

Review Article

Application of Ozone in Dentistry: A Review

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ABSTRACT:

Ozone (O₃) is a naturally occurring gaseous molecule made up of three oxygen atoms. Ozone has been used successfully for the management of various diseases for more than a decade. It has unique properties that includes immunomodulation, analgesic, detoxicating, antimicrobial, bioenergetic and biosynthetic actions. Application of ozone is painless, non-invasive in nature, and relative absence of discomfort and side effects increase the patient's acceptance and compliance thus making it an ideal treatment choice specially for pediatric and apprehensive patients. Present review of literature aims to discuss various application of ozone therapy in dentistry.

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INTRODUCTION

Ozone is a blue gas naturally present in stratosphere. It is made up of three oxygen atoms that give unstable oxygen gas which has highest oxidation potential. The highest oxidation potential of ozone leads to lyses of the outer membrane of the micro-organisms and therefore used in dentistry.¹ Ozone is an unstable gas releasing nascent oxygen which renders it useful in the field of medicine as an antimicrobial agent, immune, and metabolic modulator and is widely used for disinfection of medical and dental equipment as well as purification of water. The viability of Ozone against Gram-positive and Gram-negative bacteria, fungi and viruses make "Ozone therapy" an adaptable bio oxidative treatment in which ozone is dispensed through gas or dissolved in water or oil base to acquire therapeutic effects.^{2,3} Studies have shown ozone's effect on dental caries and primary root

caries, periodontal infection, disinfection of denture surfaces, wound healing and as an antimicrobial, antiviral, and antifungal agent in the oral cavity.^{3,4} Application of ozone is painless, non-invasive in nature, and relative absence of side effects and discomfort increase the patient's acceptance and compliance thus making it an ideal treatment choice specially for pediatric and apprehensive patients.⁵ Present review of literature aims to discuss various application of ozone therapy in dentistry.

PROPERTIES OF OZONE⁶

1. Ozone is an energized form of oxygen with the chemical formula O₃.
2. It is a strong oxidant.
3. Ozone is thermodynamically highly unstable compound that, depending on system conditions

- like temperature and pressure, decomposes to pure oxygen within a short life.
4. Molecular weight is 47.98g/mol.
 5. Pale blue gas, at -112°C condenses to form a dark blue liquid.
 6. It is slightly soluble in water and much more soluble in inert non polar solvents such as carbon tetrachloride and fluorocarbons where it forms 'blue' solution.
 7. 0.01ppm of ozone in air can be detected as it has a very specific sharp odor, somewhat resembling chlorine bleach.
 8. Exposure to 0.1 to 1ppm produces headache, burning eyes and irritation to the respiratory passages.

APPLICATIONS OF OZONE IN DENTISTRY

Dentists can apply ozone in the form of gas, water or oil. It has proven useful in treating a number of different dental problems:

According to Krammer, a German dentist, aqueous ozone can be used:

1. As a powerful disinfectant
2. To control bleeding
3. To cleanse wounds in bones and soft tissues
4. To improve healing by increasing the local supply of oxygen to the wound area
5. To increase the metabolic processes related to wound healing as ozonated water can increase the temperature in the wound area.

Due to these activities ozonated water can be used in candidiasis, gingivitis and as a disinfectant to rinse oral cavity. The use of ozone in dentistry described briefly below.^{7,8}

OZONE IN MANAGEMENT OF DENTAL CARIES

Ozone therapy has shown to be effective in reducing the number of microorganisms responsible for carious lesions, briefly follow ups of some in-vitro cases saw successful use of ozone for pit and fissure caries as well as in primary root caries cases. Ozone can convert acid produced by cariogenic microorganism into acetic acid which can buffer the cariogenic acid and promote remineralisation of the carious lesion. It has been suggested that the application of ozone to carious dental lesions will reverse these lesions and provide an alternative to conventional drilling and filling.⁹⁻¹¹

ROLE OF OZONE IN HYPERSENSITIVITY

Exposure of dentinal tubules with related symptoms of sensitivity is an extremely common problem in common dental practice that can be effectively managed by ozone therapy.

Delivering ozone spray for 60 sec followed by mineral wash onto the exposed dentine produce quick relief from root sensitivity, with a lasting effect. Smear layer present over the exposed root surface prevents deeper penetration of ionic Calcium and

Fluorine into the dentinal tubules. Ozone removes this smear layer, opens up the dentinal tubules, broadens their diameter and then Calcium and Fluoride ions flow into the tubules easily, deeply and effectively to plug the dentinal tubules, thereby preventing the fluid exchange through these tubules. Thus, ozone can effectively terminate the root sensitivity than using conventional methods.^{12,13}

OZONE AND PERIODONTAL DISEASES

Gingival and Periodontal diseases represent a major concern both in dentistry and medicine. The majority of the contributing factors and causes in the etiology of these diseases are reduced or treated with ozone in all its application forms (gas, water, oil). The beneficial biological effects of ozone, its anti-microbial activity, oxidation of bio-molecules precursors and microbial toxins implicated in periodontal diseases and its healing and tissue regeneration properties, make the use of ozone well indicated in all stages of gingival and periodontal diseases.¹⁴

OZONE IN PROSTHODONTICS

Denture stomatitis is routinely encountered in clinical practice which is a manifestation of plaque accumulation on the surface of the denture and hence effective denture plaque control should be initiated to prevent such outcomes. One successful method to do so is the use of ozone as denture cleaner. Denture stomatitis can be controlled by topical application of ozonated oil over tissue surface and over denture surface.^{15,16}

OZONE IN ENDODONTICS

Conventional endodontic therapy does not reach into all the microtubules which may harbour bacteria and their toxins. Ozone offers some of the best results seen to date in the treatment of internal tooth infections. Ozone gas in a ~4 g/m³ concentration (HealOzone; KaVo, Biberach, Germany) is used clinically for endodontic treatments. Nagayoshi et al. (2004) found that ozonated water (0.5–4 mg/L) was highly effective in killing both gram positive and negative micro-organisms. Gram negative bacteria, such as *Porphyromonas* (P.) *endodontalis* and *P. gingivalis* were substantially more sensitive to ozonated water than gram positive oral streptococci and *C. albicans* in pure culture.^{17,18}

USES IN ORAL SURGERY

Ozone is used from simple tooth extraction to large surgical procedures. Ozone increases oxygen release in the tissue by erythrocytes that leads to faster healing of wounds. It also leads to vasodilation and increase blood supply to the ischemic areas that leads to faster healing. Kazancioglu et al. (2014) concluded that ozone application reduces post-operative pain after 3rd molar surgery. Ozone has anti-hypoxia and haemostatic properties that overcome the use of

hyperbaric oxygen in osteomyelitis. Studies showed that ozone provides favourable environment by reducing inflammation and necrosis.^{19,20}

OZONE IN PEDIATRIC DENTISTRY

The application of Ozone therapy in the management of dental caries is widely studied. Most of the child patients have fear and anxiety towards dental treatment. Dahnhart JE et al. (2003) evaluated the anxiety level of children (and their parents) treated with ozone and found that all children & parents reported significant anxiety prior to ozone treatment. However, following the treatment, the children reported they would be pleased to return for future treatments.¹⁶

OZONE IN WOUND HEALING

Ozone reduces the post-extraction healing time by forming a pseudo-membrane over the socket, so protecting it from any physical and mechanical insults. Ozone therapy was found to be beneficial for the treatment of the refractory osteomyelitis in the head and neck in addition to treatment with antibiotics, surgery and hyperbaric oxygen. In alveolitis, there is accelerated healing by irrigation with ozonated water after removal of the necrotic pulp & debris under antibiotic coverage.¹⁷

USE OF OZONE FOR DECONTAMINATION OF TOOTHBRUSH

Ozone application was found to remove the toothbrushes bristles microbiota following conventional brushing.¹⁹

DENTAL UNIT WATER LINES DISINFECTION

Ozone can be used for Dental unit water lines purification and to minimize cross infection due to its antimicrobial efficiency and lack of side effects. In dental unit water lines, ozone achieved a 57 percent reduction in biofilm and a 65 percent reduction in viable bacteria in spite of a very low dosage and short time of application.¹⁹

OZONE IN IMPLANT DENTISTRY

Peri-implantitis is very bothering to both the dentist and the Patient. In cases of peri-implantitis, both forms of ozone can be used, gaseous or aqueous. Ozone gas is infiltrated via PVC or silicone caps that cover the abutment fully and is sealed around the gingival borders. Ozonated water is used to irrigate during debridement and curettage. Ozonized oil can also be used as a topical application over the treated areas 3-4 times a day.²³

DISCUSSION

The word ozone originates from the Greek word "ozein", which means odor and was first used in 1840 by German chemist Christian Friedrich Schonbein, 'the father of ozone therapy'. Ozone is a triatomic molecule of oxygen with powerful oxidative potential

which makes it a potent antimicrobial, antihypoxic, immunostimulating, analgesic, bioenergetic and biosynthetic agent, offering a wide range of therapeutic benefits, in various fields of medicine and dentistry.²⁴

Ozone is clinically easier, less expensive and faster when compared with other antimicrobial and oxidant caries treatments. Ozone should not be compared to conventional drilling and filling approaches. Since ozone is the most powerful antimicrobial and oxidant that can be used in dentistry thus fairly obvious that ozone should be used in combating the microorganisms associated with dental caries. Since aqueous ozone exhibits the highest level of biocompatibility compared to commonly used antiseptics, it should be considered for extensive use in this area of dentistry. Ozone should be considered an adjunct to existing treatment and preventive methods rather than an isolated treatment modality.²⁵

The ozone therapy has been more beneficial than present conventional therapeutics due to its multiple properties and uses in the field of dentistry. Also, it can be concluded that this therapy has very little contraindications such as Bleeding Organs, Thrombocytopenia, Uncontrolled hyperthyroidism, Acute alcohol intoxication, Pregnancy Ozone. However, further research is still needed to justify the routine uses of ozone in dentistry.⁷

CONCLUSION

Ozone therapy has been used in medical field successfully for treatment of various diseases. In recent time Ozone is used in almost all aspects of dentistry. It has unique properties that includes immunomodulation, analgesic, antihypnotic, detoxicating, antimicrobial, bioenergetic and biosynthetic actions. Main advantage with ozone is that it is biocompatible and side effects are less when given in proper ratio and judiciously.

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