

Review Article

Ozone Therapy: A New Paradigm in Periodontics

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Abstract:

The oral cavity appears as an open ecosystem, with a dynamic balance between the entrances of microorganisms, colonization modalities, and host defenses aimed to their removal. Gingival and Periodontal diseases represent a major concern both in dentistry and medicine. The oral biofilm formation and development, and the inside selection of specific microorganisms have been correlated with the most common oral pathologies, such as dental caries, periodontal disease, and peri-implantitis. The mechanical removal of the biofilm and adjunctive use of antibiotic disinfectants or various antibiotics have been the conventional methods for periodontal therapy. Ozone (O₃) is a triatomic molecule, consisting of three oxygen atoms, and its application in medicine and dentistry has been indicated for the treatment of 260 different pathologies. 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. The aim of this review article is to throw a light on the various aspects of basics of ozone therapy and discuss its application in the management of periodontal diseases.

Key words: Gingivitis; ozone therapy; periodontitis.

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Introduction

The word ozone comes from the Greek “ozein” meaning odorant.^[1] Ozone is a colorless gas form of oxygen and is present in atmosphere. It is one of the most important gases in the stratosphere due to its ability to filter ultraviolet rays, which is critical for the maintenance of biological balance in the biosphere. It has been used to purify water throughout the world for many years as it is highly effective in killing bacteria present in different forms.^[2] It is an unstable gas and it quickly gives up nascent Oxygen molecule to form Oxygen gas. Due to the property of releasing nascent Oxygen, it effectively kills bacteria, fungi, viruses and parasites at a lower concentration.^{[1],[2]}

Periodontitis is a destructive inflammatory disease of the supporting tissues of the teeth and is caused either by specific microorganisms or by a group of specific microorganisms, resulting in progressive destruction of periodontal ligament and alveolar bone with periodontal pocket formation, gingival recession, or both.^[3] To avoid elimination, bacteria need to adhere to either hard dental surfaces or epithelial surfaces and they are able to achieve this by the process of formation of oral biofilm.^[4] The mechanical removal of the biofilm and adjunctive use of antibiotic disinfectants or various antibiotics have been the conventional methods for periodontal

therapy. Ozone therapy is one of the modern non-medication methods of treatment.^{[3],[4]}

Ozone Therapy: Historical aspects

In 1785, Van Marum noticed that air near his electrostatic machine acquired a characteristic odor when electric sparks were passed. In 1801, Cruickshank observed the same odor at the anode during electrolysis of water. In 1840, Schonbein named the substance "Ozein" which is a Greek word for smell.^[2] However, it was not until 1932 that ozone was seriously studied by the scientific community, when ozonated water was used as a disinfectant by Dr. E.A. Fisch,^[5] a Swiss dentist. Fisch had the first idea to use ozone as either a gas or ozonated water in his practice. At the time, ozone therapy was difficult and limited due to the lack of ozone-resistant materials, such as Nylon, Dacron, and Teflon, until 1950 when ozoneresistant materials were manufactured. At that time Joachim Hänsler, a German physicist and physician, joined another German physician, Hans Wolff, to develop the first ozone generator for medical use. Their design continues to be the basis for modern equipment.^[1]

Ozone Therapy: Goals

The salient goals of ozone therapy include the following: inactivation and elimination of pathogens like bacteria, viruses, yeast, fungus and protozoa; purification of blood and lymph; reduction of inflammation and pain; improvement of circulation; improvement of brain function and memory; and simulation of the humoral anti-oxidant system.^{[1],[2],[4]}

Ozone Therapy: Mechanism of action

The physico-chemical properties of ozone are accredited for its application in Periodontics. Its known actions on human body are antimicrobial, analgesic, immunostimulating, antihypoxic and biosynthetic.^[2]

Anti microbial effect: It is known that ozone can kill bacteria by rupturing their cell membranes within a few seconds. In medicine and dentistry, ozone is used as a powerful sterilizing agent either in the gaseous or aqueous phase, as it successfully kills bacteria, fungi and viruses. Ozone has been found to have a bactericidal effect, particularly in staphylococcal, streptococcal and other infections.^[6]

Immunostimulating effect: Ozone influences cellular and humoral immune system. It stimulates proliferation of immunocompetent cells and synthesis of immunoglobulins. It also activates function of macrophages and increases sensitivity of microorganisms to phagocytosis. Ozone causes the synthesis of biologically active substances such as interleukins, leukotrienes, and prostaglandins which is beneficial in reducing inflammation and wound healing.^[4]

Antihypoxic effect: Ozone improves the transportation of oxygen in blood, which results in change of cellular metabolism activation of aerobic processes and use of energetic resources. Ozone improves the metabolism of inflamed tissues by increasing their oxygenation and reducing total inflammatory processes.^[4]

Biosynthetic effect: It activates mechanisms of protein synthesis increases amount of ribosomes and mitochondria in the cells. These changes on the cellular level explain elevation of functional activity and regeneration potential of tissues and organs.^[4]

Ozone Therapy: Ozone Generators

To produce therapeutic grade ozone, following ozone generators can be used: Ultraviolet system: it produces low concentrations of ozone and is used in esthetics, saunas and for air purification; Corona discharge system: it produces high concentrations of ozone, it is easy to handle and it has a high controlled ozone

production; and Cold plasma system: it is used in air and water purification.^{[1],[2]}

Ozone Therapy: Medical grade ozone

It is a mixture of pure oxygen and pure ozone in the ratio of 0.05% to 5% of O₃ and 95% to 99.95% of O₂. Due to the instability of the O₃ molecule, medical grade ozone must be prepared immediately before use. Within less than an hour after preparation only half of the mixture is still ozone while the other half is transformed into oxygen. As a result, it is impossible to store ozone over long periods of time. In order to control the decomposition of O₃ into oxygen it can be associated with a vehicle with aqueous properties to promote the conversion more quickly or with a vehicle with more viscous properties to retard the conversion.^[1]

Ozone Therapy: Potential Applications in Periodontal Therapy

Periodontitis is chronic gingivitis with associated loss of attachment. The development and course of periodontitis appears to be dependent upon specific inherited, behavioural or environmental conditions—so called risk factors and certain risk determinants (genetics, socioeconomic status and gender).^[6] It is a multifactorial disease process in the mouth. The role of microorganisms, host response, in the etiology of periodontal disease is well established. The undisputed disinfection power of ozone over other antiseptics makes the use of ozone in treatment of periodontitis a very good alternative and/or an additional disinfectant to standard antiseptics. Ozone can be used in various forms for treatment of periodontal disease: ozonated water, ozonized olive oil and gaseous ozone.^[2]

Thanomsub *et al.* 2002 tested the effects of ozone treatment on cell growth and ultra-structural changes in bacteria (*Escherichia coli*, *Salmonella sp.*, *Staphylococcus aureus* and *Bacillus subtilis*). It was discovered that ozone at 0.167 mg/min/l can be used to

sterilize water, which is contaminated with up to 10⁵ cfu/ml bacteria within 30 min. Destroying of bacterial cell membrane was observed, subsequently producing intercellular leakage and eventually causing cell lysis.^{[2],[7]}

Ozonated water (4 mg/l) was found effective for killing gram-positive and gram-negative oral microorganisms and oral *Candida albicans* in pure culture as well as bacteria in plaque biofilm and therefore might be useful as a mouth rinse to control oral infectious microorganisms in dental plaque. In implant dentistry, the use of ozone is currently being investigated for the decontamination of the implant surface in Peri-implant therapy.^[2]

Nagayoshi *et al.* examined the effect of ozonated water on oral microorganisms and dental plaque. Dental plaque samples were treated with 4mL of ozonated water for 10 s. they observed that ozonated water was effective for killing gram-positive and gram-negative oral microorganisms and oral *Candida Albicans* in pure culture as well as bacteria in plaque biofilm and therefore might be useful to control oral infectious microorganisms in dental plaque.^{[1],[8]}

Huth *et al.* in 2006, in their study declared that the aqueous form of ozone, as a potential antiseptic agent, showed less cytotoxicity than gaseous ozone or established antimicrobials (chlorhexidine digluconate [CHX]: 2%, 0.2%; sodium hypochlorite 5.25%, 2.25%; hydrogen peroxide-H₂O₂ 3%) under most conditions. Therefore, aqueous ozone fulfills optimal cell biological characteristics in terms of biocompatibility for oral application.^{[2],[9]}

Kronusova 2007 used ozone in following cases: Prevention of dental caries in fissures of the first permanent molars in children, application of ozone in prepared cavity, after tooth extraction, in case of post extractional complications, in patients with chronic gingivitis, periodontitis and periodontal abscesses, herpes labialis, purulent

periodontitis, dentition difficilis, etc., Almost all patients with gingivitis showed subjective and objective improvement of their status, as well as patients with periodontal abscess, where no exudation was observed. Application of ozone after tooth extraction was found also quite useful - only 10% of patients suffered from such complication as *alveolitis sicca*, but even in these cases the clinical course was shorter and more moderate.^{[2],[10]}

Huth, *et al.* in 2011 compared the effectiveness of ozone with that of the established antiseptic CHX, against periodontal microorganisms. There were no significant differences in the effectiveness of aqueous ozone (20 µg ml⁻¹) or gaseous ozone (≥4 g l⁻¹) compared with 2% CHX but they were more effective than 0.2% CHX. Therefore, high-concentrated gaseous and aqueous ozone merit further investigation as antiseptics in periodontitis therapy.^{[2],[11]}

Dodwad *et al.* in 2011 compared the effect of oral irrigation with ozonated water, 0.2% Chlorhexidine and 10% Povidone iodine in patients with chronic periodontitis. The study concluded that local ozone application can serve as potent atraumatic, antimicrobial agent to treat periodontal disease non-surgically both for home care and professional practice. It may also serve as good tool during supportive periodontal therapy.^{[2],[12]}

Conclusion

Dentistry is varying with induction of modern science to practice dentistry. The ozone therapy has been more beneficial than present conventional therapeutic modalities that follow a minimally invasive and conservative application to dental treatment.^[3] In contrast with traditional medicines and modalities such as antibiotics and disinfectants, ozone therapy is quite inexpensive, predictable and conservative.^[4]

References

1. Gupta G, Mansi B. Ozone therapy in periodontics. *Journal of Medicine and Life* 2012;5:59-67 .
2. Srikanth A, Sathish M, Harsha AVS. Application of ozone in the treatment of periodontal disease. *J Pharm Bioallied Sci* 2013;5:S89-94.
3. Saini R. Ozone therapy in dentistry: A strategic review. *J Nat Sci Biol Med* 2011;2:151-3.
4. Benita P. Ozone therapy – a new approach in periodontal management. *IOSR Journal of Dental and Medical Sciences* 2014;13:20-4.
5. Fish E. Apparatus for the production and use of ozone in therapeutics. United States Patent 2,054,367. September 15, 1936.
6. Iliadis D, Millar BJ. Ozone and its use in periodontal treatment. *Open Journal of Stomatology* 2013;3:197-202.
7. Thanomsab B, Anupunpisit V, Chanphetch S, Watcharachaipong T, Poonkhum R, Srisukonth C. Effects of ozone treatment on cell growth and ultrastructural changes in bacteria. *J Gen Appl Microbiol* 2002;48:193-9.
8. Nagayoshi M, Fukuizumi T, Kitamura C, Yano J, Terashita M, Nishihara T. Efficacy of ozone on survival and permeability of oral microorganisms. *Oral Microbiology & Immunology* 2004;19:240.
9. Huth KC, Jakob FM, Saugel B, Cappello C, Paschos E, Hollweck R, et al. Effect of ozone on oral cells compared with established antimicrobials. *Eur J Oral Sci* 2006;114:435–40.
10. Seidler V, Linetskiy I, Hubalkova H, Stankova H, Šmucler R, Mazanek J. Ozone and its usage in general medicine and dentistry. A review article. *Prague Medical Report* 2008;109:5–13.
11. Huth KC, Quirling M, Lenzke S, Paschos E, Kamereck K, Brand K, et al. Effectiveness of ozone against periodontal

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pathogenic microorganisms. Eur J Oral Sci 2011;119:204–10.

12. Dodwad V, Gupta S, Kumar K, Sethi M, Masamatti S. Changing paradigm in pocket therapy-ozone versus conventional irrigation. Int J Public Health Dent 2011;2:7–12.

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