

Cryotherapy - Following Intraoral Surgeries and for Treatment of Oral Lesions : A Review

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ABSTRACT

Many intraoral surgeries that involve reflection of mucoperiosteal flaps with or without the removal of bone are followed by varying degrees of facial swelling. In an attempt to minimize or limit this swelling, many oral and maxillofacial surgeons and periodontists, advice patients to apply cold dressings to the affected side of the face during the first few hours after the operation. This regimen is advocated in many text books of oral and maxillofacial surgery and Periodontics. Cryotherapy has been used in Oral Medicine and Pathology for over 30 years.

Key words: Cryotherapy, Oral lesions, Intraoral surgeries.

INTRODUCTION

Hippocrates (460-377 BC) described the use of ice and snow packs as a local therapy for limiting edema and pain, which he employed prior to surgery. Similarly, Napoleon's personal surgeon, the military surgeon Dominique Jean Larre, described his experience, particularly in cases of amputation, with extremely low temperatures during their retreat from Moscow in 1812. British physician, Arnott in 1851 reported tissue destruction by freezing^{1,2,3}. Local cold application is used to control inflammation, pain and edema to reduce spasticity and to facilitate movement despite the frequent use of cooling in orthopedic rehabilitation and physiotherapy, as evidenced by the plethora of reports in the literature, there is paucity of scientific evidence in the oral & maxillofacial surgery literature to justify treatment that is largely applied in an empirical manner^{4, 5, 6}.

Indications of cryotherapy

Cryotherapy is prescribed commonly after

intraoral surgery to inhibit swellings and discomfort⁶. Cryotherapy has been indicated in the treatment of keratotic, hyperplastic, granulomatous, vascular, pigmented salivary gland lesions, mucoceles, haemangiomas, fibro-epithelial polyps, fibrous epulides and papillomas and for lesions of the lip such as mucoceles, haemangiomas or melanotic macules. Minimal scarring also contributes to the cosmetic effect².

Contra indications

Cryotherapy is contraindicated in patients suffering from cold hypersensitivities or intolerances, hypertension, Raynaud's disease, rheumatoid arthritis, arteriosclerosis, paroxysmal cold hemoglobinuria, cryoglobulinemia. Cold therapy should be employed with caution in very old or very young patients as they may frequently have impaired thermal regulation. These contra-indications certainly apply to peripheral limbs, though some of these may not be absolute contra-indications in the oral region, with its superior collateral blood supply^{1,6,8}.

Modes of cold application following intra oral surgery

There are numerous techniques to induce heat abstraction like ice packs, ice massage, ice wrapped in paper towel, gel pack, ice chips in plastic bag, ice in a wash cloth, melted ice water through wet towels, rubber ice bags. It is also beneficial to suck ice chips intermittently during the first 24 hours after intraoral surgery. These methods will keep the tissues cool and reduce inflammation and swelling ^{6,7}.

Physiological effects of cryotherapy

Temperature change

The first physiological response i.e. temperature change, to cold/ice pack works on the principle of conduction. Cryotherapy doesn't convey cold to tissues because cold is not transferable. In contrast, tissues lose heat because they warm the cold agent. Ebrall *et al.* (1992) advocated that using a wet ice pack, decreased skin warmth from 37°C to 7.6°C within 5 minutes and to 5°C within 10 minutes. The target temperatures that need to be reached to accomplish the desired physiological end point remained unsolved ^{7,9}.

Blood Flow (Hemodynamics)

Cold application results in vasoconstriction of blood vessels. After any surgery application of cold resulted in reduced hemorrhage and perfusion of fluids and ultimately resulted in decreased edema. Subsequent to vasoconstriction, there may be vasodilatation despite continued use of cold. This vasodilatation is referred to as a "*hunting response*" (occurs after 20-30 minutes) represents the flow of blood through arteriovenous anastomoses. Accordingly, it was suggested that ice should not be applied that long because it could induce a hunting response. *Know et al.* found that 20 minutes application of ice to the cheek was necessary to reduce buccal mucosal blood flow. But a 10 minute application did not show any significant change ^{7,10,11}.

Edema

Swelling can be caused by hemorrhage and/or edema. After an injury, bleeding usually stops within 5 minutes because of clotting. The greatest amount of swelling after oral surgery was recorded on second post-operative day or after 48-72 hours.

Decreased temperature also reduces tissue metabolism and permeability. Cold could prevent swelling, but cannot decrease the edema that is already present⁷.

Pain Reduction

A pronounced pain killing effect has been described following cryotherapy in connection with thoracic surgery, treatment of anal fissures, hernias, skin grafts, knee replacements, surgical removal of third molars and periodontal surgeries. Superficial nerves demonstrated the greatest nerve velocity and cold blocked sensory fibers before motor fibers. *De Jong et al* (1966) indicated that nerve transmission ceased between 9°C and 18°C. Some investigators indicated that an ice pack took upto 9 minutes to reduce the temperature to less than 13.6°C which is apparent threshold for analgesia. After cessation of cold therapy, when the temperature reached 15.6°C, pain was again felt if the skin was pricked with a pin ^{6,7,12}.

Stages of cryotherapy⁷

Following application of ice, four stages were described by Hocutt *et al* (1982):
 I stage - 1-3 minutes – No sensation to cold
 II stage - 2-7 minutes – Aching or burning feeling
 III stage - 5-12 minutes – Local numbness
 IV stage - >12 minutes – Deep dilatation.

Impact of cold on the skin

Cold therapy for > 30 min could induce frost bite. Frost bite is temporary or permanent damage of skin if subjected to 23°F (-5°C) or colder for an extended period of time. Factors other than temperature that influence frost bite development are method of cooling, length of cold administration and body part where it is applied ^{9,11}.

Length of intervals and durations of time for cold therapy

Lavelle & Synder (1985) limited cold therapy time to 10 min intervals instead of 20 min as it may achieve the same skin temperature but with less hunting response. *Meeusen & Lievens* also supported 10 min interval. They demonstrated that the permeability of lymphatic vessels increased after upto 10 min of cold therapy. *Malone et al* also limited cryotherapy to less than 20 minutes to avoid peripheral nerve damage. *Knight* proposed that if

cold is applied for 10 minutes, then it should be removed for 20 minutes (1:2 ratio) ^{7,11}.

Post surgical cryotherapy

Bastian et.al., assessed the usefulness of cryotherapy after III molar extractions with respect to pain control and swelling. They reported that there was significantly less pain and swelling after nitrous-oxide was applied directly to the bone. It was supported by Laureano Filho *et.al.* that cold applied for 30 min every 1.5 hours for 48 hours manifested less pain and swelling than the contra lateral side ^{9,11}.

Cryotherapy for treatment of oral lesions

The basic technique of cryotherapy stresses rapid cooling, slow thawing and repetition of the freezing process to maximize tissue destruction. Two methods are recognized:

- a) Closed system with the use of probes and nitrous oxide.
- b) An open system with the use of liquid nitrogen spray or a cotton tip.

Liquid nitrogen sprays & cotton swabs are more accessible to clinicians but are not suitable for use in the oral cavity due to lack of control over the temperature achieved within cells and the area of freezing, which makes this method hazardous to use intraorally. For most benign mucosal lesions, a 1-2 minute freeze cycle using a cryoprobe is sufficient, premalignant / malignant lesions need 2-3 minute freeze cycles and for smaller lesions 20-30 seconds cycles are adequate. In cases where hyperplastic tissue exists, freezing of the mass and then removing the bulk of tissue, followed by further freezing of the tissue base results in higher success rates ².

Tissue destruction following cryotherapy

During the freeze cycle as the temperature

drops, it is believed that extra cellular water undergoes crystallization. In addition, membrane lipids harden at low temperatures decreasing cell resistance to shrinkage. As extracellular stores of water diminish, the electrolyte concentration increases. In order to counter act this concentration gradient, intracellular water moves out of the cell, and this water becomes involved in the crystallization process. Also, intracellular ice formed remains trapped within the cellular membrane. As a result of these processes, intracellular electrolytes reach toxic levels, which become lethal to the cell. During a slow thaw cycle, cells at the periphery of the cryo lesion will take up excess electrolytes. To equalize this gradient, water enters the cell and can lead to swelling and lysis ^{2,8}.

Damage to tissues following cryotherapy of intra oral lesions

The epithelial basal layer is severely damaged, while the parabasal and intermediate layers of epithelium are affected less. Damage to muscle is observed 24 hrs post cryotherapy. Damage to collagen fibers is yet undetermined. Studies on bone show that it may be devitalized by cryotherapy. Cartilage is functionally intact after freezing cycles. The neuron is devitalized by freezing but the axon sheath is resistant to freezing and remains intact ¹³.

CONCLUSION

The efficacy and therapeutic value of treatment with cold has been debatable. Cryotherapy is extremely useful in patients for whom surgery is contraindicated. The scientific evidence from clinical trials is however fragmentary. It is concluded that ice therapy would provide several benefits, yet the evidence based approach to apply cryotherapy following intra oral surgical procedures should be established more convincingly.

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