Clinical Reversal of Primary Occlusal Fissure Carious Lesions (POFCLs) Using Ozone in General Dental Practice

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BACKGROUND

Occlusal and root surface caries forms the largest percentage, up to 70%, of new carious lesions seen in general dental practice, with inter-dental caries forming some 15% of all new cases. Traditional approaches to the diagnosis, management and treatment of occlusal caries have changed over the last 20 years, but diseased tissue is cut out, and replaced with some type of filing material or restoration. Every advance in the material technology has started from the premise of prior caries removal, or tissue amputation. The dental profession has never had a system where caries can be left to remineralise predictably before some type of restorative system is placed, that would minimise tissue loss and patient trauma.

Current research with ozone has opened up a whole range of potential treatment protocols. The new treatment protocols do not require removal of the diseased or carious tissue. Published papers have shown that after ozone treatment for just 10 seconds, debris and bacteria impacted in a fissure can mineralise, 'sealing' a fissure against potential decay.

The Aims of this Study To assess the reliability of using the DIAGNOdent (KaVo, Germany) to assess the presence of decay, and the safety & efficacy of a novel ozone delivery system (HeaIOzone, CurOzone USA) with or without a final restoration for the management of POFCLs in general dental practice. The study data was collected over a 4-month period.

Material & Methods The data sets were obtained from a total of 579 POFCLs in 173 patients who presented to UKSmiles over a 4-month period from December 2001 through to the end of March 2002.

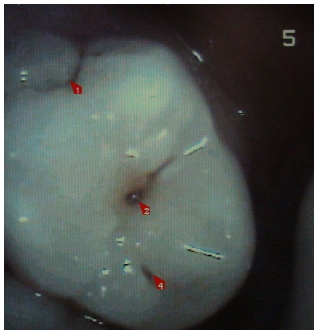

Figure 1, 2 & 3. Appearance of an occlusal surface, with pit and fissure caries present; Data Collection Software; The DIAGNOdent

Equipment used All patients were examined with an intra-oral camera (DPS, UK). Where primary caries was detected, images were stored (Schick, USA). Images were annoted to allow re-assessment at review. The ProphyFlex (KaVo) was used to clean the surfaces before assessment with the DIAGNOdent (KaVo). In addition to the DIAGNOdent values, each lesion measured was assessed as to its treatment needs. Various indices have been used in past studies, and a Clinical Severity Index (CSI), developed by Professor Edward Lynch (Queens University, Belfast) & Dr Julian Holmes (UKSmiles, Wokingham) was used to determine how long each lesion was to be treated with ozone. This varied from 10 seconds for the lowest (4) CSI score to 40 seconds with the highest (1) CSI score.

The HeaIOzone The HeaIOzone (CurOzone, USA) ozone delivery system is a portable apparatus. The unit comprises an ozone generator that delivers ozone (O_3) at a concentration of 2, 200 ppm. A vacuum pump pulls air through the generator at 615 cc/min to supply ozone to the lesion and purges the system of ozone after ozone treatment. A disposable removable silicone cup (diameters ranging between 3 and 10 mm), attached to the hand piece, is provided for receiving and exposing a selected area of the tooth to ozone. The tightly fitting cup seals the selected area on the tooth to prevent escape of ozone. Patients in all the above groups used a standard toothpaste and mouth rinse 1,100-ppm sodium fluoride (Curozone toothpaste and mouth rinse, Natural White, U.S.A) for at least 4 weeks after the first application of ozone to treated tooth surfaces.


Ozone delivery system (HeaIOzone, Curozone, USA) & Toothpaste / Mouth Rinse system.

Results & Discussion Previous research has shown that remineralisation *in-vivo* can be achieved when the correct oral conditions exist, but it can be unpredictable. The main clinical problem with non-invasive or pharmaceutical approaches to the management of caries seems to be the difficulty in suppressing or eliminating micro-organisms for a long enough period of time to allow caries reversal and remineralisation of the lesion. After treatment with pharmaceutical agents, organisms may re-colonise in POFCLs. Caries reversal is associated with several factors including the level of microbial reduction and the oxidant effects of ozone on POFCLs.
In a recent paper on the clinical management of primary root carious lesions (PRCLs) using ozone *in-vivo*, Baysan, A *et al* (2001) the results were staggering in comparison to other agents and studies. Just 10 seconds of exposure to ozone reduced the number of colony forming units (cfu) from 7,000,000 to 4,000 after 10 seconds, and less than 1 after 20 seconds.

Other studies (Inaba *et al.,* (1996 & 1997) have shown that removal of organic materials from dentine lesions was an acceptable approach to enhance remineralisation. In this light, part of the dramatic remineralisation results shown after ozone application in this and other studies can be accounted for, as it is known that ozone is one of the most powerful oxidants available. It may also indicate that ozone has the ability to remove proteins in carious lesions, and to enable calcium and phosphate ions to diffuse through the lesions, a phenomenon resulting in remineralisation of the majority of POFCLs after ozone application in this study.

After the initial elimination of the numbers of total micro-organisms, decolonisation of the micro-organisms may be retarded by the lack of available organic substrates essential for the metabolism of cariogenic bacteria. As the ecological niche of these acidogenic and aciduric micro- organisms would be severely disrupted, this will in turn interfere with recolonisation and re-growth by this specific micro flora. This may result in long-term suppression of acidogenic and aciduric micro- organisms in POFCLs. Previous workers, for example Emilson (1981), have also reported that after a short-term intensive pharmacological treatment, there is significant *in-vivo* suppression of bacterial growth.

The Clinical Severity Index developed by Professor Edward Lynch and Dr Julian Holmes was necessary to avoid errors from the DIAGNOdent values. The data show how caries develops in different age groups. The 0-6 age group represent the majority of child patients with only primary dentitions. Previous studies have shown that as the teeth are smaller, and the nerve tissue cavity large, decay quickly spreads to cause nerve tissue death and necrosis. Ozone has been shown to be very effective in this age group. The 7-14 age group represents the mixed dentition stage, and the 15-25 age group will have developing pre-molar, second and third molar surfaces erupting. All these developing occlusal fissure surfaces are prone to potential decay but improved oral hygiene, coupled with ozone treatment and specialised oral mouth rinses would seem to provide the greatest possible protection in this study. The last age group, the 56-85 age group, show how decreased manual dexterity, as well as dry mouth could account for most of the developing lesion seen in this group. However, ozone treatment provided a great improvement for the treated lesions.

The results acquired from this initial ozone study mirror those from studies in research centres. It is known that the delivery system used is safe, and cannot expose the patient, the operator, or any surrounding team members to ozone. The use of ozone is very cost-effective, as ozone is only made by the unit when required. The initial investment required is high, but an unpublished study by Holmes, J & Lynch, E (2001) has shown that patients are prepared to pay for this treatment. Published research into patient acceptability by H.Domingo *et al* (2001) show that this treatment modality is well accepted, as there are none of the usual problems associated with conventional treatment (injections, pain, drilling, noise, smells, etc) and that patients are willing to pay an increased fee as an alternative to traditional treatment. Treatment with ozone is also cost-efficient, and very time-efficient.

Current research with ozone has opened up a whole range of potential treatment protocols. The new treatment protocols do not require removal of the diseased or carious tissue. Published papers have shown that after ozone treatment for just 10 seconds, debris and bacteria impacted in a fissure can mineralise, 'sealing' to fissure against decay. This morphological change in the surface of a tooth can be measured by a technique developed by Jovanovski V. and Lynch E. (2000) at Queen's University, Belfast, to an accuracy of 1 micron.

Previous studies and literature reviews have shown that a surface that re-mineralises is never seen to decay. So it follows that if this morphological change and re-mineralisation is predictable, the current protocol could be modified, by modifying the cleaning stage of the treatment protocol to the use of bristle brushes only. Whilst this may appear on the face of it to be a retrograde step, the use of a brush to remove the bulk of the impacted debris will allow ozone induced remineralisation of the remaining debris to begin. By leaving the debris impacted into the fissures and sterilising it with a 20+ second exposure to ozone with the HeaIOzone unit, then there would be no need to place fissure sealant materials which are prone to bonding failure due to poor preparation, compromised chemical bonding at the margins, and where debris has been incompletely removed before enamel etching. In addition, the problem of inadequate drying or isolation prior to placement of a resin-sealed type restoration or preventive restoration technique would be eliminated; and with it, the preventive care of patients could be improved.

At UKSmiles, we have treated successfully patients from a wide age group. All patients want the benefits of modern dental care that is non-invasive, painless, and does not require the use of a drill. The young patient's attitude to future dental care is often highly influenced by traumatic dental care in the early years. And with increasing age and anxiety about dental treatment, dental care is often postponed until more radical treatment is required due to past experiences. These situations can be overcome using early intervention strategies. In this respect, the use of ozone should be considered especially for the young, medically compromised patients, those who are in long-term care, domiciliary care patients and homebound people (Baysan *et al.,* 2001). There is no injection or tissue amputation involved in ozone treatment and the ozone delivery system is portable. Research by H.Domingo *et al* (2001) has already shown that this treatment modality is acceptable to the public.

To conclude, this pilot study has shown that this novel treatment regime using ozone is capable of clinically reversing POFCLs and can be considered a revolutionary alternative to conventional "drilling and filling" or "amputation" therapy for caries treatment.

This is an edited version of the full text submitted to Professor Edward Lynch, Queen's University, Belfast for appraisal. The full study is available by request to Dr Julian Holmes, or from the Internet at **www.the-o-zone.cc**. This study was not supported by any Company and was funded in full by Dr Julian Holmes, UKSmiles. Dr Julian Holmes has no financial benefit from any company mentioned in this study. Full references are available.