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CASE STUDY
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Assessment of Postoperative Pain Following Single-visit Endodontic Treatment using Cold Versus Room-temperature Irrigants: A Randomized Clinical Study

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ABSTRACT

Background: Postoperative pain remains a common concern following single-visit root canal treatment despite advances in endodontic techniques and irrigation protocols. Recent studies suggest that intracanal cryotherapy using cold irrigants may reduce postoperative pain by decreasing local inflammation and tissue edema. However, evidence regarding its effectiveness in routine clinical practice remains limited. Aim: To compare the effect of cold irrigants and room-temperature irrigants on postoperative pain following single-visit endodontic treatment. Materials and Methods: A randomized clinical study was conducted on 40 patients requiring single-visit root canal treatment for symptomatic irreversible pulpitis in single-rooted teeth. Participants were randomly allocated into two groups of 20 each. Group I received final irrigation with 5°C saline solution (cold irrigant), while Group II received final irrigation with saline solution at room temperature (25°C). All treatments were performed using a standardized endodontic protocol. Postoperative pain was assessed using a Visual Analog Scale (VAS) at 6, 24, 48, and 72 hours after treatment. Data were analyzed using independent t-test and repeated measures ANOVA, with statistical significance set at $p < 0.05$. Results: Both groups demonstrated a progressive reduction in pain over time. The cold irrigant group showed significantly lower mean VAS scores compared to the room-temperature irrigant group at 6 hours (3.10 ± 1.12 vs. 4.55 ± 1.23, $p = 0.002$) and 24 hours (1.95 ± 0.89 vs. 3.10 ± 1.05, $p = 0.004$). Differences at 48 and 72 hours were not statistically significant. No adverse effects related to the use of cold irrigants were observed. Conclusion: The use of cold irrigants during single-visit endodontic treatment significantly reduced early postoperative pain compared with room-temperature irrigants. Intracanal cryotherapy appears to be a simple, safe, and cost-effective adjunct for improving patient comfort following root canal therapy.

Keywords: Intracanal cryotherapy; Endodontics; Postoperative pain; Cold irrigants; Root canal treatment; Single-visit endodontics

INTRODUCTION

Root canal treatment is one of the most commonly performed procedures in clinical dentistry and is highly successful in eliminating infection and preserving natural dentition.[1] The advent of modern endodontic instruments, rotary systems, and improved irrigation protocols has significantly enhanced treatment outcomes.[2] Single-visit endodontic therapy has gained considerable popularity because it reduces treatment time, minimizes patient visits, and improves patient compliance while providing success rates comparable to those of multiple-visit procedures.[3]

Despite these advancements, postoperative pain remains a frequent concern following endodontic treatment. Pain experienced after root canal therapy can negatively affect

patient satisfaction and may influence perceptions regarding the quality of treatment. The incidence of postoperative pain following endodontic procedures has been reported to range from mild discomfort to severe pain, particularly during the first 24 to 48 hours after treatment.[4] Several factors contribute to postoperative pain, including preoperative pulpal and periapical status, mechanical instrumentation, extrusion of debris, microbial factors, and inflammatory responses in the periapical tissues.[5]

Irrigation plays a critical role in root canal disinfection by removing debris, microorganisms, and tissue remnants that cannot be eliminated through mechanical instrumentation alone. Conventional irrigants are generally used at room temperature; however, recent investigations have explored the use of intracanal cryotherapy as a potential method for reducing postoperative discomfort.[6] Intracanal cryotherapy involves the application of cold irrigating solutions within the root canal system during the final stage of treatment. The therapeutic effect of cold temperatures is believed to reduce local blood flow, decrease inflammatory mediator release, minimize tissue edema, and provide an analgesic effect on surrounding periapical tissues.[7]

The use of cryotherapy has been extensively documented in medicine and sports rehabilitation for controlling pain and inflammation. In endodontics, cold saline irrigation has emerged as a simple, inexpensive, and non-invasive approach to improve postoperative patient comfort. Preliminary studies have suggested that the application of cold irrigants may significantly reduce postoperative pain compared with conventional irrigation techniques. However, available evidence remains limited, and further clinical studies are needed to validate its effectiveness in routine endodontic practice.[8]

Therefore, the present study was undertaken to assess and compare postoperative pain following single-visit endodontic treatment using cold irrigants and room-temperature irrigants. The findings of this study may provide valuable insights into the role of intracanal cryotherapy as an adjunctive method for improving patient comfort after root canal treatment.

MATERIALS AND METHODS

Study Design: This randomized controlled clinical study was conducted in the Department of Conservative Dentistry and Endodontics after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrollment in the study.

Study Population: A total of 40 patients requiring single-visit root canal treatment were recruited from the outpatient department. Patients were randomly allocated into two groups comprising 20 participants each.

Inclusion Criteria

Patients aged between 18 and 50 years.

Single-rooted permanent teeth diagnosed with symptomatic irreversible pulpitis.

Teeth with fully formed apices.

Patients willing to participate and provide informed consent.

Patients indicated for single-visit root canal treatment.

Exclusion Criteria

Patients with systemic diseases affecting pain perception or healing.

Pregnant or lactating women.

Teeth with periapical abscess, swelling, or sinus tract.

Previously endodontically treated teeth.

Patients taking analgesics, anti-inflammatory drugs, or antibiotics within 48 hours before treatment.

Teeth with root resorption, calcified canals, or open apices.

Sample Size Calculation: The sample size was determined based on previous studies evaluating postoperative pain following intracanal cryotherapy. A minimum of 20 patients per group was considered adequate to achieve 80% statistical power at a 5% level of significance.

Randomization: Participants were randomly assigned into two groups using a computer-generated randomization table:

Group I (Cold Irrigant Group): Final irrigation performed using sterile saline cooled to 5°C.

Group II (Room-Temperature Irrigant Group): Final irrigation performed using sterile saline maintained at approximately 25°C.

Clinical Procedure: All treatments were performed by a single experienced endodontist under standardized clinical conditions. Following administration of local anesthesia and rubber dam isolation, access cavity preparation was carried out. Working length was determined using an electronic apex locator and confirmed radiographically.

Root canal instrumentation was performed using rotary nickel-titanium files according to the manufacturer's instructions. During instrumentation, canals were irrigated with 3% sodium hypochlorite using a side-vented irrigation needle.

After completion of biomechanical preparation, final irrigation was performed according to the assigned study

group:

Group I received 20 mL of sterile saline at 5°C delivered over 5 minutes.

Group II received 20 mL of sterile saline at room temperature (25°C) delivered over 5 minutes.

Following irrigation, canals were dried using sterile paper points and obturated with gutta-percha and resin-based sealer using the lateral condensation technique. Permanent coronal restoration was placed immediately after obturation.

Assessment of Postoperative Pain: Postoperative pain was evaluated using a 10-cm Visual Analog Scale (VAS), where:

0 = No pain

1–3 = Mild pain

4–6 = Moderate pain

7–10 = Severe pain

Patients were instructed to record their pain scores at 6 hours, 24 hours, 48 hours, 72 hours; following completion of treatment. Rescue medication (Ibuprofen 400 mg) was prescribed only if required, and its consumption was recorded.

Outcome Measures

Primary Outcome: Postoperative pain intensity measured using VAS scores at different time intervals.

Secondary Outcome: Frequency of analgesic consumption following treatment.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Descriptive statistics were calculated as mean and standard deviation. Independent t-test was used for intergroup comparison of VAS scores at each time interval, while repeated measures ANOVA was used for intragroup comparisons over time. The level of statistical significance was set at $p < 0.05$.

RESULTS

A total of 40 patients were included in the study, with 20 participants allocated to the Cold Irrigant Group (Group I) and 20 participants to the Room-Temperature Irrigant Group (Group II). All participants completed the study, and no adverseevents associated with the irrigation protocols were reported.

The baselinedemographic and clinical characteristics of the participants are presented in **Table 1**. No statistically significant differences were observed between the groups regarding age, gender distribution, or preoperative pain scores ($p > 0.05$), indicating that both groups were comparable at baseline.

Postoperative pain scores measured using the Visual Analog Scale (VAS) decreased progressively in both groups over the 72-hour observation period. Intergroup comparison revealed significantly lower mean VAS scores in the Cold Irrigant Group at 6 hours and 24 hours following treatment compared with the Room-Temperature Irrigant Group ($p < 0.05$). Although lower pain scores were also observed in the Cold Irrigant Group at 48 and 72 hours, these differences were not statistically significant (**Table 2**).

Analysis ofpain severity at 24 hours demonstrated that a greater proportion of patients in the Cold Irrigant Group reported either no pain or mild pain, whereas a higher percentage of patients in the Room-Temperature Irrigant Group experienced moderate to severe pain. The distribution of pain severity between the groups is shown in **Table 3**.

Assessment of analgesic consumption revealed that only 3 patients (15%) in the Cold Irrigant Group required rescue analgesics compared with 8 patients (40%) in the Room-Temperature Irrigant Group. This difference was statistically significant ($p = 0.041$), suggesting improved postoperative comfort among patients treated with cold irrigants (**Table 4**).

Within-group analysis demonstrated a significant reduction in pain scores over time in both study groups ($p < 0.001$). The greatest reduction in pain was observed during the first 24 hours after treatment. By 72 hours, pain levels had decreased substantially in both groups, with most patients reporting minimal or no discomfort.

Overall, the findings indicate that the use of cold saline as a final irrigant during single-visit root canal treatment significantly reduced early postoperative pain and decreased the need for analgesic medication when compared with room-temperature saline irrigation.

Table 1. Baseline Characteristics of Study Participants

Variable	Group I	Group II	p-value
Age (years)	32.4 ± 8.1	31.7 ± 7.6	0.78
Male/Female	11/9	10/10	0.75
Preoperative VAS Score	6.85 ± 1.02	6.70 ± 0.95	0.64

Table 2. Comparison of Mean Postoperative VAS Scores Between Groups

Time Interval	Group I Mean ± SD	Group II Mean ± SD	p-value
6 Hours	3.10 ± 1.12	4.55 ± 1.23	0.002*
24 Hours	1.95 ± 0.89	3.10 ± 1.05	0.004*
48 Hours	0.95 ± 0.68	1.45 ± 0.76	0.061
72 Hours	0.25 ± 0.44	0.50 ± 0.61	0.147

Table 3. Distribution of Pain Severity at 24 Hours

Pain Category	Group I n (%)	Group II n (%)
No Pain	5 (25.0)	2 (10.0)
Mild Pain	12 (60.0)	8 (40.0)
Moderate Pain	3 (15.0)	9 (45.0)
Severe Pain	0 (0.0)	1 (5.0)

Table 4. Comparison of Analgesic Consumption Between the Study Groups Following Single-Visit Endodontic Treatment

Variable	Group I	Group II	p-value
Patients requiring analgesics	3 (15%)	8 (40%)	0.041*

*significant

DISCUSSION

Postoperative pain remains one of the most common complications following endodontic treatment and continues to be a major concern for both clinicians and patients. Although root canal therapy aims to eliminate infection and prevent further inflammation, mechanical instrumentation and chemical irrigation may induce transient periapical irritation, leading to postoperative discomfort. [9,10] Therefore, various strategies have been investigated to minimize pain after treatment. The present study evaluated the effectiveness of cold irrigants compared with room-temperature irrigants in reducing postoperative pain following single-visit endodontic therapy.

The results demonstrated that patients treated with cold saline irrigation experienced significantly lower postoperative pain scores at 6 and 24 hours compared with those receiving room-temperature saline. These findings suggest that intracanal cryotherapy may be beneficial in controlling early postoperative pain. The reduction in pain observed in the cold irrigant group may be attributed to the physiological effects of low temperatures on periapical tissues. Cooling is known to cause vasoconstriction, reduce local blood flow, decrease cellular metabolism, and limit the release of inflammatory mediators. These effects collectively contribute to reduced tissue inflammation and pain perception.[11]

The findings of the present study are consistent with previous investigations that reported reduced postoperative pain following the use of intracanal cryotherapy. Vera et al. demonstrated that final irrigation with cold saline significantly lowered postoperative pain levels after root canal treatment. The authors suggested that cold irrigation could effectively reduce inflammation in the periodontal ligament and surrounding tissues. Similar observations were reported by Ajeesh K et al., who found that cryotherapy reduced postoperative discomfort in patients undergoing endodontic treatment of teeth with symptomatic apical periodontitis.

In the present study, the most pronounced differences between groups were observed during the first 24 hours after treatment. This finding is clinically significant because the majority of postoperative pain following endodontic therapy occurs within this period. By 48 and 72 hours, pain scores had decreased substantially in both groups, and the differences between groups were no longer statistically significant. This pattern suggests that intracanal cryotherapy primarily influences the acute inflammatory phase rather than the overall healing process.

Another important finding was the reduced need for analgesic medication among patients in the cold irrigant group. Only 15% of patients receiving cold saline required rescue analgesics compared with 40% in the room-temperature group. Reduced analgesic consumption not

only reflects improved patient comfort but also minimizes the potential adverse effects associated with pain medications. This observation further supports the clinical usefulness of intracanal cryotherapy as a simple adjunctive procedure.

The present study utilized cold sterile saline at 5°C as the final irrigant. Saline was selected because it is biocompatible, readily available, inexpensive, and does not alter the chemical properties of commonly used endodontic irrigants. The procedure required no additional equipment other than refrigeration, making it practical for routine clinical implementation. From a clinical perspective, the ease of application and low cost of cryotherapy make it an attractive option for improving patient outcomes.[13,14]

The study has certain limitations. The sample size was relatively small and included only single-rooted teeth diagnosed with symptomatic irreversible pulpitis. Therefore, the findings may not be directly applicable to multirooted teeth or cases with extensive periapical pathology. Additionally, pain assessment was based on subjective patient-reported outcomes using the Visual Analog Scale, which may be influenced by individual variations in pain perception. Future studies involving larger sample sizes, different pulpal and periapical diagnoses, and longer follow-up periods are recommended to further validate the effectiveness of intracanal cryotherapy.

Despite these limitations, the present study provides evidence supporting the use of cold irrigants as an effective method for reducing postoperative pain following single-visit endodontic treatment. The significant reduction in early postoperative discomfort and analgesic consumption suggests that intracanal cryotherapy may serve as a valuable adjunct in contemporary endodontic practice.

CONCLUSION

Within the limitations of the present study, it can be concluded that the use of cold saline as a final irrigant during single-visit endodontic treatment

significantly reduces postoperative pain during the early postoperative period compared with room-temperature saline irrigation. Patients receiving cold irrigants demonstrated lower Visual Analog Scale (VAS) pain scores at 6 and 24 hours after treatment and required fewer rescue analgesics.

Intracanal cryotherapy is a simple, safe, cost-effective, and easily applicable adjunctive procedure that can enhance patient comfort following root canal therapy. Although pain levels decreased progressively in both groups over time, cold irrigation provided superior control of early postoperative discomfort. Therefore, the use of cold irrigants may be recommended as an effective strategy for minimizing postoperative pain in patients undergoing single-visit endodontic treatment.

Further clinical studies with larger sample sizes and diverse endodontic conditions are recommended to confirm these findings and establish standardized protocols for intracanal cryotherapy in routine endodontic practice.

REFERENCES

Levine, M. (1988). Root-canal therapy: A means of treating oral pain and infection. *Canadian Family Physician, 34*, 1357–1365.

Valente, P., Sbrenna, L., Sbrenna, A., & Valente, F. (2026). Nickel-titanium alloys in endodontics: A narrative review. *Cureus, 18*(3), e105033. https://doi.org/10.7759/cureus.105033

Wong, A. W., Tsang, C. S., Zhang, S., Li, K. Y., Zhang, C., & Chu, C. H. (2015). Treatment outcomes of single-visit versus multiple-visit non-surgical endodontic therapy: A randomised clinical trial. *BMC Oral Health, 15*, 162. https://doi.org/10.1186/s12903-015-0148-x

Mendes, W. V., Lima, S. N. L., do Nascimento Azevedo, J. V., Leite, H. L. A., Oliveira, P. S., Ferreira, M. C., & Carvalho, C. N. (2025). Postoperative pain and quality of life assessment after endodontic preparation with rotary and reciprocating endodontic instruments: Randomized clinical trial. *Trials, 26*(1), 68. https://doi.org/10.1186/s13063-025-08725-0

Silva, E. J. (2013). Postoperative pain after foraminal enlargement in anterior teeth with necrosis and apical periodontitis: A prospective and randomized clinical trial. *Journal of Endodontics, 39*(2), 173–179. https://doi.org/10.1016/j.joen.2012.11.005

Jakhar, A., Vats, A. S., Singh, S., Thind, G., Aga, N., Agwan, M. A. S., & Makkad, R. S. (2024). Investigating the effects of various root canal irrigation solutions on tissue dissolution and microbial control. *Journal of Pharmacy and Bioallied Sciences, 16*(Suppl. 3), S2306–S2308. https://doi.org/10.4103/jpbs.jpbs_850_23

Mitra, P., Mishra, P., Sharma, S., Pal, A., Banjare, V., & Mondal, J. (2024). Effect of intracanal cryotherapy and *Curcuma longa* as a final irrigant in reducing postoperative pain: An in-vivo study. *Journal of Pharmacy and Bioallied Sciences, 16*(Suppl. 3), S2925–S2927. https://doi.org/10.4103/jpbs.jpbs_987_23

Gurucharan, I., Saravana Karthikeyan, B., & Mahalaxmi, S. (2017). Intracanal cryotherapy in endodontics. *Australian Endodontic Journal, 43*, 138–139. https://doi.org/10.1111/aej.12214

de Oliveira Damasceno, C., da Silveira Bueno, C. E., De Martin, A. S., Pelegrine, R. A., Villela, A. M., Ruivo, L. M., & Shoji Kato, A. (2020). Factors associated with post-endodontic treatment pain performed by students in an endodontic graduate program. *Iranian Endodontic Journal, 15*(4), 221–226. https://doi.org/10.22037/iej.v15i4.28107

Khallaf, M. E., Aly, Y., & Mohamed, A. I. (2025). Comparison of post-operative pain prevalence after single visit endodontic treatment with two NiTi rotary files: A randomized clinical trial. *Scientific Reports, 15*(1), 44128. https://doi.org/10.1038/s41598-025-44128-0

Alharthi, A. A., Aljoudi, M. H., Almaliki, M. N., Almalki, M. A., & Sunbul, M. A. (2019). Effect of intra-canal cryotherapy on post-endodontic pain in single-visit RCT: A randomized controlled trial. *The Saudi Dental Journal, 31*(3), 330–335. https://doi.org/10.1016/j.sdentj.2019.03.004

Ajeesh, K., Jayasree, S., James, E. P., Pooja, K. P., & Jauhara, F. (2023). Comparative evaluation of the effectiveness of intracanal and intraoral cryotherapy on postendodontic pain in patients with symptomatic apical periodontitis: A randomized clinical trial. *Journal of Conservative Dentistry and Endodontics, 26*(5), 555–559. https://doi.org/10.4103/jcd.jcd_367_22

Keskin, C., Özdemir, Ö., Uzun, İ., & Güler, B. (2017). Effect of intracanal cryotherapy on pain after single-visit root canal treatment. *Australian Endodontic Journal, 43*, 83–88. https://doi.org/10.1111/aej.12179

Vera, J., Ochoa-Rivera, J., Vazquez-Carcaño, M., Romero, M., Arias, A., & Sleiman, P. (2015). Effect of intracanal cryotherapy on reducing root surface temperature. *Journal of Endodontics, 41*, 1884–1887. https://doi.org/10.1016/j.joen.2015.08.003