



Ozone in Dentistry: A Narrative Review

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Abstract

Since more than a century ago, the allotropic form of oxygen known as ozone has been utilized successfully to treat a variety of ailments. Ozone therapy is an alternative medical procedure that utilizes the administration of ozone into the body to improve the amount of oxygen to the body in the current era of rising antibiotic resistance. Due to its advantageous biological characteristics, such as its antibacterial and immune-stimulating effects, ozone therapy has expanded the range of therapeutic options for patients of all ages with dental diseases. The objective of the present review of literature is to discuss use of ozone in dentistry.

Keywords: *Ozone, Dental application, Use of ozone.*

Introduction

As a more energetic version of atmospheric oxygen (O₂) made up of 3 oxygen atoms, ozone (O₃) is often referred to as trioxygen or triatomic oxygen. Its root is the odorant-denoting Greek word "Ozein." Due to its natural occurrence in the atmosphere, which surrounds the world at an altitude of between 50,000 and 100,000 feet, it plays a protective role in the ecological equilibrium of the planet.¹ When high energy ultraviolet light strikes an oxygen molecule in the stratosphere, it splits into two free oxygen atoms; these free oxygen atoms then collide with oxygen molecules, producing ozone. It is frequently caused by thunder and lightning and is renowned for interacting with ground-level industrial pollution.^[1,2]

Ozone, a blue gas with a concentration of 16–20 mg/m in the stratosphere, is widely distributed there. It quickly releases the developing oxygen molecule to become oxygen gas, which is why it is regarded as an unstable gas. Due to its instability, it has the largest oxidation potential when used as an antibacterial agent, which is roughly 150% higher than that of chlorine. Due to its potent oxidizing abilities, ozone is now used in the disciplines of medicine and dentistry.^[3-5]

The oral cavity appears to be an open environment with a dynamic balance between microbe entry, colonization mechanisms, and host defenses intended to keep them out: Bacteria must attach to either epithelium surfaces or hard dental surfaces in order to avoid eradication. The production and maintenance of oral biofilms as well as the internal selection of particular microbes have been linked to some of the most prevalent oral diseases, including dental caries, periodontal disease, and peri-

implantitis. The traditional approaches for periodontal therapy have been mechanical removal of the biofilm and supplementary use of antibiotic disinfectants or other antibiotics. In comparison to current conventional therapeutic methods that apply a minimally invasive and conservative approach to dental care, ozone therapy has proven to be more helpful. Exposing the ozone's chemical mechanisms also helps dentistry work practically. The objective of present review of literature is to discuss use of ozone in dentistry.

Mechanism of Action[7-9]

Antibacterial Effect: Ozone has an antimicrobial effect that renders bacteria, viruses, fungus, and protozoa inactive. First, due to the ozonolysis of double bonds, it damages the bacterial cell membrane. It also has a secondary oxidant impact, which causes phospholipid and lipoprotein to oxidize. Ozone affects Gram-positive bacteria differently than Gram-negative bacteria. Due to its antioxidative property, human body cells are resistant to antimicrobial activity, limiting their effectiveness to bacteria exclusively.

Immune Stimulating: Ozone enhances the production of immunoglobulins and immunocompetent cells, which in turn influences the cellular and humoral immune systems. It boosts the response of bacteria to phagocytosis and promotes the function of macrophages. Additionally, it triggers the cytokine synthesis and activation of additional immune cells. Interleukins, prostaglandins, and leukotrienes are produced as a result, which aids in the reduction of inflammation and the healing of wounds.

Anti Hypoxic Effect: Ozone's anti-hypoxic impact alters cellular metabolism by increasing the partial pressure of oxygen in tissues, which enhances the blood's ability to transport oxygen. Ozone improves the metabolism of injured tissues by increasing oxygenation and decreasing local inflammatory processes.

Analgesic Action: Ozone has analgesic and detoxifying properties because it triggers the release of vasodilators like NO, which dilates venules and arterioles.

Application in Dentistry

Management of Dental Caries: A majority of adults as well as many school-aged children suffer from dental caries, a serious issue with oral health. Dental caries is brought on by the human odontopathogens *Streptococcus mutans* and *Streptococcus sobrinus*. *Streptococcus mutans* colonization can inevitably lead to decay if it develops within the tooth's deep cracks, whereas *Streptococcus sobrinus* is mostly responsible for decay on the tooth's smooth surface.^[10] However, there was a noticeable decrease in ozone-treated samples when these bacteria were exposed to ozone via an ozone-generating equipment.^[11] Controlling dental caries requires a variety of strategies, such as avoiding the adhesion of cariogenic bacteria, altering cell signaling processes, boosting host defenses, and more. The use of ozone is one method for preventing dental cavities. Ozone can be used in a preventative care routine for root caries. Trials have shown that non-cavitory root caries can be reversed and arrested of progression which eliminates the need for removal. The routine includes application of ozone for 40 seconds, following with the use of remineralizing products.^[12] Cavitated lesions are less likely to be successful with ozone application.^[13] As caries pyruvate contributes to the progression of tooth demineralization, ozone application can manage further tooth demineralization.^[14,15]

Ozone in Oral Lesion: Topical ozone therapy has been used to study herpes lesions. Mandibular osteomyelitis and herpes labialis treated with ozonated oil recovered more quickly than with traditional treatments. In these situations, ozone directly neutralizes herpes virions, preventing bactericidal suprainfections and promoting tissue healing by circulatory prompting. One of the most effective oxidants we can utilize in dentistry is ozone, according to research.^[16-18]

Wound Healing: Interleukins, prostaglandins, and leukotrienes are the proteins synthesized by ozone that help in cell growth and differentiation in reduction of inflammation and wound healing. Ozone application initiates early healing of wounds by improving properties of erythrocytes, and facilitating oxygen release in the tissues. Ozone causes more blood supply to the ischemic zones caused due to surgical interventions like tooth extractions and implant placement.^[19]

University of Basel, Switzerland conducted a study of immunohistochemical, and micromorphological examinations of the wounds of the oral mucosa in which it was found that the patients who applied ozonized water on their wounds showed an acceleration of wound healing and earlier wound closing than patients who applied regular water and did not receive treatment.^[20]

Dentinal Hypersensitivity: Applying ozone spray repeatedly for 60 seconds, followed by mineral wash on the exposed dentine, quickly and effectively relieves root hypersensitivity. The smear layer covering the exposed root surfaces prevents the deep penetration of ionic calcium and fluoride into the dentinal tubules. Ozone's elimination of the smear layer widens the diameter of the dentinal tubules, opening them up and allowing calcium and fluoride ions to readily and profoundly enter. The fluid exchange through these dentinal tubules is halted by plugging them. Ozone can successfully end the underlying sensitivity issue in a matter of seconds, and the effects last longer than those achieved through conventional techniques.[21]

Ozone in Pediatric Dentistry: The use of ozone therapy in pediatric settings is primarily supported by the fact that applying ozone is a rapid, simple, painless, and successful technique. These elements of the therapy significantly increase patient compliance and treatment tolerance while also improving operator efficiency. The key to a good pediatric treatment, which can be very successfully accompanied by employing ozone therapy, is developing a positive rapport with a kid patient. Trauma to the teeth is one of the most common situations in pediatric dentistry. Human oral epithelial cells, gingival fibroblast cells, and periodontal cells have all been found to be highly biocompatible with aqueous ozone. Ozonated water is indicated in replantation of avulsed tooth without any harmful effect on periodontal cells.[22]

Ozone in Periodontal Diseases: Ozone functions as a subgingival irrigant in periodontal therapy due to its bactericidal and therapeutic qualities. In patients with chronic periodontitis, Dodwad et al. (2011) examined the effectiveness of ozonated water, 0.2% chlorhexidine, and 10% povidone-iodine as oral irrigants. According to the current study, ozonated water reduces all parameters more effectively than chlorhexidine and povidone-iodine. According to Nagayoshi et al., *Porphyromonas endodontalis* and *Porphyromonas gingivalis* were among the Gram-positive and Gram-negative species against which ozonated water was quite effective.[23]

Ozone has been found to be an effective treatment agent for periodontitis caused by fungi, viruses, and bacteria, according to research by Kshitish D et al. In order to restore a microorganism-free environment, the supragingival and subgingival tissues are currently cleaned during periodontitis treatment.[24] This makes the administration of ozone a viable and acceptable therapy choice. Ozone has been demonstrated to be bactericidal to periodontopathic organisms in vitro.[25]

Ozone in Endodontics: The use of ozone as an antibacterial in endodontics has enormous promise. When ozone is prescribed with the proper concentration, timing, and delivery into root canals following the conventional cleaning, shaping, and irrigation, it is beneficial. The literature has frequently reported on the possible use of ozone gas, ozonated water, and ozonized oil in endodontic therapy. Nagayoshi and others. (2004) discovered that ozonated water (0.5–4 mg/L) was incredibly effective at eliminating both gramme-positive and gramme-negative microorganisms. *Porphyromonas (P.) endodontalis* and *Porphyromonas gingivalis*, two gramme-negative bacteria, were significantly more susceptible to ozonated water than *C. albicans* and gramme-positive oral streptococci in pure culture.[26, 27]

Ozone in Implant Dentistry: In situations of peri-implantitis, ozone in aqueous or gaseous form may be employed. By slicing an adequate length of PVC or silicone cap, the abutment is completely covered. The implant's gingival margins need to be adequately sealed. Ozone gas infiltrations are another option in this circumstance. Ozonated water is used for irrigation during debridement and curettage. Application of ozonized oil on the treated areas three to four times per day is also suggested.[1]

Contraindication of Ozone1,[9]

- Acute alcohol intoxication
- Pregnancy
- Severe anemia
- Recent myocardial infarction
- Hyperthyroidism
- Active hemorrhage
- Thrombocytopenia
- Glucose-6-phosphate dehydrogenase deficiency (favism)
- Severe myasthenia
- Active hemorrhage
- Thrombocytopenia.

Ozone Toxicity: Ozone should never be inhaled due to the overwhelming evidence that it is extremely toxic to the bronchial-pulmonary system.[28] Mucosal cells in the respiratory tract lining fluid are highly susceptible to oxidation because the film that makes up the fluid is so thin, watery, and contains

so few antioxidants. Pulmonary embolism that happened during direct intravenous O₂/O₃ injection, a use that has been forbidden by the European Society of Ozonotherapy since 1983. Epiphora, upper respiratory irritation, rhinitis, coughing, headaches, infrequent nausea, and vomiting are all known adverse reactions.[29]

Ozone intoxication[30]

- Patient must be placed in supine position
- Vitamin E
- Ascorbic acid
- Inhale humid oxygen
- N-Acetylcysteine

Conclusion

Ozone therapy is significantly more affordable than conventional medical treatments like antibiotics and disinfectants; it will also significantly lower medical costs and invalidity. With the introduction of contemporary science to dental practice, dentistry is changing. In comparison to current conventional therapeutic methods that apply a minimally invasive and conservative approach to dental care, ozone therapy has proven to be more helpful. Exposing the ozone's chemical mechanisms also helps dentistry work practically. Patients who receive ozone therapy had much shorter treatment times overall and a more thorough bacterial eradication. With few side effects, the procedure is painless and improves the patients' toleration and fulfilment. Regulation of the uses and modes of treatment for ozone therapy necessitates more investigation.

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