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Review Article

Cryotherapy: A new paragon in the field of endodontics

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ABSTRACT

The discussion on cryotherapy mechanism, its physiological effects, and many uses in the field of endodontics was motive of this review study. The chosen articles were limited to those which were published in English by using few specific keywords. An electronic search of research papers was conducted on the complete PubMed database using certain keywords. Using combinations of the pre-defined keywords, the last access was in January 2021. According to studies, using the intracanal cryotherapy approach in combination with irrigation under negative pressure relieves post-endodontic discomfort. It was also seen that DCT (deep cryogenic treatment) had successfully raised the cyclic fatigue resistance with 24-hour soaking time by 13% and with 6-hour only 1%. Anyhow, soaking time does not influence cutting efficiency. When combined with local anaesthesia, cryotherapy has a local anaesthetic effect by lowering the nociceptors activation threshold and the conduction velocity of pain signals. Therefore, in case of symptomatic apical periodontitis, cryotherapy is a straightforward and affordable adjunctive approach for reducing postoperative discomfort and for managing pulpal hemorrhage during critical pulp therapy. Also, unquestionably an essential step in treating edoema and discomfort following endodontic surgery.

1. Introduction

The practice of cryotherapy, a well-established method, has begun to develop in the field of endodontics due to its therapeutic properties and its effect on diminishing the tissue temperature for therapeutic purposes and its effect on nickel-titanium endodontic instruments in terms of yielding mechanical properties

"Cryos" and "therapeia," are the two Greek words which stand for "cure" and "cold," respectively. Cryotherapy considers several variables, including the administration of heat or cold, exposure duration, the thermal conductivity of the tissues, temperature, the type of agent used to deliver the heat or cold, and the degree of the temperature change.[1] Cryotherapy has been proven to be beneficial in dentistry for lowering inflammation, discomfort, and arthritis related to temporomandibular joint diseases. It is usually utilised after excisional surgeries intraorally, periodontal surgery, as well as following extractions and implant implantation. Cryotherapy has reportedly been utilised in the field of endodontics to reduce postoperative discomfort and swelling following peri radicular procedures and during root canal therapy. Another use of cryotherapy in endodontics is deep cryotherapy of nickel-titanium (NiTi) endodontic files, which improved cyclic fatigue resistance and decreased the probability of file separation.[2–7] Cryotherapy has recently been successfully tested with vital pulp cryotherapy employing bio ceramic materials as a useful adjuvant for hemostasis. As a result, the purpose of this review article is to provide information about the concept of cryotherapy, its mechanism and physiological effect, as well as its

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various clinical implications and potential side effects. This information is based on the literature that is currently available.

2. Discussion

2.1. Physiological effect of cryotherapy

Compared to other dental treatments, root canal therapy is more frequently linked to severe postoperative discomfort.[8] Therefore, it is essential in endodontic practice to address postoperative discomfort. By using several strategies during the endodontic protocol, such as the use of long-lasting an aesthetic, occlusal reduction, and other techniques, post endodontic pain can be minimized in clinical practice. Preoperatively or postoperatively, medicine is provided to reduce inflammation and manage discomfort. However, therapies including lasers and cryotherapy have been recommended to prevent some side effects brought on by these medications.[9,10] Vascular, neurologic, and tissue metabolism are the three main physiological impacts of cryotherapy on tissue.

2.2. Application of cryotherapy during endodontic procedures

2.2.1. Cryotherapy during root canal irrigation

The first study on cryotherapy in endodontics was done by Vera et al. They measured the change in temperature of the exterior root surface of extracted teeth after applying Endovac for five minutes as a final rinse.[11] They concluded that lowering the temperature of the external root surface by more than 100 degrees Celsius and maintaining it for more than 4 minutes might be sufficient to have a localized analgesic and anti-inflammatory impact in the periapical region.

2.2.2. Application of cryotherapy for management of post operative pain

The findings showed that the cryotherapy group experienced significantly less post-operative discomfort than the control group.

Keskin et al.[2] employed cryotherapy for the first time in endodontics in 2016 to reduce postoperative discomfort following single-visit root canal treatments. The findings showed that the cryotherapy group experienced significantly less post-operative discomfort than the control group. However, even though they included teeth with vitally inflamed pulp in their analysis, they failed to explain the distinction between asymptomatic and symptomatic pulpitis or to distinguish between cases with or without apical periodontitis.

Studying such a broad group of individuals may have influenced the findings because postoperative pain frequency and intensity are undoubtedly influenced by the presence of inflammation and preoperative discomfort. Cryotherapy decrease the postoperative discomfort after single-visit root canal treatments in teeth with significant vital pulp, according to earlier research using the same methodology.[12]

In randomized multicenter clinical research, it was found that using cryotherapy benefited patients with necrotic pulp and symptomatic apical periodontitis have less postoperative discomfort and needed less medication.[13,14]

Additionally, the effectiveness of cryotherapy in treating irreversible pulpitis with and without apical periodontitis was evaluated in terms of lowering postoperative discomfort. The findings showed that only patients with apical periodontitis benefited from cryotherapy, while those with merely irreversible pulpitis did not significantly differ between the cryotherapy group and control group in terms of the prevalence of postoperative discomfort[15]

Cryotherapy is unsuccessful in previously asymptomatic instances lacking periapical pathosis, according to Alharthi et al.[16]

Emad et al. (Thesis,2020) examined the effects of various irrigation procedures on postoperative pain and interleukin 6 expression in subjects with symptomatic apical periodontitis in a recent unpublished study.

2.2.3. The impact of cryogenic treatment on nickel-titanium endodontic instruments

Various properties of nickel-titanium alloys like shape memory, biocompatibility, super elasticity etc. aids in better cleaning and shaping of root canal. As compared to stainless steel, Nickle-titanium exhibits greater adaptability, flexibility, and torsional fatigue resistance.

On the other hand, the machining process may prompt surface imperfections inside the cutting surfaces and a relatively reduced cutting efficiency[16] due to its pseudo elastic property. Also show lower microhardness than hardened steel instruments.[17] all these factors together diminish the cutting efficiency of Nickle-titanium instruments. To amend the cutting efficiency and wear resistance, different surface treatment procedures have been endeavored.

Kim et al[18] investigated the effects of CT on Nickle-titanium endodontic instruments and discovered that the degree of microhardness increases after CT.

Vinothkumar et al.[17] used dry CT at 185°C to examine the effects of CT on Nickle-titanium endodontic instruments on CE and wear resistance. They concluded that the deep dry CT improved the cutting proficiency of rotary Nickle-titanium endodontic instruments (ProFile) substantially ($p < 0.05$) but the effect on wear resistance was inconsequential.

When Sabet et al.,[19] examined the impact of CT on the cyclic fatigue resistance of rotary Nickle-titanium instruments (Hyflex), they found that the method had only a little impact, despite the possibility that it would lessen the

number of fracture cycles in the treated group.

After deep dry CT, George et al.[20] noted that the fracture time was suggestively longer in three different rotary files (Hero Shaper, RaCe, and K3) and came to the conclusion that the alloy's complete transition from the austenitic to martensitic phase was responsible for the increase in level of hardness.

2.2.4. Affect of intracanal cryotherapy on tooth fracture resistance

In a study on teeth that had undergone endodontic treatment, Keskin et al.[21] evaluated the effect of intracanal cryotherapy on the teeth's resistance to breakage. In comparison to the benchmark group, they concluded that the vertical fracture resistance decreased following the use of intracanal cryotherapy as a final irrigants.

2.2.5. Periradicular surgery

The use of postoperative cold therapy, which counteracts the miraculous bounce-back effect caused by the use of local anesthetics including vasoconstrictor, prevents blood from flowing nearby.

As a result, the recommended practice for postsurgical steady therapy is to lower the temperature of the operation region by applying cold.

2.2.6. Vital pulp therapy in conjunction with cryotherapy

Recently, cryotherapy was used in a case of VPT by Bahcall et al.,[17] for hemorrhage control from inflamed pulp during direct pulp capping. Sterile, Shaved water ice (0°C) had been applied for 1 minute over the immediate or close vicinity of pulpal tissue around the entire tooth, and then the liquified ice was removed with a powerful suction. Post removal, the exposed pulp was irrigated with 17% EDTA and restored with Bio ceramic material.

2.2.7. Effect of cryotherapy on inferior alveolar nerve block

In a randomised clinical experiment, Topcuoglu et al.[22,23] assessed the effect of preoperative intraoral cryotherapy administration on the success rate of inferior alveolar nerve blocks (IANBs).

The trial contained the patients having symptomatic irreversible pulpitis (SIP). They favored this procedure as a basic and reasonable assistant application to enhance the effectiveness of IANBs in SIP patients. The appropriateness of cryotherapy in producing a local anaesthetic effect by lowering the activation threshold of nociceptors and the conduction velocity of pain signals could make the extended survivability of the IANB in the cryotherapy group easier to understand.

2.2.8. Cryo-treatment's antimicrobial efficacy against enterococcus faecalis

Cryotherapic treatment combined with 5 percent NaOCl was tested by Mandras et al.[24] for its potential microbicidal effects against Ent. faecalis. Using a dental device with duct and a cryogenic liquid source (liquid nitrogen), cryotreatment was carried out, with the cryogenic fluid being injected using a cooling needle. Cryo-instrumentation and NaOCl irrigation significantly (p 0.01) reduced the amount of Ent. faecalis in the root canal. Therefore, it proved to have a significant impact on the reduction in microscopic organisms when compared to a conventional NaOCl.

3. Conclusion

Intracanal cryotherapy can be considered as a simple, cost-effective, and non-toxic therapeutic treatment option for postoperative pain control in single visit RCT cases. However, numerous research studies should be conducted in the near future to investigate the possible benefits of this technique in the treatment of other pulpal and peri-radicular diseases. Cryotherapy is an innovative and promising method that can be considered to reduce, swelling, discomfort, and post-operative pain encountered after endodontic treatment and surgeries. It has also shown the potential to control pulpal bleeding in the case of vital pulp therapy. However further studies are required to provide strong evidence to prove its therapeutic effect in the field of endodontics.

4. Source of Funding

None.

5. Conflict of Interest

None.

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