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### RESEARCH ARTICLE

#### OZONE A NOVEL INTERVENTION IN PERIODONTAL THERAPY - AN OVERVIEW

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#### Abstract

Ozone has antimicrobial, immuno-stimulatory, anti-hypoxic, bioenergetic, and biosynthetic properties. It is inexpensive, minimally invasive and lacks adverse effects. It is a powerful tool for treating bacterial, fungal, and viral infections, as well as age-related macular degeneration, ischemic disorders, ocular disorders, orthopaedic diseases, haematological diseases, neurodegenerative diseases, pulmonary diseases, renal diseases, dermatological diseases and periodontal diseases. The use of ozone is well indicated in all stages of gingival and periodontal diseases because of its beneficial biological effects, its anti-microbial activity, and its healing and tissue regeneration properties. The effects of ozone treatment in any form (gaseous, water, or oil) have been investigated and analysed with potential exceptional results in the management of periodontal diseases. This review article outlines the clinical applications of ozone therapy in periodontal diseases.

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#### Introduction:-

The word "ozone" is derived from the Greek word "ozein," which means "odour".<sup>1</sup> It is a powerful oxidizer despite being an unstable gas that quickly releases nascent oxygen radical to form oxygen gas. It has been used in human medicine for a very long time to kill bacteria, fungi, inactivate viruses, and control haemorrhages because of its ability to release nascent oxygen.<sup>2</sup> It acts in a variety of ways that include those that are antimicrobial, immuno-stimulatory, anti-hypoxic, bioenergetic, and biosynthetic.<sup>3</sup> The German chemist Christian Friedrich Schonbein known as "father of ozone therapy", was the first person to use ozone therapy in 1840<sup>4</sup>, and the first dentist to employ it in his practise was E. A. Fisch in 1930.<sup>5</sup>

Ozone treatment is a multifaceted bio-oxidative therapy that delivers ozone as a gas or as a solution in water or oil base to achieve therapeutic effects. It is distinguished by its inexpensive cost, lack of adverse effects, and minimally invasive and conservative application. Ozone treatment is a powerful tool for treating bacterial, fungal, and viral infections, as well as age-related macular degeneration, ischemic disorders, ocular disorders, orthopaedic diseases,

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haematological diseases, neurodegenerative diseases, pulmonary diseases, renal diseases, and dermatological diseases.<sup>5,6</sup> Additionally, it may be used to sterilise heat-sensitive objects, such as medical equipment and devices with small lumens.<sup>7</sup> Ozone treatment can be administered to both covid-19 patients<sup>8</sup> and cancer patients.<sup>9</sup> Ozone treatment should not be used in cases of pregnancy, glucose-6-phosphate-dehydrogenase deficiency (favism), hyperthyroidism, severe anaemia, severe myasthenia, active bleeding, acute alcohol intoxication, or recent myocardial infarction.<sup>10</sup>

In dentistry, ozone works well in dentistry to treat bacterial, fungal, protozoal, and viral infections.<sup>9,11</sup> Additionally, it reduces dental caries by remineralizing the tooth surface,<sup>11-13</sup> seems to support tissue repair and healing processes<sup>14</sup>, and can be utilised to treat non-carious cervical lesions<sup>14-16</sup>. It can also be used to manage pain,<sup>11,13,15</sup> treat mouth ulcers<sup>11</sup>, and treat TMJ disorders.<sup>15,17</sup> Ozone stimulates the growth of immunologically-competent cells and the production of immunoglobulins, among other beneficial effects on cellular and humoral immune system components.<sup>18</sup> Interleukins, leukotrienes, and prostaglandins are just a few examples of physiologically active molecules that are triggered by it and help to heal wounds and reduce inflammation. Ozone also stimulates macrophages and increases the susceptibility of microbes to phagocytosis. There are four ways it may be used: as gas, ozonized water, ozonized oil, and ozonized air. Ozonized water (aqueous form), which has the power to destroy gram-positive, gram-negative oral bacteria, and oral *Candida albicans*, is the most often employed form among all of these in periodontal treatment.<sup>19</sup> Gingivitis, aggressive periodontitis<sup>20,21</sup>, endo-perio lesions<sup>22,23</sup>, periodontal regeneration<sup>23</sup>, halitosis<sup>17,24</sup>, tooth sensitivity<sup>15,16</sup>, tooth whitening<sup>15,16</sup>, as well as cases of wound healing impairments following surgical interventions like tooth extractions or implant dentistry, can all be treated with it. Ozone has the downside of being unstable, which makes it necessary to produce the molecule right away before clinical usage because long-term storage is not viable<sup>25</sup>. Another significant side effect of using ozone gas is ozone inhalational toxicity.<sup>26</sup>

#### **Mechanism Of Action of Ozonized Water**

Ozone is a selective oxidant that only affects certain molecules, but when it dissolves in water, it becomes extremely unstable and decomposes quickly as a result of an intricate set of chain reactions.<sup>27,28</sup> Hydroxyl (OH) radicals, one of the most reactive oxidising species, are therefore produced. In aqueous environments, ozone interacts with a variety of chemical substances in two distinct and coexisting ways, one using direct molecular ozone reactions and the other via free radical-mediated reactions.<sup>29</sup> Ozone's ability to kill bacteria depends on either of these ways.

#### **Microbiological Effect Of Ozonized Water**

Both Gram-positive and Gram-negative oral organisms such as *Streptococci*, *P.gingivalis*, *P. endodontalis*, and *Candida albicans* are easily eliminated by ozonated water. When handled with ozonated water, the amount of *S. mutans* that are viable dramatically decreases, and it also prevents dental plaque from building up. Therefore ozonated water reduces diseases brought on by oral microbes found in tooth plaque.<sup>30</sup>

#### **Role Of Ozone Therapy In Periodontics**

##### **Ozone Sanitation Of Toothbrush**

Children's toothbrushes contain members of the *Streptococcae* family, while adult brushes contain members of the *Staphylococci*, *E. coli*, *Pseudomonas*, and *Enterococcus* families. After a 30-minute exposure, ozone treatment effectively lowers the bacterial burden and may be used to completely decontaminate toothbrushes.<sup>31</sup>

##### **The Use Of Ozone For Maintenance Of Oral Hygiene**

At present, ozonized distilled water (distilled water is borbotaged by ozone mixture with an ozone concentration of 2000 g/L during 10 minutes) is widely used for intensification and optimization of oral hygiene.<sup>32</sup> It can be used as a pre-rinse before professional dental treatments (100 mL of ozonized water per patient i.e. 3-5 passages with 20-30 mL each).

##### **Primary Prevention Of Periodontitis**

Ozone treatment is a type of alternative medicines that claims to boost the body's supply of oxygen by introducing ozone. Ozonated water is biocompatible with oral tissue and is a natural disinfectant. The use of ozonated water for in periodontitis patients lowers inflammation and destroys harmful microorganisms.<sup>34</sup>

### Effect On Chronic Periodontitis

Chronic Periodontitis is characterized by gingival inflammation, periodontal pockets, and loss of alveolar bone, which can eventually lead to tooth loss.<sup>33</sup> The development of periodontal disease is aided by a network of interconnected molecular pathways including pro-inflammatory mediators and reactive oxygen species (ROS).<sup>34</sup> Oxygen-dependent ROS generation and antioxidant (AO) activity may play a role in the disease's pathogenic pathways. According to a research by **Chapple, et al.** (1997)<sup>35</sup>, Periodontal disease is associated with decreased salivary AO status and increased oral oxidative damage. Periodontitis has also been linked to a rise in the levels of the oxidative stress biomarker 8-hydroxy-2'-deoxyguanosine (8-OHdG).<sup>36</sup> An alternative approach to conventional antimicrobial or antiseptic agents in the suppression of subgingival bacteria is to inhibit their growth by changing the subgingival environment, which has been shown to be highly anaerobic with a prevailing low oxygen tension.<sup>37</sup> A recent method called subgingival ozone irrigation has the potential to significantly improve the periodontal condition clinically<sup>38</sup>. Ozone treatment improves the clinical recovery from periodontal disease by reducing the proliferation of *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Tannerella forsythia*.<sup>39</sup> Ozone irrigation offers greater advantages than the most widely used periodontal agent, chlorhexidine. Ozone is more effective at reducing plaque, gingival inflammation, and bleeding. Ozone has noticeable antibacterial and antifungal effects on *Aggregatibacter actinomycetemcomitans* and *Candida albicans*. With the exception of its antiviral ability, ozone has demonstrated superior effects over chlorhexidine.<sup>39</sup>

### Treatment Of Acute Necrotizing Ulcerative Gingivitis With Ozone

The unpleasant and destructive condition known as acute necrotizing ulcerative gingivitis is marked by swelling, redness, inflammation, and a propensity to bleed. The traditional approach to treating NUG includes improving dental hygiene, mechanical plaque removal, vitamin and nutrition therapy, oxygenating agents, whole-body care, and the use of antibiotics in various combinations.<sup>40</sup> While vitamin treatment serves as an adjuvant to treat nutritional deficiencies, antibiotics and oxygenating agents are considered to eradicate the bacterial aetiology. However, the pathogenic microorganisms are not entirely eliminated by these traditional treatments. Antibiotic treatment can always be supplemented by an oxygen-rich environment by damaging the anaerobic bacteria<sup>41</sup>. Another benefit of oxygen treatment is that it may be administered locally, allowing for simple absorption into cells and mucosa. Local oxygen delivery to an infectious area also leads to accelerated healing process in any part of the body.<sup>42</sup> This is especially true in regions where mucosal integrity has been compromised and superficial wounds are not healing properly, as in NUG.

### Tooth Bleaching With Ozone

Ozone has the ability to break down chromophore groups in the tooth structure to create smaller molecules, which can lead to tooth whitening by one of the following three mechanisms: 1. bonding mechanism: In the presence of non-aqueous solvents, ozone is added by a double bond to produce ozonide, but when water is present, ozone is hydrolyzed to various products by breakage of the double bond that would have occurred; 2. substitution mechanism, in which one atom or functional group is replaced by another. 3. cleavage process, in which a carbon-carbon link is severed to form composite organic fragments.<sup>43</sup> Ozone-based bleaching results in clinically noticeable changes to the colour of the enamel while also lowering the microhardness of the enamel.<sup>44</sup>

### Aggressive Periodontitis

In patients with aggressive periodontitis, local immune mechanisms may be altered.<sup>45</sup> Improved rheological characteristics, cellular metabolism, higher intracellular ATP concentrations, and increased production of cytokines important for wound healing are all effects of ozone treatment.<sup>20</sup> **Ramzy et al.**<sup>21</sup> reported that in patients with aggressive periodontitis, SRP combined with ozone treatment significantly improved clinical indices and decreased bacterial counts when compared to SRP alone.

### Endo-Perio Lesion

Endodontic and periodontal pathogens may communicate through the many channels available, making bacterial infections in endo-perio lesions look more complex.<sup>46,47</sup> **Zehnder** detected<sup>48</sup> bacteria in root canals and in the periodontal pocket of a tooth with endodontic issues brought on by aggressive periodontal disease. The antibacterial properties of ozone are known to harm cell membranes.<sup>49</sup> According to **Ajeti NN et al. 2018**, when ozone gas was coupled with 2.5% sodium hypochlorite and 2% chlorhexidine, the number of colonies of aerobic and anaerobic bacteria reduced thus it is reasonable to use ozone gas in complicated cases.<sup>50</sup>

### Ozone For Treatment Of Halitosis

Ozone dissolved in water may offer a cheap alternative to the more expensive and less effective commercial mouth rinses to combat bad breath. However it is unstable (half-life of about 2-3 hours if kept cold) and needs to be manufactured when required. It may have a greater role in the control of oral hygiene or as a pre-surgical mouth rinse.<sup>17,24</sup>

### Ozone For Treatment Of Hypersensitivity

Ozone treatment of exposed dentin eliminates smear layers, widens the width of the dentinal tubules, and makes it easier for minerals to enter. The dentinal tubules are efficiently plugged by minerals and substances that enter the tubules readily and profoundly, whether they come from saliva or other desensitising agents like calcium and fluoride ions. This prevents the exchange of fluid via the tubules.<sup>51</sup> Dentinal hypersensitivity should not be treated with ozone application alone, although it may be a useful adjuvant to fluoride-containing desensitizers in promoting tubular occlusion.<sup>52</sup>

### Implant And Ozone Therapy

**Hauser-Gerspach et al. (2012)** investigated the effects of gaseous ozone on bacteria adhering to titanium implant surfaces and reported a reduction in bacterial counts on the surfaces that got ozone treatment and came to the conclusion that it can be employed in the treatment of peri-implantitis.<sup>53</sup>

### Conclusion:-

Contrary to conventional treatments like antibiotics and disinfectants, ozone therapy is very affordable, reliable, and conservative. Ozone therapy shortens the duration of treatment and more thoroughly eradicates the bacterial count. This procedure has few adverse effects, is painless, and improves the patient's compliance and acceptance. Scientific experts and authors have hypothesised that this therapy has enormous promise for treating a wide range of dental issues and also aids in the incapacitation of bacteria, fungus, and viruses. Further research is required to standardise and confirm these findings, though.

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