



Using The Canary System to Develop a Caries Management Program for Children

Dr. Stephen H. Abrams

Dental caries is the most common oral disease we treat in paediatric dentistry. We place restorations to restore teeth ravaged by caries. We perform pulpotomies when caries encroaches on the pulp. 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?

What is Caries?

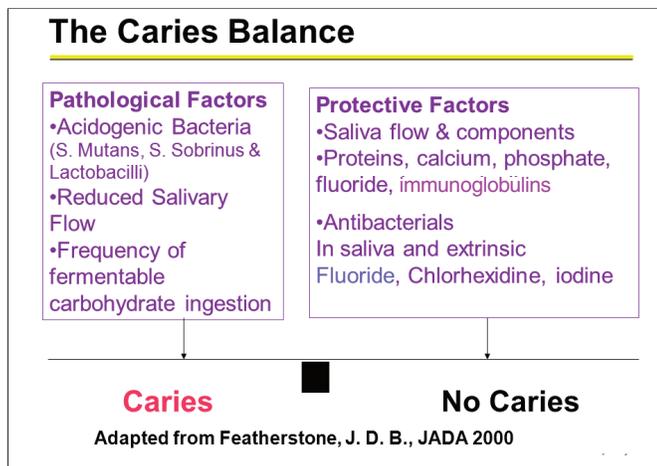


Figure 1: The Caries Balance

The tooth surface undergoes demineralization and remineralization continuously. 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 remineralization. Remineralization will occur if the acid in the plaque is buffered by saliva. This will allow calcium and phosphate present primarily in saliva to flow back into the tooth and form new mineral on the partially dissolved subsurface



crystal remnants.^{1,2} 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.^{3,4} 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).⁵

How Does The Canary System Work?

Caries involves the destruction of the crystal structure of a tooth, so one needs to find a system that does not measure bacteria but actually can detect changes in the tooth structure.

The Canary System, developed by Quantum Dental Technologies looks directly at the status of the enamel crystal by using PTR-LUM technology that measures converted heat (PTR) and light (luminescence or LUM) signatures emitted from the tooth surface. Safe pulses of laser light allow one to examine up to 5mm below the tooth surface. Caries lesions modify the thermal properties (PTR) and glow (LUM) from the healthy teeth. As a lesion grows, there is a corresponding change in the signal; as the heat is confined to the region with crystalline disintegration and LUM decreases. As remineralization progresses and enamel prisms begin to reform their structure, the thermal and

luminescence properties begin to revert back in the direction of healthy teeth. The system detects very small changes in heat (less than 1 – 2 degrees Celsius), much less than that generated by a dental curing light.

The research has demonstrated that the energy conversion technology (PTR-LUM) used in The Canary System can be harnessed to help oral health professionals detect and diagnose:

- Lesions and defects up to 5mm. below the enamel surface^{6,7}
- Occlusal pit and fissure caries^{8,9,10}
- Smooth surface caries^{11,12}
- Acid erosion lesions^{13,14,15}
- Root caries^{16,17}

- Interproximal caries lesions^{18, 19, 20, 21}
- Beneath fissure sealants^{22, 23}
- Detection of caries around the margins of restorations^{24, 25, 26}
- Beneath the intact margins of composite resins²⁷
- Demineralization and remineralization of early caries lesions (as small as 50 microns)^{28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38}

The earliest visual clinical sign of dental caries is the “white spot lesion”. When this is first seen, the carious process has been occurring for months. Figure 3 shows a cross-section (using polarized light microscopy, PLM) of a white spot lesion. Even though the surface appears intact the lesion is at least 533.01 microns in depth (half a millimeter). In this case, scanning with The Canary System™ indicates that a lesion is present while DIAGNO dent

indicates that there is no lesion present. These early lesions can be treated before cavitation and they are amenable to remineralization.^{39,40} The key is to find the lesion and use technology to monitor the changes in the lesion as it undergoes remineralization.

Detecting and Monitoring Caries Lesions in Primary Teeth

With The Canary System’s ability to detect and monitor white spot lesions, one can construct a preventive approach to treating caries. In this example, this five year old child was seen in our clinical practice with a number of caries on the anterior teeth. Some of these lesions were white spots; in essence early caries. We opted to start the child on a

preventive program and see if we could halt the caries process and allow the teeth to exfoliate naturally avoiding the placement of restorations. In this clinical situation, we used a combination of 3M ESPE Vanish Fluoride Varnish applied here times in the office and

Clinpro 5000 used at home. From August 2011 until March 2012, we were able to either arrest the caries or slow down lesion growth and the teeth are now ready to exfoliate. The Canary Patient Reports helped the family to understand the areas of concern and to focus their attention on the need to improve the home care.

Detecting Caries around Orthodontic Brackets

Incidence of white spots on orthodontically-treated teeth is quite common.^{41,42} An examination of the records of 350 patients treated at the University of Michigan found that 72% of patients had at least one new white spot lesion following orthodontic treatment. White spots are not simply surface defects but an indication of the early sign of caries developing beneath the enamel surface. Caries will develop along the margins of the orthodontic bands especially in situations where the patient does not remove the plaque and food debris. Over time, the enamel around and beneath the margin will begin to decay. The Canary System is able to scan along the margins of the orthodontic brackets and detect caries. A Canary Number above 20 indicates the



Figure 2: The Canary System

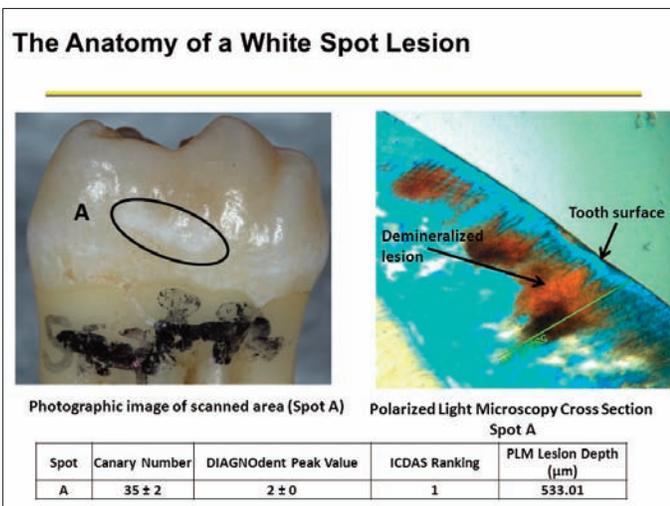


Figure 3: The Structure of a White Spot Lesion

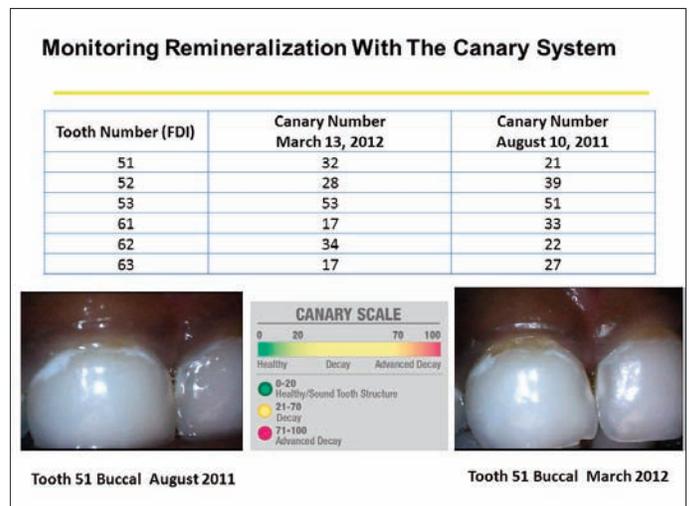


Figure 4: Monitoring Remineralization in the Primary Dentition

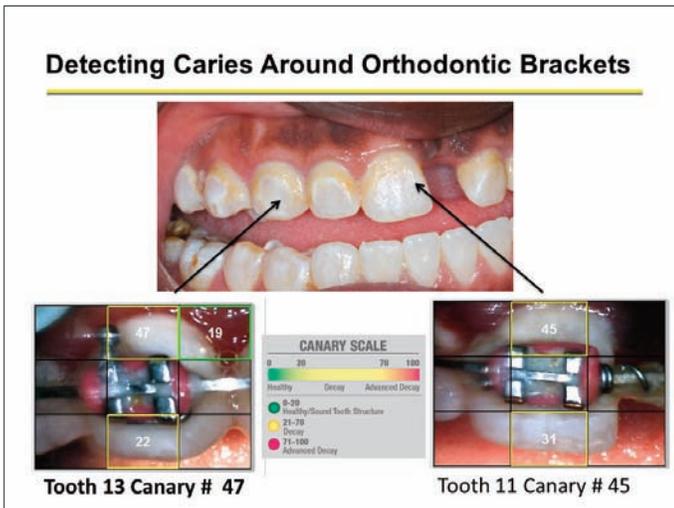


Figure 5: Detecting Caries Around Orthodontic Brackets with The Canary System

presence of a lesion. Lower Canary Numbers may indicate a small lesion at the margin which might be amenable to remineralization with products currently on the market. In this clinical situation, the patient had very poor oral hygiene and had not been seen by the orthodontist in a

number of months. When the patient was first seen in our practice, we scanned the teeth and found a very high Canary Numbers around all of the orthodontic brackets. We felt there was a high risk of both early and large caries lesions so the orthodontist removed the brackets. Upon removal,

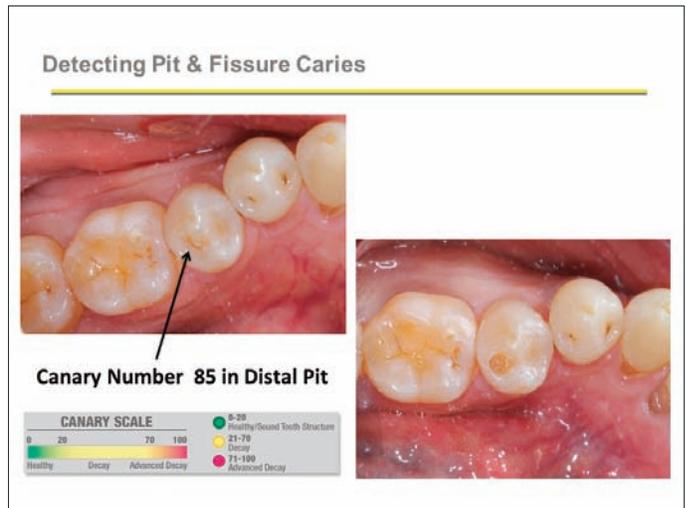


Figure 6: Detecting Pit and Fissure Caries in a Low Caries Risk Patient

white and yellow spots were found on the buccal surfaces of most of the maxillary teeth. The Canary can become part of the caries detection program as patients undergo orthodontic therapy.

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Pit and Fissure Caries

Detecting early pit and fissure caries is challenging especially in newly erupted permanent teeth. Radiographic imaging is of minimal diagnostic value because of the large amounts of surrounding enamel.^{43,44} Studies have suggested that dental X-Rays have little value in the detection of occlusal surface caries, and that dental explorers are inefficient for the diagnosis of occlusal caries.^{45,46,47,48,49} Pit and fissure caries may appear as brown stained grooves or in this situation no stain at all. Our patient was in for a routine re-care examination and we decided to scan the occlusal pits and fissures. This patient had opted not to have radiographs taken on an annual basis.

The patient had very few restorations and very good oral hygiene – two strong indicators of a lower risk for developing caries. The Canary Number on scanning the mesial pit of the mandibular left second premolar was 85 indicating the presence of a large area of caries. Upon opening the pit we found caries that extended well into dentin.

Treating caries demands the use of a highly accurate sensitive repeatable device that measures the status of the tooth structure. It should not measure bacterial by-products or porphyrins since they are not linked directly to the changes in the caries lesion. The Canary System has the ability to detect and monitor changes in the tooth's crystal structure allowing oral health

providers to set up a caries management program that involves both preventive and restorative treatment. Ongoing accurate measurements allow the oral health team to monitor the progress of various preventive therapies and when necessary change the treatment regime or initiate restorative care.

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. DTW

*References can be obtained on request.

About the author



Dr. 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 practice in Toronto Canada which has grown to involve general dentists and dental specialists. Dr. Abrams is the founder of Four Cell Consulting, Toronto Ontario, Canada, which provides consulting services to dental companies in the area of new product development and promotions. Dr. Abrams founded Quantum Dental Technologies, a company developing laser based technology for the early detection and ongoing monitoring of dental caries. He is a fellow of the Pierre Fauchard Academy and the Academy of Dentistry International, American College of Dentistry, a member of the Canadian Academy of Esthetic Dentistry, International Academy of Dento-Facial Esthetics, European Association for Caries Research and International Association of Dental Research. He has published over 90 articles in various international publications on topics ranging from early caries detection, prevention, removable prosthetics and restorative dentistry. He has developed the "Triple Laminate Technique for utilizing soft tissue undercuts when fabricating complete and partial dentures. 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 Corporations, a dental and pharmacy claims management company. He can be contacted at (416)-265-1400 or e mail; dr.abrams4cell@sympatico.ca

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