



Review Article

**Ozone Therapy in Management and Prevention of Dental Caries- A
Review**

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How to cite: R.Maithun et al, Ozone Therapy in Management and Prevention of Dental Caries, *Int J Pedo Rehab* 2022;
7(2):25-29.

<https://doi.org/10.56501/intjpedorehab.v7i2.579>

Received :28.09.2022

Accepted:20.11.2022

Web Published: 23.11.2022

ABSTRACT

Dental caries is the irreversible microbial disease of teeth causing demineralization of inorganic and destruction of organic. It is of serious concern as it can lead to pain due to various pulpal and periapical pathologies. It is a tedious job to prevent this dental caries which is very common dental problem with each and everyone. With new concepts emerging in prevention and management of caries, Ozone therapy is tool to prevent and manage dental caries. The use of ozone (O₃) gas as a therapy is sceptical due to unstable structure. The main beneficial effect of ozone is its antibacterial effect against various bacteria. These antibacterial effects are even attributed to the prevention and management of caries. This therapy is of controversy as some prove this to be less or no effective or some prove to be more effective. This article reviews various benefits of ozone therapy in prevention and management of caries and also discussion on controversies to it.

Keywords: Ozone, dental caries, antibacterial effect, prevention.

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<https://doi.org/10.56501/intjpedorehab.v7i2.579>

INTRODUCTION

Oral cavity is an ocean of microorganisms in their pathological threshold might cause various diseases like dental caries, periapical pathologies, periodontal pathologies and various other infections. Dental caries is an irreversible microbial disease-causing demineralization of inorganic and destruction of organic. They can cause severe pain if there is going to be inflammation with pulp as well as periapical tissue. This dental caries can cause pulpal pathologies like various pulpitis, various periapical lesions such as apical periodontitis, various abscess, granuloma, inflammatory cyst and might be a cause for endo-perio lesions.¹ This disease as said to be irreversible can be treated from doing a simple filling to various treatments such as root canal treatments and at sometimes leading to extraction of the teeth. One should never forget that these diseases have major contribution from the microbial flora. Though drilling is a very common and universally practised method, there are other methods that are proposed and made into practice. One such method that is very famous and widely practised is laser. Another such method which is gaining popularity because of antimicrobial effects is Ozone therapy.²

Ozone the gas that covers the Earth is very unstable and is most important of the stratosphere. They help in filtering the UV rays and protects the biology on earth.³ This ozone is used in treatment of various pathologies. It is said that they cure over 50 pathologies.⁴ The first dentist to use ozone in practice is Dr Edward Fisch.⁵ Various field of dentistry such as periodontics, surgery, endodontics etc use this ozone therapy. It is very much effective against various bacteria, fungi and viruses.⁶ This article reviews on this ozone therapy in prevention and management of dental caries.

MECHANISM OF ACTION:

This ozone therapy has been proved to be effective against various gram positive and gram negative bacteria.⁶ It said that they produce free radicals that play a crucial role in destruction of the microbes indirectly.⁷ It is also generally accepted that oxidation due to ozone starts the destruction of cell walls and cytoplasmic membranes of microorganisms; after the membrane is damaged, permeability increases and ozone molecules can easily enter into the cells.⁸ So ozone therapy acts directly as well as indirectly against microorganisms. The mechanism of ozone therapy are as follows:

1. First ozone generates free radicals that are released into the medium
2. This free radical indirectly destroys the bacteria
3. Next ozone starts the destruction of cell wall and cytoplasmic membrane of microorganism.
4. This facilitates the entry of ozone molecules
5. Ozone then attacks the enzymatic control system of the cell.
6. It also attacks various biomolecules by oxidizing it.
7. Ozone can reduce bacterial count in active carious lesion.
8. Ozone also decarboxylate pyruvic acid to acetic acid, thus remineralization might be possible when acetic acid or high pKa acids are found in resting plaque.

REVIEW ON SUPPORTING ARTICLES FOR OZONE'S BENEFICIAL EFFECT ON CARIES:

100% remineralization of caries is possible! Yes, Holmes et al in assessment of ozone therapy with daily remineralization kit, he concluded that remineralisation is possible with just 40 seconds in this therapy.⁹ This treatment can be an effective alternative for using drills. The same 40 seconds application was done by Huth et al in 2005. He proved that ozone treated lesions should reversal of occlusal non cavitated caries or reversal of that.¹⁰

Danhart et al in his study to evaluate efficacy of ozone in treating open carious lesion in anxious children showed 13% less in laser florescence value in ozone treated children.¹¹ This ozone can be an effective way to treat anxious children thus contributing greatly to behavior management.

In another study by Baysan et al in assessing the safety and efficacy of ozone with or without a root sealant for managing leathery root caries both groups showed improvements in various caries accessing methods.¹² This proves ozone to be efficient in managing leathery root caries. In a similar study of evaluating efficacy of ozone and with remineralising solution ozone alone or with remineralising solution both showed significant effect in initial fit and fissure caries.

In a study by Nagayoshi, ozone water was used against oral microorganism. Ozonated water showed significant reduction in accumulation of dental plaque and were found very effective against microorganisms both gram positive and negative.¹⁴

In an In-vitro study by Polydorou et al to evaluate the antibacterial effect of ozone against *S.mutans* showed reduced number of the organism.¹⁵ Sadatullah analyzed the antimicrobial effect of ozonated water on 24 hrs supragingival plaque. There concluded that there was 45.3% of reduction in total bacteria count when ozone water was exposed for 30 sec.¹⁶

In a study to estimate ozone effect on tooth brush microflora by Bezirtzoglou et al the microbiota at toothbrush bristles were removed and maximum decontamination was observed after 30min.¹⁷

Castillo et al in his study evaluated and concluded that when ozone exposure lasted for 40 seconds there was no viable bacteria that was obtained.¹⁸

In order to access their preventive effect Knight et al applied ozone to noncarious dentin and evaluated that there was no bio film formation in vitro from *S. mutans* and *Lactobacillus acidophilus* for over 4 weeks.¹⁹ This proves ozone is good at prevention of caries as well.

From the above articles it can be inferred that ozone has a potential effect against management and prevention of caries. They are a good antimicrobial agent but over that they also prove to remineralise. Their effect in reducing microbiota in toothbrush and also preventing biofilm formation in non-carious dentin proves that they are also an effective tool for prevention (Table1).

References	Objective	Result	Benefits of ozone
Holmes et al[9]	Ozone with remineralising patient kit on root caries	Remineralisation is possible at 18 months	A potent remineralising agent.
Huth et al[10]	Ozone on non cavitated occlusal caries	More caries reversal and decreased production	Ozone can improve prognosis of occlusal caries
Dahndart et al[11]	Ozone on open carious lesion of anxious children	Reduction in 13% laser florescence value	Effective in behaviour management and caries
Bayson et al[12]	Ozone on root caries with and without a sealant	Showed improvement in various caries test like diagnodont values	Effective against root caries.
Atabek et al[13]	Ozone on pit and fissure caries when used alone and with remineralising solution.	Both are effective	Ozone is effective on pit and fissure caries
Nagayoshi et al[14]	Ozonated water on oral microorganisms and plaque.	Inhibited experimental plaque accumulation. No organism was seen when treated for 10s	Effective in preventing biofilm accumulation.
Polydorou et al[15]	Antibacterial effect of ozone on mutans	Reduction in mutans and 80s treatment had high reduction.	Effective against <i>S. mutans</i>
Sadatullah et al[16]	Effect on 24 hrs supragingival plaque	45.3% reduction in bacterial count on 30 s exposure	Exposing for 30s almost reduce half the microbe in plaque
Bezirtzoglou et al[17]	Ozone on microflora of toothbrush	Removed microbes on tooth brush	Can be a method to disinfect toothbrush
Castillo et al[18]	Ozone on <i>S.mutans</i>	No viable bacteria when exposed for 40s	Kills all <i>S. mutans</i> at 40s
Knight et al[19]	Application of ozone on dentin to access biofilm formation	No biofilm formation on dentin after 4 weeks of exposure	Prevents biofilm formation for 4weeks.

Table 1: Studies on benefits of ozone.

REVIEW ON CONTROVERSY AGAINST OZONES BENEFITS:

Ozone by itself is highly unstable. This can be tedious for clinicians to handle gaseous ozone. In a clinical study by Kronenberg et al to compare ozone with cervitec to avoid demineralization against brackets, cervitec proved to be superior in preventing white spot lesions.²⁰

In a study by Hauser et al to compare immediate effects of ozone and CHX gel on bacteria in cavitated lesions of children

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both were found to be not effective against reducing microbes in open carious lesions.²¹ In fact, in a study by Bayson et al itself proved ozone to not kill microorganism in infected dentin under demineralised enamel.²² The failure can be due to not direct contact of ozone on dentin. Muller et al proved that there was no significant reduction in microbial load in both ozone and photodynamic therapy on viable microorganism.²³

In controversy to ozone demineralizing lesions, Zaura et al proved there was no effect on remineralisation when ozone was exposed. He found no effect in subsequent demineralisation of remineralised dentinal lesions.²⁴ From the above studies it can be inferred there are controversies on ozone's effect on remineralising demineralised tooth structure. Some authors here also prove there is no antimicrobial effect with ozone when applied (Table2).

Refs	Objective	Result	Inference
Kronenberg et al[20]	Compare ozone and cervitec/flour protector on avoiding demineralization around brackets.	Cervitec/ flour protector are superior to ozone.	Better products are available than ozone.
Hauser et al[21]	Immediate effects of ozone and CHX gel on cavitated lesions.	Both not effective in open carious lesions	Ozone effect on open carious lesions is less significant
Bayson et al[22]	Ozone on microbes of nonactivated occlusal caries.	Failed to reduce bacterial count.	Ozone here is proved to be of no use even in occlusal caries.
Muller et al[23]	Antimicrobial effect of ozone gas and photodynamic therapy	Both had minimal effect	Does serve as an alternative to conventional methods
Zaura et al[24]	To test whether ozone promotes remineralisation	No effect for remineralisation	Here the controversial result of no remineralisation was seen

Table 2: studies on controversy of ozone therapy on caries

CONCLUSION:

Ozone is an important gas in our environment as it acts as a filter against various radiations. In dentistry ozone is there into practice for past 2 decades. But its popularity and usage in common day to day practice is not routine. The availability of such therapy and its use market might be less so it failed to gain popularity. Many studies have proved ozone to be a great antimicrobial agent against oral bacteria especially Mutans. Though there are controversies to it the antibacterial effect of ozone is a proven phenomenon. They have indirect effect by producing free radicals and direct effect by facilitating cell membrane permeability and destruction of cytoplasmic biomolecules. Ozone helps remineralise and treat root caries and pit and fissure occlusal lesions. But their effect on dentin and other cavitated lesions need a lot of study to prove their effects. Their effect on deep caries, pulpal involvement and also disinfecting root canals need to be studied and presented. Though their antibacterial effects are proven, there needs a lot of studies to prove its benefits against caries at various aspects and also on deeper structures of tooth.

FINANCIAL SUPPORT AND SPONSORSHIP – Nil

CONFLICT OF INTEREST - There are no conflicts of interest.

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