



## Ozone Therapy: Application in Dentistry

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### Abstract

*The objective of this article is to understand the recent clinical applications of ozone in dentistry. Ozone has been in use as a therapeutical and clinical agent in dentistry since 1930. It has very wide applications in the filed of dentistry, and is under continuous research to further expand its potential. This article explains the recent developments in clinical applications of ozone in dentistry. Its applications in Periodontics, orthodontics, prosthodontics, and its use in prevention and management of dental caries, bleaching of discoloured teeth, healing of wounds, treating temporomandibular joint disorders, and etc are discussed.*

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**Keywords:** Ozone therapy, Ozonated water, intoxication, disinfectant, biofilms

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### Introduction

Ozone is a naturally available gas and a strong antioxidant derived from oxygen. It is also known as triatomic oxygen and is a compound consisting of three oxygen atoms. Present in the upper atmosphere, it prevents ultraviolet (UV) rays from reaching the earth's surface. It was first discovered in atmosphere by Schonbein in the second half of 19<sup>th</sup> century. It has a long history of clinical applications. Ozone therapy was accepted as an alternative medicine in the USA (1880) and has been used for over 130 years in twenty countries. During World War I, ozone was used for treating gaseous post-traumatic gangrene, infected wounds, mustard gas burns and fistulas. Ozone was introduced in dentistry by Fisch in 1930 as a disinfectant and wound healing agent [1]. It is also being used as therapeutical agent in general dentistry and paediatric dentistry. It has also been proved that ozone has antimicrobial, virucidal, disinfectant, anti-inflammatory, analgesic, immunostimulant properties. Its uniqueness is due to the non-invasive nature and absence of side effects. It is used clinically as a minimally invasive approach to treat various oral diseases like tooth decay, oral lichen planus, gingivitis, periodontitis, halitosis, osteonecrosis of jaw, dentin hypersensitivity, TMJ disorder and several others.

### Structure

Ozone consists of 3 atomic molecules of oxygen. Oxygen-oxygen bonds bind them together at an angle of 116 degrees. Ozone has an internal steric hindrance which prevents it from forming a triangular structure. As a result of this, each oxygen atom forms a single bond with another oxygen atom which results in a negative charge throughout the ozone molecule. [2]

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### Mechanism of action of ozone:

- It Causes inactivation of bacteria, viruses, fungi, yeast, and protozoa by disrupting the integrity of the bacterial cell wall by oxidation of phospholipids and lipoproteins. 0.1 ppm of ozone is sufficient to inactivate bacterial cells including their spores. In fungi, budding cells are most sensitive to ozone. In Viruses, it damages the viral capsid and interferes with the reproductive cycle by disrupting cell to cell contact by peroxidation [3]
- Its haemostatic effect of ozone is due to generation of hydrogen peroxide which causes irreversible platelet aggregation by activating Phospholipase C, phospholipase A<sub>2</sub>, cyclo oxygenises and lipoxygenases pathways, and thromboxane synthetase which in turn increases the availability of intracellular Ca<sup>2+</sup> and release of PGs and TX A<sub>2</sub>. [4]
- It is a cytokine inducer and increases production of interferons, greatest output of TNF (tumour necrosis factor), IL-2 (interleukin) which stimulates cascade of immunological responses [2]
- Biosynthesis and bioenergetics.

## Clinical Applications

### *Prevention and management of dental caries:*

The application of Ozone therapy in the management of dental caries is widely studied. Ozone can prevent tooth decay not only through its antimicrobial properties, but also by oxidizing the pyruvic acid into acetate and dioxide produced by the cariogenic bacteria. Huth et al ran a split mouth clinical trial to determine the effect of a single dose application of gaseous ozone on non-carious fissures of permanent carious in molars. Teeth treated with ozone showed reduced caries progression when compared to the untreated ones in these same patients. Ozone is a valuable method for the treatment of caries in patients having dental anxiety, considering it is proven to reduce this parameter with respect to the treatment with traditional rotatory instruments [3]

The effect of ozone in remineralizing the cavitated caries lesion is well established. A clinical trial to evaluate the clinical reversal of root caries was conducted by Baysan et al. The carious tooth was subjected the carious tooth to 10s exposure of ozone gas at 2100 ppm, followed by 5s application of xylitol and fluoride. After 6 months follow-up, lesion treated with ozone significantly resharpened compared to Controls and at 12 months follow-up 47% of ozone-treated Lesions resharpened [10]

### *Effect on biofilms:*

Streptococcus Mutans, Actinomyces naeslundii and Lactobacillus casei and other cariogenic microfloras were inactivated within 60 seconds of exposure to ozone gas. It was also found that ozonated water is effective in reducing plaque microbial load if used at a concentration of 0.1 ppm. Plaque formation by both Gram-positive and Gram-negative was prevented with a concentration of 0.5 to 4 mg/l of ozone. A concentration of 5 to 10 mg/l was helpful in case of oral candidiasis. One-minute oral rinse with 24 mg/dl showed superior effect over clotrimazole in reducing candida counts [10]

### *Bleaching of discoloured teeth:*

Crown discoloration is a major aesthetic problem in endodontically treated teeth. Conventional bleaching techniques requires more time and results are not often satisfactory [11]

### *Endodontics:*

Ozonated water can be used as an intracanal irrigant. Its disinfectant action, by means of sonication, has shown to be comparable to 2.5% NaOCl. Ozonized oil reduces the odour from infected tooth. The effect of ozone has been shown to be more significant when used in canals having the least number of organic debris. Ozone in form of gas, water or oil, has shown to be as antimicrobial agent considering its action against several bacterial strains, like Mycobacteria, Streptococcus, Pseudomonas aeruginosa, Pepto streptococcus Candida albicans, Escherichia coli, Staphylococcus aureus, and Enterococcus faecalis [12]

### *Desensitisation of sensitive necks:*

Relief from root sensitivity has been seen after ozone spray for 60 seconds followed by mineral wash onto the exposed dentine. Smear layer prevents the penetration of ionic calcium and fluorine. Ozone removes this smear layer, opens up the dentinal tubules, increases their diameter to help in the flow of Calcium and Fluoride ions into the tubules easily, to plug the dentinal tubules, preventing the fluid exchange. Thus, root sensitivity can be effectively terminated using ozone [13]

### *Healing of wounds:*

Ozone forms a pseudo-membrane over the socket, thus protecting it from and physical and mechanical insults and reduces the post extraction healing time. In refractory osteomyelitis of head and neck ozone therapy is useful alongside with antibiotics. After the removal of the necrotic pulp and debris, in alveolitis, the healing is accelerated by irrigation with ozonated water [14]

### *Temporomandibular joint disorders:*

A randomized control study was conducted by Daif, involving 60 Individuals with bilateral internal derangement of the TMJ and disc displacement with reduction. Out of total patients who were treated with ozone gas injection into the joint space, 67% either totally recovered or improved. However, direct relationship about its mechanism of action is not yet established. Further studies are required in this direction to substantiate the results [15]

### *Soft tissues pathology:*

It is reported that ozone accelerates the healing of soft tissue conditions, i.e., aphthous ulcers, herpes labialis, ANUG and other gum infections [16]

***Application in periodontics:***

Aggressive periodontitis patients having periodontal pockets were, once in a week, irrigated with 150ml of ozonated water for 5 to 10 minutes after scaling and root planning (SRP) in a clinical study. It was found that the pocket depth, plaque, bacterial count, and gingival indices were significantly reduced [10]

***Application in orthodontics:***

Cehreli SV et al. studied the effects of pre-treatment of enamel with ozone on the shear bond strength of brackets bonded with total or self-etch adhesive systems. It was concluded that enamel pre-treatment increased the value of shear bond strength of adhesive systems used for bracket bonding [17]

***Application in Prosthodontics:***

Ozone was proved to be useful for disinfection of dentures and other removable denture Alloys without compromising any of their physical properties Like reflectance, surface roughness and weight. Exposing the dentures to ozonated water along with Ultrasonication has antimicrobial activity against *Candida albicans* [18, 19]

***Contraindications of Ozone Therapy [11]:***

- Pregnancy
- G-6-p dehydrogenase deficiency
- Hyperthyroidism
- Severe anaemia
- Severe myasthenia gravis
- Acute alcohol intoxication
- Ozone allergy
- Acute alcohol intoxication

***Ozone Toxicity:***

Ozone inhalation can be toxic. Complications caused are meagre at 0.0007 per application. Some of the problems include upper respiratory irritation, cough, headache, occasional nausea, vomiting, epiphora, shortness of breath, poor circulation, blood vessel swelling, heart problems and stroke. All materials that encounter the gas must be ozone resistant due to higher oxidative power of ozone. However, in case intoxication the patient must be placed in the supine position and treated with vitamin E and n-acetyl cysteine [13]

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**Conclusion**

Treatment modalities in dentistry are changing as we now use modern science to practice dentistry. Conventional therapeutic modalities for treatments have been substantially improved with the evolution of ozone therapy. Ozone could be a promising treatment modality for several dental complication in future. However, until further research is made that establishes benefits from independent usage, ozone must only be used in combination with other conventional treatment modalities.

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