It is now accepted that caries-infected dentin may stabilize beneath a restoration and, since the late 1990s, there has been an emerging body of evidence showing that the creation of a biological seal at the cavity margin (isolating the lesion from the overlying biofilm) reduces the viability of bacteria remaining within the lesion and arrests further caries progression. Despite this, it is generally accepted amongst many dentists that bacteria in 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 bacteria, 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 has shown that de-mineralized 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 and suggests that the application of AgF and KI works synergistically with demineralized dentin to further reducing the reproductive potential of the bacteria.

**ARRESTED ROOT CARIES**

The presence of arrested root caries demonstrates 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 4.5, into a complex of hydroxyapatite (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.

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 of ozone and AgF/KI 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 hydroxyapatite dentin.

Strontium and fluoride ions from glass ionomer (GI) cement restorations have been detected in infected dentin consistent with remineralization. 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.
Leave Decay in My Cavity...

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Figure 5 shows arrested cavities 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 Oxygen 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 hydroxyapatite in the demineralized tissue. GI cements have further benefits when treating cavities as they prevent demineralization at the perimeter of the restoration, unlike composite resins which offers no such protection.

The following case clinical shows increased radiopacity that occurred under a self-curing GI cement restoration treated with oxygen. 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 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 oxygen for 40 seconds using a HealOzone (KaVo) unit. Following this the cavity was restored with a self-curing GI cement (Fujij 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 cement, a further radiograph shows a marked improvement in radiopacity below the GI base (Figure 4).

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 AgFKI and GI cement.

Informed Consent is Important

Intentionally leaving cavities 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 carries management model that often leads to the ongoing iatrogenic destruction of the dentition. The pharmacological management of cavities is a conservative alternative that enables the remineralization of carious infected teeth to form a decay resistant layer at the base of a restoration.

AgFKI has been used to arrest caries, primarily in deciduous teeth since the early 1970s. After application, free silver ions react with oral saliva to form silver sulphide, staining the teeth black. The application of AgFKI immediately after AgFKI application forms silver iodide. This is a low-solubility creamy-white precipitate with significant antibacterial properties that inhibits silver staining.

References

Dr. Knight is a general dentist and internationally noted dental educator. He was trained in aesthetic dentistry and 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 the Dental Association and has extensive political and economic expertise within the profession. He is well-versed in 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 geoffk@dental.com.au.

Disclosure: 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 Trëge and has a financial interest in this product.

Dr. McIntyre received his primary dental degree from University of Queensland in 1980 and his PhD in Microbiology and Immunology at Adelaide University in 1970, both in Australia. He is the former Dean of Adelaide Dental School and Chairman of the Department of Dentistry. Currently retired, Dr. McIntyre is a part-time Visiting Research Fellow at the University and supervising post-graduate research projects at all levels. His current research involvement includes cariology, dental erosion, glass ionomer cements; fluoride action and vehicles for use in developing countries, minimally invasive methods in restorative dentistry. He can be reached at john.mcintyre@adelaide.edu.au.

Disclosure: Dr. McIntyre reports no conflicts of interest.

Dr. Craig was formerly associate professor in Preventive Dentistry at the University of Sydney and, after that, director of the Dental Health Foundation in Australia. He has had extensive involvement in the promotion of water fluoridation and in programs designed to improve the dental health of the community including various aspects of minimal intervention dentistry. He has published in numerous scientific journals and has presented more than 200 post-graduate courses and lectures. He can be reached at dentalcook@bigpond.com.

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

Dr. Mulyani received her Bachelor of Dental Surgery from the University of North Sumatera in Indonesia. She received her Diploma in Clinical Dentistry, her Master of Dental Surgery (Pedodiagnostics), and Doctor of Philosophy (Community Dentistry) from the University of Adelaide in Australia. Currently, Dr. Mulyani works mainly in dental material research while providing supervision on research methodology for post graduate students in Dental School, The University of Adelaide. Her research interests include cariology, glass ionomer cements, erosion, and minimally invasive restorative dentistry. She was a lecturer in the Faculty of Dentistry, University of North Sumatera in Indonesia for 20 years. She has published handbooks and manuals for the students to be used in her teaching.

She also published papers in dental journals and presented papers and posters in Indonesian Dental conferences and AIDR conferences. She can be reached via e-mail at mulyani.daidjani@adelaide.edu.au.

Disclosure: Dr. Mulyani reports no conflicts of interest.

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