

Cryotherapy in Endodontics

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ABSTRACT

Since the most common reason a patient seeks endodontic therapy is because of intolerable pain, pain management becomes essential during endodontic treatment. In dentistry and medicine, cryotherapy is frequently used as a curative procedure that is thought to be beneficial in lowering inflammation, pain, bleeding, and edema. The idea behind cryotherapy is to transfer heat from the target tissue which is at a higher temperature to the target tissue, which is at a lower temperature. Furthermore, cryogenic treatment is essential for strengthening rotary endodontic files because it provides better cyclic fatigue resistance, which lowers the risk of file separation. Furthermore, it significantly enhances the superelastic Ni-Ti endodontic file-cutting efficiency. More recently, cryotherapy has been demonstrated to be used in conjunction with bioceramic materials.

Keywords: Cryotherapy, Endodontic pain, Periapical inflammation, Superelastic Ni-Ti, Vital pulp therapy.

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INTRODUCTION

The most crucial issue in the realm of endodontics is the management and avoidance of pain both during and after endodontic therapy. It has recently been demonstrated that cryotherapy can effectively reduce pain and inflammation. The Greek word for cold, "cryos," is where the name "cryotherapy" originates. The idea behind cryotherapy is to transfer heat from the target tissue which is at a higher temperature to the patient, which is at a lower temperature.¹ In order to lessen pain and inflammation following intraoral surgical operations, implant insertion, periodontal surgery, and other disorders, cryotherapy has been employed in dentistry.¹

In endodontics, cryotherapy is utilized for nerve blocks, periradicular operations, and the alleviation of pain before and following root canal therapy. Positive outcomes are also seen in the decrease of periapical inflammation. It is claimed that cryotherapy treatment improves the effectiveness of Ni-Ti endodontic devices by decreasing file separation.² Cryotherapy has become a common tool in vital pulp therapy to achieve hemostasis. Even though cryotherapy has become the standard in endodontics, numerous studies are currently being done on its particular applications. This article's goals are to explain cryotherapy, discuss its consequences for the subject of endodontics, and outline cryotherapy's potential future in the profession.

PHYSIOLOGICAL EFFECTS

Cryotherapy is a treatment method that yields outcomes based on its physiological effects. Cryotherapy has three main physiological impacts on tissue: Tissue metabolism, neurologic tissue, and vascular tissue.

Vascular Effects

By causing vasoconstriction and lowering vascular permeability, cold treatment reduces the quantity of fluid that seeps into periapical tissue, hence minimizing tissue edema and the accompanying swelling. This serves as the foundation for the cold application technique to surgical sites, which is now the accepted standard in postoperative supportive care.³

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Neurological Effects

By decreasing the nociceptive sensory nerve fibers conduction velocity, cooling causes analgesia.

Additionally, applying cold locally lowers tissue nociceptors activation threshold and has a local anesthetic effect. Furthermore, It also prompts the release of endorphins, a neuroeffective agent that hinders the transmission of nociceptive impulses to the central nervous system.^{3,4}

Effects on Tissue Metabolism

Tissue injury leads to added utilization of oxygen, leading to consequent tissue hypoxia and necrosis. By decreasing blood flow and metabolic reaction rates by over 50°C, cryotherapy inhibits the production of free radicals in tissues, which lowers oxygen consumption and stops additional tissue hypoxia that may follow tissue damage.³

IMPLICATIONS OF CRYOTHERAPY

Endodontic Pain and Management

The two most frequent issues that endodontists deal with are flare-ups following endodontic therapy and post-endodontic pain. An often occurring cause of pain is the extrusion of irritants, such as bacteria, dentin debris, irrigants, sealers, and obturating materials into the periradicular tissue.^{1,3,5}

Cryotherapy was initially reported to be helpful in endodontics by Vera et al.⁶ They employed Endovac, a negative pressure irrigation device, in conjunction with a final rinse of cold saline at 2.5°C for five minutes to assess the temperature change of the extracted tooth's exterior root surface.^{1,7} The exterior surface of the root showed a temperature reduction of more than 10°C for 4 minutes.⁸ This could potentially have a localized anti-inflammatory effect on the tissues surrounding the roots. Postoperative discomfort can be significantly reduced with the use of a final irrigant of 2.5°C cold saline irrigation.⁹

This is in line with the findings of Al-Nahlawi et al.⁷ who assessed the effects of negative pressure irrigation (EndoVac) and intracanal cryotherapy on postoperative pain following essential single-visit endodontic treatment and came to the conclusion that both interventions improved.^{1,7}

Nerve Block

The most popular mandibular nerve block, known as an inferior alveolar nerve block (IANB), is primarily used to anesthetize molar teeth. The impact of cryotherapy and IANB on mandibular molars with symptomatic irreversible pulpitis has been the subject of numerous investigations. It was determined that in cases with symptomatic irreversible pulpitis, cryotherapy is regarded as an adjuvant procedure for the effectiveness of IANB. Cryotherapy was done by inserting intraorally on the vestibular surface of the targeted tooth in tiny cold packs for 5 minutes.

Most recently, preoperative cold application increased the potency of IANBs as stated by Topcuoglu et al.⁹

The low temperature's analgesic impact is what causes the results, and cryotherapy tempts the local anesthetic effect by reducing the activation threshold of nociceptors and the conduction velocity of pain signals.²

Vital Pulp Therapy

Vital pulp therapy is a treatment method done in a tooth identified with reversible or irreversible pulpitis if required. Cryotherapy has been found to be successful in reducing the hemorrhage from the pulp tissue during direct pulp capping treatments.

On essential pulp tissue that may be exposed to caries either directly or indirectly, sterile shavings of ice at 0°C are applied, the melted ice was removed after about a minute using a high-speed suction, and the exposed surface was then rinsed with 17°C ethylenediaminetetraacetic acid (EDTA).¹⁰

Ethylenediaminetetraacetic acid is to be chosen over sodium hypochlorite as EDTA has the potential to synthesize several growth factors that help matrix secretion, differentiation of odontoblasts, and tertiary dentin development. Furthermore, it improves dental pulp stem cell adhesion, motility, and differentiation.

Following EDTA treatment, bioceramic materials are used to cover the exposed dentin, which is then covered with a permanent replacement.

After a period of 12–18 months, the tooth showed vital pulp and was fully asymptomatic and functional. To ascertain and denote the long-term outcomes of cryotherapy during vital pulp therapy, more research is necessary.¹⁰

Periapical Inflammation

The tissues around the teeth may become inflamed as a result of endodontic treatment. The local temperature will rise as a result of this. The application of cold saline lowers the root surface temperature by more than 10°C and maintains it for 4 minutes,⁸

which is sufficient to cause a limited anti-inflammatory impact on the periapical tissues, according to Vera et al.'s *in vitro* investigation.²

Nevertheless, they recommended that in order for cold saline to reach the apical part of the root, it must be given using a negative pressure irrigation device.^{2,7}

Endodontic Instruments

One of the most crucial elements in the biomechanical preparation process success is thought to be the employment of instruments. When metals are cryogenically treated during manufacture, there is a noticeable improvement in their thermal stability and surface hardness. It is a technique for gradually bringing stainless steel and superelastic Ni-Ti to room temperature after they have been exposed to below-freezing temperatures. Treatment with cryogenics consists of–

- Shallow cryogenic treatment: –80°C.
- Deep cryogenic treatment: –185 to –196°C.^{1,2}

Microhardness

Kim et al.¹¹ investigated the effects of computed tomography (CT) on Ni-Ti endodontic instruments and found that the degree of microhardness increased after the CT.¹²

Cutting Efficiency

Vinothkumar et al.¹³ used 10 rotational Ni-Ti endodontic implements that were exposed to profound dry CT at 185°C in order to study the effects of CT on wear resistance and CE. They came to the conclusion that the deep dry CT considerably improved the rotary Ni-Ti endodontic instruments (ProFile) cutting proficiency.^{12,13}

Fracture Resistance

Because there is any enamel or dentin to be microstructure near the pulp area, using a cold solution, could put extra thermal stress on the dentin structure.² Cryotherapy is a good way to manage pain following root canal surgery, but it also weakens the tooth's resistance to fracture. Further clinical research is needed to determine how long these teeth last after treatment.² The Ni-Ti rotor is treated to subzero temperatures during cryogenic treatment, after which the metal is allowed to gradually warm up to ambient temperature. The cryogenic-treated Ni-Ti files exhibit a notable enhancement in cycle fatigue resistance as compared with the untreated files. The alloy's martensitic phase completely changed from the austenitic phase, which is why this improvement was observed. Therefore, the main benefits of cryogenic treatment for Ni-Ti rotary files are decreased internal stress and enhanced wear resistance.³

Enterococcus Faecalis

Because of a number of virulence characteristics that make it challenging to eliminate from the canals, *E. faecalis* is the species most frequently linked to persistent root canal infections. Mandras et al.¹³ found that cryoinstrumentation after NaOCl irrigation considerably reduced the quantity of bacteria in the root canal compared with NaOCl alone, without the total removal of *E. faecalis*.^{4,13}

CONTRAINDICATIONS

The use of cryotherapy in patients with cardiac problems, such as arrhythmias, angina pectoris, and hypertension, is debatable because of the possibility of an increase in blood pressure from

vasoconstriction. It is also contraindicated in people who are extremely sensitive to cold. It is not advised for individuals with Raynaud illness because of vasoconstriction in the lower extremities.¹⁴

CONCLUSION

Cryotherapy is becoming an attractive method for endodontists to improve patient outcomes, especially for individuals who experience substantial postoperative pain after root canal therapy. It is a noninvasive technique with few adverse effects that has the potential to lessen postoperative pain in the short and long terms. It is simple to incorporate into daily endodontic procedures.

Investigations regarding cryotherapy has complete effectiveness and its advantages in endodontics are still ongoing. Although preliminary research indicates encouraging outcomes in pain reduction, additional clinical trials are required to validate its widespread application and enduring advantages.

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