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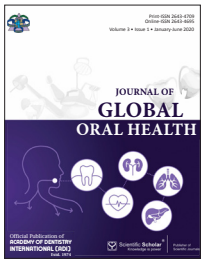

Review Article

Ozone – A versatile therapy in implant dentistry

Apoorva Salve[1], Salman Ansari[1], Deepti Gattani[1], Nupur Kar[1], Prajakta Heda[1]

[1]Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

***Corresponding author:**
Apoorva Salve,
Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

apoorvasalve@gmail.com

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ABSTRACT

Oral cavity is an open ecosystem for many microorganisms making the oral environment more prone to bacterial colonization. Several studies have indicated that accumulation of bacteria on implant surface is a primary etiology for inflammatory conditions around implants, apparently leading to peri-implant diseases. Peri-implantitis is an inflammatory process that affects the tissues around an osseointegrated implant in function, resulting in the loss of the supporting bone. Hence, proper decontamination and disinfection may aid in successful osseointegration of dental implants. Ozone (O3) is a triatomic molecule, consisting of three oxygen atoms with a wide range of valuable properties which have been proven to be effective for applications in dentistry. O3 is a powerful oxidative agent with bactericidal, virucidal, and fungicidal properties. It can be used in gaseous, liquid (water/soil), or nanoparticle form as an adjunctive therapy in the management of peri-implant diseases and to decontaminate the implant surfaces. The application of ozone therapy is a novel approach in implant dentistry with limited literature. Therefore, the objective of the present review is to assess the impact of ozone therapy on the dental implant procedures and peri-implant diseases.

Keywords: Ozone, Peri-implantitis, Implant, Decontamination

INTRODUCTION

The oral cavity is an open ecosystem for many microorganisms and is extremely prone to bacterial colonization. Several studies have indicated that accumulation of bacteria on implant surface is a primary etiology for inflammatory conditions around implants, apparently leading to peri-implant diseases. Peri-implant diseases are described as inflammatory processes in the tissues surrounding implants in response to predominantly microbial biofilms on the surface of the implants.[1] Peri-implantitis is a bacterial infection characterized by inflamed, swollen, and bleeding soft tissues resulting in suppuration and crater-like destruction of adjacent alveolar bone of an implant in function.[2,3] Decontamination of the rough surfaces of dental implants is a challenge in the treatment of peri-implantitis. For decontamination of dental implants, mechanical instruments such as dental curettes, ultrasonic devices and air-powder abrasives, laser treatment, and treatment with antiseptics and/or antibiotics are commonly used.[4-8] Surgical procedures aim to remove bacteria and to smoothen, decontaminate, and detoxify the implant surface. However, there is no consensus on the most effective protocol for implant surface detoxification.[9]

"Ozone" named by Schonbein, in the year 1840, is derived from the Greek word "Ozein" which means odorant. It is a three-atom molecule consisting of three oxygen atoms. It has been used in both an aqueous and gaseous form in medicine and dentistry.[10] It is a powerful oxidant with distinct antimicrobial activity and can act as metabolic and host immune modulator. Ozone in

periodontitis treatment is used as an adjunct to scaling and root planning (SRP) as compared to SRP alone.[11] It can be used in gaseous, liquid (water/soil), or nanoparticle form as an adjunctive therapy in the management of peri-implant diseases and to decontaminate the implant surfaces.

The application of ozone therapy is a novel approach in implant dentistry with limited literature. Therefore, the objective of the present review is to assess the impact of ozone therapy on the dental implant procedures and peri-implant diseases.

THERAPEUTIC GOALS OF OZONE THERAPY IN DENTISTRY

One of the important goals of ozone therapy is to eradicate the potential microorganisms causing the periodontal destruction. Ozone therapy induces antimicrobial, anti-inflammatory, and analgesic effects in the region of application. Hence, its other goal would be achieving these effects in the long term. It must also provide a strong anti-oxidizing effect. The therapy should activate both the cellular and humoral immune system and proliferation of immunocompetent cells along with the synthesis of immunoglobulins. It should also enhance the epithelial wound healing effect.

OZONE GENERATING SYSTEMS

Oxygen molecules in the air combine under the influence of factors such as ultraviolet radiation (from the sun) and electrical discharges (lightning).[12] For medical use highly specific, gazettes known as ozone generators are used for production of ozone. Medical grade oxygen is made to flow through high voltage tubes with outputs ranging from 4000 V to 14000 V.[12] The ozone generators work on one of the three systems: Ultraviolet light lamp, corona discharge, or cold plasma.[13-15] The two widely used ozone units used in dentistry are the healing ozone[16] and ozotop.[17] The common appliances which produce ozone for dental use include product photo (Prozone) by W&H with perio-tips and endo tips, OzonyTron by MYMED Gmb H, and HealOzone by KaVo.

ROUTES OF OZONE ADMINISTRATION

The application of ozone is procuring its place in the field of dentistry. With its versatile properties, it has also been used in implant dentistry. Three basic forms of application to oral tissue are applied: (1) Ozonated water, (2) ozonated oil, and (3) oxygen/ozone gas.[18]

The gaseous form can be administered through an open system or a sealing suction system to avoid inhalation and adverse effects. It can be used to decontaminate the implant surfaces in the management of peri-implant diseases. Ozonated water is very effective against bacteria, fungi, and viruses and is also less expensive compared to other chemical cleaners.[19] Ozonized sunflower or olive oil is effective against many bacterial and fungal infections in several studies.

MECHANISM OF ACTION

Ozone is a powerful oxidizer and very unstable at low temperatures. It is routinely used in human medicine to kill bacteria and fungi and to inactivate viruses.[11] The nascent oxygen released by the spontaneous breakdown of ozone combines with water molecules to form hydroxyl group which is a more powerful oxidizer.[20] Ozone gas has a high oxidation potential and is 1.5 times greater than chloride when used as an antimicrobial agent against bacteria, viruses, fungi, and protozoa. It also can stimulate blood circulation and the immune response.[21] 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 ozone-induced modification of intracellular contents (oxidation of proteins loss of organelle function) due to secondary oxidants effects. It stimulates proliferation of immunocompetent cells and synthesis of immunoglobulins.[22] By increasing the concentration of 2,3 diphosphoglycerate, ozone changes the configuration of erythrocytes, which enables them to return oxygen to the inflamed tissue.[23]

APPLICATIONS OF OZONE IN IMPLANT DENTISTRY

Due to the surface irregularities, dental implants are more prone to bacterial colonization which may result in bone destruction and implant loss. Hence, decontamination of dental implants is one of the major challenges while doing procedures and managing the peri-implant diseases. Ozone being a powerful oxidizer and antimicrobial agent can be a potential substitute for decontamination of implants. It can be utilized in disinfection of impression trays, preparation of implant osteotomy sites before implant, and salivary contamination of cover screw in subsequent visits. Ozone can also be employed in disinfection of gingival former, impression post, laboratory analogue, implant impression coping/scan body, abutment, crown, and bridge prosthesis and also to disinfect all implant instruments including hex drivers and torque ratchet. The utility of ozone can ultimately lead to promoting healing post implant placement as it increases blood supply to the healing implant site. It plays a pragmatic role in prevention of infection and enhancement of bone regeneration. It has to be bubbled into the socket for about 40 s for disinfection, followed by placement of the implant into the socket.[24]

Various forms of ozone have been proven to be effective in the treatment of peri-implant diseases. Gaseous ozone showed

selective efficacy to reduce adherent bacteria on titanium and zirconia without affecting adhesion and proliferation of osteoblastic cells.[25] Ozone water can also be used as a substitute for saline.

DISCUSSION

Ozone therapy is an advanced emerging technology in dentistry. Researchers have proved the beneficial biological effects of ozone, its antimicrobial activity, oxidation of biomolecule precursors, and microbial toxins implicated in periodontal diseases and its healing and tissue regeneration properties.

Shah *et al*., in 2018, concluded that ozonized water decontaminates the root surface with no negative effect on periodontal cells. One of the biological actions of ozone is its broad spectrum germicidal potency which enables its surface decontamination activity. Kshitish and Laxman (2010)[25] evaluated and compared the effects of oral irrigation with ozonated water to that of 0.2% chlorhexidine on the clinical parameters. A mean reduction in plaque index, gingival index, and bleeding index was observed in their study with ozone irrigation group.

Hauser-Gerspach *et al*. (2011),[26] in their *in vitro* study, investigated the antimicrobial efficacy of gaseous ozone on bacteria adhered to various titanium and zirconia surfaces and evaluated the adhesion of osteoblast-like MG-63 cells to ozone-treated surfaces. They concluded that three of the test surfaces, titanium (polished), and zirconia (acid etched or polished) yielded lower bacterial adhesion and, thus, may be suitable material for implant abutment. Application of gaseous ozone at 140 ppm for 24 s eliminated *Porphyromonas gingivalis* but not *Streptococcus sanguinis* to below detection limit from all surfaces. This ozone treatment did not negatively affect adhesion and proliferation of osteoblast-like MG-63 cells on the titanium and zirconia surfaces tested. Sacco and Campus (2016)[27] evaluated the clinical and microbiological effectiveness of local oxygen-ozone therapy in the treatment of patients with chronic periodontal disease and they found a significant reduction in probing depth and bleeding on probing.

Due to all the research done so far on the ozone therapy in dentistry, it can act as a promising solution for disinfection in implant dentistry.

CONCLUSION

Using modern science technology in rapidly evolving field of dentistry, ozone therapy can be an easy, quick, painless, and potential antimicrobial agent in implant dentistry. Further, clinical research is required to prove the efficacy of ozone therapy in implant dentistry.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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