Current Concepts of Oxygen Ozone Therapy for Dentistry in the United States

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Introduction

Oxygen ozone therapy (OOT) has been used successfully in many countries throughout the world for many years. It has been recently gaining interest in the medical community in the wake of an increasing number of scientific and clinical papers published in international peer reviewed medical journals. Many of the basic mechanisms of the action of ozone both ex vivo and in vivo are now well understood. The method by which ozone has affected the modulation of interleukin production and additional biological pathways has been adequately explained by multiple researchers [1,2]. This research has resulted in the rationale for the use of ozone in many pathological conditions related to pain, inflammation, oxidative stress, cancer, atherosclerosis, diabetes, acute infections and chronic infections [3].

Conventional dentistry in the United States has been very slow to embrace OOT in part because it had not been included in the didactic or clinical curriculum in any School of Dentistry in the United States. However, in December of 2008 the first presentation on "Ozone in Dental Medicine" was delivered at Tufts School of Dentistry by Dr. Philip Mollica. Prior to this presentation, the institutions had not been receptive to investigating the possible research opportunities that would verify the previous favorable findings from institutions in Germany, Great Britain, Italy, Spain, Brazil, Cuba, Russia, etc.

The recent movement to use OOT in the United States was initiated by a small group of dentists. They attended a demonstration and participation class using OOT at Capital University of Integrative Medicine (a post doctoral program in integrative health) in 1998. Soon after that presentation, a group of eight dentists from that class decided to pursue further research into the possible benefits of OOT.

The group obtained the corona discharge type of medical ozone units that utilize medical oxygen as the oxygen source and began limited clinical trials in April 2000.

After successful clinical trail results, an IRB approved study was granted by Capital University of Integrative Medicine to further research and define the uses of OOT. The primary researchers, Dr. Philip Mollica and Dr. Robert Harris, decided to utilize the evidence-based research model and establish sub-investigators in a practice-based research network. This model was successful and was repeated by the current research institution, The American College of Integrative Medicine and Dentistry. To satisfy the requests of practicing dentists, Dr. Mollica and Dr. Harris, then began offering a seminar series to teach dentists the theory and clinical applications for infection control utilizing OOT. To date, they have taught OOT to over 2,000 dentists through their seminars and presentations at major meetings, both nationally and internationally.

Clinical research is currently being conducted and monitored from multiple practice-based research network clinical centers throughout the United States [4]. As a result of the research findings, foundational protocols have been developed to address common oral infections such as periodontal disease, endodontic infections, dental caries, osteomyelitis, biphosphonate induced osteonecrosis, stomatitis and herpetic lesions. Additional therapeutic protocols have been developed for tooth related sinus infections, neuralgia, pulpal hyper-

sensitivity, extractions, and temporomandibular joint (TMJ) symptomology.

The International Academy of Oral Medicine and Toxicology has endorsed OOT in dentistry as scientifically valid and is has published a brochure to explain the value of the therapy to dentists and patients.

Therapeutic Modalities

Therapeutic methods of administration of intraoral Oxygen-Ozone (OO) include: injection of gas, irrigation with ozonated water, insufflation of periodontal pockets with gas, and topical application of ozonated oil. Injection protocols include intraosseous injection of the OO gas mixture, locally into the alveolus, subgingivally, intramuscularly, inferior alveolar nerve area, and into the pterygoid space area. These injection protocols are for treatment of all types of oral infections. Irrigation with ozonated water is also utilized for oral infections including stomatitis, herpetic lesions and periodontal infections (subgingival). Insufflation techniques with OO gas are generally utilized for caries, periodontal infections and endodontic treatment. In addition, a technique utilizing silicone full arch trays has been developed for treatment of periodontal disease, caries and biphosphonate osteonecrosis. Extraoral therapeutic protocols include nasal and ear insufflation, temporomandibular joint injections, trigger point injections and craniofacial lymphatic injections. These modalities are used for both primary and secondary supportive treatment techniques.

OO Treatment Goals in Dentistry

The therapeutic goals that support established standard of care procedures are as follows:

- Elimination of pathogens
- Restoration of proper oxygen metabolism
- Induction of friendly ecologic environment
- Increased circulation
- Immune modulation
- Stimulation of the humoral anti-oxidant system

Treatment of Dental Caries and Operative Dentistry

More than 30 studies [5] have been presented showing that low concentrations of OO gas causes inhibition of pit and fissure caries, root surface caries and interproximal carious lesions. These same studies have also shown that reversal of decay in carious lesions occurs with exposure to OO in as little as ten seconds. The protocols developed by the American College of Integrative Medicine and Dentistry encompass utilization of OO for procedures including: pit and fissure sealants, caries removal with subsequent restoration, dentinal hypersensitivity, crown and bridge preparation, carious exposures, etc. The procedure is to isolate the tooth or preparation and flow the gas slowly into the area the area to be treated for 45-60 seconds. This procedure will locally kill the microorganisms which are present in the tooth structure. The use of proper evacuation technique is essential to avoid inhalation of the gas. If inhaled, the oxidant nature of the ozone can cause an irritation to the eyes and the mucosal lining of the respiratory tract because these tissues have very limited antioxidant capacity.

Treatment of Root Canals

Endodontic (root canal) treatment of infected teeth has long been a treatment of choice and the standard of care in dentistry for an infected tooth. Endodontic treatment involves cleaning out the main canal(s) of a tooth with instrumentation, irrigation and chemicals (sodium hypochlorite-bleach). These canal(s) are then filled with a material called gutta percha before the tooth is finally restored with a crown. This procedure is intended to sterilize the tooth from all the invading bacteria that caused the tooth and the surrounding bone to become infected.

The classical endodontic community feels that this procedure prevents any bacteria from living within the tooth or ever invading the tooth again from the alveolar bone, thus saving the tooth. This is a contested theory that has been disputed by the allopathic and the integrative medical/dental communities. Studies have shown that following endodontic therapy, some bacteria, fungi and viruses remain in the multitude of the very small lateral canals and dentinal tubules that transverse the tooth root and communicate with the periodontal tissue. These studies have shown that the obligate anaerobes (which can include bacteria, virus and fungi) can remain within these canals and are even found all the way to the cementoenamel junction.

A Japanese study published in 2004 [6] demonstrated that the use of ozonated water had the same antimicrobial activity as 2.5 percent sodium hypochlorite without the tissue toxicity. The study also showed that following ozone therapy there was high metabolic activity of the associated fibroblasts indicating an increase in the healing

process. A Brazilian study, performed on dogs, found that the use of ozonated oil was actually slightly more effective than calcium hydroxide as an intracanal medicament for the treatment of *enterococcus faecalis* infections. The anaerobic bacteria create an infection that results in an area that is acidic with positively charged suppurative fluids. OO gas is the third strongest oxidant. It carries a negative charge and is electrochemically attracted to the positive charge of the infected environment. This results in the death of the pathogens and disinfection of the area.

Standard of care endodontic procedures are employed during diagnostics and treatment. Then OOT is used for disinfection of the root canals and dentinal tubules. The following steps should be added before the final fill of the canal(s):

- The files are coated with ozonated olive oil for lubrication and disinfection.
- The canals are prepared and then irrigated with ozonated water and dried.
- Before placing the root canal filling, the canals are provided with a slow insufflation of gas (45-60 seconds) with an ozone concentration of 45-50 mcg/ml.

The insufflation process allows the OO mixture to travel electrochemically into the lateral canals and tubules killing the positively charged microbes by oxidizing their cell membranes.

Treatment of Periodontal Disease

Periodontal disease is a multifactorial disease process in the mouth. It has been linked systemically to other diseases such as atherosclerosis, bronchitis, diabetes, preterm and low weight births, pancreatic cancer and others.

Traditional treatment has been either conservative treatment by root planing and scaling, surgical intervention with a scalpel or LASER therapy (for example the LANAP procedure with the Periolase, an Nd: YAG LASER).

In cases where treatment is by root planing and scaling, the sulci and pockets are initially irrigated with ozonated water by use of a syringe and a maxiprobe type canula. This process will reduce the initial pathogenic load on the patient, both locally and systemically prior to the root planing and scaling procedures. After treatment of a quadrant or half the mouth, each pocket and sulcus is insufflated with OO gas. The gas goes directly into the crevicular fluid and the tissues and sterilizes the area, thus eliminating the pathogenic organisms.

For patients undergoing LASER therapy with the Periolase, it is recommended that ozonated water be used during ultrasonic debridement.

For certain cases, the silicone tray isolation technique may be utilized. This involves fabrication of appliances made of silicone that fits snugly onto each arch. Each appliance has an inlet and an outlet valve. A low/medium concentration of OO gas flows continuously through the appliance saturating the teeth and periodontium with OO gas. Ozone gas is introduced into the tray through the in port of the tray. The small suction evacuator is attached to the outlet valve allowing the excess gas to be vacuumed away to prevent inhalation of the gas. This treatment requires multiple visits. Routine recall treatment for minor cases, such as gingivitis, utilizes pretreatment rinsing with ozonated water, irrigation of the periodontium and insufflation of any periodontal pockets. In all cases, the patient is given a jar of ozonated olive oil to take home with them and apply topically to the soft tissue. This will insure a continuous dose of OO in the form of ozonide, to the tissues. It also continues to eliminate the microbes that create the biofilm that causes reinfection of the surrounding tissues.

Adjunct Therapy for Extractions, Other Surgical Procedures and Biphosphonate Osteonecrosis

OO is so versatile that it can be used for almost any type of dental procedure. After a tooth is extracted or any basic surgical procedure it is recommended post-surgically to irrigate and insufflate the area. This reduces the positive electric potential of the wound and potential scarring with the negatively charged gas or water. Healing of the wound is generally much faster, with little or no complications. Biphosphonate necrosis has been extremely difficult to treat medically and surgically. There has been some success with OO utilizing the foundational protocols along with intraosseous injections and intraoral silicone tray treatment of the osteonecrotic lesion. The patient is always sent home with a jar of ozonated olive oil as a postoperative dressing for the wound.

Extraoral Techniques

Part of the foundational protocol involves ear insufflation and nasal insufflation with low concentrations of OO. Ear insufflation is a technique to deliver the OO into the external, middle and inner ear. The tympanic membrane is vascularized and some ozone can enter the bloodstream by this route. Ozone being a potent oxidant easily perfuses into the blood and reacts immediately with a number of molecules present in the fluids such as antioxidants, proteins, carbohydrates, and

polyunsaturated fatty acids [3]. OO, when administered nasally has to be bubbled through olive oil. This produces triozonides of triolein, which are not oxidants. But when the ozonides are inhaled they have therapeutic effects similar to ozone. The foundational protocols of the American College of Integrative Medicine and Dentistry for ozone therapy also include extraoral injections of small concentrations of OO. These small amounts, usually 1.0 ml per site, are infiltrated either subdermally or subcutaneously along the path of the external jugular chain of lymph nodes, the cervical lymph node system, the thyroid lymph nodes, the right thoracic duct and the left thoracic duct.

Conclusion

Ozone is the perfect substance for use in dental procedures.

It disinfects the tissues treated and leaves no toxic residues like chlorinated products.

It performs this task by oxidizing the cell membranes of pathogenic organisms and killing them.

The oxidizing effect of ozone is as follows: it requires one molecule of ozone to kill the same number of bacteria that would require 3,000-10,000 molecules of chlorine for the same effect and ozone performs this kill 3500 times faster than chlorine [4].

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