

Healing Dental Caries

Stephen Abrams, DDS

Healing dental caries; what a novel idea! Aren't oral health care providers already doing this? Isn't the placement of a restoration healing dental caries? Not really, restoring the effects of dental caries by restoring a tooth is not really "healing" the tooth but treating the after effects of the disease. Healing is defined as curing, helping to heal or growing back sound tissue. One could argue that dental restorations do restore tissue but are we really healing dental caries or could we possibly heal caries by actually re-crystallizing or remineralizing the damaged enamel surface. The answer is yes, we are already doing this but there are new techniques and approaches that can help us to this better.

What is dental caries? In 2001, the National Institute of Health's (NIH) Consensus Conference on the Diagnosis and Management

of Dental Caries throughout Life defined it as:

"Dental caries is an infectious, communicable disease resulting in destruction of tooth structure by acid-forming bacteria found in dental plaque, an intraoral biofilm, in the presence of sugar. The infection results in the loss of tooth minerals that begins with the outer surface of the tooth and can progress through the dentin to the pulp, ultimately compromising the vitality of the tooth."¹

One can place a number of restorations in a mouth, without treating the underlying disease. The bacteria remain in the plaque biofilm on the remainder of the teeth capable of creating new areas of decalcification and cavitation. Patients are beginning to expect that we can treat this disease or at least provide them with a reason as to why they or their

children continue to develop carious lesions.

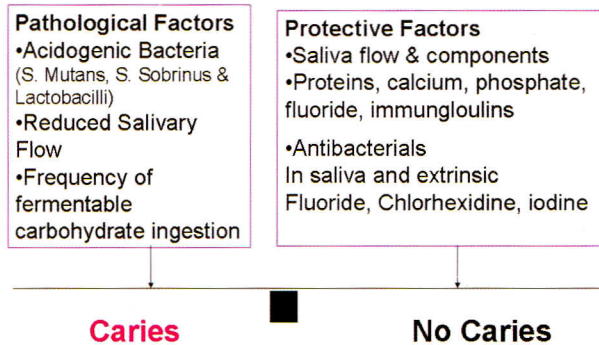
Dental caries arises from an overgrowth of specific bacteria that can metabolize fermentable carbohydrates and generate acids as waste products of their metabolism. Streptococci mutans and Lactobacillus are the two principal species of bacteria involved in dental caries and are found in the plaque biofilm on the tooth surface.^{2,3,4} When these bacteria produce acids, the acids diffuse into tooth enamel, cementum or dentin and dissolve or partially dissolve the mineral from crystals below the surface of the tooth. If the mineral dissolution is not halted or reversed, the early subsurface lesion becomes a "cavity". These early subsurface lesions are not detectable with our current technology but newer technologies coming to market are able to detect and monitor these lesions.

The tooth surface undergoes demineralization and remineralization continuously, with some reversibility. When exposed to acids, the hydroxyapatite crystals dissolve to release calcium and phosphate into the solution between the crystals. These ions diffuse out of the tooth leading to the formation of the initial carious lesion. The reversal of this process is *r e m i n e r a l i z a t i o n*. Remineralization will occur if the acid in the plaque is buffered by saliva, allowing calcium and phosphate present primarily in saliva to flow back into the tooth and form new mineral on the partially dissolved subsurface crystal remnants.⁵ The new “veneer” on the surface of the crystal is much more resistant to subsequent acid attack, especially if it is formed in the presence of sufficient fluoride. The balance between demineralization and remineralization is determined by a number of factors. Featherstone describes this as the “Caries Balance”, or the balance between protective and pathological factors (see figure 1).⁶

These early lesions (both enamel and root surface) typically have an intact hard outer surface with subsurface demineralization. The tooth surface remains intact because remineralization occurs preferentially at the surface due to increased levels of calcium and phosphate ions. Figure 3⁷ shows a cross-section of an early carious lesion using polarising light microscopy. The clinical characteristics of these early carious lesions include:

- Loss of normal translucency of the enamel resulting in a chalky white appearance particularly when dehydrated,
- Fragile surface layer susceptible to damage from probing, particularly in the pits and fissures,

The Caries Balance



Adapted from Featherstone, J. D. B., JADA 2000

FIGURE 1

- Increased porosity, particularly of the subsurface, with increased potential for uptake of stain,
- Reduced density of the subsurface, which may be detectable radiographically (depending upon mineral loss and location) or with transillumination (depending upon location and loss of mineral),
- Potential for remineralization with increased resistance to further acid challenge particularly with the use of enhanced remineralization treatments.⁸

How can we stimulate remineralization of early lesions? Traditionally, Dentistry has relied upon fluoride in tooth pastes, in municipal water supply and applied topically to stimulate or help with remineralization. We have seen the change or decrease in caries in some of our patients. Are we really healing all dental caries? Are our diagnostic tools sensitive enough to detect early lesions? The answer is that fluoride has had an effect on caries to a certain extent. It has not completely “cured” the problem.

Fluoride therapy as we currently know it cannot deal completely with a high bacterial challenge.⁹

Healing Dental Caries requires a more comprehensive approach to the problem. It requires:

1. Accurate diagnostic tools that can detect and monitor the changes in early lesions. These changes should be linked to changes in the crystal structure of the enamel or root surface
2. Dealing with dietary issues including the timing of carbohydrate intake as well as carbonated beverages and sport drinks
3. Dealing with patients with low or no saliva flow
4. Dealing with elevated levels of bacteria in the mouth
5. Dealing with oral hygiene including the effective removal of plaque, food debris and calculus

It really involves examining risk factors and dealing with the

Cyclic Process of Decay

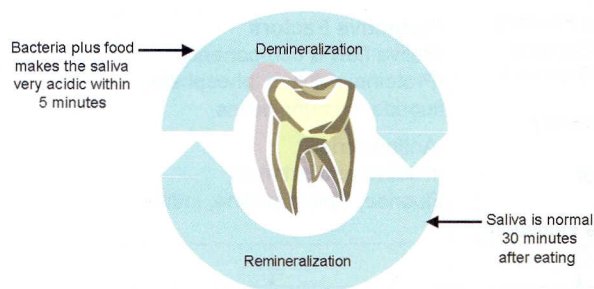
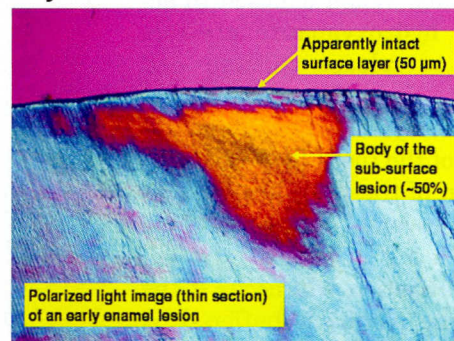


FIGURE 2

Early Carious Lesion in Enamel



Adapted from Crest web site

FIGURE 3

three major components of the disease; bacteria, diet and tooth surface integrity.

Remineralization therapy has evolved from topical fluoride applications to involve a number of novel approaches to the problem (see figure 4). The first innovation was the introduction of fluoride varnish. Numerous studies have shown a reduction in caries incidence when using fluoride varnish.^{10,11,12} But caries still does occur even when using fluoride varnish.

Calcium and phosphate are also required for remineralization and so we can consider products that either enhance the concentration of calcium and phosphate in saliva or help to attract them to the tooth surface. Products such as CPP-ACP (Recaldent), Novamin, ProArgin, and ClinPro 5000 all use calcium and phosphate in various formulations to help enhance or stimulate remineralization.^{13,14}

This is not the only approach, one can look at anti-bacterial products such as Chlorhexidine varnish (Prevora or Cervitec), Chlorhexidine rinses (Peridex) or Povidone to help reduce bacte-

rial populations. Xylitol products both inhibit the growth of *Streptococci mutans*, reduce the quantity of plaque on teeth and reharder enamel.¹⁵

So Healing Dental Caries may and will involve a combination of products. It was also involve diagnostic tools that can accurately measure the changes in the enamel or root over time. These new devices should have the following characteristics:

1. Detect & monitors de & re-mineralization
2. Detect smooth surface, root surface, occlusal surface & interproximal lesions
3. Non-invasive & safe
4. Repeatable measurements
5. Imaging and or image capture
6. System for recording measurements
7. Patient Education and Motivation

The key is to understand what these devices are measuring and then use them to track the prog-

ress of the remineralization program. In our ongoing clinical trial using The Canary System to track and monitor early carious lesions we have found a number of therapies that do stimulate remineralization. The Canary System examines the interaction of pulsed laser light on the tooth surface. By measuring both the subtle changes in reflected heat and luminescence we can measure the changes in these early lesions.^{16,17} The decreasing Canary Number indicates the remineralization of both the surface and sub-surface lesion. Our clinical trial findings mirror what we have seen in the lab and do indicate that remineralization can and does occur in patients we just need to watch and monitor the process.¹⁸

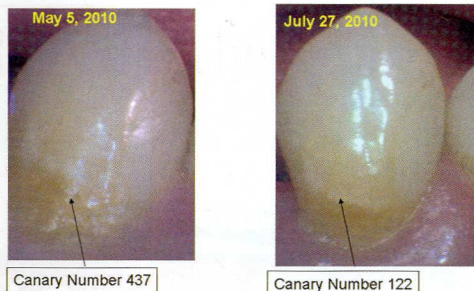
Healing Dental Caries; not such a novel idea but we have a wide range of novel products and approaches to provide our patients today. There are more products to come to market. We as oral health care providers need to understand the process and get involved in this non-invasive approach to managing dental caries. We will never eliminate the need for restorative dentistry but we will be able to expand our tools and methods for

Remineralization Product Decisions?

- ❖ Fluoride
 - ❖ CPP-ACP (Recaldent)
 - ❖ NovaMin
 - ❖ Clinpro 5000
 - ❖ Xylitol products
 - ❖ Antibacterial rinses
 - ❖ Salivary products
 - ❖ Neutralizing agents
 - ❖ CHX varnish (Prevora)
 - ❖ Sealants
 - ❖ ICON
- RISK demand?
 - Age and Ability?
 - Buffering?
 - Fluoride Uptake?
 - Contact time needed?
 - Desensitization?
 - Antibacterial activity?
 - Salivary stimulant?
 - Compliance?
 - Ongoing Monitoring of the Lesions

FIGURE 4

Surface Remineralization In High a Caries Patient



Fluoride Varnish application in office and Remineralization Tooth paste at home
Surface appears smooth and decrease in size of the white spot

FIGURE 5

REQUIREMENTS OF AN IDEAL REMINERALIZATION MATERIAL

- Diffuses into the subsurface or deliver calcium and phosphate into the subsurface
- Does not deliver an excess of calcium
- Does not favour calculus formation
- Works at an acidic pH
- Works in xerostomic patients
- Boosts the remineralization properties of saliva
- For novel or new materials; shows a benefit over fluoride

Walsh, L. J.,

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treating caries and ultimately help our patients.

DISCLOSURE

Dr. Abrams is President of Quantum Dental Technologies which has developed The Canary Dental Caries Detection System. He has not received any compensation for the preparation of this article.

OH

Dr. Stephen Abrams is the founder of Four Cell Consulting, Toronto Ontario, Canada, which provides consulting services to dental companies. Dr. Abrams recently founded Quantum Dental Technologies, a company developing laser based technology for the early detection and ongoing monitoring of dental caries. He is a founding board member of ACCERTA Claim Corporations, a dental and pharmacy claims man-

agement company. He can be contacted at (416)-265-1400 or dr.abrams4cell@sympatico.ca

Oral Health welcomes this original article

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