



OZONE THERAPY- A PROMISING ADJUNCTIVE PERIODONTAL TREATMENT

Periodontics

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ABSTRACT

Gingival and periodontal diseases play a major role in dentistry. Periodontopathic bacteria is the main etiological factor. The use of ozone in dentistry has been proposed in dentistry because of its antimicrobial, disinfectant, biocompatibility and healing properties. The primary purpose of this article is to provide a general review about ozone therapy and its clinical application as a promising adjunctive therapy in periodontal treatment. This purpose would be of importance to the future researchers in terms of what has been tried and what the potentials are for the clinical application of ozone in Periodontics.

KEYWORDS

Ozone, Antimicrobial, Immunostimulating, Antihypoxic, Biosynthetic.

INTRODUCTION

The word ozone comes from the Greek "ozein" meaning odorous. Ozone (also known as triatomic oxygen and trioxigen) is an allotropic form of oxygen occurring naturally in the Earth's atmosphere. Roughly 90% of ozone is situated in the stratosphere at a stature of 10 to 17 kilometers and is alluded to as the ozone layer, while the leftover 10% is found in the lower atmosphere. The ozone layer ingests 97 to 99 percent of medium recurrence UV radiations (200 nm to 315 nm). Ozone (O₃), like oxygen (O₂), is boring, however it has an exceptionally solid smell. It is very scant in contrast with oxygen. It is accepted that around 2 million air atoms are O₂ and only three are ozone. Photolysis is the interaction through which ozone is shaped. When the sun's UV rays reach the O₂ atoms, they split the gas. The "Dobson Unit" is used to monitor stratospheric ozone from the ground (D.U). Normal ozone concentrations range from 300 to 350 D.U.¹

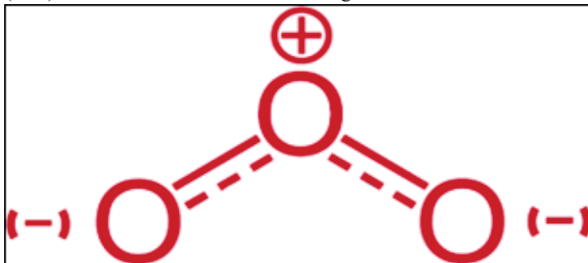


Figure 1: Chemical Structure of Ozone¹

As the amount of oxygen in the atmosphere varies, pure medical oxygen is used to create medical grade ozone. Climate-related air is mostly made up of nitrogen (N₂), which makes up 71%, oxygen (O₂), which makes up 28%, and other gases, such as ozone, which makes up 1%. These gases are influenced by temperature, altitude, and air pollution.²

Ozone, with its antibacterial, immunostimulatory, anti-inflammatory, and bioenergetic properties, has potential applications in dentistry and medicine.³ It is increasingly popular in periodontology due to its biocompatibility with fibroblasts, cementoblasts, and epithelial cells, making it a potential treatment for periodontal diseases like periodontitis. Ozone is often used as an adjuvant to scaling and root planing rather than SRP alone.⁴

History

Ozone treatment has been used since the 1800s. In 1896, Nikola Tesla founded the "Tesla Ozone Company" by obtaining a licence to operate the nation's primary O₃ generator. Aware of O₃'s antibacterial properties, doctors used it topically to polluted wounds during World War I (1914–18) when little other therapeutic resources were available. They discovered that O₃ not only healed illness but also had hemodynamic and moderating effects.⁵

In 1840, Schonbein came up with the name "ozone." When he subjected oxygen to electrical discharges, he noticed a "electrical stuff odour." Barely 16 years after its discovery, in 1856, ozone was first used in a medical setting to sterilise surgical instruments and clean the

operating room. The lack of ozone-safe polymers like Teflon, Dacron, and Nylon made ozone treatment difficult and limited before to 1950. German physician and researcher Joachim Hänsler collaborated with another physician, Hans Wolff, to create the first ozone generator for medical use. Their design still serves as the basis for many modern pieces of machinery. Its use and impact in the medical sector were changed by the Food and Drug Act in the early 20th century. E.A. Fisch, a German dental hygienist, pioneered the use of ozonated water for dental operations in 1950.⁶

Ozone Generators

Three different systems are there to generate the ozone they are as follows:

- Ultraviolet System: This system produces small amounts of ozone, which is used in cosmetics, saunas, and air purification.
- Cold Plasma System: This system is used to clean air and water.
- Corona Discharge System: This system generates massive amounts of ozone. It is the most commonly utilised framework in clinical and dental settings. It's simple to use and has a controlled ozone ageing rate.

Biological Actions

Anti-microbial Effect

Ozone works destructively against bacteria, fungi and viruses. The antimicrobial effect of ozone is a result of its action on cells by damaging its cytoplasmic membrane due to ozonolysis of dual bonds and also ozone-induced modification of intracellular contents because of secondary oxidant effects. This action is selective to microbial cells but does not damage human body cells because of their major antioxidative ability.⁷

Immunostimulating Effect

Ozone stimulates immune system proliferation, synthesis of immunoglobulins, macrophage function, and increases phagocytosis sensitivity. It reduces inflammation and aids wound healing, with high concentrations causing immunodepression.⁸

Antihypoxic Effect

Ozone improves the transportation of oxygen in blood, which results in change of cellular metabolism-activation of aerobic processes (glycolysis, Krebs cycle, β -oxidation of fatty acids) and use of energetic resources. Ozone improves the metabolism of inflamed tissues by increasing their oxygenation and reducing total inflammatory processes.⁹

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.¹⁰

Variants of Administration

Gaseous Ozone- Ozone can be used in gaseous form via an open system or via a sealing suction system to avoid inhalation and its adverse effects.

Ozonated Water- Ozonated water has been shown to be very effective against bacteria, fungi and viruses.

Ozonized Oil- In addition to gaseous and aqueous form, oils that are ozonized also seems extremely convenient. Though gaseous ozone was shown to have more effective microbicidal properties than aqueous form, due to its toxic effects if inhaled, ozonated water is the most preferred form for use in dentistry¹¹.

Goals of Ozone Therapy¹²

- Elimination of pathogens
- Restoration of proper oxygen metabolism.
- Induction of a friendly ecologic environment.
- Increased circulation.
- Immune activation.
- Stimulation of humoral anti-oxidant system.

Ozone Therapy in Periodontics¹³

Ozone is a good alternative and/or additional disinfectant to standard antiseptics because of its unrivalled disinfection potential. Periodontitis is a multi-factorial illness of mouth in which bacteria and the host's immune system play a role¹⁴. Periodontal disease is started and progressed by complicated interactions between periodontal bacteria and immune system cells.¹⁵

Ozone's antibacterial activity, oxidation of bio-particle precursors and microbial toxins implicated in periodontal illnesses, as well as mending and tissue recovery properties, make it a well-established treatment for all stages of gingival and periodontal diseases.¹⁶

Ozone is a very stable choice and a supplemental therapeutic modality to conventional sterilizers in the treatment of periodontitis, gingivitis, peri-implantitis, surgical wounds, and oral prophylaxis because of its unparalleled disinfection ability above other antiseptics. Root discomfort is instantly relieved by applying a mineral wash to the exposed dentine after a 60-second ozone spray. Aqueous or gaseous ozone may be used to treat peri-implantitis. The abutment is fully covered by cutting a long enough piece of silicone or PVC cap. The implant's gingival margins need to be properly sealed. Ozone gas infiltration may potentially be used in this situation. During debridement and curettage, ozonated water is utilized for irrigation. It is also advised to apply ozonized oil to the treated areas three to four times per day¹⁴.

Bacterial plaque that aggregated on teeth surfaces and made out of local oral verdure is the essential etiological specialist for periodontal sickness and dental caries which might bring about tooth misfortune whenever left untreated¹⁷. To treat oral infection and germs present in dental plaque and biofilm, ozonated water at a concentration of 4mg/ml is effective in destroying pathogenic gramme positive and gramme negative bacteria in mouth washes.

Ozonated water is less susceptible to Gram negative bacteria and plaque biofilms, reducing plaque formation on teeth. Combining professional teeth cleaning procedures with ozone water, such as scaling and root planing, improves the prognosis of gingivitis and periodontitis.

Applications of Ozone in Dentistry

- Biofilm purging (pathogen removal from biofilms)
- Periodontal pocket cleaning and osseous disinfection
- Avoiding dental caries
- Endodontic therapy
- Tooth sensitivity
- Temporomandibular joint therapy
- Gingival recession
- Pain management
- Infection prevention
- Rapid healing
- Regenerative surgeries
- Management of halitosis
- Tooth surface remineralization
- Teeth whitening

Other Applications of Ozone Therapy

- Cytoplasmic membrane damage
- Intracellular content oxidation
- Unique to microbial cells
- Effective against antibiotic-resistant strains
- Immunological stimulating
- a. stimulates humoral and cellular immune systems
- b. proliferation of immunocompliment cells

- c. immunoglobulin production
- d. increased phagocytosis activity
- e. activation of biologic antioxidants
 - Analgesic
 - Detoxicating and antihypoxic
 - Stimulation of aerobic processes (glycolysis, fatty acid oxidation, Krebs's cycle)
 - Bioenergetics and biosynthetics
- a. stimulates protein synthesis
- b. improves cell metabolism (ribosome, mitochondria)
- c. Synthesis of interlukins, leukotrienes, and other physiologically active compounds

Contraindications of Ozone Therapy

The ozone therapy should not be carried out in the following cases:

- In conditions after hemorrhage and hemorrhagic tendency,
- Convulsions and fits
- Mental diseases in the acute stage,
- Hyperfunction of thyroid,
- Poorly controlled diabetes,
- Myasthenia
- Pregnancy
- Deficiency of Glucose- 6- phoshate dehydrogenase
- Blood-clotting disorders such as haemophilia
- Constant consumption of anticoagulants
- Anemia
- Autoimmune disorders
- Myocardial infarction
- Ozone allergy

Ozone Toxicity

Harmfulness of Ozone inward breath can be destructive to the lungs and different organs. Epiphora and upper respiratory aggravation, rhinitis, hack, migraine, sickness, and spewing are totally known antagonistic impacts. Confusions with ozone treatment, then again, are very uncommon, happening just once per 0.0007 applications. In case of an ozone inebriation, the patient ought to be laid prostrate, given muggy oxygen, and given ascorbic corrosive, nutrient E, and n acetylcysteine. Due to ozone's extensive oxidative force, any materials that come into contact with gas, like glass, silicon, and Teflon, should be ozone resistant.¹²

CONCLUSION

Ozonation therapy is somewhat predictable, conservative, and less expensive than conventional medications and treatments like disinfectants and antibiotics. Compared to current conventional therapeutic techniques, ozone therapy has proven to be more advantageous. Using ozone therapy to treat patients reduces treatment duration significantly and more effectively eliminates bacterial counts. With very little negative side effects, the procedure is totally painless and improves the patients' tolerance and compliance. Even though more clinical research is needed to standardise ozone therapy's indications and treatment protocols, there are still a lot of promising or already proven approaches that should make ozone therapy a common treatment for dental operating site disinfection.

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