

# Remineralization of Carious Lesions — It Really Does Work!

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**D**ental caries is one of the two common diseases we treat in clinical practice on a daily basis. We place restorations to restore teeth ravaged by caries. We place implants, bridges and partial dentures to replace teeth destroyed by caries. Our preventive therapies for the most part involve cleaning tooth surfaces and applying fluoride-based products. But, what are we really doing? Are we detecting and treating the disease at its earliest stages or are we waiting for destruction of tissue before we commence any sort of treatment. Is the treatment designed to treat the disease — caries, or does it just restore missing oral tissue. Can we design therapies to treat or remineralize early carious lesions?

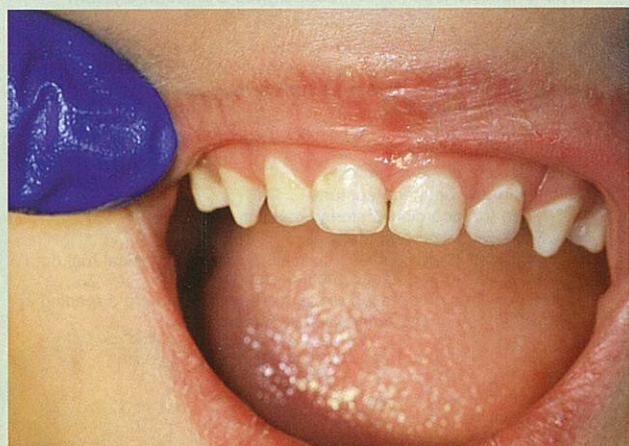
We have been taught to intervene and treat caries when cavita-

tion develops. The young patient in Figure 1 has one “cariou” lesion on the buccal surface of the maxillary right central incisor but actually has five carious lesions visible in this photograph. The white spots along the gingival crest of the maxillary primary anterior teeth are carious lesions as well and can and should be treated. Cavitation is not the point when one starts to contemplate treatment. Remineralization does work and should become part of our treatment regimen.

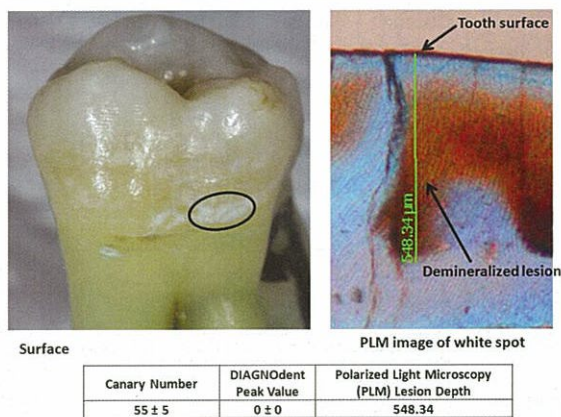
The earliest visual clinical sign of dental caries is the “white spot lesion.” When this is first seen, the carious process has been going on for months. Figure 2 shows a cross-section of a white spot lesion. Even though the surface appears intact the lesion is at least 540 microns in depth. In this

case, scanning with The Canary System indicates that a lesion is present. These early lesions can be treated before cavitation and they are amenable to remineralization.<sup>1,2</sup> The key is to find the lesion and use technology to monitor the changes in the lesion as it undergoes remineralization.

So how does one introduce remineralization into clinical practice? If one is using fluorides in preventive therapies then this is the first step in starting to remineralize carious lesions. There are a wide range of remineralization therapies on the market today. The key is to find the right combination and then monitor the outcomes with various caries detection technologies. Figure 3 provides a short summary of the various remineralization therapies that



**FIGURE 1**—Early white spot lesions in the maxillary primary dentition.



**FIGURE 2**—Extracted white spot study.

can be used in clinical practice and at home. Remineralization therapy is not a substitute for the core preventive tools for plaque removal: brushing and flossing.

Lesions can remineralize but one needs to monitor the lesion and make sure that patients follow the home care regime. Detection, motivation, and monitoring are the essential tools for a remineralization / preventive program. If we cannot monitor lesion changes on an ongoing basis then we are forced to wait for frank cavitation or larger lesion development before we can intervene and either change or re-motivate our patients. The ideal caries detection system should be an essential part of any remineralization program. Figure 4 provides some of the key characteristics of such a system. Accurate repeatable measurements with a system to store the information and provide patient motivation are the critical elements of a caries detection system.

Remineralization therapy has evolved from topical fluoride applications to involve a number of novel approaches to the problem (Fig. 3). The first innovation

was the introduction of fluoride varnish. Numerous studies have shown a reduction in caries incidence when using fluoride varnish.<sup>3-5</sup> But caries still does occur even when using fluoride varnish.

Calcium and phosphate are also required for remineralization. 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 are designed to help attract calcium and phosphate to the tooth surface 3M ESPE Clinpro™ 5000 provides calcium and phosphate to help enhance or stimulate remineralization.

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 bacterial populations. Xylitol products both inhibit the growth of Streptococci mutans, reduce the quantity of plaque on teeth and re-harden enamel.<sup>6</sup> Walsh in 2009 (Fig. 5) provides a clear and succinct list of requirements of a remineralization system.<sup>7</sup>

## REMINERALIZATION OF BROWN SPOT LESIONS: A CASE REPORT

A female patient, in her mid-twenties, had brown spot lesions along the gingival crest of the second molars and the mandibular first molars. A remineralization program was started two years ago in an attempt to stabilize the lesions and prevent cavitation. At that time, the lesion surfaces were brown in colour but had some roughness on the surface. Results from monitoring tooth 37 over the last 12 months are displayed in Figure 6. The remineralization therapy consisted of a combination of 3M ESPE Vanish™ White Fluoride Varnish applied every 3-4 months in the office and the home use of 3M ESPE's Clinpro™ 5000 tooth paste used nightly. Over the last twelve months, using The Canary System™ to monitor the lesions, they appear to have stabilized. The tooth surface is much smoother and no cavitation has developed. Visually, there are no signs of remineralization or colour change since initially this is mostly a sub-surface phenomena. Using caries detection devices such as The Canary System™, we can monitor remineralization of the lesion.

## Office + Home Therapy

Office	Home
<ul style="list-style-type: none"> <li>• Topical Fluoride (gels and foams)</li> <li>• Fluoride Varnish</li> <li>• Anti-Microbial Therapy                             <ul style="list-style-type: none"> <li>- Prevora</li> <li>- Cervitec</li> </ul> </li> <li>• Oral Hygiene &amp; Patient Motivation</li> <li>• Diet Counselling</li> <li>• Ongoing Monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Toothpastes &amp; Topical Application                             <ul style="list-style-type: none"> <li>• Clinpro 5000 Toothpaste</li> <li>• ProArgin in Colgate</li> <li>• MI Paste</li> <li>• Novamin</li> <li>• Prevident</li> </ul> </li> <li>• Sugar Substitutes                             <ul style="list-style-type: none"> <li>• Xylitol</li> </ul> </li> <li>• Mouthwashes                             <ul style="list-style-type: none"> <li>• Peridex</li> <li>• Tricolsan Products</li> </ul> </li> <li>• Gums &amp; Mints                             <ul style="list-style-type: none"> <li>• Recaldent</li> <li>• Xylitol</li> </ul> </li> </ul>

Effective Plaque Removal with Brushing & Flossing

FIGURE 3

## The Characteristics of an Ideal Caries Detection System

1. High sensitivity & specificity for caries detection
2. Detects & monitors de & re-mineralization
3. Detects smooth surface, root surface, occlusal surface & interproximal lesions
4. Detects caries around restoration margins
5. Non-invasive & safe
6. Repeatable measurements
7. Imaging and or image capture
8. System for recording & storing measurements
9. Patient Education and Motivation
10. In-vitro and in-vivo data & publications including clinical trial data demonstrating to detect & monitor carious lesions
11. Minimal or no preparation of the tooth surface before a reading
12. Ability to detect and monitor erosion lesions

> The key is to understand what the device is measuring

FIGURE 4

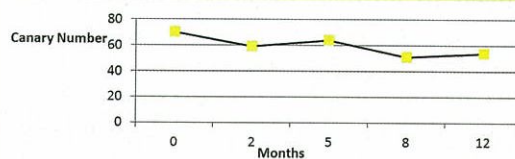
## Requirements of an Ideal Remineralization Material

- 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

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FIGURE 5

## Remineralization of a Brown Spot Lesion



3M ESPE Vanish Fluoride Varnish & Clinpro 5000 Tooth Paste

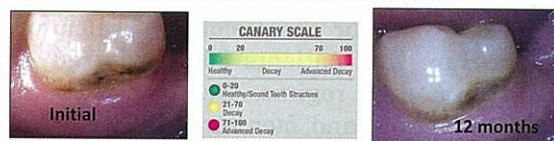


FIGURE 6

## DOES REMINERALIZATION THERAPY WORK ON ALL THE TEETH?

One cannot assume that if remineralization occurs on one tooth or even one tooth surface, it will occur throughout the mouth. Dental caries is a multi-factorial disease and different locations throughout the mouth have increased or decreased the risk for lesion progression even with a remineralization program in place. Factors such as the ability to remove plaque, frequency of exposure to remineralization agents, salivary flow, tooth surface topography, or exposure to parafunctional forces all have an influence on the lesion growth and outcome of any remineralization therapy or change the “caries balance.” In the clinical

case shown in Figure 7, the brown spot lesions on the maxillary cuspids did not appear to change but canary readings indicated that the sub-surface lesion was increasing in size. In this situation, a number of surfaces were used to monitor the ongoing results of the remineralization therapy. The lesions on the buccal surfaces of the mandibular molars also had large brown areas which had not cavitated but remained stained and rough over a one year period. During this time, the patient was seen every three months and both home and office therapies were used with very poor outcomes. Discussions with the patient revealed that consumption of soft drinks and moderately elevated

sugar intake had shifted the “caries balance” despite our efforts to remineralize these lesions. At this point in time, decisions now need to be made regarding restoration of lesions vs. continuing remineralization therapy.

## MONITORING REMINERALIZATION THERAPY AND TREATMENT PLANNING

A young boy approximately five-years of age present in our clinic (Fig. 8) with multiple white spot lesions. Since the child was anxious and we knew that the anterior teeth would be exfoliated within the next 24 months, we opted to begin remineralization therapy rather than invasive restorative therapy. The goals were to stabilize the lesions and to im-

### Is Remineralization Therapy Working?

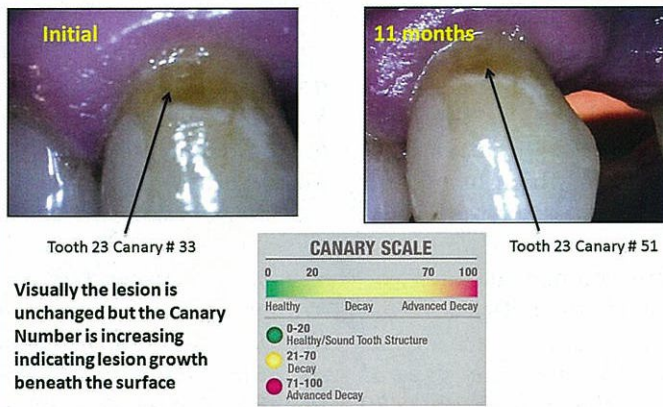


FIGURE 7

### Monitoring Remineralization With The Canary System

Tooth Number (FDI)	Canary Number March 13, 2012	Canary Number August 10, 2011
51	32	21
52	28	39
53	53	51
61	17	33
62	34	22
63	17	27

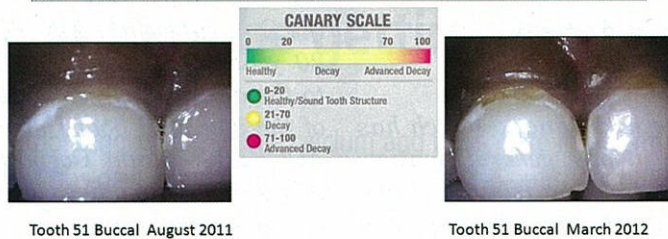


FIGURE 8

prove the oral hygiene. Since the child was under six years of age, we opted to use a fluoride varnish and a fluoridated tooth paste. At recall, seven months later, some of the lesions had stabilized while others such as the maxillary primary right central incisor had continued to demineralize. The teeth were becoming mobile so we have opted to continue to remineralize the lesions, emphasize oral hygiene and shift the caries balance before the permanent teeth erupt. We will be seeing the patient every three months to ap-

ply fluoride varnish and monitor the lesions.

Remineralization of carious lesions does work but there are a number of factors that impact upon the outcome. The major factor is patient compliance or the ability of our patients to maintain regular home care, watch their diet and sugar intake etc. Treating caries with remineralization therapies means engaging patients in their oral health care. This is not an impossible task. Patients do treat other medical

conditions. If we establish the right monitoring system, with the ability to check outcomes on a regular basis and actively engage our patients in their care, we can successfully remineralize or at least stabilize early carious lesions. We need to use accurate tools to measure lesion progression and engage our patients and staff within our clinical practices. We, as dentists, continue to provide the diagnosis, design the treatment plans, supervise outcomes and provide more invasive treatments. In our clinical practice, we use The Canary System to monitor the lesion change. The system provides online and printed reports for the patients and imaging for our preventive staff. Using The Canary System and 3M's Vanish Fluoride Varnish and Clinpro 5000, we have been able to establish a remineralization program for our patients.

### OFFICE INTEGRATION

At the present time in Canada, depending upon the province, billing codes do exist for application of remineralization therapies, fluoride varnish, recall examinations or specific diagnostic tests. It is up to the clinical practice to decide how or if they will bill for these services and which staff will provide the services. The diagnosis and treatment plan needs to be developed by the dentist and the results of the ongoing therapy need to be monitored. Ideally, either the hygiene team or a dental assistant could be involved in the remineralization program. Depending upon the remineralization therapy used, the amount of plaque and calculus on the tooth surfaces, either the hygienist or dental assistant can apply the remineralization therapy and measure the changes in the lesion.

In our clinical practice, we typ-

ically use fluoride varnish (Vanish™ 3M ESPE) for our in-office remineralization treatment. We have one of our hygiene team see the patient, scan the lesions with The Canary System, look for other areas of new demineralization and then apply the fluoride varnish. We then dispense Clinpro 5000 (3M ESPE) as the home based therapy and provide oral hygiene instruction. The Canary System provides the patient with a report so that they are involved and engaged in their therapy (it is also available on the web portal). The dentist reviews and monitors the outcomes on a regular basis. If the lesions are not improving, (based upon our Canary measurements), we change our home

team with the tools to treat caries from earliest lesion to frank cavitation. The end result: our patients are able to maintain the integrity of their dentition. **OH**

#### **Disclosure:**

Dr. Stephen Abrams is the CEO and Co-Founder of Quantum Dental Technologies which has developed The Canary System mentioned in this article. He has not received any compensation for the preparation of this article.

*Stephen Abrams is a general dental practitioner with over 30 years of clinical experience. Upon graduation from the University of Toronto, Faculty of Dentistry in 1980 he established a group prac-*

*on topics ranging from early caries detection, prevention, removable dentures, design of dental programs and restorative dentistry.*

*Dr. Abrams has also been active within the profession. He has honorary fellowships in a number of dental societies including Pierre Fauchard, American College of Dentists and the International College of Dentists. He is a member of Alpha Omega Dental Fraternity. He has been very active in the Ontario Dental Association, chairing their Dental Benefits Committee for the last thirteen years, negotiating with the provincial government and local municipalities across Ontario on various government sponsored dental programs. He has dealt with issues of access to dental care, design of dental programs and the value of preventive dentistry while leading this ODA Task Force. In 2002, Dr. Abrams was awarded the Barnabus Day Award from the Ontario Dental Association for 20 years of distinguished service to the dental profession. He is one of the founding board members of ACCERTA Claim Corporation, a dental and pharmacy claims management company.*

## Remineralization does not replace restorative dentistry but provides the oral health team with the tools to treat caries from earliest lesion to frank cavitation

therapies and review oral hygiene and home care with the patient. Education is not as daunting as it seems since the Canary reports help the patient to understand what we are monitoring and how they can help to improve their oral health.

Remineralization of carious lesions does happen. It happens naturally and if we engage our patients in the process, we can shift the "caries balance" and remineralize lesions. The key is to find the right mix of remineralization therapies, an accurate repeatable detection device, a quick and simple communication tools for patients and a system to quickly monitor outcomes on a regular basis. Remineralization does not replace restorative dentistry but provides the oral health

*tice in Toronto Canada which has grown to involve general dentists and dental specialists. In 1999, Dr. Abrams began working on a non-invasive laser based device for the detection and monitoring of caries. He currently jointly holds patents on this new technology. In 2006, he founded Quantum Dental Technologies to finish development of The Canary System. The Canary System, based upon the PTR-LUM technology and is currently available in Canada and Europe.*

*He is a senior member of the European Organization for Caries Research (ORCA) where he has presented a number of papers on the detection of caries using The Canary System. Dr. Abrams has published over ninety articles in various international publications*

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