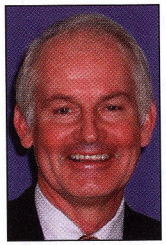
Leave Decay in My Cavity? You Must Be Kidding!



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It is now accepted that caries infected dentin may stabilize beneath a restoration[1] and, since the late 1990s, there has been an emerging bank of evidence showing that the creation of a biological seal at the cavo margin (isolating the lesion from the overlying biofilm) reduces the viability of bacteria remaining within the lesion and arrests further caries progression.[2]

Despite this, it is generally accepted amongst many dentists that bacterially infected dentin is irreversibly decomposed, unable to remineralize and should be removed prior to placing a restoration. This removal of softened dentin to create a firm base for a restoration has been one of the traditional cornerstones of restorative dentistry. However, if carious dentin does not have an inhibitory effect upon invading bacstrates the ability of a tooth to heal itself by the remineralization of carious tooth structure. Arrested caries are inevitably black in color as sulphur salts become incorporated into the remineralizing tissue. Once these lesions remineralize, they remain resistant to further caries attack unless there are dramatic changes in the oral environment. This is partly due to the remineralization process that transforms tooth dentin, carbonated apatite with a demineralization pH of around 5.5, into a complex of hydroxyl and fluorapatite[4] (plus other ions in the oral environment) that is able to resist demineralization at a pH of around 4.5. This is a pH level that pushes the biological tolerance of many oral bacteria.

Figure 1. Arrested caries exposed beneath a lost restoration, after 18 months. Hardened tissues resisted scratching with a sharp probe.

The ability of carious teeth to remineralize may be assisted by preventing biofilm formation over the lesion, without which caries are unable to progress. Both the application

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teria, it infers that the dentin pulp complex is the only vital tissue in the body without a front line physiological response to bacterial invasion. What are the evolutionary parameters that maintain a single point of tissue vulnerability in the body against infection?

A recent study[3] has shown that demineralized dentin was more effective in reducing the viability of *streptococcus mutans* than dentin treated with an antibacterial substance (silver fluoride [AgF] and potassium iodide [KI]). This suggests there are substances that may be released by carious dentin that inhibit bacteria viability. When AgF and KI are applied to the surface of demineralized dentin there is a further substantial reduction in bacterial viability[3] and suggests that the application of AgF and KI works synergistically with demineralized dentin in further reducing the reproductive potential of the bacteria.

ARRESTED ROOT CARIES

The presence of arrested root caries demon-

of ozone[5] and AgF/KI[6] to dentin prevents biofilm formation. This is analogous to dressing a soft tissue wound with materials such as silver ointment or iodide to assist healing.

In caries affected dentin some demineralization occurs, but the collagen matrix remains intact enabling reconstitution of a hydroxyl fluorapatite dentin.

Strontium and fluoride ions from glass ionomer (GI) cement restorations have been detected in infected dentin consistent with remineralization.[7] The nature and composition of the remineralized tissues will depend upon the ions present and the extent of degradation of the supporting collagen matrix.

The hardening of carious dentin may be compared to skin scar tissue formation.

continued on page 132

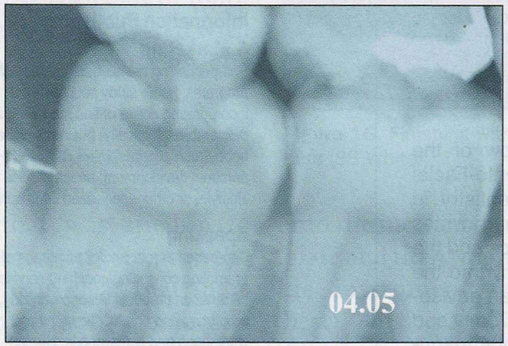

Figure 2. A patient presented with a large asymptomatic lesion that showed extensive caries radiographically.

Figure 3. The dentin was treated with HealOzone (KaVo), and a self-curing glass ionomer (GI) cement restoration was then placed over the lesion.

Figure 4. Twelve months after placement, one can see that there was a significant increase in radiopacity within the carious dentin.

Leave Decay in My Cavity?...

continued from page 130

Figure 1 shows arrested caries after 18 months beneath a lost GI cement restoration. There is no black staining since the lesion was isolated from the oral environment. The surface of the lesion has a cracked appearance due to the dehydration of the hydrated carious dentin during the hardening process. The surface of the lesion is obviously not remineralized dentin, but a tissue hard enough to resist marking with a sharp probe.

PHARMACOLOGICAL MANAGEMENT OF CARIES

Case Report 1: Glass Ionomer Combined With Ozone Treatment

GI cements pharmacologically assist with the remineralization of carious dentin by providing a source of fluoride, calcium, or strontium ions (depending upon the GI used). These ions can penetrate more than 100 µm into dentin to assist with the formation of hydroxyl and fluorapatite in the demineralized tissue.[7,8] GI cements have further benefits when treating caries as they prevent demineralization at the perimeter of the restoration, unlike

Figure 5. A carious lesion was evident on the occlusal surface of a lower molar.

Figure 6. Enamel was removed to gain access to the caries and a moat was prepared in sound dentin at the dentin-enamel junction with a No. 3 round slow speed bur.

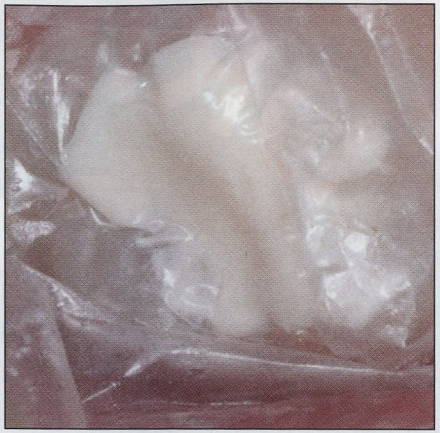

Figure 8. A 3cm square piece of thin flexible plastic was placed over the preparation. The patient held this in centric occlusion for 4 minutes until the GI cement had cured.

INFORMED CONSENT IS IMPORTANT

Intentionally leaving caries under a restoration may have the potential to lead to legal problems if a patient is unaware of the nature of procedure. This is especially true if another practitioner should have to radiograph the restoration and be unaware of this treatment protocol. Dentists who carry out remineralization procedures are well advised to provide their patients with written explanatory notes about the procedure and the benefits that can be achieved.

CONCLUSION

Restoration of teeth by amputation is a caries management model that often leads to the ongoing iatrogenic destruction of the dentition. The pharmacological management of caries is a conservative alternative that enables the remineralization of caries infected teeth to form a decay resistant layer at the base of a restoration.

AgF has been used to arrest caries, primarily in deciduous teeth since the early 1970s. After application, free silver ions react with oral sulphides to form silver sulphide, staining the teeth black. The application of KI

composite resins which offers no such protection.[9]

The following clinical case shows increased radiopacity that occurred under a self-curing GI cement restoration treated with ozone.

A patient presented with a large carious lesion on a lower second molar (Figure 2). Although the lesion was asymptomatic, a periapical radiograph showed extensive caries that

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may well have resulted in a pulp exposure during cavity preparation.

Overlying caries were removed and the lesion was etched with phosphoric acid for 5 seconds, then washed and dried with oil-free air. The residual softened caries were treated with ozone for 40 seconds using a HealOzone (KaVo) unit. Following this the cavity was restored with a self-curing GI cement (Fuji Triage [GC America]). Extensive radiolucency below the restoration is apparent, immediately after restoration placement (Figure 3). However, 12 months later, when the patient was recalled to have a composite resin (Ice [Southern Dental Industries]) placed over the GI, a further radiograph shows a marked improvement in radiopacity below the GI base (Figure 4).

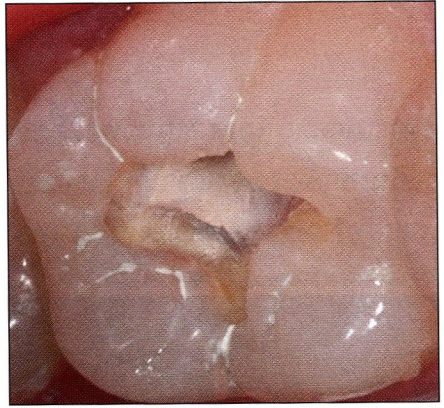

Figure 7. After etching, silver fluoride was applied to the preparation, followed by potassium iodide. The cavity was then washed and dried with oil-free air. A creamy-white precipitate formed on the remaining carious dentin.

Case Report 2: Glass Ionomer Used With Silver Fluoride and Potassium Iodide

The following case report describes a pharmacological approach to managing a carious lesion using AgF/KI and GI cement:

Figure 9. After the GI was cured, minimal contouring was required to complete the restoration.

The patient presented with occlusal caries on a lower molar in Figure 5.

Enamel was removed to gain access to the lesion. A moat was then prepared in sound dentin with a No. 3 slow speed round bur, at the dentin-enamel junction (DEJ) around the perimeter of the caries (Figure 6). Next, the preparation was etched with 37% phosphoric acid for 5 seconds, washed with water, and dried with oil-free air. AgF was then applied to the preparation, followed by KI until the precipitation turned from cloudy white to clear. The cavity was washed and dried again with oil-free air (Figure 7).

After isolating the preparation from moisture with strategically placed cotton rolls, a self-curing GI cement (Riva [Southern Dental Industries]) was placed into the preparation to slightly overfill the preparation. AgF/KI enhances the bond strength between self-curing GI and dentin.[10] A 3 cm square piece of a plastic freezer bag was placed over the GI and the patient asked to close in into centric occlusion for 4 minutes until the GI had cured (Figure 8). After curing, minimal contouring was required to complete the restoration (Figure 9).

immediately after AgF application forms silver iodide. This is a low-solubility creamy-white precipitate with significant antibacterial properties that inhibits silver staining.✦

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Dr. Knight is a general dentist and internationally noted dental speaker from Melbourne, Australia with special interests in minimal intervention aesthetic dentistry. He has pioneered techniques for the pharmacological management of dental caries and periodontal disease. He has introduced a number of innovative clinical techniques for aesthetic enhancement with minimal tooth preparation and he is named on several dental patents. Apart from his broad clinical base, he has been State President of his Dental Association and has extensive political and economic experience within the profession. He is well focused on the many problems of dentistry and the solutions needed to survive today's rapidly changing environment. He has been published in *Quintessence International, Australian Dental Journal*, and *Journal of Periodontal Research.* He has produced a series of clinical videos and written numerous articles on aesthetic and adhesive dentistry that have been translated and published in a number of languages. He can be reached via e-mail at geoffbds@dentalk.com.au.

Diclosure: Drs. Knight and Craig are named on a process patent associated with the use of silver fluoride and potassium iodide. Dr. Knight was associated with the development of Fuji Triage and has a financial interest in this product.

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Disclosure: Dr. Mulyani reports no conflicts of interest.

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Diclosure: Drs. Knight and Craig are named on a process patent associated with the use of silver fluoride and potassium iodide.

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