

**Review Article**

**Applications of ozone therapy in pediatric dentistry – Literature review**

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**ABSTRACT:**

Though ozone is not new to the medical field, Ozone dental therapy falls under the category of new treatment protocols. Ozone therapy has wide range of applications in almost all fields of dentistry due to its unique properties. Ozone due to its atraumatic, painless, non-invasive nature and minimal discomfort, was found to be highly acceptable to the patient and improved patient's compliance, thus playing a very important role in paediatric dentistry.

**Keywords:** Ozone therapy, pediatric dentistry

**INTRODUCTION:**

Ozone (O<sub>3</sub>) is a natural gaseous molecule made up of three oxygen atoms. The word ozone originates from the Greek word ozein, which means odour and was first used in 1840 by German chemist Christian Friedrich Schonbein "The father of ozone therapy." Ozone exists as colourless gas, with a pungent odour at room temperature, detectable even at concentrations as low as 0.02–0.05 ppm. Its half-life varies with temperature variation. At 20 °C it has a half-life of 40 min at 0 °C about 140 min.

Ozone therapy can be defined as a versatile bio-oxidative therapy in which oxygen/ozone is administered via gas or dissolved in water or oil base to obtain therapeutic benefits. [1] Early in the 1930's E.A.Fisch was the first dentist to use ozone in dentistry. Due to its anti-microbial property ozone is a potent disinfecting agent and aids in wound healing during surgeries.

**OZONE PRODUCTION:**

Oxygen molecules in the air combines under the influence of factors such as ultraviolet radiation (from the sun) and electrical discharges (lightning). Intense physical stress on water (such as in areas of waterfalls and ocean waves crashing onto rocks) also results in production of ozone in nature. For medical use highly specific gazettes known as Ozone Generators are used for production of ozone. The Ozone Generators work on one of the three principles: Ultra-violet light lamp, Corona discharge or Cold plasma. In dentistry, there are two widely used ozone units: the heal ozone and ozotop.

**PROPERTIES OF OZONE:**

Ozone is known for its antimicrobial, virucidal, and disinfectant properties. It is a potent immunostimulant, has anti-inflammatory and analgesic properties, and promotes tissue regeneration.

The main health benefits of ozone therapy include the following:

- inactivation and elimination of Gram-positive and Gram-negative bacteria, fungi, and viruses;
- stimulation of immune system and improvement of circulation;
- decrease in inflammation and pain;
- stimulation of humoral anti-oxidant system;
- restoration of appropriate oxygen metabolism;
- prevention of shock and stroke injury;
- induction of friendly ecological environment;
- increase in brain function and memory activities

#### **MODES OF ADMINISTRATION OF OZONE:**

Three fundamental forms of application of ozone to oral tissues are - (1) ozonated water, (2) ozonated olive oil, and (3) oxygen/ozone gas. Ozonated water and olive oil have the capacity to entrap and then release oxygen/ozone, an ideal delivery system. These forms of application are used singly or in combination to treat dental disease. The different modes of ozone application include:

1. OZONE GAS APPLICATION - Ozone generating equipment converts oxygen to ozone. The ozone is thereafter led to a hand piece fitted with a silicone cup. Differently shaped silicone cups are available that correspond to the form of various teeth and their surfaces. This ensures close contact between the silicone cup and the carious area of the tooth so that the ozone does not escape. The ozone is led through the silicone cup over the tooth for a minimum of 10 seconds. The ozone in the silicone cup is collected again and reconverted to oxygen by the apparatus.

2. OZONE AQUEOUS SOLUTION - The following properties of ozone are used in this case: Disinfectant and sterilizing effect, Hemostatic effect, especially in cases of hemorrhages; Accelerated wound healing, improved oxygen supply and support of metabolic processes.

3. OZONE OIL - Ozonated oils are pure plant extracts, through which pure oxygen and ozone are passed. The plant extracts undergo a chemical reaction to form a thick, viscous oil, or in some cases, a petroleum jelly-like product. The final products contain ozonides. This method of external application is harmless.

#### **DENTAL APPLICATIONS OF OZONE:**

Ozone has shown positive effects in general dentistry for sterilization of equipment, management of surgical wound healing, dental caries and preventive conservative, gingivitis and periodontitis, oral lichen planus, halitosis, post-surgical pain, osteonecrosis of the jaw and prevention of post-extraction alveolitis, plaque and bio-films' formation, root canals' disinfection, reducing dentin hypersensitivity, controlling temporomandibular joint disorders, and enhancing teeth whitening.

#### **ANTIMICROBIAL EFFICACY OF OZONE:**

Ozone is one of the most powerful antimicrobial agents that is currently used in dentistry. Dental caries is caused by an ecological niche of caries producing organisms and eliminating these cariological organisms provide a tremendous clinical and long-term preventive advantage for patients. Research has shown, application of ozone for a period of 10 seconds could reduce the number of Streptococcus mutans and Streptococcus sobrinus in vitro due to the antimicrobial effectiveness of ozone, as a gas and in the form of ozonated water.

### **CLINICAL USE OF OZONE THERAPY IN PEDIATRIC DENTISTRY:**

The applications of ozone therapy in a pediatric practice rely mainly on the fact that ozone application is a very quick, effective, easy, and especially a painless procedure to perform. These aspects of the treatment not only enhance the operator efficiency but also effectively improves the patient compliance and tolerance to the treatment procedure. Attaining a positive rapport with a child patient is the key to a successful pediatric treatment which can be very effectively accompanied by using ozone therapy. Special needs patients are often afraid and less co-operative, such as young patients, so ozone therapy could be applied to this kind of patient too.

#### **A) DENTAL CARIES MANAGEMENT:**

Dental caries and early loss of primary teeth are the most common childhood diseases affecting the quality of life in kids in the world. Many cavity lesions of teeth of very young patients are being left untreated as a cause of difficulty in management.

The main aim of preventive dentistry and of the minimally invasive approaches of caries in paediatric dentistry is to avoid early loss of primary teeth, to preserve the development of the facial-skeletal system, and to arrest caries progression of primary tooth. It is desirable that teeth remain in the mouth until the natural exfoliation, in order to guarantee the integrity of primary dentition without causing the child pain and infection or risk of re-currant caries and, therefore, failure of dental restoration.

Beretta and Federici Canova suggest ozone therapy as part of a possible ultraconservative atraumatic treatment of deciduous teeth with deep carious lesions, with a partial excavation of dentin. They introduced an excellent alternative for deep caries treatment in primary teeth to be clinically performed in one appointment. The essential advantage of this procedure is the removal of dental tissue avoiding the invasion of the pulp chamber and the progression of caries infection, as minimally as possible.

Ozone, despite its high oxidizing power, can kill or inhibit *S. mutants* and *L. acidophilus* in the carious lesion without removing the infected tissue. It can oxidize and induce the lysis of the bacterial cell wall and it is able to transform the pyruvic acid produced by the bacteria into acetic acid and carbon dioxide, arresting or reversing the progression of caries. Using ozone, it is possible to preserve a layer of dentin called "ex-carious", preventing the exposure of the pulp and avoiding the subsequent pulpotomy in very young children.

Ozone therapy is a health-safe, simple, painless, and very conservative approach that might be suitable for monitoring caries progression in unco-operative children with traditional dental treatments until appropriate cooperation and compliance can be attained.

#### **B) PULPECTOMY:**

Caries in primary teeth progresses rapidly and the complete elimination of all soft, demineralized carious dentin in asymptomatic teeth with deep caries may result in pulp exposure.

A successful primary root canal treatment depends on proper shaping and cleaning of the root canal system followed by obturation with hermetic root canal filling. However, the complex internal nature of primary teeth makes it difficult to achieve correct tooth shaping. Therefore, ideal irrigation and root canal disinfection are important.

Current practice suggesting the use of Sodium Hypochlorite had been limited because of its bitter taste, foul smell, and toxicity when injected into the peri radicular tissues. Ozone with its advantages as: its oxidation power; lack of mutagenicity and biocompatibility; rapid microbicidal effects, especially against anaerobes and *E. faecalis*; and ease of handling can be used as an excellent alternative in paediatric patients.

Ozone has even been suggested as an obturating material for primary teeth. Doneria et al. proposed zinc oxide ozonated oil (ZnO-OO) as an obturating material or alternate treatment option for teeth requiring pulpectomy.

Ozone may be useful together with fissure sealants with amorphous calcium phosphate, fluoride content, or nano-hydroxyapatite and for initial caries prevention. Unal et al. found an improved remineralization capacity of the fissure sealants with gaseous ozone on non-cavitated incipient pit and fissure caries.

Another interesting field of application of ozone is the regenerative endodontics of traumatic injuries, Ozone shows a high biocompatible and regenerative properties and, at the same time, antimicrobial capability. According to a study conducted by Küçük et al, 2 mg/L of ozonated water is the recommended concentration as a possible adjuvant irrigating agent for the regenerative endodontic procedures, with the aim to induce the proliferation of the pulp cells.

- C) Wound healing: Ozone reduces the post-extraction healing time by forming a pseudo-membrane over the socket, so protecting it from any physical and mechanical insults. 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 alveolitis, there is accelerated healing by irrigation with ozonated water after removal of the 16 necrotic pulp & debris under antibiotic coverage.

#### **CONTRAINDICATIONS:**

Ozone is contraindicated in certain medical conditions like pregnancy glucose- 6 – phosphate dehydrogenase deficiency (favism), recent myocardial infarction, hyperthyroidism, severe anaemia, severe myasthenia, haemorrhage, 18 acute alcohol intoxication and ozone allergy.

#### **ADVERSE EFFECTS:**

Despite its beneficial uses, it is necessary to keep in mind that ozone can be toxic after inhalation when the concentration is more 0.01 ppm in the oral cavity during therapy. Pulmonary complications could occur as side-effects, causing a sore throat, increase in asthma, and even damage to lungs. If not used correctly or in excessive amounts, long-term exposure of the operator to ozone is related with various side effects: irritation of the upper airways, epiphora, rhinitis, coughing, bronchoconstriction, headaches, and vomiting.

#### **DISCUSSION:**

Ozone is clinically easier, less expensive, and faster when compared with other antimicrobial and oxidant caries treatments. Ozone should not be compared to conventional drilling and filling approaches. Since ozone is the most powerful antimicrobial and oxidant that can be used in dentistry thus obvious that ozone should be used in combating the microorganisms associated with dental caries.

Ozone should be considered an adjunct to existing treatment and preventive methods rather than an isolated treatment modality. Most of the dentists that are using ozone therapy treatments today use the treatment in conjunction with plaque and diet control, chemotherapeutic approaches such as fluoride or chlorhexidine, sealants, and stepwise excavation. It is thus clear that clinical dentistry has adopted ozone to be used in conjunction with other clinical approaches, not as an alternative.

#### **CONCLUSIONS:**

Ozone therapy is suggested in the management of deep dental caries, ECC, MIH, root canal therapy, remineralization, dental hygiene, and dental prophylaxis, in young children and unco-operative paediatric patients. Ozone is a simple and pain-free technique. Not least is the advantage of its ability to reduce the patient's anxiety and stress level by improving co-operation. All researchers agree on this point. Ozone therapies with conscious sedation, laser therapy, "atraumatic restorative technique," and other minimally invasive techniques are part of modern paediatric dentistry. Its main aim is to guarantee quality care, in both very young patients and patients with special needs.

#### **REFERENCES:**

1. Biological assessment of ozone therapy on experimental oral candidiasis in immunosuppressed rats  
Laila E. Amin Oral Biology, Faculty of Dentistry, Mansoura University, 35516 El-Gomhoria Street, Egypt
2. Ozone Therapy in Dentistry A Brief Review for Physicians WILLIAM C. DOMB Director, Inland Institute of Aesthetic Dentistry, Upland, CA, USA
3. OZONE IN PEDIATRIC DENTISTRY: A MIRACLE THERAPY Dr. Krunal S. Soni\*, Satabdi Saha\*, Dr. Niharika\*\*, Prof (Dr.) Subrata Saha
4. Ozone therapy in dentistry T. Manigandan<sup>1</sup>, SP. Mangaiyarkarasi<sup>2</sup>, R. Hemalatha<sup>2</sup>, VT. Hemalatha<sup>1</sup> and N.P. Mural
5. Antimicrobial Effect of Ozone Therapy in Deep Dentinal Carious Lesion: A Systematic Review Hemraj Badhe<sup>1</sup>, Ritesh Kalaskar<sup>2</sup>, Shruti Balasubramanian<sup>3</sup>, Henpu Kamki<sup>4</sup>, Ashita Kalaskar<sup>5</sup>
6. Application of Ozone Therapy in Paediatric Dentistry Maurizio D'Amario<sup>1,\*</sup>, Mariachiara Di Carlo<sup>1</sup>, Salvatore Massimo Natale<sup>2</sup>, Lucia Memè<sup>3</sup>, Giuseppe Marzo<sup>1</sup>, Giorgio Matarazzo<sup>4</sup> and Mario Capogreco<sup>1</sup>