



## Ozone Therapy in Dentistry Diş Hekimliğinde Ozon Terapisi

Ramachandran Sudarshan<sup>1</sup>, G. Sree Vijayabala<sup>2</sup>

<sup>1</sup> Dept of Oral Medicine and Radiology, Sibar Institute of Dental Sciences, Guntur, India

<sup>2</sup> Dept of Oral Medicine and Radiology, Thai Moogambigai Dental College, Chennai, India

### ABSTRACT

With the advancements in the field of dentistry, new treatment protocols are budding day by day to combat human ailments in a much natural better and simpler way. One such advancement is the application of ozone in dentistry. Ozone is a natural element that protects us from ultraviolet rays. It has several properties including analgesic, immunostimulant and antimicrobial properties. In dentistry its uses are abundant in disorders like gingival diseases, infection control, temporomandibular disorders, radiation and chemotherapy induced mucositis, lichen planus etc. Researchers believe that this therapy is in state of equilibrium with benefits and drawbacks. This review throws light on the history, properties, methods of administration, uses in the field of medicine and dentistry, toxicity, contraindications of ozone.

**Key words:** Ozone therapy, alternative medicine, dentistry

### ÖZET

Diş hekimliğindeki gelişmelere paralel olarak insanlardaki hastalıklarla başetmek için çeşitli alternatif doğal ve basit çözümler üretilmiştir. Ozon terapisinin dişhekimliğinde kullanımı bu yöndeki uygulamalardan biridir. Ozon insanları ultraviyole ışınlarından koruyan doğal bir elementtir. Analjezik, immun sistemi uyarıcı ve antimikrobiyal birçok özelliği bulunmaktadır. Diş hekimliğinde gingival hastalıklarda, enfeksiyon kontrolünde, temporomandibular hastalıklarda, radyasyon ve kemoterapiye bağlı mukozitte, liken planusta kullanım alanı bulmuştur. Araştırmacılar bu terapi yönteminin yarar-zarar oranının dengeli olduğunu bildirmişlerdir. Bu yazıda ozon terapisinin tarihçesi, özellikleri, uygulama yöntemleri, tıpta ve diş hekimliğinde kullanım alanları, toksisitesi, kontrendikasyonları gözden geçirilmiştir.

**Anahtar kelimeler:** Ozon terapisi, alternatif tıp, diş hekimliği



## Introduction

Ozone, a triatomic oxygen, is found as natural gas in the upper atmosphere that prevents earth from the threatening UV light<sup>1</sup>. It is colorless with an acrid odour. Ozone presents at levels less than 20 µg/m from earth's plane making life sustainable<sup>2</sup>. Ozone therapy is an established version of therapy since 1880 in United States and has been used for several countries for several years.<sup>1</sup> Ozone use in dentistry reported long back by Swiss therapist A. Fisch with his first publication as thesis in 1935<sup>3</sup>. The medical ozone prepared from pure oxygen through silent electrical discharge. Medical ozone generators are outfitted with controller as the concentration and disintegration depends on the parameters like temperature, pressure and volume<sup>4</sup>. Ozone has immunomodulating, analgesic, detoxifying, antiinfectious and metabolism activation<sup>5</sup>.

Mode of administration of intraoral oxygen-ozone (OO) include: injection, irrigation, insufflations of periodontal pockets, and topical application. Injection protocols include intraosseous injection of the oxygen-ozone gas mixture, locally into the alveolus, subgingivally, intramuscularly, inferior alveolar nerve area, and into the pterygoid space area<sup>6</sup>. Despite the accumulation of sufficient data, doubt stil persists concerning its toxicity versus efficiency. This element of doubt prevents its widespread acceptance. Further its application in the different fields makes it difficult to categorize as a therapeutic agent resulting in conflict<sup>7</sup>. This review portrays the history, medicinal, dental, toxicity and recent advancements of ozone therapy in various branches.

## Properties

Ozone gas is immunostimulating, potent analgesic, detoxicating, antimicrobial, bioenergetics and biosynthetic properties as it causes activation of the metabolism of carbohydrates, proteins and lipids<sup>5</sup>.

## Applications

### Microbiology

The main reason for cell death is the local damage of cytoplasmic membrane due to ozonolysis and also ozone-induced modification of intracellular contents because of secondary oxidants effects. This action is non-specific and selective to microbial cells. It does not damage

human body cells because of their major antioxidative ability. Ozone is efficient in liquid environment and acidic pH. It is proficient against antibiotic resistant strains. Mechanism of action against viral infection based on Sensitivity to peroxides and of reverse transcriptase<sup>3</sup>.

### **Pathology**

Ozone has its role in the production of interleukins, leukotrienes and prostaglandins, synthesis of immunoglobulins, function of macrophages and sensitivity to phagocytosis<sup>3</sup>. Ozone also influences cellular and humoral immune system.

### **Biochemistry**

Ozone causes increases in the partial pressure of the oxygen and the transport of oxygen resulting in change of cellular metabolism and activation of aerobic pathway<sup>3</sup>.

### **Physiology**

Ozone prevents formation of erythrocytes aggregates and increases their contact surface for oxygen transportation. Ozone causes secretion of vasodilators such as nitrous oxide, which are responsible for dilatation of arterioles and venules. It also activates mechanisms of protein synthesis, increase amount of ribosome and mitochondria in cells. These changes on the cellular level explain elevation of functional activity and regeneration potential of tissues and organs<sup>3</sup>.

### **Administration**

Therapeutic methods of administration of intraoral Oxygen-Ozone include: injection of gas, irrigation with ozonated water, insufflations of periodontal pockets with gas, and topical application of ozonated oil. Injection protocols include intraosseous injection of the ozone gas mixture, locally into the alveolus, subgingivally, intramuscularly, inferior alveolar nerve area, and into the pterygoid space area. These injection protocols are for treatment of the many types of oral infections<sup>6</sup>.

Despite ample clarification, confusion persists concerning its potential toxicity as an oxidant agent vs. the reported clinical efficacy. This confusion is a major factor preventing a more widespread acceptance. Furthermore, the use in specialties so diverse and others makes it

difficult to categorize ozone as a therapeutic agent. This may cause conflicts between the different fields of application and the various areas<sup>7</sup>.

**Table.1. Administration Ways of Ozone**

<b>1. Medicine based on methods of administration</b>
<b>a. Rectal Ozone/Oxygen Insufflation</b>
<i>Indications</i>
<i>Local</i>
Ulcerous colitis
Anal fistulae and fissures
<i>Systemic</i>
Hepatitis B and C
For immunomodulation
<b>b. Minor Autohaemotherapy with Ozone</b>
<i>Indications</i>
Acne vulgaris
Allergies
As an adjuvant in cancer therapy
<b>c. Topical Ozone Applications</b>
<i>Indications</i>
External ulcers
Local infections (herpes simplex, herpes zoster, mycosis)
Eye injuries and infections.
<b>d. Ozonized Water</b>
<i>Indications</i>
Local infections
Mycosis, mycotic infections
Herpes simplex and herpes zoster
Burns, also superinfected burns
Intraoperative rinsing
Eye injuries and infections
Surgical scars
Oedemas of traumatic or bacterial origin.
Peroxidic Oils
Long-term treatment of injuries, burns and local infections, ulcers

<b>e. Ozone/Oxygen Gas Mixture</b>
<i>Indications</i>
Skin lesions, burns, superinfected wounds, ulcers
Injecting Ozone
<b>f. Intraarticular O<sub>3</sub></b>
<i>Indications</i>
Symptoms of the rheumatic and degenerative joint diseases
<b>2. Subcutaneous and Intracutaneous Application (O<sub>3</sub>/O<sub>2</sub> blistering)</b>
<i>Indications</i>
Herpes zoster
Neural therapy

## Role in Dentistry

### Oral Surgery

Ozone can be used for almost any type of dental procedure. After a tooth is extracted or any basic surgical procedure, it is recommended post-surgically to irrigate and insufflate the area. This reduces the positive electric potential of the wound and potential scar with the negatively charged gas or water. Healing of the wound is generally much faster and with less or no complications<sup>6</sup>.

Biphosphonate necrosis has been extremely difficult to treat medically and surgically. There has been some success with Ozone utilizing the foundational protocols along with intraosseous injections and intraoral silicone tray treatment of the osteonecrotic lesion. The patient is always sent home with ozonated olive oil as a postoperative dressing for the wound<sup>6</sup>.

Ozonated water is suitable for prophylactic applications against infections after osteotomies. Since ozone improves several properties of erythrocytes and facilitates oxygen release in the tissues, it leads to vasodilatation of vessels and improved blood supply to ischemic zones. Thus, it is useful in wound healing impairments, after surgical interventions like tooth extractions or implant dentistry. Ozone can be used as an alternative to hyperbaric oxygen therapy after the removal of the bone sequestra. Its mechanism of action is based on the extensive oxidation property and on the fact that ozone contacted bacteria can be more easily

recognized and destroyed by granulocytes and the complement system. It also increases the phagocytosis performance of polymorphonuclear cells<sup>8</sup>.

### **Conservative Dentistry**

Gaseous ozone has been proved to reduce pain immediately after treatment and on application of ozone; desensitization of dentine lasts for longer period of time. Smear layer present over the exposed root surface prevents the penetration of calcium and fluoride ions deep into the dentinal tubules. Ozone removes this smear layer, opens up the dentinal tubules, broadens their diameter and allows the calcium and fluoride ions to flow into the tubules easily, deeply and effectively to plug the dentinal tubules, preventing the fluid exchange through these tubules. Thus, ozone can effectively reduce the root sensitivity problem immediately and also lasts longer<sup>1</sup>.

Ozone can be used to kill bacteria present in carious lesion, painlessly and even without anaesthetic. Ozone is applied to the carious lesion in a controlled manner, safely killing bacteria that have caused caries, thus requiring minimal of physical intervention and just a few seconds. In cases of incipient caries, ozone can kill bacteria in the demineralized part and this demineralized tooth structure then, can be remineralized using a special remineralization kit, containing Calcium, Fluorine, Phosphorus and Sodium, all in their ionic forms<sup>9</sup>.

Ozone oils can be used to sterile the root canal systems and to clear the canals of necrotic debris by virtue of ozone's bactericidal and effervescent properties. Ozone oils are ozonated sunflower oil or olive oil or groundnut oil. This ozone oil irrigation is more quick and efficient in canal sterilization than that conventional irrigation by the sodium hypochlorite and sodium peroxide combination<sup>9</sup>.

### **Periodontal Treatments**

Ozonated water strongly inhibited the accumulation of dental plaque. Ozonated oil is used as a safe therapeutic alternative in patients with Acute Necrotizing Ulcerative Gingivitis. Healing and bactericidal properties makes it useful as a subgingival irrigant<sup>9</sup>.

### **Oral Medicine**

Ozone has been reported to accelerate the healing of soft tissue conditions, i.e. aphthous ulcers, herpes labialis. Ozone therapy was found to be beneficial for the treatment of the

refractory osteomyelitis in the head and neck in addition to treatment with antibiotics, surgery and hyperbaric oxygen. In alveoli, there is accelerated healing by irrigation with ozonated water after removal of the necrotic pulp & debris under antibiotic coverage<sup>9</sup>.

In a recent report, patients with lichen planus and oral lichen planus (n=178) were treated with tissue insufflation, injection, cupping and ozonated oil applications. The results were encouraging and there was no prominent side effects unlike more traditional pharmacological approaches<sup>10</sup>. In another study, patients with bilateral internal derangement of the temporomandibular joints, disc displacement with reduction in which direct injection of ozone gas into the superior joint space was given. Each joint received 2 mL ozone-oxygen mixture (ozone gas concentration 10 µg/mL). The injections were repeated 2 times per week for 3 weeks. Around 87% of the patients who received ozone gas injections into the superior joint space either completely recovered or improved<sup>11</sup>.

Ozone protocols were tried in mucositis induced by chemotherapy and radiotherapy involved application of ozone in both aqueous and gaseous forms. Ozone in a gaseous form was provided at 40 to 60 seconds per lesion; the aqueous solution of ozone bubbles and water is 2 to 4 ppm. The gaseous ozone concentration is 2100 ppm, with a flow rate of ozone/air mix at 5m/s; the patient gargled with the aqueous solution for 1 to 2 minutes. The mucositis responded positively to gaseous and aqueous ozone therapy, enabling her to eat normally, eliminate pain medication, and improve her quality of life during oncological therapeutic interventions<sup>12</sup>.

### **Prosthodontics**

Ozone gas can be applied as a prophylactic treatment prior to etching and the placement of sealant with no negative impact on sound enamel physical properties, including knoop surface microhardness, or contact angle<sup>9</sup>. The longer exposure to ozone gas has a strong bactericidal effect on microorganisms within the dentinal tubules of deep cavities, which could result in increasing the clinical success of restorations, with no negative impact on dentin and enamel shear bond strength to adhesive restoration. Ozone can be applied for cleaning the surface of removable partial denture alloys with little impact on the quality of alloy in terms of reflectance, surface roughness, and weight. Gaseous ozone is used to disintegrate smear layer and to disinfect the prepared tooth. Denture stomatitis can be controlled by topical application of ozonated oil over tissue surface and over denture surface<sup>9</sup>.

## Other Dental Pathologies

Ozone could be effective against periodontal pocket disinfection and osseous disinfection, gum recession, pain control, infection control and also could control halitosis<sup>13</sup>.

## Toxicity

Ozone inhalation can be toxic to the pulmonary system and other organs. The known side effects are epiphora, upper respiratory tract irritation, rhinitis, cough, headache, occasional nausea and vomiting. However, complications caused by ozone therapy are infrequent. In the event of ozone intoxication, the patient must be placed in the supine position, inhale humid oxygen, and take ascorbic acid, Vitamin E and nacetylcysteine. Further, because of its high oxidative power, all materials that come in contact with the gas must be ozone resistant such as glass, silicon and Teflon<sup>8</sup>.

## Contraindications

Pregnancy, severe anaemia, hyperthyroidism, thrombocytopenia, severe myasthenia, acute alcohol intoxication, recent myocardial infarction, hemorrhage from any organ, Glucose-6-phosphatedehydrogenase deficiency and ozone allergy<sup>1</sup>.

Prolonged inhalation of ozone can be deleterious to the lungs and other organs but well calibrated doses can be therapeutically used in various conditions without any toxicity or side effects. Direct intravenous injections of ozone/oxygen gas should not be practiced due to the possible risk of air embolism<sup>1</sup>.

## Recent Advancements

Ozone was found to be effective as an antibacterial agent to treat oral infections caused by *Actinomyces naeslundii*, *Lactobacilli casei* and *Streptococcus mutans*. Exposure of about 60 s exhibited 99.9% killing efficiency, but exposure for such a long period showed degradation of saliva proteins. So exposure of 10 s to 30 s was proved effective to kill significant number of bacteria. A single subcutaneous injection of O<sub>3</sub> in mouse with spared nerve injury of the sciatic nerve was found to decrease the neuropathic pain-type behavior. Mechanism of this action is yet unclear but O<sub>3</sub> was observed to regulate the expression of the genes that play vital role in onset and maintenance of allodynia<sup>2</sup>.



## Conclusion

The concept of use of ozone in dentistry is an entirely new arena of therapy and further research in large scale is needed in this area to better validate its valuable therapeutic applications. Such research will surely pave way to the better future of dentistry.

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**Correspondence Address / Yazışma adresi:**  
Ramachandran Sudarshan  
Department of Oral Medicine and Radiology  
Sibar Institute of Dental Sciences, Guntur, INDIA  
07416433735  
E-mail: Sudharshanram@yahoo.co.in