Ozone: A New Revolution in Dentistry

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Introduction

Ozone is a natural gaseous molecule made up of three oxygen atoms. The word ozone originates from the Greek word ozein, which means odor and was first used by German chemist Christian Friedrich Schönbein, father of ozone therapy (1799-1868) in 1840 when, working with a voltaic pile in the presence of oxygen, noticed the emergence of a gas with an “electric and pungent smell” that could be a sort of “super-active oxygen”.[1] Industrial ozone generators are used for industrial application and disinfection of water, after it was shown the potent and broad bactericidal activity of ozone. The first medical application seems to have been the use of ozone for treating gaseous, post-traumatic gangrene in German soldiers during the 1st world war.[2] However, a big step forward was the invention of a reliable ozoniser for medical use by the physicist Joachim Hansler (1908-1981). The idea to use ozone in medicine developed slowly during the last century and it was stimulated by the lack of antibiotics and the disinfectant properties of ozone. Ozone, which is used for medical purposes, is a gas mixture comprised of 95 to 99.95% oxygen and 0.05 to 5% pure ozone. Due to proven therapeutic advantages of ozone, many fields in dentistry could benefit from ozone therapy. From the historical data, the first dentist who used ozone was Edward Fisch in 1950 when he healed Austrian surgeon Ernst Payr for a gangrenous pulpite and thereby inspired him to begin a line of investigations dedicated to ozone use in health care, reported his results at the 59th Congress of the German Surgical Society in Berlin (1935) and wrote: “which other disinfectant would be tolerated better than ozone? The positive results in 75% of patients, the simplicity, the hygienic conditions and innocuity of the method are some of the many advantages”.

Ozone Generation

Joachim Hänsler and Hans Wolff, German physicians, developed the first ozone generator for medical use. Their design continues to be the basis for modern equipment.

Medical grade ozone is a mixture of pure oxygen and pure ozone in the ratio of 0.05% to 5% of O₃ and 95% to 99.95% of O₂. Due to the instability of the O₃ molecule, medical grade ozone must be prepared immediately before use. Within less than an hour after preparation only half of the mixture is still ozone while the other half is transformed into oxygen. As a result, it is impossible to store ozone over long periods of time. In order to control the decomposition of O₃ into oxygen, it can be associated with a vehicle with aqueous properties to promote the conversion more quickly or with a vehicle with more viscous properties to retard the conversion. There are three different systems for generating ozone gas:

- Ultraviolet System: produces low concentrations of ozone, used in esthetics, saunas, and for air purification.
- Cold Plasma System: used in air and water purification.
- Corona Discharge System: produces high concentrations of ozone. It is the most common system used in the medical/dental field. It is easy to handle and it has a controlled ozone production rate.

Commercially available ozone generator: CurOzone USA Inc. (Ontario, Canada) developed the HealOzone, which is now distributed by KaVo Dental (KaVo, Biberach, Germany), for use in dentistry.

Mode of delivery:
The route of ozone administration is topical or locoregional in gaseous or aqueous form or as ozonated olive or sunflower oil.

Applications of Ozone in Dentistry

The use of ozone has been proposed in dentistry because of its antimicrobial, disinfectant, biocompatibility and healing properties. Ozone has been applied for treatment of early carious lesions, sterilization of cavities, root canals, periodontal pockets, enhancing epithelial wound healing such as ulcers and herpetic lesions. Bleaching of discoloured root canal treated teeth, Desensitization of extremely sensitive teeth, treatment of periimplantitis, and as a rinse for the avulsed teeth or as a denture cleaner and decontamination of used toothbrush.

Caries prevention [3,4,5,6,7] Ozone can be used to kill bacteria present in carious lesion, painlessly and even without anaesthetic. Ozone is applied to the carious lesion in a controlled manner, safely killing bacteria that have caused caries, thus requiring minimal of physical intervention and just a few seconds. In cases of incipient caries, ozone can...
kill bacteria in the demineralized part and this
demineralized tooth structure then, can be
remineralized using a special remineralization kit,
containing Calcium, Fluorine, Phosphorus and Sodium,
all in their ionic forms.
Endodontic treatment [8,9,10]
Ozone oils can be used to sterile the root canal
systems and to clear the canals of necrotic debris by
virtue of ozone’s bactericidal and effervescent
properties. Ozone oils are ozonated sunflower oil or
olive oil or groundnut oil. This ozone oil irrigation
is more quick and efficient in canal sterilization than that
conventional irrigation by the sodium hypochlorite and
sodium peroxide combination.
Periodontal treatments:[11,12]
Ozonated water strongly inhibited the accumulation of
dental plaque. Ozonated oil is used as a safe
therapeutic alternative in patients with Acute
Necrotizing Ulcerative Gingivitis. Healing and
bactericidal properties makes it useful as a subgingival
irrigant.
Healing wounds: [13]
Ozone has been reported to accelerate the healing of
soft tissue conditions, i.e. aphthous ulcers, herpes
labialis, ANUG and other gum infections. It also
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.
Bleaching [14]
In root canal treated teeth, crown discolouration is a
major aesthetic problem, especially in anterior teeth.
Conventional walking bleaching requires much more
time and results are not oftenly satisfactory. Also,
capping the tooth with ceramic crown is not always a
good idea. But, now, ozone has the answer to all
these questions.
Ozone can be successfully used for lightening the
yellowish tinge of tetracycline-stained rat incisors.
Desensitization of sensitive root necks
Quick and prompt relief from root sensitivity has been
documented after ozone spray for 60 seconds
followed by mineral wash onto the exposed dentine in
a repetitive manner. This desensitization of dentine
lasts for longer period of time. Smear layer present
over the expose root surface prevents the penetration
of ionic Calcium and Fluorine deep into the dentinal
tubules. Ozone removes this smear layer, opens up
the dentinal tubules, broadens their diameter and then
Calcium and Fluoride ions flow into the tubules easily,
deeply and effectively to plug the dentinal tubules,
preventing the fluid exchange through these tubules.
Thus, ozone can effectively terminate the root
sensitivity problem within seconds and also results last
longer than those by conventional methods.
Ozones in Prosthodontics:
Ozone gas can be applied as a prophylactic treatment
prior to etching and the placement of sealant with no
negative impact on sound enamel physical properties,
including knoop surface microhardness, or contact
angle. 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, with no
negative impact on dentin and enamel shear bond
strength to adhesive restoration. 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.
Gaseous ozone is used to disintegrate smear layer
and to disinfect the prepared tooth. Denture stomatitis
can be controlled by topical application of ozonated oil
over tissue surface and over denture surface.
Decontamination of tooth brush:
Ozone application was found to remove the
toothbrushes bristles microbiota following conventional
brushing.
Contraindications of ozone

The following are contraindications of ozone therapy

1. Pregnancy
2. Glucose- 6- phoshate dehydrogenase deficiency
(favism)
3. Hyper thyroidism
4. Severe anemia
5. Severe myasthenia
6. Active hemorrhage

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