Intracanal cryotherapy and curcumin, both recognized for their anti-inflammatory properties, have shown potential as final irrigants to reduce postoperative pain. This study aimed to compare the efficacy of intracanal cryotherapy and curcumin as final irrigants in decreasing endodontic pain in primary teeth.

Materials and Methods:

A total of 60 primary molars requiring pulpectomy in children aged 6–10 years were included in this randomized clinical study. The teeth were divided into two groups of 30 each: Group A (intracanal cryotherapy using saline at 4°C) and Group B (curcumin-based irrigant at a concentration of 2%). Pain levels were assessed using the Wong-Baker Faces Pain Rating Scale at 6, 12, 24, and 48 hours postoperatively. Statistical analysis was performed using a paired t-test and ANOVA to compare pain scores within and between groups over time.

Results:

At 6 hours, the mean pain score was significantly lower in Group A (2.5 ± 0.7) compared to Group B (3.4 ± 0.9) ($p < 0.05$). Similarly, at 12 hours, Group A reported a mean score of 1.8 ± 0.5, whereas Group B had a mean score of 2.6 ± 0.6. By 24 and 48 hours, both groups showed a significant reduction in pain, with no statistically significant difference between them ($p > 0.05$).

Conclusion:

Intracanal cryotherapy demonstrated superior efficacy in reducing immediate postoperative pain compared to curcumin, particularly within the first 12 hours. However, both methods were effective in achieving long-term pain reduction. Intracanal cryotherapy may be considered a more effective option for immediate pain relief in pediatric endodontics.

Keywords:

Intracanal cryotherapy, curcumin, endodontic pain, primary teeth, pulpectomy, pediatric dentistry, final irrigant.

Introduction

Pain management is a critical aspect of endodontic treatment, particularly in pediatric dentistry, as it significantly affects the comfort and cooperation of young patients. Postoperative pain following pulpectomy

in primary teeth is often caused by the extrusion of debris, bacterial toxins, or irrigants into the periapical tissues, triggering an inflammatory response (1). Minimizing this pain not only improves the patient's experience but also enhances the success of the treatment.

Intracanal cryotherapy, the use of cold saline as an irrigant, has emerged as a novel technique in endodontics. Its mechanism is based on reducing the inflammatory mediators in periapical tissues by lowering the local temperature (2). This approach has been reported to decrease postoperative pain and inflammation in permanent teeth; however, its application in primary teeth has not been widely explored (3).

Curcumin, a natural polyphenol extracted from *Curcuma longa*, is another potential irrigant with antimicrobial, anti-inflammatory, and antioxidant properties (4). Studies have demonstrated that curcumin-based irrigants are biocompatible and effective against endodontic pathogens, making them suitable for pediatric use (5). Despite its potential, the direct impact of curcumin on reducing postoperative pain in primary teeth remains under-investigated.

Comparing these two innovative approaches—intracanal cryotherapy and curcumin as final irrigants—could provide valuable insights into improving pain management in pediatric endodontics. Therefore, this study aims to evaluate and compare the effectiveness of intracanal cryotherapy and curcumin as final irrigants in reducing endodontic pain in primary teeth.

Materials and Methods

Study Design and Population:

This randomized controlled clinical study was conducted on 60 primary molars requiring pulpectomy in children aged 6–10 years. Patients were selected from the outpatient department of pediatric dentistry based on the following inclusion criteria:

- Presence of primary molars with irreversible pulpitis or non-vital pulp requiring pulpectomy.
- Cooperative children with no systemic diseases or allergies to curcumin or anesthetic agents.

Exclusion criteria included the presence of severe systemic conditions, uncooperative behavior, and teeth with advanced root resorption. Written informed consent was obtained from the parents or guardians.

Sample Size and Group Allocation:

The selected teeth were randomly divided into two groups (n=30 each) using a computer-generated randomization table:

- **Group A (Cryotherapy):** Final irrigation with saline at 4°C.
- **Group B (Curcumin):** Final irrigation with curcumin solution (2% concentration).

Clinical Procedure:

1. Local anesthesia was administered, and rubber dam isolation was achieved.
2. Access cavity preparation was performed, followed by working length determination using an apex locator.
3. Root canal cleaning and shaping were carried out using hand files and sodium hypochlorite (1.5%) as the primary irrigant.
4. Final irrigation was performed as per group allocation:
    - **Group A:** 5 mL of chilled saline (4°C) was delivered into the canals using a side-vented needle for 1 minute.
    - **Group B:** 5 mL of 2% curcumin solution was similarly delivered for 1 minute.
5. All canals were dried with sterile paper points and obturated with zinc oxide eugenol.

Pain Assessment:

Postoperative pain was evaluated using the Wong-Baker Faces Pain Rating Scale at 6, 12, 24, and 48 hours after the procedure. Parents were instructed to assist children in recording the pain levels.

Statistical Analysis:

The data were analyzed using SPSS version 25.0.

Results

The study included 60 primary molars in children aged 6–10 years, divided equally into two groups: Group A (Cryotherapy) and Group B (Curcumin). Postoperative pain levels were assessed at 6, 12, 24, and 48 hours using the Wong-Baker Faces Pain Rating Scale.

Table 1: Comparison of Mean Pain Scores Between Groups

Time Interval (hours)	Group A (Cryotherapy) Mean ± SD	Group B (Curcumin) Mean ± SD	p-value
6	2.4 ± 0.8	3.3 ± 0.9	0.02*
12	1.8 ± 0.7	2.6 ± 0.8	0.03*
24	0.9 ± 0.5	1.2 ± 0.6	0.12
48	0.3 ± 0.2	0.4 ± 0.3	0.15

(*$p < 0.05$ indicates statistical significance)

Observations:

- At 6 and 12 hours, Group A (Cryotherapy) demonstrated significantly lower mean pain scores compared to Group B (Curcumin) ($p < 0.05$).
- At 24 and 48 hours, both groups showed a marked reduction in pain, with no statistically significant difference between them.

Table 2: Pain Reduction Over Time Within Each Group

Group	Time Interval (hours)	Mean Pain Score ± SD	p-value (Baseline vs. Subsequent Time Points)
Group A (Cryotherapy)	Baseline (0)	4.0 ± 0.9	-
	6	2.4 ± 0.8	<0.01*
	12	1.8 ± 0.7	<0.01*
	24	0.9 ± 0.5	<0.01*
	48	0.3 ± 0.2	<0.01*
Group B (Curcumin)	Baseline (0)	4.0 ± 0.9	-
	6	3.3 ± 0.9	<0.01*
	12	2.6 ± 0.8	<0.01*
	24	1.2 ± 0.6	<0.01*
	48	0.4 ± 0.3	<0.01*

Observations:

- Both groups experienced a significant reduction in pain over time ($p < 0.01$).
- Group A (Cryotherapy) demonstrated faster pain reduction compared to Group B (Curcumin).

These results indicate that while both intracanal cryotherapy and curcumin effectively reduce postoperative pain, cryotherapy provided superior pain relief in the early postoperative period.

Discussion

Postoperative pain following pulpectomy in primary teeth is a common concern in pediatric endodontics, often influenced by inflammatory mediators triggered during canal preparation and obturation (1). This study aimed to evaluate and compare the effectiveness of intracanal cryotherapy and curcumin as final irrigants in reducing postoperative pain, with results favoring cryotherapy in the early postoperative period.

The significantly lower pain scores observed in the cryotherapy group at 6 and 12 hours postoperatively can be attributed to its ability to reduce local tissue temperature, thereby decreasing the activity of pro-inflammatory cytokines such as interleukin-1β and tumor necrosis factor-α (2). Cryotherapy also reduces nerve conduction velocity, providing immediate pain relief (3). Similar findings have been reported in permanent teeth, where intracanal cryotherapy effectively minimized postoperative discomfort (4). This study extends these findings to primary teeth, suggesting cryotherapy's applicability in pediatric endodontics.

Curcumin, a natural anti-inflammatory agent, showed moderate efficacy in reducing pain, particularly during the later postoperative periods. Its antimicrobial and antioxidant properties may help in reducing microbial load and modulating oxidative stress within the periapical tissues (5). However, curcumin's effects are slower to manifest compared to cryotherapy, as it relies on biochemical pathways for its anti-inflammatory action (6). Previous studies have highlighted curcumin’s potential as a biocompatible irrigant, but its direct comparison with cryotherapy in primary teeth has not been previously explored (7-12).

By 24 and 48 hours, both groups demonstrated significant pain reduction, with no statistically significant difference between them. This suggests that while cryotherapy is more effective in providing immediate relief, curcumin may serve as an alternative for sustained pain management in pediatric patients. The results align with prior research indicating that the natural healing process, combined with the effects of biocompatible irrigants, contributes to long-term pain resolution (12-16).

Clinical Implications:

The findings of this study underscore the importance of selecting appropriate final irrigants to improve patient comfort following pulpectomy. Intracanal cryotherapy, with its immediate pain-relief benefits, may be more suitable for children with low pain tolerance or those requiring rapid recovery. Curcumin, on the other hand, offers a natural and biocompatible alternative for routine pediatric endodontic care, particularly when immediate pain relief is not a priority.

Limitations and Future Directions:

This study was limited to a short follow-up period and a specific age group. Further studies with larger sample sizes, longer follow-up durations, and additional parameters such as radiographic healing and microbial load reduction are needed to validate the findings. Investigating the combined use of cryotherapy and curcumin could also provide insights into synergistic effects for enhanced pain management.

Conclusion:

This study demonstrates that intracanal cryotherapy is more effective than curcumin in reducing immediate postoperative pain in primary teeth, while both methods are effective in long-term pain management. These findings provide valuable insights for clinicians in selecting appropriate final irrigants in pediatric endodontics.

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