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Review

Application of Ozone Therapy in Dentistry

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Abstract

Ozone refers to a tri-atomic oxygen molecule and is present in stratosphere abundantly. Ozone is known to have multiple medical and dental properties. Use of ozone therapy in the field of dentistry dates back to 1930s where wound healing and disinfection were its initial use. Later, owing to its properties its use expanded to treatment of various oral disorders. Ozone treatment has been more effective than conventional therapies that follow a less invasive and conservative approach to dental treatment. The purpose of this research is to review the available information about applications of ozone in dentistry. Ozone treatment has so far been used for wound healing, tooth decay, oral lichen planus, gingivitis, periodontitis, halitosis, osteonecrosis of the jaw, postoperative pain, plaque and biofilms, dentin hypersensitivity, temporomandibular joint disorders, among several others. Ozone has been successfully transformed the oral and dental treatment. Ozone therapy is a very effective treatment with no side effects or pain. It also reduces the patient's anxiety and level of stress as it reduces the duration of treatment. Ozone provides a painless alternative to the common treatment of tooth decay and has been proven to stop root decay, pits and fissure and relieve ulcers clinically. Its anti-microbial action against endodontic flora is quite promising, however more clinical research and trials in future can be beneficial.

Keywords: *ozone, dental, oral, treatment, pain*

Introduction

Ozone is a three-atom oxygen-based natural gaseous molecule. The term ozone comes from the Greek word ozein, which means odor, and was coined in 1840 by German chemist Christian Friedrich Schonbein, known as the founder of ozone therapy. Ozone is abundant in the stratospheric layer of the atmosphere, which protects living beings from ultraviolet light. Medical-grade ozone has been utilized as a non-medication therapeutic approach for more than a century. E.A. Fisch, a dentist in the 1930s, was the first to employ ozone therapy in his clinic to aid in wound healing and disinfection during dental procedures. The antibacterial properties of ozone are the fundamental reason for its usage in dentistry. Ozone therapy is a versatile bio-oxidative therapy in which oxygen or ozone is delivered as a gas or dissolved in water or oil to achieve therapeutic effects (1).

Oral lesions are generated by a variety of etiological factors, with microorganisms playing a key role. The mainstay of a successful dental therapy is the elimination of these microbial infections. The effects of ozone treatment on various bacteria have been investigated. It has been claimed that a 60-second exposure killed 99.9% of cariogenic bacteria such as *Actinomyces naeslundii*, *Streptococcus mutans*, and *Lactobacillus casei*. However, due to the breakdown of salivary proteins after such a lengthy duration of contact, 10 s–30 s of treatment was found to be efficient in killing a large number of bacteria. When comparing the survival rates of Streptococcus mutans and Lactobacillus casei in different mediums, the salivary media showed a higher survival rate than the saline medium (2, 3). Due to its indisputable disinfection capacity over other antiseptics, ozone is an excellent alternative and extra disinfectant to regular antiseptics. It is possible to employ aqueous ozone in the following ways: disinfectant, which is its extremely effective role, to keep the bleeding under control, to clean wounds in the bones and soft tissues, increase the local availability of oxygen to the wound region to enhance healing. Because ozonated water can raise the temperature in the wound area, it can help with metabolic processes connected to wound healing. In cases of gingivitis, oral thrush, or stomatitis, ozonated water can be used as a mouth rinse, as a spray to clean the affected area and disinfect the oral mucosa, or as a water jet to treat painful gingivitis and stomatitis (4).

The use of ozone in oral care is a relatively recent and alternative therapeutic option in dentistry. The effect of biological and digital information leads to the utilization of ozone administration via diverse methods for a variety of oral cavity treatment choices. Ozone is a kind of oxygen that plays an important part in the treatment of oral disorders. Ozone therapy is the least invasive therapeutic method available, requiring no discomfort or agony. It also reduces the therapy duration, which lessens the patient's anxiety and stress. It is used in various fields of dentistry including periodontology, endodontics, oral surgery, prosthodontics, orthodontics, restorative dentistry also oral diseases, wound healing, and tooth mineralization are all treated with it. Because it may enter the upper respiratory tract via intra-oral administration, there are potential adverse effects associated with its use (5). The purpose of this research is to review the available information about applications of ozone in dentistry.

Methodology

This study is based on a comprehensive literature search conducted on June 19, 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the information about applications of ozone in dentistry. There were no restrictions on date, language, participant age, or type of publication.

Discussion

The oral cavity appears to be an open ecosystem with a dynamic balance between microbe entry, colonization modes, and host responses aiming at eradicating them: Bacteria must attach to either hard tooth surfaces or epithelial surfaces to evade eradication. The production and maintenance of oral biofilms, as well as the selection of specific microbes on the inside, have been linked to the most common oral diseases, including dental caries, periodontal disease, and peri-implantitis. The traditional treatments for periodontal therapy have been mechanical removal of the biofilm and supplementary use of antimicrobial disinfectants or different antibiotics. Ozone is a triatomic molecule made up of three oxygen atoms, and its use in medicine and dentistry has been linked to the treatment of 260 various diseases. Ozone therapy has proven to be more helpful than current conventional therapeutic techniques for dental treatment that are minimally invasive and conservative. The

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explanation of ozone's chemical mechanisms is also beneficial to dental practice (6).

Dental Applications of Ozone

Enterococcus faecalis has been linked to the development of endodontic disease, and it is particularly resistant to sodium hypochlorite, the antibiotic most typically used in root canal therapy. Ozone has been proved to be successful in killing this organism along with the others found inside roots, including viruses and fungi. The depth of penetration of this therapy can reach its desired targets by using ozone gas, ozonated oils, and water. Furthermore, harmful germs have been found in the bone at the end of the roots for many years after standard root canal therapy has been performed. Ozone can kill the bacteria that infest this area and remove the poisonous waste products that impede the osseous structures from fully recovering. Endodontic infections must be treated as urgently as those caused by periodontal disease or caries due to their rapid systemic spread which can lead to severe complications (7).

Kumar stated that ozonated water which is constituted of 4 mg per litre was found to be effective in eliminating gram-positive and gram-negative oral microorganisms, as well as oral Candida albicans, in pure culture and bacteria in plaque biofilm, and to be useful in controlling oral infectious germs in dental plaque. In nonsurgical curettage, ozonated water can be utilized in the ultrasonic water reservoir, as a pre-treatment rinse before scaling and root planning, and to irrigate pockets with a syringe and canula. The original pathogenic load on the patient will be reduced both locally and systemically as a result of this procedure. Following treatment, each pocket and sulcus is insufflate with ozone gas, which sterilizes the area by directly entering the tissues. When compared to chlorhexidine, ozone can inactivate periodontitis-causing germs and has an antifungal impact, however, but had no antiviral effect (8). Naik stated plaque biofilm is the primary cause of both caries and periodontal disease. Oral infectious germs in tooth plaque may be controlled by ozone. The accumulation of experimental dental plaque was greatly reduced by ozonated water. In patients with acute necrotizing ulcerative gingivitis, ozonated oil is used as a safe therapeutic alternative. It can be used as a subgingival irrigant because of its healing and antibacterial characteristics. Ozone's antibacterial properties not only help to reduce the amount of cariogenic bacteria in the mouth, but they also help to reduce the number of microorganisms in the root canal. However, it was not able to entirely remove the microorganisms embedded in the biofilm. When ozone therapy is utilized in implants, it helps to prevent infection and improve bone regeneration. Ozone is bubbled into the socket for around 40 seconds, then the implant is placed into the socket (9).

Deep pits and fissures are hard to clean, making them more prone to food lodgement and bacterial growth. In such circumstances, ozone treatment has proven to be very helpful. Prior to ozone therapy, it is recommended that the fissures be cleaned. This allows the ozone to easily reach the caries. Following the ozone treatment, it is recommended that a remineralizing agent be applied and the clean fissures be sealed. The smear layer is removed by ozone, leaving exposed dentin that has been occluded by the remineralizing chemical. Study conducted by Huth concluded that ozone administration dramatically decreased non-cavitated early fissure caries in patients at high caries risk during 3-month period (10, 11). Ozone therapy can be used for a variety of procedures in oral surgery, including minor extractions, severe jaw infections, and osteotomies. Ozone promotes wound healing, improves erythrocyte characteristics, and enables oxygen delivery to tissues. This results in vasodilation, which improves blood flow to the ischemic areas. As a result, it can be utilized successfully in cases of poor wound healing following surgical procedures such as tooth extractions or in implant dentistry (12). Kazancioglu explored the impact of ozone therapy on pain, edema, and trismus after third molar surgery and concluded that it effectively reduced postoperative pain while having no effect on swelling or trismus (13).

Findings of a randomized trial showed that 87% of participants who received ozone gas injections into the superior joint space either recovered fully (37%) or improved (50%) as compared to the patients of other group where only a third of the patients 33% treated with nonsteroidal anti-inflammatory medications and muscle relaxants exhibited improvement in their clinical dysfunction indices. Hence, intra-articular ozone gas injection can be considered as a viable new therapeutic option for temporomandibular internal derangement (14). Results of another randomized trial in 2020 showed that after treatment with ozonized water, the amount of bacteria in the left quadrants was significantly reduced, both for particular species and for the total count, compared to the right quadrants. The efficacy of ozonized water in the treatment of moderate to severe chronic periodontitis was proven in the study (15). Ozone therapy has been claimed to be useful in treating a variety of soft tissue lesions, including aphthous ulcers

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and herpes labialis. The rapid healing effects of ozone are responsible for this application. Tissue insufflation, injection, cupping, and ozonated oil treatments were used to treat patients with oral lichen planus. In contrast to more standard pharmacological treatments, the therapeutic outcomes in these patients were encouraging, with no discernible side effects (16, 17). Sinha concluded in his study findings that in patients receiving single-visit endodontics, ultrasonic and sonic activation of ozone resulted in less discomfort than when no ozone treatment was used (18).

Chemotherapy and radiotherapy are commonly used in individuals with carcinomatous lesions, and they almost always result in mucositis. In cases of mucositis, ozone therapy in both aqueous and gaseous forms has shown significant outcomes, allowing the patient to eat regularly and improving the patient's quality of life throughout oncological therapeutic operations (19). Patients who are receiving cancer treatment, bisphosphonates, or denosumab, as well as those who have had a trauma such as a tooth extraction or dental surgery, may develop osteonecrosis of the jaw as a side effect. It's marked by a decrease of blood supply to the bone, which causes it to break down and reveal the alveolar bone. Patients with bisphosphonate-associated osteonecrosis of the jaw have a poor prognosis after surgery. The effectiveness of mouthwashes and antibiotics after surgery has been inconsistent. Ozone therapy has been shown to be an effective treatment for post-surgery osteonecrosis of the jaw, particularly in individuals with lesions larger than 2.5 cm (20).

Compared to traditional treatment modalities like antibiotics and disinfectants, ozone therapy is very cost-effective; it will significantly reduce both medical costs and invalidity. The practice of dentistry is changing as a result of the introduction of modern science. Ozone therapy has proven to be more helpful than current conventional therapeutic techniques for dental treatment that are minimally invasive and conservative. The explanation of ozone's chemical mechanisms is also beneficial to dental practice. When patients are treated with ozone therapy, the treatment time is drastically reduced, and the bacterial count is more precisely eradicated. The procedure is painless and has low side effects, increasing the patients' tolerance and fulfilment. It's important to remember the drawbacks of this contentious strategy. To govern the indications and treatment processes of ozone therapy, more research is needed (6). Literature is established regarding the advantages and use of ozone in the field of dentistry however, more clinical research studies are needed to generate evidence-based results of use of ozone therapy in clinical settings and set-up which will further strengthen literature and signify the importance of use of ozone therapy.

Conclusion

Ozone therapy has a wide range of uses in field of dentistry. Immunostimulant, analgesic, detoxicating, antibacterial, bioenergetic, and biosynthetic effects are among its distinctive features. Its atraumatic, painless, non-invasive nature, and lack of discomfort promote patient tolerance and compliance, making it an excellent therapy option although more clinical research is need of time.

Disclosure

Statement

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Ethical consideration

Non-applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

Authors' contribution

All authors contributed equally to the drafting, writing, sourcing, article screening and final proofreading of the manuscript.

References

1. Bhuvaneswaran M. Principles of smile design. Journal of conservative dentistry : JCD. 2010;13(4):225-32.

2. Jafri Z, Ahmad N, Sawai M, Sultan N, Bhardwaj A. Digital Smile Design-An innovative tool in aesthetic dentistry. Journal of oral biology and craniofacial research. 2020;10(2):194-8.

3. Coachman C, Yoshinaga L, Calamita M, Sesma N. Digital smile design concepts. The Technologist. 2014:1-35.

4. Coachman C, Paravina RD. Digitally Enhanced Esthetic Dentistry - From Treatment Planning to Quality Control. Journal of esthetic and restorative dentistry :

 http://dx.doi.org/10.52533/JOHS.2022.2801

official publication of the American Academy of Esthetic Dentistry [et al]. 2016;28 Suppl 1:S3-4.

5. Santos FR, Kamarowski SF, Lopez CAV, Storrer CLM, Neto AT, Deliberador TM. The use of the digital smile design concept as an auxiliary tool in periodontal plastic surgery. Dental research journal. 2017;14(2):158-61.

6. Blatz MB, Chiche G, Bahat O, Roblee R, Coachman C, Heymann HO. Evolution of Aesthetic Dentistry. Journal of dental research. 2019;98(12):1294-304.

7. Zanardi PR, Laia Rocha Zanardi R, Chaib Stegun R, Sesma N, Costa BN, Cruz Laganá D. The Use of the Digital Smile Design Concept as an Auxiliary Tool in Aesthetic Rehabilitation: A Case Report. The open dentistry journal. 2016;10:28-34.

8. Cattoni F, Mastrangelo F, Gherlone EF, Gastaldi G. A New Total Digital Smile Planning Technique (3D-DSP) to Fabricate CAD-CAM Mockups for Esthetic Crowns and Veneers. International journal of dentistry. 2016;2016:6282587.

9. Zotti F, Pappalardo D, Capocasale G, Sboarina A, Bertossi D, Albanese M. Aesthetic Dentistry, How You Say and How You See: A 500-People Survey on Digital Preview and Color Perception. Clinical, cosmetic and investigational dentistry. 2020;12:377-89.

10. Meereis CT, de Souza GB, Albino LG, Ogliari FA, Piva E, Lima GS. Digital Smile Design for Computer-assisted Esthetic Rehabilitation: Two-year Follow-up. Operative dentistry. 2016;41(1):E13-22.

11. Omar D, Duarte C. The application of parameters for comprehensive smile esthetics by digital smile design programs: A review of literature. The Saudi dental journal. 2018;30(1):7-12.

12. Cervino G, Fiorillo L, Arzukanyan AV, Spagnuolo G, Cicciù M. Dental Restorative Digital Workflow: Digital Smile Design from Aesthetic to Function. Dentistry journal. 2019;7(2).

13. Garcia PP, da Costa RG, Calgaro M, Ritter AV, Correr GM, da Cunha LF, et al. Digital smile design and mock-up technique for esthetic treatment planning with porcelain laminate veneers. Journal of conservative dentistry : JCD. 2018;21(4):455-8.

14. Sathya B, Malathi Suresh SM, Gold N, Mary P, Subbiya A. Digital Smile Designing -'A New Era' In Aesthetic Dentistry -A Review Digital smile designing. 2021;12:2073-7.

http://dx.doi.org/10.52533/JOHS.2022.2801