

*Review Article*

## Ozone Therapy- A Paradigm Shift in Dentistry

Rahul Kaul<sup>1</sup>, Paras Angrish<sup>1</sup>, Parul Jain<sup>1</sup>, Navjot Singh Sasan<sup>2</sup><sup>1</sup>PG Student, Dept. of Pedodontics and Preventive Dentistry; Dr. R Ahmed Dental College and Hospital, Kolkata.<sup>2</sup>Private Practitioner, Jammu.

Corresponding Author: Rahul Kaul

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### ABSTRACT

Ozone is a colorless gas form of oxygen and is present in atmosphere. It is a powerful oxidizer. It effectively kills bacteria, fungi, viruses and parasites at a dramatically lower concentration. So far, arresting and reversing the process of caries without invasive treatment are unpredictable and rely highly on patient compliance. Most people suffer anxieties about being treated for tooth decay or more precisely; they fear the injections and drills, but, now, with ozone treatment, this is all the thing of the past. Ozone possibly could arrest the progress of the lesion and may, in the presence of fluoride, perhaps allow re-mineralization to occur which in turn delay or prevent the need for traditional methods of dental conservation. The versatility of ozone therapy, its unique properties, noninvasive nature, absence of side effects or adverse reactions are responsible for its wide spread use like treatment of caries, bleaching of discoloured teeth, desensitization and treatment of some soft tissue infections. Treating patients with ozone cuts off the treatment time with a great deal of difference, it eliminates the bacterial count more precisely and moreover, completely painlessly, hence, increasing the patients' acceptability and compliance.

**Keywords:** Ozone, Oxygen, Dentistry.

### INTRODUCTION

Ozone is a naturally occurring molecule that exists in the form of a gas in the stratosphere in the layer known as the 'ozone layer.' protecting living organisms on earth from U.V. Radiation. Ozone is an unstable gas quickly giving up nascent oxygen which is a strong oxidant rendering multiple beneficial effects like an effective antimicrobial agent, disruption of tumor metabolism, metabolic & immune modulation, sterilization of medical & dental

equipment, purification of drinking water etc. [1]

**History:** Christian Friedrich Schonbein, a german chemist is considered as Father of Ozone therapy .In 1840 he detected an "Odorful Gas" on passing electrical discharge through water (Ozen a greek word that means "Odor").

During World War I & II – Ozone was used to treat wounded soldiers in trenches.

By early 20th century Ozone use got legalized in USA.

1950 – Dr E.A. Feisch; a German Dentist first used Ozone on regular basis in Dental Practice.

2001 – Dr. Sieg Fried wrote a text book about use of Ozone in Medicine.

2004 – Prof. Edward Lyrich Published “Ozone – The Revolution in Dentistry”.

### **Biological Actions:**

#### **1. Effect on Bacteria, Virus, Fungus, Protozoa:**

Ozone acts by damaging the bacterial cell membranes by ozonolysis and oxidates intra cellular proteins leading to loss of organelle function. [2] This action of ozone is selective to microbial cells and thus does not affect human body cell as the later have good antioxidative ability. Ozone is very effective in antibiotic resistant strains with accelerated efficiency in acidic PH environment. [3]

**Viruses:** Ozone makes the infected cell intolerant to peroxides and changes the activity of reverse transcriptase thus hampering viral protein synthesis. [4]

**Fungal & Protozoa:** Ozone inhibits cell growth at certain stages.

#### **2. Cellular and Humoral Immune system:**

Ozone reactivates the immune system through Macrophage activation and Cytokine release which inturn boost immune system; [5] which makes it useful in patients with low immune status and immunodeficiency.

**3. Anti-inflammatory:-** Ozone stimulates release the of interleukins, leukotrienes and prostoglandins, [4] thus reducing inflammation and thereby promoting wound healing.

**4. Effect on Micro-circulation:** Ozone causes secretion of nitrous oxide which is a vasodilator and hence dilates arterioles & venules. It prevents clumping of red blood corpuscles’ and increases their contact area for oxygen transportation. It also activates aerobic processes like glycolysis and krebs cycle at cellular level thus stimulating

circulation of blood and hence used in treatment of circulatory disorders. [6]

**Pharmacodynamics:** Ozone, a powerful biocide takes only 10sec to kill 99% of bacteria, fungi & viruses. 25 micro grams of Ozone per ml of Oxygen is the amount of ozone used in treatments and this translates into 0.25 parts of Ozone to 99.75 parts of Oxygen. [1] The potency of one molecule of Ozone equalizes to 3000 to 10,000 molecules of chlorine and thus is 3500 times more pathogenic to microbes with no side effects of chlorine.

#### **Modes of Ozone Generation in Dentistry:**

The most common methods of ozone production used for therapeutic purposes are given below.

- **Ultra-Violet System:** Useful for purifying air but generates less concentration of ozone.
- **Cold Plasma System:** Useful for purifying water and air.
- **Corona Discharge System:** Most popular systems in medicine and dentistry. It has controlled production rate and easily generates high ozone concentration.

#### **Modes of Ozone Administration:**

Ozone is administered on patients for therapeutic purposes in various forms like ozone gas, as an aqueous solution, oil or as ozonated water.

##### **1. Ozone Gas**

- An Ozone generator produces ozone by passing air through high voltage in a polyurethane console. Some of the commercially available Ozone Units for medical use are:
  - HealOzone TEC 3 (Curozone, USA).
  - Prozone (W&H)
  - O3 ozicure ozone device

- The generated Ozone is applied to patient through hand piece which gets adapted to teeth through a silicon cup and is exposed for a minimum period of 10 seconds. The used ozone is passed through a reducing agent to convert back to oxygen and then led back to the generator.
2. Ozone aqueous Solution
    - Useful for disinfection and sterilization. Displays hemostatic effect in cases of hemorrhage. Found to accelerate wound healing as it improves oxygen supply and supports metabolic processes.
  3. Ozone Oil
    - Useful for external application. Ozone is passed through plant extracts to form a thick gel containing ozonides.
  4. Ozonated water
    - Studies have shown that ozonated water increased metabolic activity of L29 mouse fibroblast cells and improved lipopolysaccharide induced inflammatory response. It also had strong bactericidal activity against plaque biofilm.

## Uses in Dentistry:

### 1. Dental Caries:

- Treating early tooth carious lesions : Can be used along with Diagnodent to assess the caries risk in the earliest stages. [7] Ozone application significantly improved non-cavitated initial fissure caries in patients at high caries risk over a 3- month period. [8]
- Treatment of Pit and fissure caries; Clinical recommendations involve opening the lesions and caries removal leaving only upto 1mm of caries on pulpal floor prior

to ozone treatment and subsequent restoration. [9]

- Established carious lesion: In established carious lesions, ozone therapy has to be done along with restorative therapy and patient has to be educated about the maintenance phase of caries treatment involving oral hygiene maintenance and balanced diet. Immediately after ozone treatment it is advisable to apply a remineralising agent containing 2% Sodium Fluoride and 5% Xylitol.
- Proximal Caries Lesions and Root caries: Increasing exposure time of ozone from 10sec to 20sec, changed its antimicrobial effect from disinfection to sterilization. Application of ozone for 40 seconds results insignificantly reduced S.mutans count. Application of ozone for 60 second almost eliminated cariogenic species in carious lesions in roots like S.mutans, L.casei, A.naeslundii. [10,11]

**2. Hypersensitive Teeth:** Enamel and Dentine loss occurring due to multiple factors like attrition, abrasion, erosion, trauma from occlusion may cause hyper sensitivity and diagnosis of etiology is vital. After elimination of cause 40 to 60 sec application of ozone is found to instantly reduce pain in these sensitive teeth. [7]

Ozone removes the smear layer, opens the dentinal tubules and broadens their diameter. Thus when a remineralizing agent is applied, calcium & fluoride ions flow into dentinal tubules and plug them preventing fluid exchange thus terminating sensitivity.

**3. Cracked Tooth Syndrome:** After exploration of the crack, assess the prognosis and tooth is exposed to ozone for 60 – 120 sec and seal the tooth [7] with an intermediate restoration like GIC. The tooth

needs to be periodically assessed and restored.

#### **4. Necrotic root canals & Peri-apical**

**Lesions:** Ozone showed effectiveness over most of bacteria found in cases of pulp necrosis. Ozone demonstrated anti-microbial action against bacterial strains such as Mycobacteria, Staphylococcus, Pseudomonas, enterococcus, E coli, Peptostreptococcus, E fecalis & Candida albicans in invitro research models. [12] In infected necrotic canals, ozonized oils can be used as an intra-canal dressing. Also intra canal gas circulation of ozone at a flow rate of 0.5-1 l/min with net volume of 5 gm/ml for 2-3 min showed encouraging results against pathogenic microbes in the root canal.

**5. Bleaching:** The bleaching effect with ozone is seen when the bleaching agent is placed in the access cavity & crown is exposed to ozone for a minimum of 3 to 4 minutes with marginal success [13]

#### **6. Antibacterial Effect of Ozone on**

**Plaque Biofilm:** Ozonated water is effective in killing gram-positive, gram-negative bacteria and oral Candida albicans causing periodontal disease. Ozonated water had nearly the same antimicrobial activity as 2.5% sodium hypochlorite and also the metabolic activity of fibroblasts was high when the cells were treated with ozonated water

#### **7. Ozone therapy in oral and maxillofacial**

**surgery:** Ozone exposure promotes more complete and rapid normalization of nonspecific resistance and T-cell immunity. It has been found beneficial for treatment of refractory osteomyelitis in head and neck in addition to antibiotics, surgery, and hyperbaric oxygen. It has been documented that dental extraction becomes possible in a patient with avascular bisphosphonate related jaw osteonecrosis in those patients who have received

pyrophosphate analogues when treated with ozone therapy. [14]

#### **8. Ozone for treatment of Periimplantitis:**

Ozone a powerful anti microbial agent kills microorganisms causing periimplantitis. In addition it shows positive wound healing effect due to increased tissue circulation.

#### **9. Ozonated Oil in Decontamination of Avulsed Tooth before Reimplantation:**

2 minute irrigation of the avulsed tooth with non- isotonic ozonated water not only provides mechanical cleansing, but also decontaminates the root surface, with no negative effect on periodontal cells remaining on the tooth surface before reimplantation. [15]

#### **10. Ozone as Denture Cleaning Agent:**

Application of ozonated water may be useful in reducing the number of C albicans on denture plates. [16]

### **ADVANTAGES OF OZONE**

- Heal Ozone treatment of dental caries removes the requirement for physical removal of diseased tissue and promotes remineralisation.
- Extremely time efficient.
- Provides pain free treatment for patients.
- Pedodontists can provide the most modern and the most natural treatment available to their patients without fear that they may cause any physical or mental trauma.

### **Ozone Toxicity**

- Ozone gas should not be inhaled as the bronchial pulmonary system is very sensitive to ozone.
- Ozone should not be administered I.V as there would be a risk of air embolism. [17]
- Other side effects include
  - Epiphora
  - Upper respiratory irritation,
  - Rhinitis, Cough, Nausea,

- Vomiting,
- Shortness of breath,
- Blood vessels swelling,
- Heart problem
- Stroke.

In the event of ozone intoxication patient must be placed in SUPINE POSITION and treated with Vitamin- E and N-acetyl cysteine.

### **Contraindications** <sup>[18,19]</sup>

- Pregnancy
- Glucose 6 phosphate dehydrogenase deficiency
- Hyperthyroidism
- Severe anemia
- Severe Myasthenia
- Acute alcohol intoxication
- Recent Myocardial Infarction
- Haemorrhage from any organ
- Ozone allergy

### **Ozone intraoral side effects:** <sup>[20]</sup>

- Xerostomia
- Mucositis
- Loss of the sense of taste
- The obliteration of intraosseous vessels is caused, resulting in a deficient vascular supply of the spongy medullary spaces

### **CONCLUSION**

Ozone offers a painless alternative to conventional treatment for tooth decay and has proven to halt primary root caries, primary pit and fissure decay and clinically reverse the lesion. Its anti microbial action on endodontic flora is quite promising. Treating patients with ozone therapy lessens the treatment time with an immense deal of variation and it eradicates the bacterial count more specifically. The treatment increases the patients' tolerability and fulfillment with minimal adverse effects. Contraindications of this controversial method should not be forgotten. Further research is needed to

regulate indications and treatment procedures of ozone therapy.

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