# OVERVIEW OF OZONE THERAPY IN CARIES AND OTHER ORAL AND DENTAL DISEASES

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# ABSTARCT

Ozone application in care of oral health arises as innovative and unconventional treatment modality in dental practices. Ozone is a kind of oxygen that has a positive impact in oral diseases managed by numerous ways of treatment options. Its distinctive features are analgesic, immunostimulant, antimicrobial, antihypnotic, detoxicating, bio-energetic and biosynthetic functions. Its pain free, atraumatic, non-invasive nature, and comparative lack of discomfort and fewer side effects raise the patient's competency and acceptability ensuring it as a perfect treatment option. This review generally highlights the efficacy of ozone in oral health care management and its remedial prospective along with its clinical use in periodontology, endodontic, restorative dentistry, oral pathologies, oral surgery, prosthodontics, orthodontics, wound healing, and tooth mineralization.

Keywords: Antimicrobial, Caries Lesion, Ozone therapy, ,Root Caries ,Hypersensitive teeth

# INTRODUCTION

Ozone is a natural allotrope of oxygen exists at top most layers of air defending alive creatures on world from Ultraviolet Radioactivity. It is an unsteady gas, rapidly release nascent oxygen that possesses a potent oxidation property executing various valuable effects such as an effective antimicrobial mediator, interruption of cancerous metabolism, metabolic & immune modulation, disinfection of dental and medical apparatus and drinking water purification [1]. Ozone can halt white spot lesions and back the early phase caries process consequently leading to a favorable results in minimally operative dentistry.

# HISTORY

A German chemist Christian Friedrich Schonbein in 1840, initially observed and sensed an "Odorous Gas" on crossing electricity through water. He is recognized as father of Ozone treatment.

In 1785, another researcher Van Marum detected unusual odor of air around him as the stimulus arose in the electrostatic machine. In 1801, Cruickshank sensed the similar odor on the anode side in splitting water using electricity.Sconbein designated this element "Ozein," in 1840 which is a Greek word that means "to smell". Later on, Werner Von Siemens manufactured an ozone generator in 1857 that was used for sterilization of operation theaters. These generators were termed as "Siemens type" ozone generators. The first ozone generator was designed in Monaco in 1860 that was applied for plant treatment which was later on used by Lender in 1870 for the medical treatment [2].

In the era of 19<sup>th</sup>century, Dr. Fisch practically utilized ozonated water in dental practice for the first time and presented to German doctor Dr. Erwin Payr. He applied ozone in surgical procedure and published review consists of 290 pages titled "Ozone Treatment in Surgery" at the 59th Convention of the German Surgical Society in 1935 [3]. In 1950, a German Dentist Dr E.A. Fiseh used Ozone regularly in Dental Practice.

By the early 20th century, ozone was legalized in USA.

2001 – Dr. Sieg Fried published a text book regarding use of Ozone in Medicine.

2004 - Prof. Edward Lyrich wrote journal "Ozone - The Revolution in Dentistry".

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With the advancement and emerging technology in dentistry with progressive time, Ozone treatment is identified as a better substitute to traditional management methods owing to its minimally invasive nature.

# **BIOLOGICAL ACTIONS OF OZONE**

# **Effect on Bacteria:**

Ozone harms the cell membranes of bacteria by the process of Ozonolysis and dissolves proteins inside cell, causing a functional loss of organelles [4]. It is believed that oxidation affects only microbial cells rather than human body cell because human cells possess good anti-oxidative property. Ozone is effectively function against antibiotic resistant strains with augmented competency in acid PH situation [5].

**Effect on Viruses:** Ozone develops intolerance against peroxides and alters function of reverse transcriptase consequently impeding synthesis of viral protein [6].

Effect on Fungal & Protozoa: Ozone stops cell development and multiplication at some phases.

# Humoral and Cellular Immune system:

Ozone revitalizes the immunity by activation of macrophage and release of cytokine that is particularly needed in immune deficient patients. [7].

**Anti-inflammatory:-** Ozone provokes discharge of interleukins, leukotrienes and prostaglandins as a result decreases inflammatory process and encouraging wound curing [6].

**Effect on microcirculation:** Ozone dilates arterioles and venules by secretion of nitrous oxide that is a potent vasodilator. It inhibits clustering of RBCs' and increases their capacity for oxygen transference. It also stimulates respiratory process such as glycolysis and Krebs cycle at cellular level consequently encourages blood supply therefore beneficial in management of vascular disorders [8].

# **Pharmacodynamics:**

Ozone, a potent chemical substance that destroys 99% of bacteria, viruses and fungisimply in 10 seconds. The effectiveness of 1 molecule of ozone equals to 3000 to 10,000 molecules of chlorine and consequently 3500 folds potent against pathogens without adverse effects [9].

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# Ways of Ozone Generation in Dentistry:

Usually, method of ozone making used for remedial purpose includes:

**1. Ultra-Violet System:** Beneficial for refining atmosphere but produces lower concentration of ozone.

2. Cold Plasma System: Valuable for water purifying in addition to atmosphere.

**3. Corona Discharge System:** It is the widespread system in medicine and dentistry. It has organized production rate and simply creates higher ozone concentration [10].

# MODES OF OZONE ADMINISTRATION:-

Many forms of Ozone are directed on patients for remedial purposes such as ozone gas, as an aqueous solution, oil or ozonated water.

**1. Ozone Gas:** An Ozone generator creates ozone gas by crossing air through higher electrical energy in a polyurethane support. Few commercially obtainable ozone Units for medical purpose includes: Prozone (W&H), HealOzone TEC 3 (Curozone, USA), and O3 ozicure ozone device. The produced ozone is administered to patient by use of hand piece that adjusted to teeth through a silicon cup and is exposed for a minimally ten seconds. The utilized ozone is crossed through a reducing mediator to reconvert into oxygen and finally returned to the generator.

**2. Ozone Water Solution:** It is beneficial for sterilization and disinfection. It shows hemostatic effect in hemorrhagic patients. Furthermore, it enhances oxygen supply and supports metabolic processes to hasten wound healing.

**3. Ozone Oil:** It is externally administered. Plant extracts are passedtoOzone to produce a gel which is thick in consistency having ozonides.

**4. Ozonated Water:** Researches have revealed that ozonated water augmented metabolism of fibroblast cells and enhanced inflammatory response induced by lipopolysaccharide. It also carries potent bactericidal action contrary to plaque biofilm [11].

# DISCUSSION

# OZONE THERAPY IN TREATMENT OF CARIES AND OTHER DENTAL DISEASES

Dental cavities initiated as a result of biological function of pathogenic microorganisms. It has been reported in many literature that ozone is effective in eradication of dental caries. This is elucidated by the fact that pyruvic acid is oxidized to carbon dioxide and acetate by action of ozone [12].

#### 1. Management of pit and fissure caries

Deeply existed pits and fissures are not easily clean and therefore extremely probable to trap foodstuff particles that encourage bacterial progression. Ozone administration in those cases has been observed to be extremely effective. It is recommended that fissures must be cleaned before ozone treatment that allows the ozone to freely contact with caries. Following ozone application, remineralizing agent is applied along with sealing of the clean fissures [13].

Ozone clears the smear layer while remineralizing agent occludes the dentinal tubules. A research by Huth et al. observed that application of ozone considerably enhanced non-cavitated fissure caries at early stage in patients at high risk of caries. [14].

#### 2. Management of root caries

Application of ozone is considered as component of a full protective care regimen because it markedly reverses and captures the superficial non-cavitated root caries lesions [15]. The favorable outcomes are improved as ozone is applied in combination with the low ingestion of Carbohydrates, increased utilization of products containing fluoride and improved oral health maintenance.[15]Similarly, another research byBaysan A and his colleague assessed the ozone impact on the microorganism involved in primary root caries.They concluded that application of ozonemarkedly reduced most of the micro-organisms in primary root caries within10 to 20 sec with no side effects [16].Likewise, one more research byBaysan A assessed the ozone therapy as non-invasive, therapeutic management of root caries.[17].

### **3. Restorative dentistry**

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One of the studies evidently proved the efficiency of ozone on dental material and supported the application of ozone before etchant and sealant application. It was concluded that there was no significant change seen on the properties of enamel and dentin physically including contact angle and bonded restorative materials [18]. In case of long lasting use, ozone gas possesses potent bactericidal influence on pathogenic microbes in the dentinal tubules of deep cavities, therefore enhancing successful results of filling materials [19].

#### 4. Endodontics

Ozone has enormous prospective as a bactericidalagent in endodontics [20]. Ozone is highly effectual as it is administered in required concentration, time along with proper placement into root canals followed by completion of conventional cleaning, shaping and irrigation. Few literatures have been repeatedly reported the probable application of ozone gas, ozonized oil, and ozonated water endodontically [21].Consequently, ozone treatment can boost the extent of non-invasive treatment of these lesions in periapical infection

#### 5. Hypersensitive teeth

Ozone application has ability to minimize the sensitivity of exposed enamel and dentin in addition to sensitivity of root. Application of ozone for the duration of just 40–60s is reported to immediately decrease pain in exposed teeth. Ozone removes the accumulated debris layer, exposes the dentinal tubules and broadens their opening. Later, application of remineralizing agent covers the dentinal tubules entirely without difficulty, obstructing liquid transfer from these tubules. Consequently, sensitivity terminates within seconds after application of ozone that remains for longer interval [22].

#### 6. Ozone in periodontics

Application of Ozone disinfects the gingival and periodontal pockets that are frequently occupied by gram-negative and gram-positive microbes. It is also believed that ozone water is also used for irrigation of areas affected throughout the period of oral prophylaxis and root planning [23,24]. Another study by Dodwad *et al.* in 2011 contrasted the result of oral cavity irrigated with ozonated water, Chlorhexidine (0.2%) and Povidone iodine (10%) in chronic periodontitis patients. They concluded that ozone application locally can consider as an effective atraumatic, bactreicidal agent to provide home care in periodontal disease conservatively. It may also reflect a good supportive periodontal therapy in professional practices [25].

# 7. Oral medicine

Ozone therapy has been observed to be effective successfully against numerous soft tissue lesions such as aphthous ulcers, and herpes labialis [26].

Kumar et al concluded that ozone therapy although needs a gaseous form to be more effectual against oral candidiasis, oral lichen planus, aphthous ulcerations, herpes labialis, and angular cheilitis. However, topical application can also give superior outcomes with no toxicity and adverse effects. Therefore, it is accepted as a less invasive therapy for the oral infections and immunological disorders [27].

Additionally, chemotherapy and radiotherapy are usually executed in patients with carinomatous lesions that consistently cause mucositis. In those cases of mucositis, application of ozone therapy in both liquid and gas forms has revealed favorable results, facilitates patient to eat effortlessly, and enhances the quality of life in cancercurative treatments [28].

# 8. Prosthodontics

A number of micro-organisms particularly C. albicans are commonly inhabitant on denture surfaces. Accumulated plaque on surface of denture causes Denture stomatitis that is normally encountered in clinical practice. Therefore, usage of ozone as denture cleanser effectively reduces the adherence of various microbes such as C. albicans, methicillin resistant S. Aureus and viruses on dentures. It is observed that application of ozone as cleanser of removable partial denture alloys does not affect the physical features of the alloy like surface texture, reflectance and weight [29].

# 9. Oral surgery

Ozone usage exhibits a broad spectrum of application in oral surgery; from a simple extraction case to a severe mandible infection or osteotomy techniques. Ozone improves curing of wound, augments various properties of red blood cells and supports oxygen liberation to the tissues that

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leads to dilatation of vessels and eventually enhances the blood circulation to the blood restricted areas. Consequently, it can be effectively applied in wound healing impairments after surgery; for instance simple to complicated tooth extractions or implant dentistry [30]. Application of ozonized oil shows positive results to improve tissue regeneration in surgical site and wound healing of the extraction socket [31, 32].

A research by Kazancioglu et al. assessed the result of ozone treatment on agony, inflammation and trismus after 3<sup>rd</sup> molar surgical procedure and observed that ozone therapy successfully decreased pain postoperatively whereas there was persistent swelling and trismus observed [33]. It was also revealed by another research that gas injection of ozone in joint space showed positive results in patients with internal derangement of the temporomandibular joint [34,35].

Furthermore, Shabaan et al have reported effectual ozone usage in patients with temporomandibular joint infection and found that it is valuable conservative method in the internal derangement treatment [36].

# **10. Pedodontics**

A successful pediatric treatment relies on gaining a progressive relationship with a child patient that can be easily achieved using ozone therapy. Similarly, Dahnhardt et al. treated carious lesions with ozone in anxious children. It was observed that 93% anxiety was reduced by use of ozone therapy [37].

#### **11. Orthodontics**

Likewise, Ghobashy et al. evaluated the effect of ozonized olive oil gel in decreasing demineralization of enamel near brackets in orthodontic treatment. The application of ozonized olive oil gel besides regular oral hygiene regimen had shown considerably minimal decalcification of teeth in orthodontic patients [38].

Conversely, owing to potent oxidizing property, ozone may have negative impact on resin tooth bonding associated with the inhibition of oxygen polymerization. Recently, Cehreli SV et al. assessed the effect of pretreatment with ozone prophylaxis of enamel on shear bond strength of brackets adhesion with self-etched adhesive method. Their research revealed that pretreated enamel with ozone did not influence onshear bond potency of adhesive system applied for bracket adhesion [39].

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# **CONCLUSION**

Ozone therapy has a broad spectrum of applications that covers all fields of dental practices. It showed a painless, atraumatic substitute to traditional treatment for carious lesions and demonstrated to arrest primary root decay, primary pit and fissure caries and clinically back the carious process. Its non-invasive procedure and comparative comfort increases patient's tolerability and responsiveness thus ensuring it best treatment option; particularly for children. However, further researches are needed to explore effectiveness of ozone therapy and cost benefits in endodontics, periodontics, orthodontics and oral medicines as well to enhance its successful prospective in dentistry.

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