

# Cryotherapy as an Adjunct to Cleaning and Shaping in Endodontics: A Review

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## Abstract

Cryotherapy refers to treatments that are done at reduced temperatures. In the recent times, Cryotherapy has found use in the field of endodontics during root canal irrigation, primarily to reduce post-operative pain after non-surgical endodontic therapy. In this review, we are throwing some light over use of Cryotherapy in root canal irrigation, its clinical implications along with positive and negative side effects based on currently available literature. Vital pulp cryotherapy is a process in which sterile water ice shavings are applied on exposed pulp tissue. Cryogenic fluid, when used as an irrigant has shown efficacy in antibacterial action as it can reach the desired depth and bring about immediate freezing of bacterial cells along with their subsequent Cryodestruction. Use of cold saline solution (2.5 °C) as the final irrigant brings about reduction in external root surface temperature by more than 10°C for 4 minutes, which might be produce a local anti-inflammatory effect in the periradicular tissues. In addition, Various clinical and experimental studies have highlighted the role of Cryoirrigation in controlling post-operative pain after endodontic therapy.

**Key words:** Cryotherapy, Endodontics, Root canal irrigants

## Introduction

The word “cryotherapy” comes from the term “cryos” meaning “very cold” or “ice-cold” in Greek language. Therefore, cryotherapy refers to treatments that are done at reduced temperatures.<sup>1</sup> The early Egyptians used low temperatures in the treatment of inflammation and lesions as early as 2500 BCE. Hippocrates, who used Cryotherapy, suggested local and/or systemic ice application for medicinal purposes.<sup>2</sup> The purpose of Cryotherapy is to reduce heat and as a result, benefit from a reduction in inflammation.<sup>3</sup> Cryotherapy has been in use in control of pain for more than 50 years.<sup>4</sup> The three

important physiological tissue reactions following the application of low temperatures are, a reduction in the local blood flow, a decrease in metabolic activity, neural receptor activation in the subcutaneous tissues and skin.

<sup>5</sup> This treatment is commonly used in various medical fields, like neurology,<sup>6</sup> orthopaedics, <sup>7</sup>physiotherapy,<sup>8</sup> traumatology,<sup>9</sup> plastic surgery,<sup>10</sup> maxillofacial surgery,<sup>11</sup> dental surgery,<sup>12</sup> and relatively recently endodontics.<sup>13,14</sup>

Cryotherapy has been in use for more than 50 years in oral medicine and in pathology. However, Evidence of tissue degradation by freezing dates back to 1851.

Initially, this use was limited to treating lip cancer and cancer of the oral cavities. It's uses in the area of the head and neck are currently extensive and include treatment of various benign growths in the skin, as well as malignant lesions.<sup>15</sup>

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surgical endodontic therapy.<sup>14</sup> In this review, we are throwing some light over use of cryotherapy in root canal irrigation, its clinical implications along with positive and negative side effects based on currently available literature.

### 1. Vital Pulp Cryotherapy

When a carious tooth is diagnosed with reversible or irreversible pulpitis and caries excavation leads to direct or indirect pulp exposure, then vital pulp capping or partial pulpectomy is the choice of treatment. However, Pulps that have a pre-treatment diagnosis of necrosis or upon pulp chamber access are observed to have partial necrosis of the pulp; vital pulp therapy is contraindicated. It is necessary to remember that pulpal bleeding may be a clinical marker for the severity of pulpal inflammation.<sup>16</sup> Haemorrhaging in pulps with a pre-treatment diagnosis of mild or reversible pulpitis appears to stagnate and be easily regulated with ice application. Cryo-technique involves the use of sterile water ice shavings over the exposed pulpal tissue. The melted ice should then be removed with a high-speed suction after one minute, followed by irrigation with 17% EDTA.<sup>17</sup> Use of sodium hypochlorite is not advised while performing vital pulp cryotherapy procedure, since it has been shown to destroy pulpal stem cells.<sup>18</sup> Use of EDTA solution is encouraged since has been shown to release bioactive growth factors from dentin, thereby stimulating secretion of matrix, odontoblastic differentiation, and tertiary dentin formation along with promoting adhesion, migration, and differentiation of dental pulp stem cells.<sup>18,19</sup>

In case of profuse bleeding, partial pulpectomy can be performed in order to remove the inflamed pulp tissue before placing sterile ice shavings while performing vital pulp cryotherapy.<sup>17</sup>

### 2. Role in Antimicrobial Action

Various irrigating solutions have been used in endodontics to reduce the bacterial load in the root canal system. Of the available solutions, Sodium hypochlorite (NaOCl) is currently the most commonly used.<sup>20,21</sup>

Yamamoto and Harris<sup>22</sup> have explained the effects of Cryotherapy involving use of liquid nitrogen over microorganisms. The process of freezing and thawing

has shown to cause disruption of the cell wall, leakage of intracellular constituents and conformational changes in protein structure. The cryogenic fluid has been experimentally used in various studies against the gold standard irrigant, sodium hypochlorite, and has shown more efficacy in antibacterial action as it can reach the desired depth and bring about immediate freezing of bacterial cells along with their subsequent cryodestruction.<sup>23</sup>

### 3. Role in Reducing periapical inflammation

Periapical Inflammation has been associated with injury to the periapical tissues before, during or after the endodontic therapy. The result of periapical extension of pulpal inflammation, excessive instrumentation beyond the root apex during cleaning and shaping of root canals or over extended obturation can lead to periapical injury and result in periapical inflammation with classic signs of increased local temperature, swelling, pain and redness. Vera *et al.*<sup>24</sup> have established the fact that cryotherapy helps to reduce the external root surface temperature during endodontic treatment. Use of cold saline solution (2.5 °C) as the final irrigant brings about reduction in external root surface temperature by more than 10°C for 4 minutes, which might be produce a local anti-inflammatory effect in the periradicular tissues.<sup>24</sup> Inflamed periradicular tissues may be treated with cryotherapy by intracanal irrigation with a cold substance along with a negative pressure irrigation device. The micro cannula of the negative pressure system can be applied to the full working length (WL) and to the continuous flow of the irrigant.<sup>24,25</sup>

### 4. Role in Reducing Post-operative pain

Various clinical and experimental studies have highlighted the role of cryoirrigation in controlling post-operative pain after endodontic therapy. Keskin *et al.*<sup>14</sup> evaluated the efficacy of saline solution at a temperature of 2.5 °C when used as the final irrigant on postoperative pain after single-visit root canal treatment of vital teeth, and found it to be extremely effective. Similar results were found by Al Nahlawi *et al.*<sup>13</sup> upon evaluation of level of post endodontic pain with the usage of intracanal cryotherapy with negative pressure irrigation (EndoVac) after vital single-visit endodontic treatment. As far as pain control during treatment of necrotic pulps is concerned, Vera *et al.*<sup>26</sup> concluded

the results in favour of cryotherapy after conducting randomised control trials. Gundogdu *et al.*<sup>1</sup> found that all the cryotherapy applications i.e. intracanal, intraoral, and extra oral application resulted in lower postoperative pain levels and lower VAS scores of pain level in all the human subjects. Pain control with intracanal cryotherapy can be attributed to the fact that cold therapy results in a decrease in the flow of blood due to induced vasoconstriction at the application site followed by reduction in tissue metabolism and oxygen utilisation which in turn minimises oedema and local release of pain mediators.<sup>6</sup> At the same time, leukocytes play a vital role in the inflammatory response of a soft tissue lesion. Therefore, cryotherapy has been shown to be effective in decreasing the amount of leukocytes adhering to the endothelial wall of capillaries, resulting in less of these cells migrating to the affected tissues, reducing endothelial dysfunction and inflammatory response.<sup>27</sup> Moreover, it affects peripheral nerve endings by decreasing the threshold needed to trigger the tissue nociceptors and the pace of painful nerve impulses. Cryotherapy causes a local anaesthetic effect by lowering the threshold for activation of these tissue nociceptors and the pain signal conductivity.<sup>26</sup>

### Conclusion

Cryotherapy has been used in other dental specialities over the years, and has recently found its use in Endodontics. Studies have been conducted to evaluate the effectiveness of cryo-irrigation in reducing periapical inflammation, reducing post-operative pain and also its antimicrobial action. In addition, cryotherapy has also been shown to be an effective adjunct in vital pulp therapy. The initial research on cryotherapy have shown promising results. Further research is required to investigate the benefits of cryo-irrigation in treatment of pulpal and periradicular diseases.

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