

Ozone therapy and its role in periimplantitis

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Abstract

Implants have gained their focus as a replacement of missing teeth because of their high success rate, and long-term results. In spite of their high success rate, complications are sometimes encountered, leading to the development of peri implant diseases, i.e peri implant mucositis and periimplantitis and ultimately results in the failure of an implant. Since periimplantitis is caused because of the bacterial contamination, it should be managed by impeding the inflammation along with the decontamination of the implant thereby preventing the additional bone loss. Various decontamination

procedures like mechanical debridement, chemical therapy and surgical procedures are advocated, out of which mechanical debridement is most commonly opted, but this can damage the implant surface along with its metallic contamination. Therefore, certain materials like ozone can be utilized to increase the success rate along with improving the osseointegration. This article provides an overview regarding the application of ozone in the treatment of periimplantitis and summarizes the invitro and in vivo studies where in ozone is employed for the management of periimplantitis.

Keywords: Periimplantitis, Ozone therapy, Implants, Decontamination

Introduction

Replacement of the missing teeth, with an implant has gained its importance since they exhibit increased retention, stability, functional efficiency and improve quality of life, thus providing better long-term results.¹ Overall, the dental implants demonstrate a high success rate but they exhibit certain complications and develop peri-implant diseases.²

Peri-implant mucositis, is defined as “an inflammatory lesion of the mucosa surrounding an end osseous implant without loss of supporting peri-implant bone”.³ At times this Peri-implant mucositis may progress into Peri-implantitis, which can affect the treatment outcome and ultimately leads to implant failure.⁴

Peri-implantitis is marked by the destructive inflammatory process affecting the soft and hard tissues encircling an osseointegrated implant, thereby causing the formation of peri-implant pocket and reduction of supporting bone.⁵ Peri-implantitis can be managed by impeding the inflammatory process surrounding an implant and thereby, restricting additional loss of marginal bone.² Peri-implantitis therapy aims at resolving the inflammation surrounding an implant by

decontamination, while maintaining the implant-supporting tissues.⁶ Peri-implantitis is caused as a result of bacterial infection. So, the treatment of periimplantitis aims at eliminating the bacteria from the surface of an implant, and also to lower the colonization of the bacteria.⁷

Decontamination methods aim to eliminate the bacteria, smoothen, decontaminate, and detoxify the surface of an implant by mechanical debridement, chemical therapy and surgical procedures.⁶ In general, mechanical instruments are used to eliminate the bacteria from the subgingival implant surfaces, but in contrast these can damage the implant surface structure and can cause metallic contamination of the implant.⁷

Therefore, certain materials may be utilized to increase the success rate of implant survival. In various surgical procedures, where in the oral mucosa is involved, materials such as ozone (O₃) has been asserted to own properties that enhance the clinical outcomes.⁸

Ozone is utilized as a functionalizing agent with the motive of improving the osseointegration, about an implant surface both in dental and Orthopedics fields.³ Implant surface materials like zirconia and titanium has no adverse effect when treated with gaseous ozone.⁷

Table 1: history of ozone

Year	Name	Contribution
1785	Van Marum	Observed a peculiar odour from an electrostatic machine.
1801	Cruickshank	Spotted the same characteristic smell during water electrolysis. ⁹
1840	Schonbein	Coined the term “Ozein” (Greek meaning = smell)
1857	Werner Von Siemens	Created an ozone generator which was used in the medical field, starting with the disinfection of operating theatres- called as “Siemens type” ozone generator
1860	Monaco	ozone generator was utilized in the water treatment plant.
1870	Dr. C. Lender	Introduced in the medical field, for purifying blood in the test tubes
1901	Wiesbaden	ozone is utilized for municipal water purification. ¹⁰

1902	Medical Reform – a scientific journal	Ozone when used for the treatment of tuberculosis and wound care exhibited positive results.
1920	Dr. Edwin Parr	Started using ozone for disinfection.
1931	Dr. E.A. Fisch	For the first time used ozone in the form of ozonated water in the field of dentistry. ⁹

Forms of ozone

Different forms of ozone have been employed in the field of dentistry for numerous purposes:

Gaseous ozone: Acts as a fumigating agent therefore used for disinfection of operatories and instruments. when used against bacteria, viruses, fungi and protozoa it exhibited high oxidation potential.

Ozonated water: Causes rupture of cell wall of microorganisms associated with the lesion thus bringing about their rapid inactivation. Ozonated water when irrigated sub gingivally, plays a crucial part in periodontal treatment by minimizing inflammation of the gingiva, inhibiting attachment loss and thus enhances the periodontal health.

Ozone Nanobubbles: Ozone nanobubbles being miniscule in size, causes deeper perfusion, and in addition they release ozone together with the kinetic energy due to its cavitation effect, which disturbs the biofilms and results in destroying the microorganisms.

Ozonated Oil: It is prepared by passing pure oxygen and ozone through the pure plant extracts. ozonized Sunflower oil has proved efficacy against Staphylococci, Streptococcus, Enterococci, Pseudomonas and Mycobacteria.

Discussion

Role in implant dentistry

In addition to the bactericidal, virucidal and fungicidal properties, ozone also stimulates the blood flow and

thus, ozone therapy enhances the decontamination of an implant. Among different biological macromolecules, poly-unsaturated fatty acids and –SH groups are predominantly affected, where in proteins and the membranes are damaged because of the powerful oxidation effect of ozone. In inflammatory diseases like periimplantitis, it has been documented that ozone can be administered as a therapeutic agent. Resolution of periimplantitis can be achieved through the debridement of the implant surface with ozone application. In case of implant exposure, coverage with graft material along with ozone water irrigation resulted in the successful integration.¹¹ Prior to the placement of an implant, Ozone if bubbled for a duration of about 40sec in to the socket can prevent infections and also helps in bone regeneration. Matsamura K et al in his study found that there is periodontal cell regeneration surrounding implants treated with ozone similar to the periodontal cell regeneration encircling the natural teeth.¹²

Karapetian et al in his study, investigated the effectiveness of periimplantitis treatment methods, where he compared the conventional, surgical and ozone therapy effectiveness in periimplantitis patients. Results showed that the patients treated with ozone has superior treatment outcome in reducing the bacteria.¹³

There have been studies conducted to assess and evaluate the efficacy of ozone therapy on periimplantitis. (Refer Table-2)

Table 2

Sn.	Author	Aim/ objective	Results
1.	El Hadary AA, Yassin HH, Mekhemer ST, Holmes JC, Grootveld M (2011)	To assess the ozonated plant oil effect under Cyclosporin A (CsA) influence on the osseointegration.	Group administered with topical ozonated plant oil demonstrated better organization of mature bone and its osseointegration throughout dental implants. ¹⁴
2.	Arakawa S, Sugisawa M, Leewananthawet A – (2017)	Effect of Ozone nanobubble water (ONBW) on peri-implantitis lesions with non-surgical treatment was examined.	100ml of ozone nanobubble water presented no signs of inflammation, Bleeding on probing and presented with pocket depth of 3 mm. Following 12 weeks of the treatment, there is depletion of the periodontal bacteria (red complex). ¹⁵
3.	Isler SC, Unsal B, Soysal F, Ozcan G, Peker E, Karaca IR- (2018)	Determined the impact of additional topical gaseous ozone therapy on the decontamination of implant surfaces in Surgical regenerative therapy (SRT) of peri-implantitis.	After 12-months follow-up, there is reduction of the plaque index, gingival index, Probing depth, CAL, defect depth in the group treated with ozone, in comparison with the control. ⁶
4.	Mohammed G Sghaireen et al – (2020)	Compared the effect of saline and topical ozone water irrigation with respect to healing of the soft tissues following dental implant placement.	The study concluded that irrigation of the sites with 10ml of ozonated water solution showed no signs of clinical inflammation and exhibited merged incision margins on 1 st and 5 th day postoperatively. ⁸
5.	McKenna DF, Borza Badi-Farahani A, Lynch E – (2013)	Assessed the effect of subgingival ozone and/or hydrogen peroxide on the development of peri-implant mucositis.	Ozone in combination with either H ₂ O ₂ or saline were equally effective and has optimum gingival health scores, and is effective in controlling bleeding compared with oxygen + saline, oxygen + H ₂ O ₂ . ⁴

6.	Hauser-Gerspach I, Vadaszan J, Deronjic I, Gass C, Meyer J, Dard M, Wal Timo T, Stübinger S, Mauth C- (2012)	Investigated the antimicrobial efficacy of gaseous ozone on bacteria adhered to various titanium and zirconia surfaces and to evaluate adhesion of osteoblast-like MG-63 cells to ozone-treated surfaces.	Gaseous ozone showed selective efficacy to reduce adherent bacteria without affecting the surface structures of titanium and zirconia specimens and did not influence osteoblastic cell adhesion and proliferation negatively. ⁷
7.	Tonon CC, Panariello BH, Spolidorio DM, Gossweiler AG, Duarte – (2021)	Antimicrobial effect of varied concentrations of ozonized physiological saline solution was evaluated against the oral biofilms which were developed on the titanium surface	Antibiofilm activity of ozonized saline solution has better effect when applied for about 1 minute at a concentration of 80 µg/NmL, when compared to the saline, Chlorhexidine. ¹⁶
8.	Shekhar A, Srivastava S, Bhati LK, Chaturvedi A, Singh S, Agarwal B, Arora K – (2021)	Effect of ozone therapy was evaluated with regards to inflammation, pain, and wound healing following implant placement.	Tissues treated with ozone exhibited better wound healing, with minimal tissue inflammation and reduced pain. ¹⁷
9.	Faccioni F, Bevilacqua L, Porrelli D, Khoury A, Faccioni P, Turco G, Frassetto A, Maglione M. (2021)	Effect of instrumentation with grade IV titanium ultrasonic tip was assessed on various grade IV titanium implant surfaces and Their decontamination was compared among chlorhexidine, blue laser, ozone.	Ozone is found to be efficacious in the decontamination regardless of the type of implant surface, among the different therapies to ultrasonic instrumentation with titanium tips. ¹⁸

Contraindications of ozone

Ozone therapy is contraindicated in patients with Glucose-6-phosphate dehydrogenase deficiency, Severe anemia, Severe myasthenia, Active hemorrhage, myocardial infarction, Hyperthyroidism, and in Pregnant women.¹⁹

Ozone in Toxification

Ozone is not harmful when administered at concentration of 0.05ppm for about 8hours duration. Ozone at concentration of 0.01 ppm can be administered in the oral cavity.²⁰ Ozone (>0.0007% per application dose) can cause ozone toxicity.¹¹ Ozone toxicity can be managed by placing the patient in the supine position

and making them inhale humid oxygen. In cases of chronic exposure, administration of Vitamin E is more beneficial. Medication such as budesonide inhibits the airway neutrophilic inflammatory response.²⁰

Conclusion

Dentistry has advanced in providing sophisticated treatment for the patients. Several authors have suggested that ozone therapy has resulted in the incapacitation of the viruses, fungi and bacteria because of its antimicrobial power. Ozone is a therapeutic agent of choice because of its capacity to improve the circulatory system along with the immune response modification. Patient's acceptability is more because of

the painless and lesser treatment duration with minimal side effects.¹¹

An impressive body of scientific research have been done on oxygen-ozone therapy wherein they have highlighted their positive biological effects on various clinical cases. Despite their long history, only 8% of the doctors are familiar with its use.⁹ As mentioned above, many researches has suggested, ozone to be of potential use in the treatment of periimplantitis.

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