Occlusal dental caries
One of the most important procedures that dentists carry out every day of their working lives is the detection, monitoring and treatment of early occlusal dental caries.

Epidemiological data suggests that dental pit and fissure caries in permanent molars is a major issue for six- to 12-year-old children. There is evidence to suggest that up to 20% of these were initiated during the eruption stage.

Until the introduction of Diagnodent (Kavo), we as dentists had to rely on our eyes to detect occlusal fissure caries. The tooth surface had to be examined under good illumination and then the degree of ‘stickiness’ to a standard sharp dental probe was assessed for the detection and diagnosis of carious lesions or defects they caused.

This degree of ‘stickiness’ was very subjective but, if present, usually indicated a carious lesion that required further treatment, which meant a restoration.

Unfortunately, the use of radiographs do not help us in the diagnosis of occlusal fissure caries, as often by the time we can see a radiolucency on the radiograph there is already a cavity present.

Remineralisation of caries
We now have a far better understanding of the early carious lesion and appreciate that the tooth surface is in a constant state of flux between the loss of dental mineral content, resulting from acid attack produced by dental plaque microorganisms and remineralisation by calcium and phosphate from oral saliva between these episodes of acid attack.

It is this ability of the tooth structure to remineralise that is the key to our modern approach to monitoring and treating carious lesions – and in a way that does not always require amputation and loss of tooth substance, which can cause weakening of the tooth structure.

To quote Dr GV Black (1896): ‘We will be engaged in practising preventive rather than reparative dentistry when we will so understand the aetiology and pathology of dental caries that we will be able to combat its destructive effects by systemic medication’.

Early carious lesions can be arrested if the balance of the environment can be changed in favour of remineralisation, leading to a state of so-called caries reversal. This can be achieved with a lowering of the consumption of fermentable carbohydrates coupled with a much improved level of oral hygiene and the use of fluoride. However, this is not always a predictable approach.

It would seem logical that if the microbial load to a susceptible tooth or lesion, together with the associated lowering of the metabolites such as organic acids, were reduced then healing or remineralisation of the carious lesion would take place in a far more predictable way.

The situation can be even further enhanced by control of the biofilm with high mineral content toothpastes, mouthwashes and sprays.

This is part of the basis of ozone treatment together with remineralising topical medicaments.

Christopher Howard Dalton BDS is a dental surgeon practising in Cardiff, Wales.
Professor Liviu Steier has described ozone as becoming the gold standard for dental disinfection and we would do well to heed these words.

For a selection of published research proving the efficacy of ozone treatment, email pd@fmc.co.uk.

Accurate detection of occlusal caries

With the Cariescan Pro (Figure 1), we now have a method of detecting occlusal fissure caries and monitoring it with an accuracy of 94.8%, which is both simple to use and understand, and relatively inexpensive.

The Cariescan Pro is a small, battery-operated device that passes a low voltage current through a dry tooth with the circuit being completed via a lip hook. It then measures changes in tooth mineral density using AC impedance spectroscopy technology (ACIST) to quantify dental caries.

No zeroing is required as the measurement is compared directly to a classification map of normal densities built up through six years of research to identify healthy or carious tooth structure.

The unit displays a numerical value between 0-100 along with colour-coded lights. Further readings can be easily taken by placing the sensor on another site or dry tooth.

The numerical values can be classified as follows:

- A reading of 0-50 means a low probability to caries
- A reading of 51-90 means a medium probability to caries
- A reading of 91-100 means a high probability to caries.

The Cariescan is Bluetooth enabled, so the data can be transferred to proprietary software called Remoteview where the information can be displayed in diagrams, graphics and charts for patient monitoring. To involve the patient, and to aid with motivation and compliance for any suggested treatments, a copy can be printed off.

Recently, the TRAC research division of Clinicians Report (for CR Foundation) carried out extensive evaluations to verify the clinical effectiveness of four caries detecting systems. Cariescan was the only product to be awarded excellent in any categories and was described as the easiest and fastest to use, performing better than all previous products.

The Cariescan now enables us to achieve one of our ultimate goals, which is to accurately diagnose and monitor occlusal pit and fissure caries and then, depending on severity and various other clinical factors, we can remineralise, seal or amputate.

The Healozone X4

I could not imagine practising minimal invasive dentistry without my Healozone.

Tens of thousands of dentists worldwide now use it every day to allow them to be most conservative in their cavity preparation to allow ‘heal and fill’.

Together with advances in diagnosis and detection of fissure and proximal caries, we are also fortunate to have available the next generation in ozone treatment units, namely the Healozone X4, which delivers four times the dose of ozone of its predecessor and that is smaller, easier to use and relatively inexpensive.

Ozone is proven to be one of the most powerful antimicrobial agents we can use. I described earlier how ozone can influence the balance towards the remineralisation process, so the introduction of this unit is very exciting because of the effects of ozone in destroying micro-organisms, fungi and viruses.

Ozone is a colourless gas with a pungent smell. Chemically, it is the triatomic allotropic form of oxygen and has many medical and industrial applications.

The Healozone X4 is a relatively small...
molecular electrical ozone generator (Figure 2).

**Healozone and safety**

Healozone X4 utilises a closed system in operation, so is ideally suited for use in the oral cavity as it is completely safe to use – unlike some other ozone systems that release ozone into the air.

The problem with using gaseous ozone in dentistry is that ozone is toxic and will attack the lung tissues. The Healozone X4’s closed system makes it hazard free to the operator, the surgery assistants and, most importantly, the patients. The handpiece uses single-use silicone rubber cups to seal over the tooth surface (Figure 3).

Each cup is colour-coded for size and some come in double lengths. These cups are made of two welded components: first, a stiff ring that locks onto the handpiece and, the second, a softer and longer silicone ring that forms the cup that seals perfectly over the tooth surface being treated. It is the integrity of this seal that allows air to be drawn through the hose by the unit’s vacuum pump, which then switches on the ozone production. If the seal is interrupted for any reason then the production of ozone ceases, allowing this system to be totally safe.

The handpiece is connected to the main unit by a hose via quick release couplings, which are lubricated with silicone grease to prevent seal damage. The unit beeps every second to indicate treatment progression and has an easy-to-read visual display.

On completion of the timed ozone delivery, the unit continues to suck for a couple of seconds to clear any ozone from the system before returning to stand-by mode for further treatments. Unused ozone is drawn through the system, through a biological filter and then to a catalytic converter, which breaks down any unreacted ozone into oxygen. Thus only air and oxygen are returned to the surrounding air in the surgery.

Ozone production requires dry air, so the unit incorporates a bulk desiccant air dryer to remove humidity from the air. The Healozone X4 displays when the air dryer has to be changed. The unit also has a moisture separator, which collects saliva and other moisture drawn in with the returned ozone. This prevents contamination of the catalytic converter or ozone neutraliser. The unit displays a warning when this filter needs to be changed.

The Healozone X4 has the ability to produce ozone from oxygen in the ambient air (with an ozone concentration...
of at least 4.7g/m3) or from pure oxygen from an attached oxygen bottle (high concentration mode with an enormous ozone concentration of at least 32g/m3). This choice gives more flexibility when choosing treatment options, especially as there is a third ‘endo mode’ for root canal disinfection.

Four different treatment modes can be predefined and stored in the Healozone X4.

**Clinical Severity Index**

My Cariescan/Healozone treatment protocols utilise the caries ‘Clinical Severity Index’, as developed and slightly modified from the original ‘Ekstrand Index’ by Professor Edward Lynch and Dr Julian Homes.

Referring to the Cariescan readings, they are:

- **Assessment D1 and D2 – Cariescan readings 0-50.** A 20-second application of Healozone together with preventive care, which becomes more intensive the higher the reading, including using the application of GCP Glass Seal. Further monitoring.
- **Assessment D3 – Cariescan readings 51-90.** A 30/40-second application of Healozone with the possibility of operative care, ie, minimal fissurotomy for the higher readings, depending on the patient profile with the application of GCP Glass Seal or Fill (see below), together with intensive preventive care. Further monitoring.

For a reading of 100, there is likelihood of established dentine caries, which indicates operative care is advised, subject to patient profile, ie, fissurotomy to establish the extent of the lesion. Healozone would then be applied as D4 prior to simple restoration. However, this is a very conservative preparation that only removes the peripheral caries and can leave 1mm of caries on the floor of the cavity.

**Patient compliance**

It has to be stressed that the success of all of the above protocols depends very much on patient compliance and the changing of their lifestyles. Patient and parent motivation has to be assessed and encouraged for them to understand that their compliance is part of the treatment plan.

Healozone will create the improved environmental conditions around the tooth, which then enables nature to allow natural remineralisation of the tooth surface.

Time has to be spent with our patients to gain their understanding and thus increase their motivation. It is important that our patients appreciate that this a very complex subject, as we are trying to modify the biofilm by turning it from a cariogenic biofilm to a healthy one.

**Glass Carbomer technology**

We are so fortunate to have a restorative material that can now perfectly complement our use of ozone by enhancing the remineralisation process.

Glass Carbomer (GCP Dental) was developed by a group of dentists, chemists, and scientists that set out to find a dental restorative that would allow the tooth to regenerate itself to mimic its original structure. One of the major objectives was the elimination of toxic materials.

It became evident that fluoride aluminium-silicate glass, along with a patented liquid (silica) and nano-fluoride/
hydroxyapatite additives, provide the perfect initiator for the regeneration of natural tooth structure through biometric processes.

This chemistry, coupled with the use of ozone that produces the perfect environment for remineralisation to take place, offers very exciting treatment modalities, which are able to create an entirely biological structure that has properties similar or equivalent to natural tooth structure.

Glass Carbomer is the first dental restorative material to make use of natural mineralisation processes (biomimetic). It is a completely biocompatible restorative material and thus can be applied directly to the prepared and Healozone treated cavity, as can the GCP Glass Seal. It does not contain any monomers, Bisphenol A, resins or mercury and there is absolutely no need to etch or use bonding agents.

**Healozone and Glass Carbomer use**

The Healozone treatment is simple. After Healozone treatment, the cavity is bulk filled evenly in one layer, taking care not to trap any air bubbles. The material is an autocure product with a working time of one minute 15 seconds from the start of mixing. During the soft finishing stage (one minute 15 seconds), GCP can be shaped and moulded to create fissure patterns using GCP Gloss. This material is specially designed to facilitate the modelling and shaping of GCP Glass Fill. It is 100% monomer-free and, once applied, it imparts a gloss to the surface as well as a protective layer, which prevents desiccation, contributing to the superior characteristics of the set product.

The shaping and modelling can be carried out using instruments such as Optrasculpt (Ivoclar Vivadent) or a finger press technique, both with GCP Gloss. At this stage, any excess material can be removed easily.

A high energy LED thermo lamp is then used for 60-90 seconds to advance the cure and reach the final set (in one layer up to 8mm), giving a very hard material with high flexural and compressive strengths. The lamp is easy to use and is extremely durable, being LED technology. The Carbo LED lamp is a heat curing lamp as GCP Glass Fill and the other products are hardened not by UV light but precisely focused heat, which means that the lamp is brought as close to the restoration as possible. Once cured, the material can be finished with fine/extra fine diamonds with water spray. The surfaces can then be polished as desired. If a matrix has been used for the restoration, it is advisable not to remove this for five minutes post-curing to maintain the integrity of the marginal ridges and cervical/vertical margins.

In my opinion, Healozone and GCP Glass Fill is the technique of choice for children and caries susceptible elderly patients (Figure 4).

In addition to GCP Glass Fill, the material comes in GCP Glass Seal, which is a patented product used as a restorative cement sealer. Again, it has the same specially developed nano-fluoride hydroxyapatite particles, which provide an extremely low solubility. GCP Glass Seal can be used in both deciduous and permanent dentitions.

Once set, the process of mineralisation begins immediately and forms a complete layer of fluorooapatite within one year.

In addition, separate crown and bridge cements are also available that are biocompatible and have a natural fusion with zirconium crowns.

**Use in practice**

Having used Diagnodent and the original Healozone for the last 10 years, I have found it extremely easy to incorporate Cariescan and Healozone X4 into my practice. Similarly, the same applies to the use of Glass Carbomer products.

They are all very patient friendly and complement one another in a unique way.

The two clinical case presentations in this article illustrate the use of Healozone and Glass Carbomer using no local anaesthetic.

**Conclusion**

I cannot imagine practising dentistry without such techniques and materials in the 21st century, because we can at last start to treat the disease and not just the consequence of the disease.

We are very fortunate to be practising dentistry today as we are now gaining the understanding and have the techniques to provide modern treatment.

This is a new age in dental medicine and, as never before, the decisions we make and the advice we give can have far reaching consequences.

**Further information**

For a selection of peer-reviewed research papers that have proven the efficacy of the Healozone and that support why so many dentists around the world are using it in their daily practice, please email pd@fmc.co.uk.