Effects of Various Cryotherapy Applications on Postoperative Pain in Molar Teeth with Symptomatic Apical Periodontitis: A Preliminary Randomized Prospective Clinical Trial

Eyup Candas Gundogdu, DDS, and Hakan Arslan, Assoc Prof, Dr, DDS

Abstract

Introduction: The purpose of the study was to evaluate the effects of intracanal, intraoral, and extraoral cryotherapy on postoperative pain in molar teeth with symptomatic apical periodontitis. **Methods:** A total of 100 patients were randomly distributed into 4 groups: control (without cryotherapy application), intracanal cryotherapy application, ıntraoral cryotherapy application, and extraoral cryotherapy application. The postoperative pain of the patients was recorded at the first, third, fifth, and seventh days. The data were statistically analyzed by using linear regression, χ^2, one-way analysis of variance, Tukey post hoc, and Kruskal-Wallis H tests ($P = .05$). **Results:** There were no statistically significant differences among the groups in terms of demographic data ($P > .05$). The preoperative pain levels and preoperative visual analogue scale (VAS) scores of pain on percussion were similar among the groups ($P > .05$). The linear regression analysis demonstrated that group variable had the most significant effect on postoperative pain at day 1 ($P < .001$) among the other variables (group, age, gender, tooth number, preoperative pain levels, and VAS scores of pain on percussion). When compared with the control group, all the cryotherapy groups exhibited less percussion pain and less postoperative pain at the first, third, fifth, and seventh days ($P < .05$). **Conclusions:** Within the study limitations, all the cryotherapy applications (intracanal, intraoral, and extraoral) resulted in lower postoperative pain levels and lower VAS scores of pain on percussion versus those of the control group. *(J Endod 2018;44:349–354)*

Key Words

Cryotherapy, endodontics, postoperative pain, temperature reduction

Significance

The cryotherapy applications (intracanal, intraoral, and extraoral) resulted in lower postoperative pain levels and VAS scores of pain on percussion than those of the control group.

Many patients believe that root canal therapy is painful, often because of previous experiences, communications with others, and/or unfavorable information from various media types (1). Patients experience various levels of pain before, during, and after root canal therapy (2). A recent systematic review showed that between 3% and 58% of patients reported experiencing postoperative endodontic pain (3). Periapical tissue inflammation is one of the major causes of postoperative pain (4). Factors such as mechanical injuries, chemical injuries, and microorganisms can influence the development of postoperative pain (5). Pain occurring after root canal therapy can be very distressing to both the patient and dental professional. Patients consider postoperative pain and inflammation as a benchmark of the clinician's skills (3). Patient experiences and misconceptions like these demonstrate the importance of reducing endodontic postoperative pain.

Many research studies focus on endodontic postoperative pain management. Several strategies have been used to mitigate postoperative pain including preoperative patient-calming approaches and explanations (6), glide path applications (7), occlusal reductions (8), application of different mechanical techniques and motions (kinematics) during root canal treatment (9), and pharmacologic methods (long-acting anesthesia (10), medication using antihistamines (11), nonsteroidal anti-inflammatory drugs (12), salicylic acid (13), acetaminophen (14), combinations of ibuprofen and acetaminophen (15), narcotic analgesics (16), combinations of narcotic analgesics with salicylic acid (17), and steroidal anti-inflammatory drugs (18).

The term *cryotherapy* is derived from the Greek word *cryos*, which translates to "very cold" or "icy cold". Therefore, cryotherapy refers to treatments that use low temperatures (19). As early as 2500 BCE, the ancient Egyptians used low temperatures to treat injuries and inflammation. In ancient Greece, cryotherapy was used by Hippocrates, who recommended the use of local or systemic application of cold for therapeutic reasons (20). Cryotherapy aims to remove heat and thus gain an advantage by reducing inflammation (21). Cryotherapy has been used in clinical applications for pain management since the 1960s (22). The 3 basic physiological tissue responses after the application of cold temperatures are a decrease in local blood flow, inhibition of neural receptors in the skin and subcutaneous tissues, and a decrease in metabolic activity (23). Today, cryotherapy is applied in many branches of medicine including

From the Department of Endodontics, Faculty of Dentistry, Ataturk University, Erzurum, Turkey.
Address requests for reprints to Dr Hakan Arslan, Department of Endodontics, Faculty of Dentistry, Ataturk University, Erzurum 35620, Turkey. E-mail address: dt_hakan82@hotmail.com
0099-2399/$ - see front matter

https://doi.org/10.1016/j.joen.2017.11.002

orthopedics (24), traumatology (25), physiotherapy (26), neurology (27), maxillofacial surgery (28), plastic surgery (29), dental surgery (30), and recently endodontics (intracanal cryotherapy) (31, 32).

An *in vitro* study demonstrated that using cold saline solution as the final irrigant reduces the external root surface temperature by more than 10°C and maintains it for 4 minutes, which may be enough to produce a local anti-inflammatory effect in the periradicular tissues (33). After this *in vitro* study, 2 clinical studies demonstrated that intracanal cryotherapy applications result in significant reduction in postoperative pain levels (31, 32). However, there is no related study on the effect of intraoral and extraoral cryotherapy applications for post-endodontic pain. Therefore, the purpose of this study was to evaluate the effects of intracanal, intraoral, and extraoral cryotherapy applications on postoperative pain in molar teeth with symptomatic apical periodontitis. The null hypothesis was that there would be no difference between the control group and cryotherapy groups in terms of postoperative pain.

Materials and Methods

The study was conducted in the Department of Endodontics, Dental Faculty, Ataturk University, Erzurum, Turkey between June 15, 2016 and September 30, 2016. The Research Ethics Board of the University approved the study protocol (10/2015). A pilot study was conducted to determine the sample size required for the main study. In this pilot study, the effect size determined was 3.922. According to this effect size, 8 samples were found to be sufficient (95% power) for 4 groups. However, to allow for unforeseen circumstances and/or difficulties, the effect size was changed to 0.40, and 100 samples were used for the 4 groups (92% actual power). Accordingly, the number of samples required was determined to be 100.

Before the experiment proceeded, patients were randomly and separately distributed into 4 groups for the pilot and main studies by using a Web program available at www.randomizer.org (Figure 1).

Inclusion and Exclusion Criteria for Pilot and Main Studies

The inclusion criteria were healthy patients, age ≥ 18 years, and having a maxillary or mandibular molar tooth with vital pulp. These patients were also required to display symptomatic apical periodontitis. Symptomatic apical periodontitis was determined on the basis of the clinical symptoms of severe preoperative pain (visual analogue scale [VAS] > 60) and severe percussion pain (VAS > 60).

The exclusion criteria were the absence of bleeding in the pulp chamber on access cavity preparation, the presence of any systemic disease or allergic reactions, use of any type of analgesic or antibiotic medication within 3 days, a previous root canal treatment, sinus tracts/local gum swelling around the affected tooth, severe periodontal disease, the presence of periodontal pockets >3 mm in the affected tooth, the presence of a periapical radiolucency, excessively curved roots, excessively long or short root length, problems in determining working length, broken files, overinstrumentation, and overfilling/incomplete filling.

The assessment was performed in 2 stages. In the first stage, the non-molar teeth were excluded from the study by the clinic secretary. The eligible patients were forwarded to the study authors. In the second stage, the authors assessed the molar teeth for eligibility.

Treatment Procedures for Pilot and Main Studies

Each patient signed informed consent forms. Demographic data (age, gender, and tooth number) were recorded for the patients who met the inclusion criteria. In addition, preoperative pain levels and preoperative VAS scores of pain on percussion were recorded by the patients.

A single operator (E.C.G.) performed the treatments on all patients. All patients received 1 cartridge of anesthetic containing 4% articaine HCl with 1:100,000 ratio of epinephrine (Ultracaine D-S Forte; Aventis, Istanbul, Turkey). All procedures were completed under rubber dam isolation. After the cavity access preparation was complete, a size 10 K-file was inserted into the canal. Root canals were prepared with RECIPROC (VDW, Munich, Germany) files and a SILVER RECIPROC (VDW) endodontic motor by using the RECIPROC ALL mode recommended by the manufacturer.

After preparing the coronal thirds of the root canals, the root canals were irrigated with 2 mL 2.5% NaOCl. Working lengths were determined by using an electronic apex locator (Root ZX Mini; J. Morita Co, Tustin, CA). The working length was established at 0.5 mm short of the full length as determined by the electronic apex locator. A new file was used for each patient, and the preparation was performed according to the manufacturer's instructions. If the size 20 K-file did not reach to the working length, then the root canal was prepared with R25. If the size 20 K-file went passively to the working length but the size 30 K-file did not, then the root canal was prepared with R40. If the size 30 K-file went passively to the working length, then the root canal was prepared with R50. If necessary, the root canal was prepared with sizes 45 through 80 K-files. Two milliliters 2.5% NaOCl was used between each pecking (in-out) motion. To remove the smear layer, 5 mL 2.5% NaOCl was applied for 1 minute, followed by 5 mL 5% EDTA (Werax, İzmir, Turkey) for 1 minute. Irrigation activation procedures were not applied. Eleven total milliliters NaOCl was used. The milliliter breakdown was coronal enlargement, 2 mL NaOCl; first pecking, 2 mL NaOCl; second pecking, 2 mL NaOCl; and smear removal after third pecking, 5 mL NaOCl.

The root canals in the control, intraoral, and extraoral cryotherapy groups were irrigated with 20 mL room temperature saline solution for 5 minutes. In the intracanal cryotherapy group, the root canals were irrigated with 20 mL cold saline solution (2.5°C) for 5 minutes.

After these final irrigations, the root canals were dried with absorbent paper points (Pearl Endo; Beraydent, Ankara, Turkey). The root canals were then filled by using matching single cones (RECIPROC; VDW) and 2-Seal sealer (VDW). The pulp chamber was filled with a flowable composite resin, and then a nanohybrid composite resin was inserted into the cavity by using an incremental technique. This resin was cured for 10 seconds (for each increment) by using an LED light-curing unit (VALO Cordless; Ultradent, South Jordan, UT) with an output of 1000 mW/cm^2.

Groups

Control Group. After completion of the NaOCl and EDTA irrigation, the root canals were given a final irrigation with 20 mL room temperature saline solution for 5 minutes.

Intracanal Cryotherapy Group. After completion of the NaOCl and EDTA irrigation, the root canals were given a final irrigation with 20 mL cold (2.5°C) saline solution for 5 minutes. The root canal filling and restoration procedures were then performed.

Intraoral Cryotherapy Group. Like the control group, the root canals in this group were given a final irrigation with 20 mL room temperature saline solution for 5 minutes. Next, small ice packs (wrapped in sterile gauze) were placed intraorally in the mouth on the vestibular surface of the treated tooth. Patients were instructed to keep the ice pack in the mouth for 30 minutes.