



## Ozonated implants: A review

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### Abstract

Role of Ozone in and around dental implants has been scarcely documented. Implants have been used to support dental prostheses for many decades. Ozone helps in bone regeneration. During implant placement, the socket is prepared and ozone is bubbled into the prepared socket for about 40 seconds followed by placement of implant into the socket. This prevents infection and accelerates bone regeneration. Hence, Ozone in its various forms promotes bone healing and is helpful in reducing perimplantitis.

**Keywords:** dental implants, ozone, ozone gas, ozonated water, osseointegration

### Introduction

The term ozone comes from the Greek word “ozein” meaning odorant. It is an allotropic form of oxygen, also known as triatomic oxygen or trioxygen (O<sub>3</sub>). It is produced naturally during thunderstorms and by the action of UV rays on atmospheric oxygen<sup>[1]</sup>.

Ozone acts as an antimicrobial (bactericidal, viricidal, and fungicidal) and has various roerties such as immunostimulating, immune modulatory, anti-inflammatory, biosynthetic (enhances metabolism of carbohydrates, proteins, lipids), bioenergetic, antihypoxic, analgesic, haemostatic, etc<sup>[2, 3, 4]</sup>

Ozone therapy is be defined as a versatile bio-oxidative therapy in which ozone is administered in various forms like ozone gas, as an aqueous solution, oil or as ozonated water for therapeutic purposes<sup>[2]</sup>

Ozone is used in various fields such as medicine, industry, and dairy farming for sterilization, deodorization, and bleaching. Recently, its usage has entered various sectors of dentistry as well. Ozone Gas is most frequently used in restorative dentistry and endodontics. Ozone aqueous solution is useful for disinfection and sterilization. It shows hemostatic effect in cases of hemorrhage and is helpful in accelerated wound healing. It also improves oxygen supply and support of metabolic processes. Ozonated Water may be useful to control oral infections and various pathogens<sup>[5, 6, 7]</sup>. Dr. Kramer postulated that it can be used in a number of different ways: 1.as a mouth rinse (especially in cases of gingivitis, periodontitis, thrush or stomatitis); 2. as a spray to cleanse the affected area, and to disinfect oral mucosa, cavities and in general dental surgery; 3.as an ozone/water jet to clean cavities of teeth being capped, receiving root canal therapy, and in treating painful gingivitis and stomatitis. Ozonized Oils are pure plant extracts, through which pure oxygen and ozone are passed to form a thick gel containing ozonides. They are effective antimicrobials<sup>[2, 3]</sup>.

### Ozone and Osseointegration in Implants

Scientific literature has documented its multiple usages in all dental departments but its role in and around dental implants has been scarcely documented. Implants have been used to support dental prostheses for many decades, but they have not always enjoyed a favourable reputation. This situation has changed dramatically with the development of endosseous osseointegrated dental implants. They are the nearest equivalent replacement to the natural tooth, and are therefore a useful addition in the management of patients who have missing teeth because of disease, trauma or developmental anomalies<sup>[8]</sup> Titanium is a lightweight metal with high corrosion resistance and good biocompatibility. Therefore, it is widely used as a dental implant material in dentistry. The titanium surface and bone become fixed through the process of osseointegration, which results in close integration between the two at the light microscopic level. This process of integration requires approximately 6 months for the maxilla and 3 months for the mandibular bone, which is a relatively long period of time when compared to prosthetic treatment such as dentures and bridges<sup>[9]</sup>. Although improvement of the implant surface microstructure and techniques such as immediate loading and early loading have been attempted to improve the

process, cell adhesion in the early stage remains important to clinical outcome. Cell adhesion is affected by the physicochemical properties of the titanium surface such as its microstructure, wettability, and adhesion with carbon compounds. In addition, there is still room for improvement in the ratio of the titanium surface area that is in close contact with the bone, which is currently 45-65 %. In the titanium implants now used in implant treatment, cell adhesion, proliferation, and differentiation decrease over time due to adhesion of carbon compounds to the titanium surface <sup>[9]</sup>

Dental implants have provided advanced restorative solutions for tooth loss; however implantation should be performed meticulously to prevent the various complications that may accompany this procedure. The early postoperative period is particularly important and invariably depends on soft tissue healing at the surgical site. Therefore, certain materials may be utilized to increase the success rate of implant survival. Among these materials O<sub>3</sub> has been claimed to possess properties that enhance the clinical outcomes of various surgical procedures involving the oral mucosa <sup>[10, 11]</sup>.

When ozone dissolves in water, free radicals are formed due to the reaction with OH<sup>-</sup> ions, imparting ozonated water with strong oxidizing action <sup>[10, 11]</sup> Murakami *et al* <sup>[12]</sup>, investigated the cleaning effect of ozonated water for removing carbon compounds from the titanium surface, the carbon compounds were found to be removed immediately after treatment.

In some literature it has been proven that gaseous Ozone showed efficacy to reduce adherent bacteria like *Porphyromonas gingivalis* and *Streptococcus sanguis* on from Titanium and Zirconia without affecting adhesion and proliferation of osteoblastic cells from all surfaces with in 24 sec to below the detection limit while streptococcus was more resistant and showed the highest reduction on zirconia substrates <sup>[14]</sup>.

Sunarso *et al* <sup>[15]</sup>, functionalized the superhydrophilic surfaces of implants by applying ozone gas to increase the osseointegrativity and reduce inflammatory responses around the implant. After 24 hours, the contact angle of the water to the implant surface was zero degree. Also hydroxyl groups increased and carbon pollution decreased significantly at implant surface, then by adding rat marrow cells the adhesion and growth of these cells was investigated after day 1 and 4 days invitro. The number of cells and cellular characteristics was better in implants treated with ozone molecules. Hadary *et al* <sup>[16]</sup> investigated the effect of using topical ozone containing oils on osseointegration of implants in an invivo animal study done on rabbit population receiving cyclosporine A. Radiographic, histopathological and electron microscope scans were performed to evaluate bone formation around implants. There was no significant difference in the amount of bone formation in both control and study groups which received ozone containing vegetable oil but the authors suggested ozone could promote bone formation. Furthermore it has been reported that O<sub>3</sub> has a powerful effect in reducing plaque and bleeding scores in patients with peri-implantitis in preparation for surgery. Ozone therapy can also be used in perimplantitis cases. The use of topical aqueous O<sub>3</sub> therapy in this context has not been investigated thoroughly. Hence, a clinical study was conducted to evaluate the effect of topical aqueous O<sub>3</sub> therapy on wound healing and pain following dental implant placement. Results revealed that O<sub>3</sub> treatment was found to enhance soft tissue healing one day after dental implant placement. The attachment of the soft tissue to the implant serves as a biological seal that prevents the development of inflammatory peri-implant mucositis and peri-implantitis. Thus, the soft tissue seal around implants ensures healthy conditions and stable osseointegration and therefore the long-term survival of implants. During placement of implants, ozone gas is bubbled into prepared socket and implant is placed. This reduces percentage of infection in implant cases <sup>[17, 18]</sup>.

### **Advantages**

The use of O<sub>3</sub> therapy in dentistry is considered a cost-effective and a conservative modality with minimal adverse effects. Ozone is a versatile blue gas. It has applications all over the world in various fields and we have touched many aspects of ozone in this article. In dentistry it is proved to be minimally invasive and cost effective choice of treatment <sup>[2]</sup>.

### **Contraindications**

Pregnancy, Hyperthyroidism, Severe anemia, Severe myasthenia gravis, Active haemorrhage, G6PD deficiency are the contradictions of ozone therapy <sup>[19]</sup>.

### **Side-Effects**

On the other side, there are some side effects as well such as direct intravenous injection of ozone increases risk of embolism, Burning sensation to eyes, Difficulty to breathe, rhinitis, occasional nausea, vomiting, blood vessel swelling, poor circulation, heart problems, respiratory tract irritation and at times stroke <sup>[2, 19]</sup>

### **Conclusion**

Ozone being considered as a perfect substance for use in dental procedures, is nowadays taking the pathway of conventional dentistry in following a minimally invasive and conservative application to dental treatment. Ozone helps in osseointegration and helps in reducing periimplantitis as well.

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