Contemporary Orofacial Sciences (2023) 1(2):25-28
10.30486/cofs.2023.1989712.1009

ORIGINAL RESEARCH

# Evaluating the effect of different cryotherapy methods on postoperative pain in one-visit root canal treatment of mandibular molars with symptomatic irreversible pulpitis

Mahnaz Sadat Hoseini[1], Parisa Ranjbarian[2*], Amin Mortaheb[3], Ebrahim yousefi[4]

Received: 2023-06-24 / Accepted: 2023-09-21 / First publication date: 2023-09-28
© The Author(s) 2023

## Abstract

**Backgrounds: Cryotherapy might help in reducing pain after root canal treatment. This study aimed to investigate the effect of different methods of cryotherapy on post-endodontic pain of one-visit root canal treatment in mandibular molar teeth with symptomatic irreversible pulpitis.**

**Materials and Methods: This clinical trial study enrolled 60 patients with symptomatic irreversible pulpitis in a mandibular molar tooth. Before obturating the root canals, teeth were divided into four groups. Group 1: Control (without cryotherapy) Group 2: intracanal cryotherapy with final canal irrigation with 2.5 °C normal saline for 5 minutes, group 3: intraoral cryotherapy with the application of an ice pack 30 minutes inside the mouth and Group 4: extraoral cryotherapy. Patients' post-endodontic pain was recorded on the first and third days. Data were analyzed by two-way analysis of variance, Tukey, and LSD post hoc test at the error level of 5%.**

**Results: Pain reduction was highest, respectively, in the intracanal, control, and extraoral cryotherapy groups on the first and third days, although not significant ($p>0.05$). In each group, pain was reduced on the third day after treatment ($P<0.05$). Pain showed no relation to gender ($p>0.05$).**

**Conclusion: Despite the limitations, based on the results of this study, the application of cryotherapy has a limited effect in reducing pain after root canal treatment. Time is more effective than cryotherapy in reducing pain.**

**Keywords:** Cryotherapy, Postoperative pain, Symptomatic irreversible pulpitis

## Introduction

Pain and discomfort after endodontic treatments are unpleasant for patients and dentists, with a considerable impact on patient's quality of life. A recent systematic review shows that 3% to 58% of patients have experienced pain after root canal treatment (1, 2). Numerous factors contribute to pain after root canal treatment. Gender, presence and size of the periapical lesion, presence, and intensity of pain before treatment, pulp condition, and intracanal irrigants and medicaments are examples (3-7).

Studies have focused on pain management after endodontic treatment. Various methods exist to reduce pain after root canal treatment. The most common are different painkillers (8-11). Although these medications are safe, they can cause side effects like gastrointestinal intolerance, renal, liver, and respiratory disorders. Thus, non-pharmacological solutions such as shortening the occlusal surfaces, different methods of root canal preparation, low-level laser therapy (LLLT), and cryotherapy are applied to reduce pain (12-14).

The term cryotherapy is derived from the Greek word "cryos", which means "cold" (15, 16). Today, various methods of cryotherapy are used, including crushed ice, frozen gel packs, thermogenic chemical reaction packs, cold towels, and cooling sprays (17). Also, cryotherapy is used in different branches of medical sciences, including orthopedics (18), pathology (19), physiotherapy, maxillofacial surgery (20, 21), and recently in root canal treatments (13, 24).

An in vitro study showed that using a low-temperature final irrigation of root canals for 4 minutes may be sufficient to create a local anti-inflammatory effect in the surrounding radicular tissues (14). Afterward, clinical studies showed that intracanal cryotherapy significantly reduces postoperative pain (13, 22-25).

Therefore, the present study evaluated intra-canal, intra-oral, and extra-oral cryotherapy on pain reduction after one-visit root canal treatment in mandibular molars with symptomatic irreversible pulpitis.

**Corresponding Author:** Parisa Ranjbarian
Department of Endodontics, Faculty of Dentistry, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
Email: p.ranjbarian@khuisf.ac.ir

1. Faculty of Dentistry, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
2. Department of Endodontics, Faculty of Dentistry, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
3. Endodontist, Isfahan, Iran
4. Faculty of Dentistry, Isfahan (Khorasan) Branch, Islamic Azad University, Isfahan, Iran

[ Downloaded from cofs.khuisf.ac.ir on 2026-11-26 ]

[ DOI: 10.30486/cofs.2023.1989712.1009 ]

## Materials and Methods

This clinical trial study was conducted in the endodontics department of the Faculty of Dentistry of Isfahan Azad University with ethics code IR.IAU.KHUISF.REC.1400.008 approved by the ethics committee of the Islamic Azad University of Isfahan (Khorasgan).

After informed consent, 60 mandibular molars with symptomatic irreversible pulpitis of patients with no medical history and no history of the application of any medication with a positive response to an electric pulp (EPT), increased response to the cold test, pain level more than 54 mm (Heft-Parker VAS that confirming symptomatic irreversible pulpitis) (26) and absence of lesion in periapical radiography were included in the study.

In this study, Heft-Parker VAS (Figure 1) with a range of 0-170 mm was used to assess the intensity of pain, and the patient indicated the level of pain on the scale, based on this scale, there are 4 degrees of pain: 0 for no pain, 1to 54 indicates mild pain, 55 to 114 indicates moderate pain and Greater than 114 as severe pain.

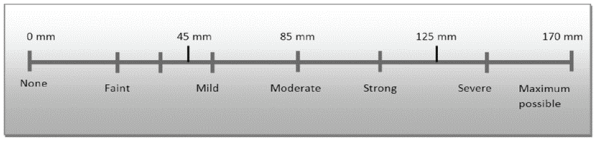



**Figure 1.** Heft-Parker VAS

Two endodontics with almost similar work experience performed all the treatments. First, an IANB injection of 2% lidocaine anesthetic with epinephrine 1.100000 was applied. After adequate anesthesia, the access cavity was prepared, and K file 10 was inserted into the canal to determine the working length. Root canals were prepared using rotary files, in the mesial canals, preparation was done up to 25.6% file (race rotary file, FKG, Switzerland), and in the distal canals, up to 30.6% (race rotary file, FKG, Switzerland). After changing each file, the canals were irrigated with 1 ml of 2.5% sodium hypochlorite. The preparation was conducted according to the manufacturer's instructions. To remove the smear layer, 5 ml of 2.5% sodium hypochlorite was used for 1 minute, and then 5 ml of 17% EDTA was used for 1 minute. Irrigation activation methods were not used in this study. Then patients were equally divided into four groups.

In this study, a small pack of ice ( 1.5 x 3 cm) was kept in a refrigerator at -18 °C. Wrapped in sterile gas and applied in the desired location for intra or extra-oral cryotherapy. For intra-canal cryotherapy, normal saline with a temperature of 2.5°C was used as the final canal irrigant (27). The root canals in the control, intra, and extraoral cryotherapy groups were irrigated with 20 ml normal saline solution kept at room temperature as the final irrigant. In the intra-canal cryotherapy group, the root canals were irrigated with 20 ml of cold normal saline solution (2.5 °C) for 5 minutes. Then in all patients canals were obturated with the cold lateral technique and teeth were restored with temporary restoration.

In the intraoral cryotherapy group, an ice pack was placed in the vestibular mucosa of the treated tooth for 20 minutes after endodontic treatment. In the extraoral cryotherapy group, after the treatment, the patients were asked to place the ice pack (wrapped in sterile gauze) on the face on the surface of the treated tooth for 20 minutes. (The patients were asked to remove the ice pack for 1 to 2 minutes if they felt extremely cold or burning).

After treatment to reduce the severe pain, patients were prescribed 400 mg of ibuprofen and instructed to record pain on the VAS (Figure 1) on days 1 and 3 and to document any analgesic used. If the patient had no or mild pain (a VAS scale up to 54 mm) was regarded as successful, and for VAS more than 54 mm, cryotherapy was considered unsuccessful. Two-way analysis of variance with Tukey and LSD post hoc tests for pairs of groups using SPSS 26 software was used to examine the data.

## Results

The distribution of the pain frequency of patients based on pain intensity in different cryotherapy methods is shown in Figure 2. The lowest rate of reported pain was in the intracanal cryotherapy group, the intraoral cryotherapy group, and the extraoral cryotherapy group on both days.

In the comparison between treatment groups)

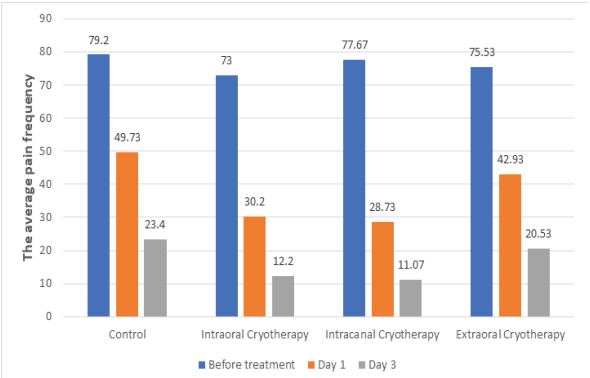



**Figure 2.** Distribution of the average pain frequency

Calculated based on the Kruskal-Wallis test), there was no significant difference between the mean pain frequencies of the groups (Table 1).

The results of the intra-group comparison(Calculated based on the Friedman test) showed that in all four treatment groups, the average amount of pain decreased over time, and this difference was significant between the times before treatment, the first day, and the third day after treatment (p-value<0.05). In the comparison between treatment groups, the difference in pain scores before treatment, one and three days after treatment did not show any significant difference (p-value>0.05) (Table 1).

[ Downloaded from cofs.khuisf.ac.ir on 2026-11-26 ]

[ DOI: 10.30486/cofs.2023.1989712.1009 ]

**Table 1.** The results of inter-group (treatment Groups) comparisons of pain level of patients after root canal treatment in mandibular molars with symptomatic irreversible pulpitis

| Treatment Group | | p-value at day 1 | p-value at day 3 |
|---|---|---|---|
| Control | Intracanal Cryotherapy | 0.999 | 0.999 |
| | Intraoral Cryotherapy | 0.213 | 0.406 |
| | Extraoral Cryotherapy | 0.577 | 0.650 |
| Intracanal Cryotherapy | Intraoral Cryotherapy | 0.161 | 0.321 |
| | Extraoral Cryotherapy | 0.486 | 0.551 |
| Intracanal Cryotherapy | Extraoral Cryotherapy | 0.902 | 0.978 |

There was a significant difference between pain before treatment, day 1 and 3 after treatment, and as the results of the intra-group comparison showed time was a statistically significant factor.

Based on the results of the Mann-Whitney test, the P value related to the significance of the average pain according to gender in all groups was greater than 0.05, thus, with a confidence of 0.95, there was no significant difference between the mean of men and women. Also, regarding the interaction effect of group and gender, as the P value was greater than 0.05 in all groups, gender and groups had no interaction effect on pain after treatment.

## Discussion

Physiological and clinical evidence show cryotherapy can reduce musculoskeletal pain, muscle spasms, edema, inflammation, and muscle and body temperature through vasoconstriction. Also, a notable decrease in tissue metabolism, oxygen consumption, and local enzyme activity occurs after cryotherapy (28-31).

In the present study, no patient with severe pain was observed on day one or three after the treatment. In both day 1 and 3 intervals, the lowest rate of pain was reported in the intracanal cryotherapy group, the intraoral cryotherapy group, and the extra-oral cryotherapy group.

A reason for the absence of a significant relationship between the studied groups can be due to the rapid disappearance of the effect of temperature reduction in cryotherapy treatments. In the research of Vera et al., who examined intracanal cryotherapy on reducing the root surface temperature of an extracted single-rooted tooth observed that the surface temperature of the root was decreased to 10 degrees and maintained for 4 minutes in which local antiseptic effect in the surrounding tissues can be gained (14). In the mentioned study necrotic teeth with apical periodontitis were enrolled, so the discrepancy between the results of the present study and Vera's study could be due to the absence of apical periodontitis in our research.

Gundogdu et al (25) Turkey investigated the effect of intra-canal, intra-oral, and extra-oral cryotherapy compared to the control group and stated that all methods of cryotherapy applied reduced pain levels after treatment compared to the control group. The results of the present study have a conflicting relationship with the research of Gundogdu et al. This can be due to the type of teeth (mandibular molars in the present study) and the absence of apical periodontitis in the present study. Another factor might be the method of root canal treatment.

Bazaid et al. (22) have reported intracanal cryotherapy is effective in reducing postoperative pain in patients with irreversible pulpitis and apical periodontitis. However, it does not affect patients with irreversible pulpitis without apical periodontitis. The results of Baziad et al.'s study are consistent with the present study.

There was no relationship between gender and pain reduction between groups in our study consistent with previous research as Gundogdu et al (25).

Other factors such as previous painful experiences, the patient's expectation regarding the amount of pain, the type of communication between the patient and the dentist, the presence of pain before treatment (mechanical allodynia), chronic apical periodontitis, and the presence of sinus tract can affect the result of cryotherapy and have not been investigated in previous research.

## Conclusion

Based on the results of our study, there was no significant relationship between cryotherapy and pain reduction. Time was the only factor that showed a statistically significant relation to pain reduction.

**Conflict of Interests:** None

## References

1. Taintor JF, Langeland K, Valle GF, Krasny RM. Pain: a poor parameter of evaluation in dentistry. Oral Surg Oral Med Oral Pathol. 1981;52(3):299-303.
2. Sathorn C, Parashos P, Messer H. The prevalence of postoperative pain and flare-up in single-and multiple-

[ Downloaded from cofs.khuisf.ac.ir on 2026-11-26 ]

[ DOI: 10.30486/cofs.2023.1989712.1009 ]

visit endodontic treatment: a systematic review. Int Endod J. 2008;41(2):91-9.
3. Harrison JW, Baumgartner JC, Svec TA. Incidence of pain associated with clinical factors during and after root canal therapy. Part 2. Postobturation pain. J Endod. 1983;9(10):434-8.
4. Sadaf D, Ahmad MZ. Factors associated with postoperative pain in endodontic therapy. Int J Biomed Sci. 2014;10(4):243-7.
5. Genet J, Hart A, Wesselink P, Thoden van Velzen S. Preoperative and operative factors associated with pain after the first endodontic visit. Int Endod J 1987;20(2):53-64.
6. Gotler M, Bar-Gil B, Ashkenazi M. Postoperative pain after root canal treatment: a prospective cohort study. Int J Dent. 2012;2012 :310467
7. Trope M. Relationship of intracanal medicaments to endodontic flare-ups. Endod Dent Traumatol. 1990;6(5):226-9.
8. Torabinejad M, Dorn SO, Eleazer PD, Frankson M, Jouhari B, Mullin RK, et al. Effectiveness of various medications on postoperative pain following root canal obturation. J Endod. 1994;20(9):427-31.
9. Attar S, Bowles WR, Baisden MK, Hodges JS, McClanahan SB. Evaluation of pretreatment analgesia and endodontic treatment for postoperative endodontic pain. J Endod. 2008;34(6):652-5.
10. Gallatin E, Reader A, Nist R, Beck M. Pain reduction in untreated irreversible pulpitis using an intraosseous injection of Depo-Medrol. J Endod. 2000;26(11):633-8.
11. Ryan JL, Jureidini B, Hodges JS, Baisden M, Swift JQ, Bowles WR. Gender differences in analgesia for endodontic pain. J Endod. 2008;34(5):552-6.
12. Arslan H, Khalilov R, Doğanay E, Karatas E. The effect of various kinematics on postoperative pain after instrumentation: a prospective, randomized clinical study. J Appl Oral Sci 2016;24(5):503-8
13. Keskin C, Özdemir Ö, Uzun İ, Güler B. Effect of intracanal cryotherapy on pain after single-visit root canal treatment. Aust Endod J. 2017;43(2):83-8
14. Vera J, Ochoa-Rivera J, Vazquez-Carcaño M, Romero M, Arias A, Sleiman P. Effect of intracanal cryotherapy on reducing root surface temperature. J Endod. 2015;41(11):1884-7.
15. Dykstra JH, Hill HM, Miller MG, Cheatham CC, Michael TJ, Baker RJ. Comparisons of cubed ice, crushed ice, and wetted ice on intramuscular and surface temperature changes. J Athl Train. 2009;44(2):136-41.
16. Freiman A, Bouganim N. History of cryotherapy. Dermatol Online J. 2005;11(2):9.
17. Hubbard TJ, Denegar CR. Does Cryotherapy Improve Outcomes With Soft Tissue Injury? J Athl Train. 2004;39(3):278-279.
18. Cina-Tschumi B. Evidenz-basierte Pflege am Beispiel von Kälteanwendungen nach ausgewählten orthopädischen Eingriffen--eine Literaturstudie [Evidence-based impact of cryotherapy on postoperative pain, swelling, drainage and tolerance after orthopedic surgery]. Pflege. 2007;20(5):258-67.
19. Daniel DM, Stone ML, Arendt DL. The effect of cold therapy on pain, swelling, and range of motion after anterior cruciate ligament reconstructive surgery. Arthroscopy. 1994;10(5):530-3
20. Ernst E, Fialka V. Ice freezes pain? A review of the clinical effectiveness of analgesic cold therapy. J Pain Symptom Manage. 1994;9(1):56-9.
21. Ameerally PJ, Colver GB. Cutaneous cryotherapy in maxillofacial surgery. J Oral Maxillofac Surg. 2007;65(9):1785-92.
22. Bazaid DS, Kenawi LMM. The effect of intracanal cryotherapy in reducing postoperative pain in patients with irreversible pulpitis: a randomized control trial. Int J Health Sci. 2018;8:83-8.
23. Vera J, Ochoa J, Romero M, Vazquez-Carcaño M, Ramos-Gregorio CO, Aguilar RR, et al. Intracanal cryotherapy reduces postoperative pain in teeth with symptomatic apical periodontitis: a randomized multicenter clinical trial. J Endod. 2018;44(1):4-8.
24. Alharthi AA, Aljoudi MH, Almaliki MN, Almalki MA, Sunbul MA. Effect of intra-canal cryotherapy on post-endodontic pain in single-visit RCT: A randomized controlled trial. Saudi Dent J 2019;31(3):330-5.
25. Gundogdu EC, Arslan H. Effects of various cryotherapy applications on postoperative pain in molar teeth with symptomatic apical periodontitis: a preliminary randomized prospective clinical trial. J Endod. 2018;44(3):349-54.
26. Topçuoğlu HS, Arslan H, Topçuoğlu G, Demirbuga S. The effect of cryotherapy application on the success rate of inferior alveolar nerve block in patients with symptomatic irreversible pulpitis. J Endod. 2019;45(8):965-969
27. Yeh CJ. Simple cryosurgical treatment for oral lesions. Int J Oral Maxillofac Surg. 2000;29(3):212-6.
28. Christmas KM, Patik JC, Khoshnevis S, Diller KR, Brothers RM. Pronounced and sustained cutaneous vasoconstriction during and following cryotherapy treatment: role of neurotransmitters released from sympathetic nerves. Microvasc Res. 2018; 115:52-7.
29. Olson JE, Stravino VD. A review of cryotherapy. Phys Ther. 1972;52(8):840-53.
30. Algafly AA, George KP. The effect of cryotherapy on nerve conduction velocity, pain threshold and pain tolerance. Br J Sports Med. 2007;41(6):365-9.
31. Nadler SF, Weingand K, Kruse RJ. The physiologic basis and clinical applications of cryotherapy and thermotherapy for the pain practitioner. Pain Physician. 2004;7(3):395-400.

[ Downloaded from cofs.khuisf.ac.ir on 2026-11-26 ]

[ DOI: 10.30486/cofs.2023.1989712.1009 ]