

## Application of Ozone Therapy in Dentistry

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**ABSTRACT:**

Ozone therapy has successfully being used in the medical field for treatment of various diseases for more than 100 years. The versatility of ozone therapy, its unique properties, noninvasive nature, absence of side effects or adverse reactions were responsible for its wide spread use. This review of literature is an attempt to summarize its therapeutic potential in dentistry and its possible clinical application in future.

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**Key words:** *Ozone therapy, dentistry, Ozone therapy indications, Ozone therapy contraindications.*

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### INTRODUCTION

Ozone also known as triatomic oxygen and trioxygen is a naturally occurring compound consisting of three oxygen atoms.<sup>1</sup> Ozone, a naturally found gas in the upper atmosphere filters potentially damaging ultraviolet light from reaching the Earth's surface.<sup>2</sup>

In 1840, Shonbein named the substance, which gave odour ozone, from the Greek word "ozein"- to smell. Ozone has a long history of research and clinical applications. Ozone therapy was accepted as an alternative medicine in the USA from 1880 and has been used for over 130 years in twenty countries throughout the world. During World War I, ozone gas was used for treating gaseous post-traumatic gangrene, infected wounds, mustard gas burns and fistulas in German soldiers. E.A. Fisch was the first dentist to use ozone in his practice in the 1930s. He used ozonated water during dental surgeries to aid in disinfection and wound healing. Today ozone therapy is used extensively in Europe in both dentistry and medicine. 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.<sup>3,4</sup>

### MECHANISM OF ACTION.<sup>5</sup>

Ozone has been shown to possess unique properties and has potential applications to the clinical practice of dentistry and medicine. There are several known actions of ozone, such as antimicrobial (bactericidal, viricidal, and fungicidal), immunostimulating, immune modulatory, anti-inflammatory, biosynthetic (activation of the metabolism of carbohydrates, proteins, lipids), bioenergetic, antihypoxic, analgesic, haemostatic, etc.

### INDICATIONS OF OZONE THERAPY IN DENTISTRY

Ozone has therapeutic applications in various dental treatment modalities. Ozone therapy presents great advantages when used as an adjunct to conventional treatments.

#### ***Ozone in the management of caries.***

Ozone, in gaseous or aqueous phase, has been shown to be a powerful and reliable antimicrobial agent against bacteria, fungi, protozoa, and viruses.<sup>6</sup>

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Ozone has a severely disruptive effect on cariogenic bacteria, resulting in elimination of acidogenic bacteria. The strongest naturally occurring acid, produced by acidogenic bacteria during cariogenesis is pyruvic acid. Ozone can decarboxylate this acid to acetic acid.<sup>7</sup> It has been shown that remineralization of carious lesions can be encouraged when the production of acetic acid, or other high pKa acids found in resting plaque, buffers plaque fluid.<sup>8</sup>

Treatment with ozone gas significantly reduced caries progression, remineralised and arrested carious lesions in patients at high caries risk. It was also observed that ozone treatment being noninvasive provoked least state of anxiety compared to traditional dentistry. Noncavitated lesions were more likely to reverse than cavitated lesions.<sup>9-13</sup> Initial studies have indicated that an application of ozone is capable of clinically reversing leathery root carious lesions.<sup>14,15</sup>

#### **Ozone in management of hypersensitivity**

Clinical trials documented gaseous ozone reduces pain immediately after treatment and on application of ozone, desensitization of dentine lasts for longer period of time. Smear layer present over the exposed root surface prevents the penetration of calcium and fluoride ions deep into the dentinal tubules. Ozone removes this smear layer, opens up the dentinal tubules, broadens their diameter and allows the Calcium and Fluoride ions to flow into the tubules easily, deeply and effectively to plug the dentinal tubules, preventing the fluid exchange through these tubules. Thus, ozone can effectively reduce the root sensitivity problem immediately and also lasts longer.<sup>16,17</sup>

#### **Ozone therapy in endodontics**

Ozone has great potential to be used as an antimicrobial in endodontics.<sup>18</sup>

Micro organisms are one of the cause in the failure of root canal therapy. Ozone is one of the most powerful antimicrobial agents with enormous advantages to reduce the number of micro organisms in the root canal.<sup>19</sup> Ozone is effective when it is prescribed in sufficient concentration, used for an adequate time and delivered correctly into root

canals after the traditional cleaning, shaping and irrigation has been completed. Studies have proved the potential use of ozone gas, ozonated water and ozonised oil in endodontic therapy.<sup>20,21</sup>

#### **Ozone in Restorative dentistry**

Studies that assessed the efficacy of ozone in restorative dentistry and its effect on dental materials concluded that ozone gas can be applied prior to etching and the placement of sealant with no negative impact on sound enamel physical properties, including knoop surface microhardness or contact angle.<sup>22</sup> The longer exposure to ozone gas has a strong bactericidal effect on microorganisms within the dentinal tubules of deep cavities, which could result in increasing the clinical success of restorations,<sup>23</sup> with no negative impact on dentin and enamel shear bond strength of adhesive restoration.<sup>24</sup>

#### **Antibacterial Effect of Ozone on Plaque biofilm**

Both caries and periodontal disease are caused primarily by plaque biofilm. Ozone might be useful to control oral infectious microorganisms in dental plaque. The antimicrobial property of ozone is not only effective in reducing the number of cariogenic bacteria, but also causes significant reduction in the micro organisms present in the root canal. However it was not successful in completely eliminating these bacterias embedded in the biofilm.<sup>25-29</sup>

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. The aqueous form of ozone, as a potential antiseptic agent, showed less cytotoxicity than gaseous ozone or established antimicrobials like chlorhexidine digluconate, sodium hypochlorite or hydrogen peroxide under most conditions. Therefore, aqueous ozone fulfils optimal cell biological characteristics in terms of biocompatibility for oral application.<sup>30-32</sup>

Ozone may be considered as an adjunctive to conventional treatment strategy due to its powerful ability to inactivate microorganisms.

### **Ozone therapy in oral and maxillofacial surgery**

Ozone has a positive influence on bone metabolism and reparative process of the bone.<sup>33</sup> In patients with chronic mandibular osteomyelitis, it was observed that medical ozone exposure promoted more complete and rapid normalization of nonspecific resistance and T-cellular immunity, thus accelerating clinical cure and reducing the incidence of complications.<sup>34</sup>

Ozone therapy is also 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.<sup>35</sup>

Ozone therapy in the management of bone necrosis or in extraction sites during and after oral surgery in patients treated with Bisphosphonates may stimulate cell proliferation and soft tissue healing.<sup>36</sup> When a combination therapy of a course of antibiotics, surgery and ozone therapy was given to patients with Osteo necrosis of jaw in patients with multiple myeloma there was a decrease in both the incidence of osteoradionecrosis of the jaw and the extent of lesions.<sup>37</sup> It has been documented that dental extraction becomes possible in a patient with avascular bisphosphonate-related jaw osteonecrosis or in those who received pyrophosphate analogous when treated with ozone therapy.<sup>38</sup> Compared with other therapeutic choices like antibiotics, surgical treatment, the new treatment protocol recommends the use of ozone therapy as therapeutic support in the treatment of bisphosphonate related osteo necrosis of the jaws.<sup>39</sup>

### **Ozone for treatment of periimplantitis**

For the prevention of periimplantitis an adequate and steady plaque control regimen must be ensured. Ozone, a powerful antimicrobial kills the microorganisms causing periimplantitis. In addition ozone shows a positive wound healing effect due to the increase of tissue circulation. Gasiform ozone or ozonized water shows an increased healing compared to wound healing without ozone therapy.<sup>40</sup>

### **Effect of ozone on wound healing**

The impact of ozone on epithelial wound healing in the oral cavity was observed by Filippi. It was found

that ozone-water can be used daily to speed up the healing rate in the oral mucosa. This effect can be seen in the first two postoperative days. The comparison with wounds without treatment showed that daily treatment with ozone water accelerates the physiological healing rate.<sup>41</sup> Patients under ozone therapy healed more quickly and without the need for systemic medication, compared to the control group. Application of ozone after tooth extraction reduced the post-extraction complications.<sup>42</sup>

### **Use of ozonated water in decontamination of avulsed teeth before replantation**

A high level of biocompatibility of aqueous ozone on human oral epithelial cells, gingival fibroblast cells, and periodontal cells has been found.<sup>43,44</sup> Two-minute irrigation of the avulsed teeth with non-isotonic ozonated water not only provides mechanical cleansing, but also decontaminate the root surface, with no negative effect on periodontal cells remaining on the tooth surface before replantation.<sup>44</sup>

### **Antimicrobial efficacy of ozone as denture cleaners**

Microbial plaque accumulating on the dentures is composed of several oral microorganisms, mainly *C. albicans*. Denture plaque control is essential for the prevention of denture stomatitis. The application of ozonated water may be useful in reducing the number of *C. albicans* on denture plates.<sup>45</sup> The use of ozone as denture cleaner is effective against methicillin-resistant *S. aureus* and viruses.<sup>46</sup>

Ozone can be applied for cleaning the surface of removable partial denture alloys with little impact on the quality of alloy in terms of reflectance, surface roughness, and weight.<sup>47</sup>

Direct exposure to gaseous ozone was a more effective microbicide compared with ozonated water. Therefore gaseous ozone can be clinically useful for disinfection of removable prosthesis.<sup>48</sup>

There is also some evidence on the effectiveness of aqueous ozone application in adjunct to amino-alcohol for decontamination of the implant surfaces.<sup>27</sup>

### **Biofouling of dental unit water system**

Ozone, applied for 10 minutes, caused 65% reduction of the total viable bacterial counts but was

not successful in completely eliminating the unwanted biofilm from the tubing surfaces.<sup>49</sup>

### CONTRAINDICATIONS<sup>5, 50,51</sup>

The following are contraindications for the use of ozone therapy:

Pregnancy, severe anaemia, hyperthyroidism, thrombocytopenia, severe myasthenia, acute alcohol intoxication, recent myocardial infarction, hemorrhage from any organ, Glucose-6-phosphate-dehydrogenase deficiency and ozone allergy. Prolonged inhalation of ozone can be deleterious to the lungs and other organs but well calibrated doses can be therapeutically used in various conditions without any toxicity or side effects.<sup>3,52,53</sup> The European Cooperation of Medical Ozone Societies warns that direct intravenous injections of ozone/oxygen gas should not be practiced due to the possible risk of air embolism.

### CONCLUSION

Scientific researches suggest ozone therapy has great potential in the treatment of various conditions encountered in dental practice looks promising. In future, the focus should be on well designed double blind randomized clinical trial and establishment of safe and well defined parameters to determine the precise indications and guidelines for routine use of ozone in the treatment of various dental pathologies.

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