

# OZONE IN PEDIATRIC DENTISTRY: A MIRACLE THERAPY

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## ABSTRACT

Ozone therapy has successfully been used in the medical field for treatment of various diseases for more than 100 years. Introduction of ozone therapy has truly revolutionized dentistry. Ozone therapy is completely painless, noninvasive and has advantages of lack of side effects or adverse reactions, increased patient's acceptability and compliance thus making it an ideal treatment option for pediatric patients where patient compliance is of prime importance. This article reviews the clinical application of ozone in pediatric dentistry.

## KEY WORDS

**Caries disinfection, ozone, ozone as antiseptic, ozone in fissure and root caries**

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## INTRODUCTION

The word ozone is derived from the Greek "ozein" meaning odorant.<sup>1</sup> Ozone (O<sub>3</sub>) is a gas with a characteristic, penetrating odor that is present in small amounts in atmospheric air. Ozone is a triatomic molecule consisting of three oxygen atoms with a molecular weight of 47.98 g/mol.<sup>1,2</sup> It is a blue gas, with a strong odor and absorbs the harmful ultraviolet rays present in the light spectrum from the sun and protects the living creatures from the ultraviolet rays.

There is no doubt that oral hygiene forms the fundamental basis for the prevention of dental caries. Research suggests that the process of decay, in which, establishment of an acid based niche environment where demineralization exceeds remineralization, starts in the microbiological coating over the surface of the tooth, called plaque. Plaque consists of food debris, bacteria normally present in the oral cavity and various proteins. Plaque needs to be disrupted and removed on a regular basis to prevent infection and damage. A lot of times, tooth morphology makes oral hygiene difficult. The use of ozonated water reduces unattached bacteria, micro organisms in plaque, found around and on tooth surfaces.<sup>3</sup>

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. Interest of Ozone use in medicine and dentistry is due to its anti-microbial, disinfectant, bio-compatibility and healing properties.

## HISTORY:

1840- Christian F. Schonbein, a German chemist first discovered ozone and he is considered as the father of ozone therapy.

1857 – Joachim Hensler, a German physicist and Hans Wolf German Physician developed first Ozone generator for medical use.

1870 – Dr. C. Lender first used Ozone in medical field for purifying blood in test tubes.

1883 – Dr. Charles Kenworthy published his experiences with Ozone in Florida Medical Journal.

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

1930- A German Dentist, Dr. E.A. Fisch, used ozone on a regular basis in his dental practice in Zurich, Switzerland and published numerous papers on the subject.

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

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

### ANTIMICROBIAL EFFICACY OF OZONE

Ozone is one of the most powerful antimicrobial agents that are 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 was capable of reducing the numbers 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.<sup>4</sup>

Polydorou et al<sup>5</sup> studied antibacterial effect of KavoHealozone device on *Streptococcus mutans* in comparison with the already proven activity of two dentin bonding systems. Their findings show that an 80 seconds application of ozone is a very promising therapy for elimination of residual micro-organisms in deep cavities and therefore of potentially increasing the clinical success of restorations. A 40 seconds application of ozone was found to reduce significantly the numbers of *Streptococcus mutans*, but not to extend of other treatments. A longer period of ozone activity could be advantageous as a result of its anticariogenic effect.

Nagayoshi et al<sup>6</sup> tested the efficacy of ozonated water on survival and permeability of oral micro-organisms and dental plaque. They confirm that ozonated water (0.5–4 mg/l) was highly effective in killing of both gram positive and gram negative micro-organisms. Gram negative bacteria, such as *Porphyromonas endodontalis* and *Porphyromonas gingivalis* were substantially more sensitive to ozonated water than gram positive oral streptococci and *Candida albicans* in pure culture. Furthermore ozonated water had strong bactericidal activity against bacteria in plaque biofilm. In addition, ozonated water inhibited the accumulation of experimental dental plaque in vitro.

### CLINICAL APPLICATIONS

**Prevention and management of dental caries :** The application of Ozone therapy in the management of dental caries is widely studied. Most of the child patients have fear and anxiety towards dental treatment. Dahnhart JE et al<sup>7</sup> evaluated the anxiety level of children (and their parents) treated with ozone and found that all children & parents reported significant anxiety prior to ozone treatment. However, following the treatment, the children reported they would be pleased to return for future treatments. Also, 80% of the parents said they would

be willing to pay more for this therapy compared with traditional drilling and filling.

Huth et al<sup>8</sup> ran a split mouth clinical trial to assess the effect of a single 40 second application of gaseous ozone on non cavitated fissure caries in permanent molars. The ozone-treated teeth showed reduced caries progression when compared to the untreated control lesions in these same patients. Kronusova M<sup>9</sup> found that Ozone treatment either alone or combined with a remineralizing solution was found to be effective for remineralization of initial fissure caries lesions. Ozone has been shown to reverse pit and fissures caries in deciduous teeth.<sup>10</sup>

**Management of Periodontal diseases :** Studies found that ozonated water strongly inhibited the formation of dental plaque and was highly effective in killing of both gram positive and gram negative microorganisms.<sup>11</sup> Ozonated water can be used in the ultrasonic water reservoir, also as a pretreatment rinse before scaling, root planning and the sulci, pockets are irrigated using syringe and canula in non surgical pocket curettage. This process will reduce the initial pathogenic load on the patient locally and systemically. After treatment, each pocket & sulcus is insufflated with ozone gas which directly goes into tissues, sterilizing the area. The patients are also given ozonated oil to apply topically to the soft tissue. Huth et al<sup>12</sup> in their study reported that the aqueous form of ozone, as a potential antiseptic agent, showed less cytotoxicity than gaseous ozone or established antimicrobials under most conditions.

**Root canal therapy in deciduous teeth :** Nagayoshi and colleagues<sup>13</sup> found nearly the same antimicrobial activity (against *E. faecalis* and *Streptococcus mutans*) and a lower level of cytotoxicity of ozonated water as compared with 2.5% NaOCl. They stated, “Ozone is known to act as a strong antimicrobial agent against bacteria, fungi, and viruses. Ozonized oils can also be used as a temporary root canal dressing in infected necrotic cases. In peri-apical lesions, ozone gas infiltration contributes in the non-surgical management of these lesions. Siqueira and colleagues<sup>14</sup> evaluated the antibacterial activity of the ozonated oil and calcium hydroxide pastes against bacterial species commonly associated with the etiology of periradicular diseases. Of the tested medicaments, ozonated oil was the most effective against the evaluated bacterial species.

**Bleaching of discolored teeth :** Ozone is used to lighten the discoloration in root canal treated teeth. Crown discoloration is a major aesthetic problem, especially in anterior teeth. Conventional walking bleaching requires much more time and results are not often satisfactory. Also, capping the tooth with ceramic crown is not always a good idea. Ozone can also, be successfully used for lightening the

yellowish tinge of tetracycline-stained rat incisors, as reported by Tessier J and colleagues<sup>15</sup> in their experimental study.

**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 necrotic pulp & debris under antibiotic coverage.<sup>16</sup>

**Decontamination of toothbrush:** Ozone application was found to remove the toothbrushes bristles microbiota following conventional brushing.

**Dental unit water lines disinfection :** Ozone can be used for Dental unit water lines purification and to minimize cross infection due to its antimicrobial efficiency and lack of side effects. In dental unit water lines, ozone achieved a 57 percent reduction in biofilm and a 65 percent reduction in viable bacteria in spite of a very low dosage and short time of application.<sup>17</sup>

#### CONTRAINDICATIONS:

Ozone is contraindicated in certain medical conditions like pregnancy, glucose-6-phosphatedehydrogenase deficiency (favism), recent myocardial infarction, hyperthyroidism, severe anemia, severe myasthenia, hemorrhage, acute alcohol intoxication and ozone allergy.<sup>18</sup>

#### OZONE TOXICITY:

Therapeutic administration of Ozone did not cause any deleterious effects. But the inconsistent use of Ozone was reported to cause certain side effects like epiphora, upper respiratory tract irritation, rhinitis, cough, headache, occasional nausea, vomiting, shortness of breath, blood vessel swelling, poor circulation, heart problems and at times stroke.<sup>18</sup> Because of its extreme oxidant capacity, good ozone hygiene is required. Correctly scavenging the excess ozone gas and preventing it from escaping into the office environment is essential. Because of ozone's high oxidative power, all materials that come in contact with the gas must be ozone resistant such as glass, silicon and Teflon.

However, in the event of ozone intoxication the patient must be placed in the supine position and treated with vitamin E and n-acetylcysteine. The European Cooperation of Medical Ozone Societies

warns from direct intravenous injections of ozone/oxygen gas that should not be practiced due to the possible risk of air embolism.<sup>2</sup>

## 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 fairly obvious that ozone should be used in combating the microorganisms associated with dental caries. Since aqueous ozone exhibits the highest level of biocompatibility compared to commonly used antiseptics, it should be considered for extensive use in this area of dentistry.<sup>19</sup>

Ozone should be considered an adjunct to existing treatment and preventive methods rather than an isolated treatment modality. The vast majority 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.<sup>6</sup>

The new Caries Elimination System, based on ozone (O<sub>3</sub>) gas, is delivered through a hose and hand piece into a polymer cup that is placed around the tooth surface to be treated. The ozone penetrates through the decayed tissue, eliminating any bacteria, fungi and viral contamination. It also denatures the acid metabolites of the bacteria when delivered in 10-second bursts; ozone gas at a concentration of 2,200 ppm can eliminate 99 per cent of the microflora, and so halt the decay process. The solubility of ozone in water (50 ml ozone in 100 ml water at 0°C) is ten times greater than that of oxygen. The half-life of ozone ranges from 1 hour at 22°C to approx. 3 hours at 4°C, when double-distilled water is used as a solvent.

## CONCLUSION

Ozone has a place in 21st century oral health care: its proven powerful antimicrobial efficacy and undoubtedly potent oxidant ability, reduces cariogenic microorganisms and provide beneficial effects against organic acids in lesions, in conjunction with existing management strategies for dental caries to tip the "caries balance."

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