International Journal of Research in Medical Sciences
Sharanya AJ et al. Int J Res Med Sci. 2025 Dec;13(12):5598-5603
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20254004

Review Article

Cryotherapy in endodontics: a comprehensive review of applications, mechanisms, and future perspectives

Sharanya A. J., Promila Verma*, Rhythm

Department of Conservative Dentistry and Endodontics, King George's Medical University, Lucknow, Uttar Pradesh, India

Received: 09 October 2025
Accepted: 20 November 2025

***Correspondence:**
Dr. Promila Verma,
E-mail: promilarajesh@yahoo.co.in

ABSTRACT

Cold temperatures, therapeutically used in cryotherapy, are a valuable adjunct in endodontics. It is reviewed in terms of its history, principles, techniques, clinical uses, and evidence base. Mechanisms include vasoconstriction, reduced metabolism, modulation of nerves (analgesia), and anti-inflammatory effects. Cold saline irrigation, cryoprobes, external cold packs and cryogenic instrument treatment are standard methods. Cold saline irrigation (2.5–4°C) is strongly evidenced to reduce postoperative pain after root canal treatment (RCT). It may also enhance the success of local anaesthesia, especially in inflamed teeth. However, it is encouraging in its role in vital pulp therapy and regenerative endodontics, but more research is needed. The fatigue resistance of NiTi files may be improved by cryogenic treatment. Temperature and duration must be carefully controlled for safety, patient screening (including contraindications such as cold hypersensitivity), and proper technique. For pain, it is effective; however, further research is needed for other applications and protocol optimisation. Cryotherapy overall improves patient comfort and may enhance outcomes, aligning with modern endodontic principles.

Keywords: Cryotherapy, Endodontics, Cold therapy, Root canal treatment, Postoperative pain, Intracanal irrigation, Local anaesthesia, Inflammation, Vital pulp therapy, Cryogenic treatment

INTRODUCTION

Cryotherapy is the use of cold temperatures for therapeutic benefit (from the Greek words for cold ("cryo") and cure ("therapeia")).[1] It is used in endodontics where it refers to applying cold substances (or devices) to teeth and surrounding tissues.[2,3] The primary goals are to reduce inflammation, manage postoperative pain, and promote the healing of pulpal/periapical tissues.[4] Physiological responses are employed by it, including vasoconstriction (reduced blood flow and metabolism), slowed nerve conduction (analgesia), and decreased oxygen demand, which may limit tissue damage.[6-8]

Cold therapy has been used therapeutically for injuries and inflammation since ancient Egypt (c. 2500 BCE) and Greece (Hippocrates, 4th century BCE).[9-11] The use of liquid nitrogen for cryosurgery dates back to the early 20th century, and modern medical applications emerged in the same period.[12,13] In the 1960s, dermatology, oncology, and dentistry began to treat oral lesions.[14-16] It was adopted by sports medicine in the 1970s and 1980s for injuries and recovery, and whole-body cryotherapy emerged in Japan.[17,18]

It is relatively recent (dating back to the early 2000s) but has significant potential. It is essential because it reduces the patient's analgesic needs after RCT and also increases patient comfort.[21,23,24] It can modulate inflammation in pulpal/periapical tissues and may help healing.[25-27] It also may improve local anaesthesia efficacy, especially in complex cases, such as irreversible pulpitis (hot teeth").[29-31] In addition, cryogenic treatment is used to improve the mechanical properties of NiTi instruments (such as fatigue resistance) and thus potentially reduce fracture risk and increase safety.[32-34] Therefore, cryotherapy is becoming a valuable, non-invasive adjunct to endodontic therapy that is patient-centred and biologically based.[35-38]

EVOLUTION OF CRYOTHERAPY IN ENDODONTICS

Later than its general dental use, endodontic cryotherapy evolved (around the 1960s for oral lesions).[1,2] In the late 1990s/early 2000s, specific endodontic applications became popular.[3] The focus of the initial studies was on managing postoperative pain after RCT using simple external cold packs.[4,7] This provided some relief, but it was not a targeted delivery. One of the first significant steps was the use of cold saline for intracanal irrigation and its direct application in the root canal.[9,10]

From the early 2000s, modern techniques have developed rapidly due to advances in technology and increased understanding of physiology. Controlled intracanal cooling was achieved using cold probes or specialised devices.[13-15] Comparative studies were made to refine cold saline irrigation protocols (optimal temperature: 2.5–4°C, duration: 1–5 min). Thus, cryotherapy was directed into the canal, either directly via saline, cooled materials, or devices.[19,21] Effects on anaesthesia and instrument properties were expanded upon in research.[22,23]

Cryotherapy is now an accepted adjunct, based on growing evidence.[25] Post-RCT pain is common, and cold saline irrigation (2.5–4°C, 1–5 min) has been proven effective in reducing post-RCT pain.[26-28] Precise temperature control is provided by advanced devices, which sometimes include irrigation.[29,31] The applications of VPT and REPs remain actively researched.[2,4,33,37] NiTi files are cryogenically treated to increase fatigue resistance. It is emphasised that clinical trials and systematic reviews guide the evidence-based practice. Optimal parameters are currently being researched, and novel delivery systems are also being explored.

PRINCIPLES AND MECHANISMS OF CRYOTHERAPY

Heat transfer principles are used in cryotherapy.[1] Heat flows from warmer dental tissues to the colder medium (e.g., saline) when cold is applied. The rate is a function of the temperature gradient, the thermal conductivity of tissues (enamel < dentin < pulp), the agent, and application duration.[3,6] The objective is to control and localise cooling (above freezing). Cooling/rewarming rates are influenced by specific heat capacity.[4] This may lead to thermal contraction, thereby affecting microcirculation.[7] Controlled irrigation or devices are applied to these principles.

Cold application triggers notable biological effects, including vasoconstriction, which reduces blood flow, limits the influx of inflammatory mediators, and decreases oedema, thereby lowering tissue metabolism and oxygen demand.[9,10] Cryotherapy induces analgesia primarily by decreasing nerve conduction velocity in A-delta and C fibres. This leads to transient alterations in cellular activity, likely due to changes in membrane permeability. It may also temporarily decrease dentin permeability.[13] Ongoing investigations are exploring its impact on odontoblast viability and the potential to stimulate reparative dentinogenesis.

Additionally, cryotherapy exerts immunomodulatory effects by downregulating pro-inflammatory cytokines such as IL-1β and TNF-α, and by modulating immune cell responses.[16] However, antimicrobial effects are limited at therapeutic temperatures, but reduced metabolism may impede bacterial growth.[26] Controlled cold (above freezing, of limited duration) is generally considered safe for pulp vitality.

Cryotherapy reduces cellular metabolism and ATP demand, alters membrane fluidity, and modulates signalling pathways.[20] It alters cell membrane fluidity and affects ion channels, receptors, and transporters involved in signalling. It downregulates molecularly pro-inflammatory gene expression (TNF-α, IL-1β, IL-6). MMP activity may be modulated, thus limiting tissue breakdown.[24] Analgesia results from the inhibition of sodium channels and the activation of TRPM8. It induces vasoconstriction through α2C-adrenergic receptors and alters the activity of immune cells. Emerging evidence also explores effects on heat shock proteins and stem cells. They are also studying effects on heat shock proteins and stem cell behaviour.[23,29]

CRYOTHERAPY TECHNIQUES IN ENDODONTICS

Cold sterile saline (2.5–4°C) is a standard material.[1,2] Specialised devices deliver controlled cooling through delivery systems such as probes or integrated irrigation.[3,30] Cryoprobes can generate localised sub-physiological temperatures—typically above freezing—in the root canal.[4] Experimental obturation has utilised cold carriers, with safety ensured through real-time temperature monitoring using thermocouples and infrared thermometers.[6] External ice packs are adjunctive.[7] Emerging technologies include cold plasma and cryogenic chambers for instrument sterilisation at –196°C. Supportive tools, such as rubber dams and protective gels, are essential for a safe application.[10,28]

The most common method is cold saline irrigation (2.5-4°C, 1-5 min) as a final rinse. Targeted cooling within the canal is offered by cryoprobe application.[13] Postoperative swelling/pain is managed externally with cryotherapy (ice packs). Cryospray delivers cooled mist.[16] Pulsed cryotherapy uses cycles of cooling and rest. Cold plasma offers both cooling and potential antimicrobial effects. Before use, NiTi file properties are enhanced by cryogenic treatment of instruments. The use of REPs is explored, and combined approaches (e.g., cryo + medication) are examined. Depending on the clinical goal and context, method choice is.[29,35]

Ensuring safety during cryotherapy is essential. Temperatures should be carefully controlled, ideally between 2.5 °C and 4°C for irrigation, while avoiding freezing within the canal. Application time must be limited to 1–5 minutes to prevent tissue damage, especially in vital pulp. Patients with cold hypersensitivity, cryoglobulinemia, or severe cardiovascular conditions must be identified through thorough medical history screening. Proper isolation with rubber dams protects surrounding tissues, and all equipment must be well-maintained, sterilised, and electrically safe.[28] Sudden temperature shifts should be avoided to prevent thermal shock. Clinicians must monitor patient comfort, adhere to established protocols, obtain informed consent, and be trained in emergency preparedness, even though adverse events are rare.[33] Require adequate clinician training. Document procedures thoroughly. Rare complications (emergency preparedness). Obtain informed consent.

CLINICAL APPLICATIONS

Vital pulp therapy

VPT (pulp capping, pulpotomy) promises the benefits of cryotherapy in reducing inflammation and promoting hemostasis. The environment for capping materials may be improved by applying cold (e.g., 2-4°C saline, 1-2 min) to exposed pulp.[2,3,5] Some studies suggest improved vitality maintenance. Pulp injury must be avoided by careful temperature/duration control.[6] It is also being explored in its role in enhancing REPs. Further long-term clinical evidence is needed.[27]

Root canal treatment

The adjunctive cryotherapy during RCT is primarily cold saline irrigation (2.5-4°C, 1-5 min) to reduce postoperative pain by decreasing periapical inflammation.[9,10] It may also help in debris removal. Another application is to enhance local anaesthesia success in \ hot teeth" (irreversible pulpitis), often with external cold before injection.[12,37] Symptomatic relief can be offered by managing flare-ups with intracanal cold irrigation. Cold Gutta-Percha technique is experimental.[11] Final cold saline irrigation for pain control is the most established use.[17-19]

Management of postoperative pain

This is cryotherapy's most evidence-based application in endodontics. Inflammation and procedural factors are responsible for the post-RCT pain. Intracanal cold saline irrigation (2.5–4°C, 1–5 min), typically used as a final step, is effective in reducing pain.[17,18] Mechanisms include vasoconstriction (reduced oedema and mediators), slowed nerve conduction, and decreased metabolism.[16,20] A substantial number of RCTs and meta-analyses have confirmed that pain scores, analgesic use, and VAS values are significantly reduced compared to controls.[10,12,17,18,20,21] Optimal duration is often 5 minutes. This postoperative pain and swelling are also managed with external cryotherapy (ice packs). External cold pre-treatment may also reduce post op pain. It provides a safe and simple non-pharmacological means to improve patient comfort.

Treatment of periapical lesions

The role of cryotherapy as an adjunct to the treatment of periapical lesions is being investigated. Periapical inflammation may be reduced by final intracanal cold saline irrigation, and resolution may be accelerated.[26] However, some studies have shown that adjunctive cryotherapy may improve radiographic healing, but more long-term evidence is still needed.[26,31] Less common and more invasive is cryosurgery during apicoectomy (with extreme cold).[27,28] REPs use in large lesions is experimental.[29,30] Cryotherapy remains a supportive adjunct; complete chemical–mechanical debridement and proper obturation are still essential for endodontic success

COMPARISON WITH CONVENTIONAL ENDODONTIC TREATMENTS

Efficacy

The main proven efficacy advantage of cryotherapy is the reduction of postoperative pain compared to conventional irrigation. It is an adjunct that may improve outcomes but does not substitute for RCT principles for overall treatment success (healing).[3,4] However, such evidence is more anecdotal.[26,31] More data are needed for comparative efficacy in VPT.[4,12,36,37] Cryogenic instrument treatment improves in vitro fatigue resistance, but it is associated with a limited proven clinical fracture rate.[19,26,40]

Patient comfort

The major advantage of cryotherapy is its significant enhancement of patient comfort, particularly in terms of reducing postoperative pain and analgesic requirements.[15,22] Also, help reduce swelling (with external application). Intra-procedural comfort is improved by improved anaesthesia success.[12,37] It offers a non-pharmacological option.[1] Transient sensitivity during the application can occur, but it is manageable. It overall improves the patient experience.

Cost-effectiveness

Cold saline irrigation has low added material cost, which may be offset by decreased analgesic/emergency visit cost.[5,7,14,28] Capital investment is required for specialised devices, whose cost-effectiveness is related to usage and benefits.[3,33] Reductions in fractures must be balanced against the costs of cryogenic instrument treatment.[9,11,40] The low cost and proven pain reduction of cold saline irrigation make it appear highly cost-effective. Other methods need more comprehensive health economic studies.

RESEARCH FINDINGS AND EVIDENCE BASE

In vitro studies

Cryotherapy decreases dentin permeability in laboratory studies, inhibits the growth and metabolism of some bacteria, and reduces the release of pro-inflammatory mediators from pulp cells.[8,13,16,17,21,22,28] It appears to have little effect on material setting times.[25] The fatigue resistance of NiTi files is consistently improved by cryogenic treatment.[19,23,26] However, biological complexity is limited, and findings should be interpreted cautiously.

Animal studies

Cryotherapy in animal models has been confirmed to decrease the size of periapical lesions and inflammation with adjunctive cryotherapy. Controlled application is considered safe for pulp vitality. In REPs, there is potential benefit for root development.[27,31] Safety protocols are generally supported. Limitations include species differences.

Clinical trials

Consistently, RCTs demonstrate that final cold saline irrigation reduces post-RCT pain and the need for analgesics. The success of local anaesthesia under challenging cases is improved by external cryotherapy.[12,37] There is currently emerging evidence for the benefits of VPT and lesion healing, although more robust, long-term trials are needed. With proper protocols, safety appears good.[3,28]

LIMITATIONS AND POTENTIAL RISKS

Contraindications

Not to be given to patients with cold hypersensitivity/urticaria, Raynaud's phenomenon, cryoglobulinemia. Be careful with severe cardiovascular disease. Do not place near major nerves for prolonged periods. Caution is advised during pregnancy. In acute abscesses, it may be inadvisable. A thorough medical history is essential.[2]

Possible complications

If done correctly, complications are rare. Transient cold sensitivity is common. Excessive cold/duration, or poor isolation, can cause tissue injury (frostbite)—a theoretical risk of thermal shock leading to microcracks. Interference with anaesthesia is possible. Delayed healing is theoretical. Nerve injury (paresthesia) is a rare occurrence. If contraindications are missed, the systemic conditions may be exacerbated. Equipment malfunction is possible.

Areas needing further research

Further clinical trials lasting more than 5 years are needed. A systematic comparison of protocol optimisation (such as temperature, duration, and method) is required. Extensive clinical investigation is necessary for the role in REPs—Deeper mechanistic studies. A study is needed on the interactions of endodontic materials. Other patient-reported outcomes, beyond pain, should also be assessed. Better delivery/monitoring systems are needed. Cost-effectiveness analyses are required.[6]

FUTURE DIRECTIONS

Future technology will include smart devices with feedback control, as well as miniaturised systems and combinations of PDT/lasers, nanotechnology agents/delivery, and alternative cooling methods (such as cryogenic gases), and integrated imaging.[14,22,28]

The development of new applications encompasses the management of cracked teeth and the treatment of root resorption, as well as enhanced outcomes for dental trauma, and improved cryoanalgesia and niche cryosurgery, including dentin modification for bonding and pediatric endodontic applications.[34]

Research needs to focus on conducting high-quality, long-term RCTs for VPT and REPs, as well as lesions, while performing protocol comparisons between treatment approaches. This should also involve exploring material interactions, developing real-time monitoring systems, and assessing patient-centred outcomes, along with sound health economic analyses.

CONCLUSION

The use of cryotherapy as a significant adjunctive tool in the field of endodontics is now firmly established through the body's natural physiological responses too cold for tangible clinical benefits. The most common method of application is through vasoconstrictive, cell metabolism-reducing, and nerve-conducting modulation, which provides significant analgesia, using methods such as intracanal cold saline irrigation. It is the strongest clinical evidence for its role in significantly diminishing postoperative pain after root canal treatment, and patients may have a more comfortable recovery period with less reliance on pharmacological interventions. It offers patient satisfaction non-invasively and non-pharmacologically and fits comfortably within the real world of contemporary minimally invasive and biologically based treatment philosophies. It should be emphasised, however, that cryotherapy is a complement, not a replacement, for meticulous conventional procedures such as cleaning, shaping, and disinfection. Nevertheless, it offers clinicians a valuable, generally safe, and often cost-effective means to improve immediate treatment outcomes, especially regarding patient comfort and inflammation control.

The potential of cryotherapy in endodontics is not limited to its well-documented applications in the present. To date, research suggests that it may be helpful in other, more complex and delicate situations, such as vital pulp therapy for the preservation of pulp health, regenerative endodontics with the intent of regenerating functional tissue, and even the contentious management of cracked teeth or medical trauma. Recent technological advances enable the development of more precise, real-time temperature control and delivery systems of novel designs. However, they are expected to further bolster refinements of existing, safety margin-enhancing techniques, although they may ultimately open up other, entirely new therapeutic avenues. However, due to this, full realisation of this potential still requires continued rigorous, high-quality investigation. Since there are multiple, diverse applications and it will take decades to perform large scale, long term clinical trials to validate efficacy beyond short term pain control and to fully elucidate the complex mechanism on the cellular and molecular level, future research needs to be prioritized to establish optimized, standardized protocols, to complete this work, on what will now become a broad spectrum of applications. Careful, evidence-based integration of cryotherapy will continue to be explored and will evolve responsibly so that cryotherapy can be maximised to enhance endodontic care on a global scale.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Belitsky RB, Odam SJ, Hubley-Kozey C. Evaluation of the effectiveness of wet ice, dry ice, and cryogenic packs in reducing skin temperature. Phys Ther. 1987;67(7):1080-4.
2. Hubbard TJ, Denegar CR. Does cryotherapy improve outcomes with soft tissue injury? J Athl Train. 2004;39(3):278-9.
3. Balasubramanian SK, Vinayachandran D. Cryotherapy – a panacea for post-operative pain following endodontic treatment. Acta Sci Dent Sci. 2017;1(1):1-3.
4. Salmassy DA, Pogrel MA. Liquid nitrogen cryosurgery and immediate bone grafting in the management of aggressive primary jaw lesions. J Oral Maxillofac Surg. 1995;53(7):784-90.
5. 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):395-9.
6. Fayyad DM, Abdelsalam N, Hashem N. Cryotherapy: a new paradigm of treatment in endodontics. J Endod. 2020;46(7):936-42.
7. 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.
8. Franz DN, Iggo A. Conduction failure in myelinated and non-myelinated axons at low temperatures. J Physiol. 1968;199(2):319-45.
9. Rosenberg PA. Clinical strategies for managing endodontic pain. Endod Top. 2002;3(1):78-92.
10. Blicher B, Pryles R, Lin J. Endodontics review: a study guide. Hanover Park (IL): Quintessence Publishing. 2016;45-66.
11. Sathorn C, Parashos P, Messer H. The prevalence of postoperative pain and flare-up in single- and multiple-visit endodontic treatment: a systematic review. Int Endod J. 2008;41(2):91-9.
12. Vera J, Ochoa-Rivera J, Vazquez-Carcaño M, Romero M, Arias A, Sleiman P, et al. Effect of intracanal cryotherapy on reducing root surface temperature. J Endod. 2015;41(11):1884-7.
13. Keskin C, Ozdemir O, Uzun I, Bal Z. Effect of intracanal cryotherapy on pain after single-visit root canal treatment. Aust Endod J. 2017;43(2):83-8.
14. Al-Nahlawi T, Hatab TA, Alrazak MA, Mahmoud SA. Effect of intracanal cryotherapy and negative irrigation technique on postendodontic pain. J Contemp Dent Pract. 2016;17(12):990-6.
15. Bazaid DS, Kenawi LM. The effect of intracanal cryotherapy in reducing postoperative pain in patients with irreversible pulpitis: a randomized control trial. Int J Health Sci. 2018;12(1):83-8.
16. Jain A, Davis D, Bahuguna R, Anand S. Role of cryotherapy in reducing postoperative pain in patients with irreversible pulpitis: an in vivo study. Int J Dent Med Sci. 2018;2:43-9.
17. Sadaf D. Limited quality evidence suggests that application of cryotherapy may be helpful in reducing postoperative pain in root canal therapy in patients with symptomatic apical periodontitis. J Evid Based Dent Pract. 2019;19(2):195-7.
18. Alharthi AA, Aljoudi MH, Almaliki MN, AlQahtani MA. Effect of intracanal cryotherapy on post-endodontic pain in single-visit RCT: a randomized controlled trial. Saudi Dent J. 2019;31(3):330-5.
19. Vieyra JP, Enriquez FJJ, Acosta FO, Molina JB. Reduction of postendodontic pain after one-visit root canal treatment using three irrigating regimens with different temperature. Niger J Clin Pract. 2019;22(1):34-40.
20. Vera J, Ochoa J, Romero M, Vazquez-Carcaño M, Ramos-Gregorio C, Aguilar R, 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.
21. Al-Abdullah A, Abdullah A, Al-Marrawi K. Comparative study to investigate the effect of cryotherapy on post-operative pain using two different preparation techniques. Int J Appl Dent Sci. 2020;6(3):163-8.
22. Thompson SA. An overview of nickel-titanium alloys used in dentistry. Int Endod J. 2000;33(4):297-310.
23. Brockhurst PJ, Denholm I. Hardness and strength of endodontic files and reamers. J Endod. 1996;22(2):68-70.

24. Brockhurst P, Hsu E. Hardness and strength of endodontic instruments made from NiTi alloy. Aust Endod J. 1998;24(3):115-9.
25. Lee DH, Park B, Saxena A, Serene PN. Enhanced surface hardness by boron implantation in nitinol alloy. J Endod. 1996;22(10):543-6.
26. Vinothkumar TS, Miglani R, Lakshminarayananan L. Influence of deep dry cryogenic treatment on cutting efficiency and wear resistance of nickel-titanium rotary endodontic instruments. J Endod. 2007;33(11):1355-8.
27. Kim JW, Griggs JA, Regan JD, Ellis SK. Effect of cryogenic treatment on nickel-titanium endodontic instruments. Int Endod J. 2005;38(6):364-71.
28. Bensely A, Prabhakaran A, Mohan Lal D, Nagarajan G. Enhancing the wear resistance of case carburized steel (En 353) by cryogenic treatment. Cryogenics. 2005;45(12):747-54.
29. Singh PJ, Guha B, Achar DRG. Fatigue life improvement of AISI 304L cruciform welded joints by cryogenic treatment. Eng Fail Anal. 2003;10(1):1-12.
30. Molinari A, Pellizzari M, Gialanella S, Straffelini G, Stiasny KH. Effect of cryogenic treatment on the mechanical properties of tool steels. J Mater Process Technol. 2001;118(1-3):350-5.
31. Moore K, Collins DN. Cryogenic treatment on three heat treated tool steels. Eng Mater. 1993;86:47-54.
32. Huang JY, Ahu YT, Liao XZ. Microstructure of cryogenic treated M2 tool steel. Mater Sci Eng A. 2003;339(1-2):241-4.
33. Sabet Y, Shahsiah S, Yazdizadeh M, Jafarzadeh M. Effect of deep cryogenic treatment on cyclic fatigue resistance of controlled memory wire nickel-titanium rotary instruments. Dent Res J (Isfahan). 2020;17(4):300-5.
34. George GK, Sanjeev K, Sekar M. An in vitro evaluation of the effect of deep dry cryotreatment on the cutting efficiency of three rotary nickel titanium instruments. J Conserv Dent. 2011;14(2):169-72.
35. Keskin C, Sariyilmaz E, Keleş A, Türker C. Effect of intracanal cryotherapy on the fracture resistance of endodontically treated teeth. Acta Odontol Scand. 2019;77(2):164-7.
36. Bahcall J, Johnson B, Xie Q, Montagnese C. Introduction to vital pulp cryotherapy. Endod Pract US. 2019;1:14.
37. Topçuoğlu HS, Arslan H, Topçuoğlu G, Semiz B. 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):965-9.
38. Mandras N, Allizond V, Bianco A, Banche M, Roana M, Tullio V. Antimicrobial efficacy of cryotreatment against Enterococcus faecalis in root canals. Lett Appl Microbiol. 2013;56(2):95-8.

Cite this article as: Sharanya AJ, Verma P, Rhythm. Cryotherapy in endodontics: a comprehensive review of applications, mechanisms, and future perspectives. Int J Res Med Sci 2025;13:5598-603.