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Review Article

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OZONE THERAPY IN DENTAL AND ORAL MEDICINE

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ABSTRACT

Three oxygen atoms make up ozone, a highly reactive substance that functions as both an oxidant and an oxidizer. It is present in the Earth's high atmosphere as a UV shield as well as on the ground level as an air pollutant and component of urban smog. Antioxidants like vitamins C and E are found in healthy cells and help prevent ozone oxidation. However, pathogens like bacteria have extremely small quantities of antioxidants in their membranes, which exposes them to ozone and causes cell membrane destruction. This paper investigates the composition, history, and application of ozone in dentistry across the globe. Wound healing, dental caries, oral lichen planus, gingivitis and periodontitis, halitosis, and osteonecrosis of the jaw have all been treated with ozone therapy thus far.

KEYWORDS: Ozone, Ozone Therapy, Dentistry, Oral Medicine, gingivitis, Halitosis, Periodontitis, Dental caries.

INTRODUCTION

Christian Friedrich Schonbein first identified ozone in 1840. Ozone is a highly reactive compound which is composed of 3 oxygen atoms and they act as an oxidant and oxidizer. Ozone acts as a protective layer from ultraviolet rays in the Earth's upper atmosphere. Ozone has been experimented for various aspects of dentistry, the first use was disinfecting operating rooms in 1856, ozone was used to purify blood in 1870, Edward fisch used ozone therapy to disinfect and heal wounds in dental surgeries with great success.[1] UV light from sunlight with a very high frequency catalyses both of these chemical processes. As a result, ozone in the stratosphere absorbs damaging B and C UV radiations that are directed towards the outer atmosphere from the sun.[13] Ozone is created in the troposphere by a complex chain of chemical processes. Nowadays, ozone is emerging as a novel adjuvant therapy in oral care. Ozone therapy improves patient acceptability since it is non-invasive, painless, and non-traumatic.[2]

Formation and Decomposition of ozone

Equations 1 and 2 describe how molecular O2 photo dissociates into individual, extremely reactive oxygen atoms that combine with another O2 to generate O2, or ozone. O3 interacts with both single and double bonds in an intermediate state.

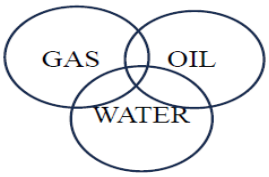
$$O2 \rightarrow 2O \quad (1)$$
$$Oxygen + O2 = O3 \quad (2)$$

Ozone radicalization can produce O3 •. O3 is protonated into HO3 in an aqueous solution, and HO3 subsequently breaks down into OH and O2. A generator is used to create ozone for medicinal applications by sending pure oxygen through a high voltage gradient of 5 to 13 mV. A gas mixture with 95% oxygen and 5% ozone is the end result. Toxic nitrogen dioxide may be produced in the combination if there is any air present. Ozone has a half-life of 40 minutes at 20°C, making it an extremely unstable gas that needs to be used right away. The generator needs to compute the exact concentrations of ozone in the mixture and have a reliable photometer. When ozone is utilized improperly or in excess, it can cause respiratory problems and be poisonous. Serious harm to the organism can result from the peroxidation of polyunsaturated fatty acids, which also oxidizes proteins, thiols, and amines.[15]

Application forms

There are various ways to deliver ozone

Ozone should not be administered intravenously because this could result in an air embolism.



Ozone generating system

The UV system, cold plasma system, and corona discharge system are the three ozone-generating systems.

Indications	Contraindications
1. Patients using ozonated water as a disinfection mouth rinse prior to treatment 2. The dental chair unit uses ozonated water to stop the growth of biofilm. 3. For oral prophylaxis, ozonated water can be utilized in the ultrasonic unit. 4. Ozone gas is applied prior to sealant placement. 5. Water application and ozone gas in root-surface caries 6. Ozone gas can be used both before and after cavity preparation. 7. Sterilizing the treated tooth with ozone gas during crown preparation 8. Lessen your sensitivity after surgery 9. By oxidizing the organic substance in dentinal tubules, ozone water or oil functions as a desensitizer. 10. Deep gingival and periodontal pockets can be irrigated with ozonated water.	1. Pregnancy 2. Hyperthyroidism 3. Thrombocytopenia 4. Immunocompromised patients 5. Severe anemia 6. Glucose 6 phosphate dehydrogenase deficiency 7. Alcohol intoxication 8. Myocardial infarction **9.** Hemorrhage **10.** Ozone allergy

Uses of ozone

Acceleration of healing

- Compared to patients who applied ordinary water and received no treatment, those who applied ozonized water to their wounds demonstrated faster wound healing and earlier wound closure.
- This could be because of the increased production of transforming growth factor beta 1 in the presence of ozone.[1]

Pain management

A study found that after oral surgery, pain levels were significantly reduced when ozone therapy and laser application therapy were combined. Pain control is crucial to dental surgery since it can have a long-term detrimental effect on the patient's quality of life.

Management of dental caries

The use of ozone is one method for reducing dental cavities. One might incorporate ozone into a regimen of preventive therapy for dental caries. Studies have demonstrated that non-cavitary root caries can be stopped in their tracks, hence avoiding extraction. The protocol is applying ozone for 40 seconds and then using remineralizing chemicals. Application of ozone to cavitated lesions is less likely to be successful. Ozone treatment can control more tooth demineralization since caries pyruvate accelerates the process.[17]

Root canal therapy

Once the blood vessels and nerves are removed from the roots, ozone is used to sterilize them. However, since bacteria can thrive in unfavorable environments, just draining the root canal is not the best way to stop bacterial growth. Regrowth of the bacteria may result in worsening issues. Ozone can disinfect the canals and keep them clean for a year, according to studies. According to a University of Zagreb study, ozone treatment significantly reduces the amounts of Propionibacterium acnes and Streptococcus mitis. When the least amount of organic material is left behind, this therapy works best. Ozonized water or ozone gas may be used. The reason this approach works so well is that oxygen poisons the microaerophilic and anaerobic bacteria.[1]

Dentin hypersensitivity

Dentin hypersensitivity is typically linked to persistent issues during pupal development. When exposed dentin comes into contact with heat, tactile, evaporative, chemical, or osmotic stimuli, it produces brief, sharp aches. After the stimuli are eliminated, there can be a persistent aching ache. According to the hydrodynamic theory, dentin is permeable throughout the tubules, and sensitivity rises with an increase in dentinal fluid flow or permeability. A corroborating investigation demonstrated that ozone treatment resulted in an average 55% reduction in pain intensity.

Gingivitis and Periodontitis

- Periodontitis and gingivitis are frequent inflammatory gum illnesses. They are a primary cause of infection-related tooth loss. It may result in malocclusion, bleeding, pus, loose teeth, sensitivity,

and swelling or soreness. Ozonated water can be used as an irrigant during the surgical procedure to remove loose or diseased teeth.

- To reduce the risk of infection, a thin layer of ozonated oil can be placed to the sutures three or four times a day. Gaseous or aqueous ozone can be used as an irrigant during curettage and debridement if the patient has peri-implantitis. Ozone treatment improved quality of life for deepithelialized gingival transplant recipients by reducing postoperative pain.

Implantology

- Protecting surgical wounds: The authors propose the use of ozonated oil to influence bone density and quality of dental implant integration, based on a study that found close contact between the surface of rabbit tibial implants and new bone growth around titanium implants in the treated group. Regarding the application method, each implant osteotomy site received 0.550 mL of ozonated sunflower oil to fill the space, and any extra oil was let to overflow over the surrounding soft tissues and bone. There has been no information provided regarding the concentration of ozone derivatives.

- Peri-implantitis, or the peri-im-plant tissues being destroyed Hauser-Ger-spach et al. discovered similar results. They used gaseous ozone to cure dental implants after colonizing them with bacteria. Samples were exposed to 2% chlorhexidine for 30 seconds as a control. Longer exposure times to gaseous ozone were likewise effective in lowering the detectable amount of P.gingivalis, while having no effect on the material's adherence or growth. Conversely, S. sanguinis was eradicated by chlorhexidine, and ozone decreased by more than 90%. The experimental setup involves applying gaseous ozone in vitro at 140 ppm and 2 L/min for 6 and 24 seconds.

Preservation of any type of sutured post-surgical wounds in the oral cavity

A case involving a 42-year-old female patient with a 10x14 mm exophytic fibrous lesion on her gingiva that was ulcerated and caused mild to moderate pain was described by Patel and Gujjari. Pretreatment with ozone involved obtaining a tiny tissue mass. Two milliliters of ozonated olive oil were used. The patient was instructed to apply the same amount three times a day, after meals, for seven days. There were no prescriptions for analgesics or antibiotics. Subsequently, the lesion was treated with 0.5 mL of ozonated oil, and the gingival lesion was completely excised while under local anesthetic. Less bleeding than normal was recorded by the authors, and a histopathological and visual examination revealed a chronic inform post ozone treatment.

Ozone's impact on dental hard tissues

The bacterial population in active carious lesions may be reduced by ozone. It may temporarily halt the development of cavities in enamel or dentin to avoid or postpone the need for tooth repair. Studies on the effects of ozone on open caries, pit and fissure caries, non-cavitated occlusal carious lesions, and primary root caries are now available. The number of microorganisms in the carious lesions in vivo and in vitro was significantly reduced, according to the short-term follow-up studies. Ozone is recommended for use in endodontic therapy due to its oxidative activity against bacterial strains such Enterococcus faecalis and Candida albicans. An additional application of ozone is treating dentin hypersensitivity.

Ozone's function in periodontics and oral medicine

- The potential effectiveness of ozone therapy in combating Candida species and periodontal infections is a crucial factor to take into account when evaluating its use in dentistry. The antibacterial qualities of ozone and its potential as an adjuvant treatment for a number of oral illnesses, such as oral candidiasis and periodontal diseases, have been the subject of numerous research. Applying ozone to the oral cavity can have antimicrobial effects because it breaks down germs' cell walls and interferes with their metabolism.

Safety, Toxicity, Contraindications

- Like many other medications, ozone is a valuable therapeutic agent, but its effects are limited to when it is taken as directed and in regulated environments. Heal Ozone is the sole instrument used to treat dental caries in the literature that has been published. They do, however, carry a considerable danger to patient safety and operator safety. HealOzone is the only device certified for intraoral usage due to its distribution system's design, which guarantees an adequate and full ozone seal. Furthermore, there were no negative effects indicated in any of the published clinical investigations.
- The safety of using the two ozone-generating devices in dentistry was evaluated by Millar and Hodson. HealOzone and the Ozi-cure devices were these. After applying gas, the two devices were compared based on the amount of ozone leakage. They came to the conclusion that while the Ozi-cure gadget shouldn't be utilized, the HealOzone was safe.

The fact that there aren't many reasons not to use ozone therapy is worth emphasizing. Ozone therapy is not recommended for patients with favism, a lack of the glucose–6 dehydrogenase phosphate (G6PD) enzyme. This is due to the fact that this enzyme is essential for both the glutathione system's operation and the oxidation of lipoperoxides. Other contraindications include severe anemia, severe myasthenia, ozone allergy, recent

myocardial infarction, thrombocytopenia, cardiovascular issues, convulsions, bleeding from any organ, and acute alcohol intoxication. Furthermore, because ozone therapy has not been properly evaluated, it is not advised during pregnancy. The direct intravenous administration of O2/O3, which has been forbidden by the European Society of Ozone Therapy since 1983, therefore resulted in a pulmonary embolism. Patients with ozone poisoning need to lie down, breathe in humid oxygen, and take N-acetylcysteine, vitamin E, and ascorbic acid/vitamin C.

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