

Holistic Approach of Ozone in Dentistry

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Abstract:

Ozone is an inorganic molecule, in whichOzein, was named by Schonbein in 1840, which is refereed to odour in Greek. Ozonated water was used as disinfectant by a swiss dentist, Dr. E.A. Fisch,since then it has been proposed to be used in the field of dentistry. Ozone has an antimicrobial potential and immunostimulating effect which reduces the level of inflammation and pain, enhances blood circulation and stimulates the humoral antioxidant system. The wide level of advantages of ozone can be utilized in the management of many dental treatment procedures in the benefit of patients.Ozonated oil, water and gaseous ozone are mostly utilized in the treatment of the most common multi factorial disease i.e. periodontitis. Ozone influences the humoral and cellular immune system to generate synthesis of biologically active substances for the reduction of inflammation and promote better wound healing Ozonated water has become an undisputed disinfection agent in the management of periodontitis and has become good alternative for antiseptics.

The implementation of ozone reduces the cost in medical purpose. The induction of modern science for dental practice has been evolved by supplication of ozone in dentistry. The therapeutic modality of ozone follows a dental treatment conservatively and its minimally invasive use is advantageous in contrast to conventional methods.

INTRODUCTION

A molecule ozone, chemical formula O_3 , is a molecule which is inorganic and an allotrope of oxygen and is completely opposite to the diatomic allotrope O_2 that is more stable, glazing from the lower atmosphere to dioxygen and it consist of a gas pertaining a blue colour, also slightly pale with an extreme pungent odour. It is made with dioxygen due to the action of discharges sent by electrical and ultraviolet dispense. It's mostly reaching less concentration with in the atmosphere. Sun ultra violet radiation is mostly absorbed by the ozonosphere region of the atmosphere.⁽¹⁾

Odour released by ozone is extremely sharp, detectable by everyone at concentrations up to 100 ppb in air and including features like chlorine. The structure was ruled out by the year 1865 with a bent dual magnetic structure.

Ozone, in standard conditions acquire a pale blue gas which precipitates at a glacial temperatures into a navy liquid and ultimately a black and violet solid. The volatility of dioxygen is in such a manner that both concentrated liquid and gaseous ozone which disintegrate explosively at increased temperatures or rapid heating to the boiling point. It's therefore used commercially only in low concentrations. Though Ozone becomes a potential respiratory hazard and a pollutant near base level however, ultraviolet radiation is prevented by the presence of ozonosphere and provides protection from reaching the surface which becomes advantageous for plants and animals. It has a wide arena of properties which deals with the treatment modalities in dentistry and medicine for an easy way of disinfection and antimicrobial use.

Physical Characteristics

It is a colourless and soluble in water but extremely soluble in nonpolar solvents like carbon or fluorocarbons, leading to a formation of a blue solution. A Navy liquid is formed on condensation at 161K (-112 °C) and a violet black solid texture is formed at temperatures below 80 K. Both concentrated gaseous ozone and liquid ozone detonates considering its boiling point, referring it. Resemblance of chlorine bleach is evident due to its sharp odour of ozone in air in about 0.01 $\mu\text{mol/mol}$, which produces irritation to the airway, simultaneously burning eyes and irritation.⁽²⁾

It is hazardous to animal lung tissue and even plastics as it persist the property of destruction to organic tissues. Ozone molecule has the electrons paired, which becomes diamagnetic, whereas O_2 has the property of being paramagnetic.

Ozone Therapy: Historical aspects

Ozein, was named by Schonbein in 1840, which is refereed to odour in Greek.[2] Ozonated water was used as disinfectant by a swiss dentist, Dr. E.A. Fisch used ozonated water as a disinfectant which has been studying ozone since 1932, he has a key interest in proposing ozonated water as disinfectant. Previously, there was ultimate shortage of ozone impervious materials like, dacron, teflon and nylon up to 1950 until the manufacturing commenced. Two German physicians, Hans Wolff and Joachim

Hänsler,constructthe primary generator of ozone with the idea towards contemporary equipment for medical use. ⁽³⁾

Ozonetherapy:

There are aims of ozone related therapies which possess the succeeding properties such as removal of pathogens and restricting the actions of bacteria, yeast , protozoa and fungi; Such Ozone therapies can induce blood purification and also reducing the level of inflammation and pain; this enhances the circulation; stimulation of the humoral anti-oxidant system and improvement of brain function and memory. ⁽⁴⁾
The physical property of ozone treatment is beneficial to use in the treatment protocols of periodontics. There are immune-stimulating, antimicrobial, analgesic, biosynthetic and anti-hypoxic effects on the body. ⁽⁵⁾

Anti microbial effect:

Ozone has the property to rupture the cell membranes of the bacteria in a very less time. It is preferred as a sturdy disinfectant with in gaseous or aqueous phase due to its bactericidal property especially against staphylococcal, streptococcal infections and even destructing fungi and viruses in medicine and dental use. ⁽⁶⁾

Immunostimulating effect:

There is stimulation of the synthesis of immunoglobulins and enhancing the immunocompetent cells to proliferate leading to activating the sensitivity of microorganisms to phagocytosis. Ozone influences the humoral and cellular immune system to generate synthesis of biologically active substances for the reduction of inflammation and promote better wound healing. ⁽⁷⁾

Anti-hypoxic effect:

There is an extreme reduction of inflammation by a profuse increase in the oxygenation in the blood which leads to a variation in metabolism of cells and stimulation of aerobic procedures with a constant utilization of energy producing resources. ⁽⁷⁾

Biosynthetic effect:

There is a regeneration of tissues and organs and changes in the functional activity at a cellular level. Protein synthesis is one of the prime factors of enhancing body metabolism. ⁽⁸⁾

Ozone Therapy: Potential Application

Ozonated oil, water and gaseous ozone are mostly utilized in the treatment of the most common multi factorial disease i.e. periodontitis. Ozonated water has become an undisputed disinfection agent in the management of periodontitis and has become good alternative for antiseptics.

Ozonated water (4 mg/l) has been determined to become an effective medium to destruct oral candida albicans, gram positive and gram negative oral microorganisms in pure. Thus it can be a highly efficient moth rinse to restrict microbial growth in the oral cavity. Ozonated water measured in a quantity of 4ml and used as a mouth rinse for 10 seconds, as per the research

performed by Nagayoshi et al, it was determined as an effective damage to the gram positive, gram negative and c. albicans. Simultaneously, in dentistry, the utilization of ozone has been researched to be a good disinfectant of the surface of implants in the therapies of Peri implant.⁽⁹⁾

Ozone Gas has a potential antimicrobial application. There are various methods of its production such as,

- The ultraviolet system is used in air purification and aesthetic purpose, as it produces low concentration.
- The most administered high production of ozone is through Corona system. It has a controlled rate of production leading to its maximum utilization in medical/ dental field.
- Purification of air and water can be achieved by cold plasma system which is equipped in the most modern methods. In order to regulate the decomposition of O₃ into oxygen it are often related to a vehicle with aqueous properties to market the conversion more quickly or with a vehicle with more viscous properties to retard the conversion.⁽¹⁰⁾

Table 1: Potential applications of ozone therapy⁽¹¹⁾

Antimicrobial (bactericidal, viricidal, and fungicidal)
Damage to cytoplasmic membrane
Oxidation of intracellular contents
Specific to microbial cell
Effective in antibiotic resistive strain
Immuno-stimulating
Activates cellular and humoral immune system
Proliferation of immunocomplement cells
Synthesis of immunoglobulin's
Enhance phagocytosis activity
Activation of biological antioxidants
Analgesic
Anti-hypoxic and detoxicating
Activation of aerobic process (Krebs cycle, glycolysis, oxidation of fatty acids)
Bio-energetic and biosynthetic
Activates protein synthesis
Enhanced cell metabolism (Ribosome, mitochondria)
Biologically active substances
Synthesis of interleukins, leukotrienes and prostaglandins
Synthesis of immunoglobulin's

Vehicles of Ozone Administration:

1. Gaseous Ozone- One of the most integral part of management of dental caries in a non invasive approach is application of Ozone as a disinfectant placed prior to restorative material for 3 minutes, it can be even utilized as a therapy for hypo mineralized teeth. One of the finest method of restoring tooth and maintaining aesthetics in dentistry.⁽¹²⁾

Gaseous ozone has also proven to be a highly microbicide compared to the aqueous form but it has given evidence of toxic effects on inhalation.

2. Water – Water consisting ozone constituents has proven to be very effective against various microbes, viruses and fungi. It is also cost friendly as compared to other cleaners. Ozonated water is beneficial to control oral infections and pathogens.⁽¹³⁾

3. Oil – Ozone Oil has been determined to be microbicidal especially towards enterococci, staphylococci, streptococci, E.coli and also Mycobacteria.⁽¹⁴⁾ Oleozone and Bioperoxoil are ozonated oil which focuses on achieving the guidelines of Ozone utilization. Sunflower ozonated oil is highly accessible and convenient to use and its application in dentistry.

Table 2: Treatment modalities of ozone in Dentistry⁽¹¹⁾

Biofilm purging (Elimination of bacterial pathogens)
Periodontal pocket disinfection and osseous disinfection
Prevention of dental caries
Endodontic treatment
Tooth extraction
Tooth sensitivity
Tempromandibular joint treatment
Gum recession (exposed root surfaces)
Pain control
Infection control
Accelerated healing
Tissue regeneration
Controlling halitosis (Bad breath)
Remineralization of tooth surface
Teeth whitening (Bleaching)

Various Studies on Ozone Therapy

A Heal Ozone device has been accepted as an efficacious treatment of Caries such as pit and fissure, root caries etc. There are various opinions regarding the duration of time about the application of ozone gas. Oxidation therapy over the microbiota has been acknowledged in several studies. (15)99% of destruction of micro- organisms has been verified on using ozone gas in span of 20 seconds. The sealing ability of bonding system of dentin is not obstructed by ozone.(16)In in- vitro studies, Ozone set to be efficacious against the bacteria found in pulpal necrosis, and it gave no impact over the bacteria organized in biofilm structure. Now such variations in the results of the study occur due to differences in methodology due to lack of studies such as in vivo studies or Randomized trials. More evidence is required to be updated with its ozone properties. One of the most predominant study done by Vandana KL et al on the use of 0.2 % of chlorhexidine and ozonated water in the management of patient with periodontitis, a randomized trial including 16 subjects affected by generalized chronic periodontitis were included in the trial for 18 days. The trial concluded in a decrease in the percentage of 12% plaque Index, 29% gingival Index and 26% bleeding index. A microbial reduction of 25% of

Actinobacillus Actinomycetemcomitans (Aa) on using ozone was acknowledged as compared to the application of chlorhexidine.⁽¹⁷⁾

Another study was conducted Sandeep S Katti et al, for assessing the effects of ozone water on periodontal tissues clinically. The patients with pocket depth > 5mm were included in the study and ozonated water was delivered during their irrigation with recording of the clinical parameters at three intervals for a month. On application of ozone water, it acts as subgingival disinfectant and proven as an alternative in the treatment of periodontal therapy which has enhanced the treatment modality. It was concluded that Subgingival irrigation with ozonized water is beneficial adjunct treatment modality to enhance periodontal health with significant role in periodontal therapy.⁽¹⁸⁾

Due to the advancement in the growing evidence of ozone therapy which is proven to be highly aesthetically accepted in its use and a strong disinfectant for reducing the microbial colonies in the oral cavity especially Actinobacillus Actinomycetemcomitans, hence reducing the extent of periodontitis. Ozone could also be considered as an alternate management strategy grateful to its powerful ability to inactivate microorganisms. Its application is suitable for both medicine and dentistry.⁽¹⁹⁾

The diverse forms of Ozone have the tendency in stimulating circulation of blood and improving the natural defence mechanism. Such therapy has inflated oxidation potential and is a good antimicrobial agent against protozoa, viruses, fungi and bacteria. It can be massively use as an antimicrobial agent for clinical use due to it persist features of profuse ability to the treatment of 260 varied pathologies in medicine and dental therapies.⁽²⁰⁾

CONCLUSION:

The traditional approach of medicine such as antibiotics and disinfectants are not less economical as compared to the use of ozone. The implementation of ozone reduces the cost in medical purpose. The induction of modern science for dental practice has been evolved by supplication of ozone in dentistry. The therapeutic modality of ozone follows a dental treatment conservatively and its minimally invasive use which is advantageous in contrast to conventional methods. Health deficient can be recovered by ozonated treatment preventing the growth of microbial organisms determining as a good antimicrobial agent through various ozone modalities which has painless management, with the patients comfort and minimal adverse effects. Certain Controversies of such methods with contraindications cannot be overlooked. Various research activities should be conducted to regulate indications and management methods through ozone modalities.

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