

Integrating 21st Century Caries Detection into your Clinical Practice

Dental caries is one of the major diseases that we treat in our clinical practices on a daily basis. It is one of the two major diseases that is the focus of our preventive appointments and our patients do expect an update on the health of their “teeth and gums” at each visit. But techniques for caries detection have not changed radically over the last 60 years, since the advent of X-ray imaging. Detection of caries depended upon locating mineral loss on bite wing radiographs, examining stain and discoloured areas on the tooth surface or probing lesions with a sharp explorer. These techniques were and still are considered the gold standards even as the treatment of the disease has evolved.

Radiographs and visual examination do have many limitations. Detecting early pit and fissure caries is challenging. Radiographic imaging is of minimal diagnostic value because of the large amounts of surrounding enamel.^{1,2} Studies³⁻⁵ 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.^{6,7} Radiographs do perform well in detecting carious lesions in interproximal areas, especially if the area of decay is at least halfway through the enamel or into dentin. But in terms of early lesion detection, radiographs are not able to detect small lesions in the order of 50-500 μ (microns) in the interproximal areas, which could remineralize or re-crystallize if detected early and suitable preventive measures instituted.⁸ An extensive review of the literature by Doveix found that “overall the strength of the evidence for radiographic methods for the detection of dental caries is poor for all types of lesions on proximal and occlusal surfaces.” He further

stated that “it is beneficial only if the intervention is the surgical removal of tooth structure and detrimental if it is used for non-invasive remineralization methods”. Radiographs and visual examination are valid diagnostic tools for the detection of larger lesions; however, there is a need for more sensitive methods especially if one wants to practice minimal intervention dentistry or to attempt remineralization of carious lesions.

A common clinical situation is the detection and ongoing monitoring of a white spot lesion. In the example in Figure 1, this lesion appears to have an intact surface. With polarized light microscopy (PLM) the lesion is at least 500 microns in depth and located just below the surface. This lesion is not visible on radiograph or picked up by DIAGNO-Dent™. So, how do you detect this lesion? How do you monitor this lesion and how do you engage your patient to take care of this lesion and others that may be present?

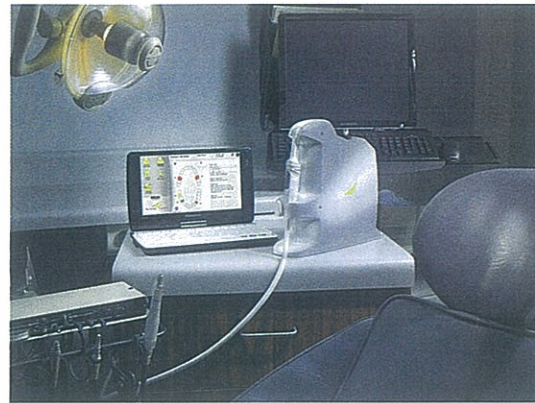
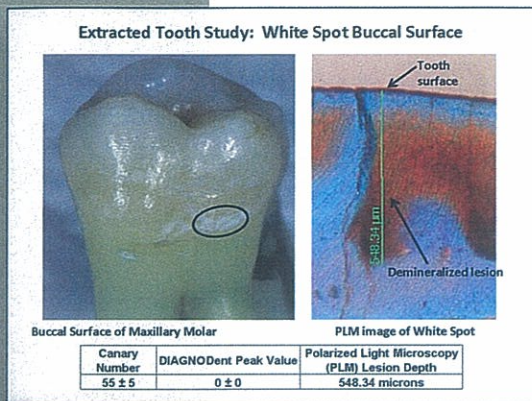
One approach is to employ detection methods that allow the oral health provider to measure changes in the crystal structure of these early lesions and then tailor a therapy regimen to the lesion size as well as the overall risk of developing additional carious lesions. The Canary System directly assesses the status of the enamel crystal by using PTR-LUM – an energy conversion technology. Pulses of laser light are shone on the tooth and the laser light is converted to heat (Photothermal Radiometry or PTR) and light (luminescence or LUM) which are emitted from the tooth surface when the laser is off. The Canary System is the only device that is able to detect changes in the crystal structure of enamel, which is far superior in assisting the dental professional in diagnos-



Stephen Abrams, DDS

Is a general dental practitioner with over 30 years of clinical experience. 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 is currently available in Canada and Europe.

Figure 1. Examining white spots.
Figure 2. The Canary System.



ing tooth decay versus tools that identify lesions by using fluorescence to detect the presence of bacterial by-products.

These harmless pulses of laser light allow a clinician to examine sub-surface caries up to 5 mm. Carious 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 (dental caries) and PTR increases 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 is so sensitive it detects very small changes in temperature (less than 1-2 degrees Celsius), much less than that generated by a conventional dental curing light and imperceptible to the patient.

The Canary Number (ranging from 0-100) is created from an algorithm combining the PTR and LUM readings and is directly linked to the status of the enamel or root surface crystal structure. A Canary Number of less than 20 indicates a healthy tooth surface. A Canary Number greater than 70 indicates a large lesion that may justify restoration. Canary Numbers falling between 20 and 70 indicate the presence of an early carious lesion that doesn't require a restoration but can be remineralized. The treatment decisions are based upon the type of remineralization treatment, position of the lesion, and overall risk of developing caries including oral hygiene. What the Canary System provides is a repeatable and reliable measurement of the lesion that is linked to the status of the crys-

tal structure.

So, how does one integrate this new technology into clinical practice? First step is to look at your practice and examine the work flow with your patients. The Canary System can be integrated in at least three ways:

- As part of the new patient exam
- As part of the preventive recare examination
- As part of a prevention program to detect, monitor, and document demineralization and remineralization

One could use The Canary System as a diagnostic tool during a new patient exam. The Canary can be used to scan a number of suspected areas including around the margins of restorations, occlusal pits and fissures, smooth surfaces and interproximal areas. The information is stored on the Canary Cloud and the patient is given a report or can access their information on-line following the appointment. It is an easy way to engage and help patients understand their oral healthcare.

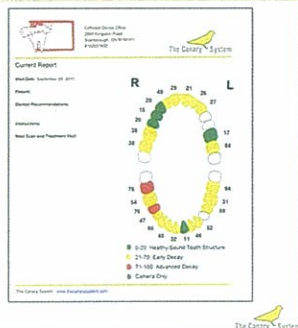
The Canary System can be used during the recall appointment to scan a few selected teeth. If caries are found that require restoration, one then arranges for further treatment. If there are white spots, brown spots and other areas of demineralization, a Canary Scan can be performed on only a few areas. The patient can then return for either a more complete examination or begin a customized remineralization program using the initial Canary Scan numbers as bench marks to measure and monitor the outcomes of the remineralization therapy.

If a practice were going to have the patient involved in a remineralization program, it could begin the program right at the recall

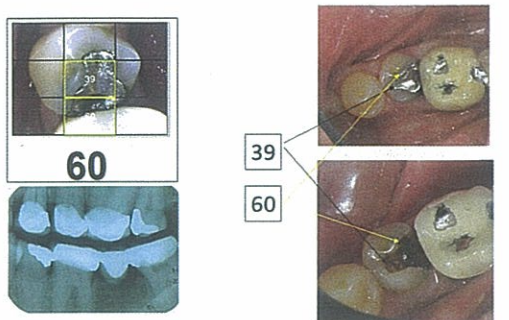
Figures 3 and 4

Canary Patient Report

- Customized patient report on dental practice letterhead
- Clear simple indication of problem areas
- Patient can track their progress
- Engages patient in their oral health care



Case Study: Caries Beneath an Amalgam



visit by applying an in-office therapy and dispensing home-based products. The application of fluoride varnish should take less than two minutes. If there are large areas of demineralization, they could arrange to have the patient back for a 30 minute visit where they could scan a number of teeth and then apply the remineralization therapy.

During the remineralization program, the follow-up visit can be as short as 15 minutes in order to scan selected teeth and apply in-office therapy such as fluoride varnish.

CLINICAL EXAMPLES

Detection of caries around the margins of restorations during a recall examination

The case study (Fig. 4) on the right are the results from Canary Scans around the margins of a mandibular right second bicuspid at a re-care appointment. The scan involved two measurements, a total of 10 seconds for both areas and set up time of four minutes. The Canary Number of 60 on the mesial marginal ridge as well as the Canary Number of 39 on the buccal cusp indicated caries and microleakage around the amalgam. This patient previously resisted replacing a number of old restorations. The Canary Scan allowed the hygienist to locate the caries on this tooth (not seen on bitewing radiographs) and one other tooth. The patient reviewed the Canary Scan and booked for both restorative procedures. An additional six minutes of recall appointment time resulted in detecting caries around existing restorations before caries had destroyed more tooth structure possibly resulting in endodontic treatment or loss of the buccal cusp.

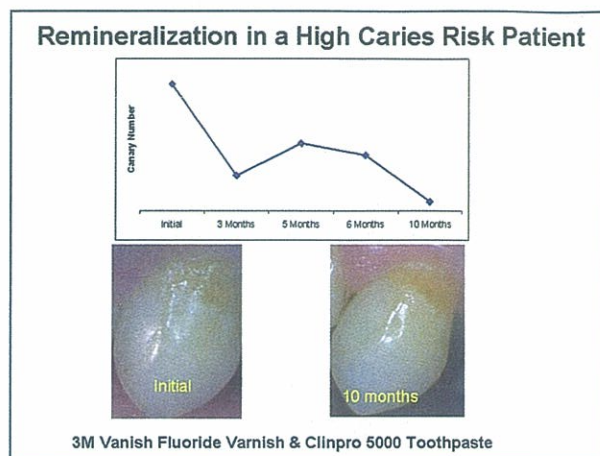
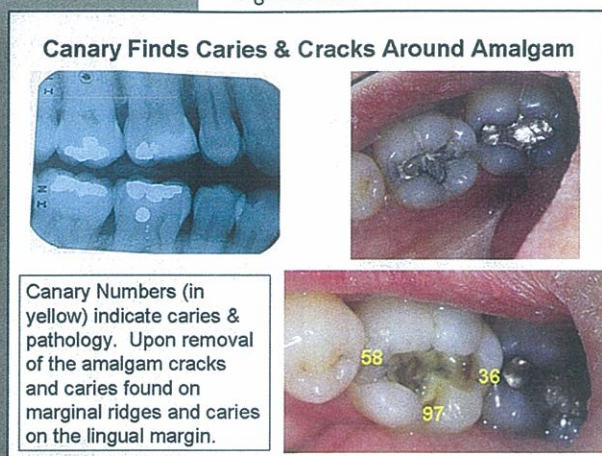
Detection of cracks and caries during an emergency examination

In this situation (Fig. 5), the patient came into the dental clinic, in pain. The clinic's usual detection tools, visual exam and radiographs, did not reveal any evidence of pathology. The dental professional performed a quick Canary Scan resulting in Canary Numbers of 58 and 36 on the mesial and distal marginal ridges, respectively. The Canary Number of 97 on the lingual margin of the amalgam indicated both microleakage and a large carious lesion. Upon removal of the amalgam, the dentist was able to visualize the cracks on the marginal ridges as well as the large carious lesion on the lingual wall of the amalgam. The Canary System located the problem quickly (which was not seen on a bitewing radiograph) and identified that the problem stemmed from the first molar and not the second molar.

Building a remineralization/prevention program

Oral health care providers have been searching for detection tools that can help monitor and document the progress of remineralization and preventive therapies. Over the years, they have tried a number of toothpastes, antimicrobial varnishes, fluoride containing products etc. to see if they could prevent caries or remineralize early lesions. They would dispense these products and then try to monitor the outcomes over time. They found that using visual exam or even radiographs could not provide them with any reliable or accurate measure of the success of the therapy. Clinicians found that patients who invested in these therapies became very frustrated when they discovered a few years later that

Figures 5 and 6



caries had developed and the therapy had been ineffective and/or there had been poor patient compliance.

The Canary System provides clinicians and patients with the ongoing feedback on the progress of the remineralization therapy. Figure 6 shows an example of how The Canary System was used in the detection, monitoring and documentation of the progress of a high caries risk patient receiving remineralization therapy. A tooth was initially assessed with The Canary System, which indicated decay that may possibly be remineralized. The clinician involved the patient in a remineralization treatment plan, which consisted of in-office application of fluoride varnish and at-home use of fluoride toothpaste. The Canary Numbers decreased over a period of ten months, indicating success of the remineralization therapy. If there is poor compliance or the therapy is not working, The Canary Numbers will not decrease. At that point in time, either the clinicians change the therapy, change patient habits or change the frequency of the visits. The patient report engages patients in their care and helps them monitor their progress.

Professional Fees

At the present time in Canada, depending upon the province, fees do exist for application of remineralization therapies, recall examinations or specific examinations and other diagnostic tests. It is up to the clinical practice to decide how or if they will bill for these services. Some of our offices in Ontario charge \$120 fee for an initial 30 minute Canary scanning examination (USCLS code 01204) and initial application of an in-office remineralization treatment (usually fluoride

varnish). During this examination, the hygiene team would identify and scan teeth with white or brown spots (Canary Numbers >20) that require remineralization. Repeat remineralization visits require 15 minutes to scan those areas in question and apply fluoride varnish. The USCLS code is 13601 - 13609. They could bill \$48.00 for the application of the varnish and provide the scanning during this visit. This service can be provided by either a hygienist or dental assistant, depending upon the professional regulations for a particular jurisdiction. So in addition to allowing the oral healthcare worker to provide superior patient care, an investment in The Canary System has a very quick financial payback.

Office Integration

Embracing new technology is both challenging and exciting. It demands that the clinical team understand the technology, educate the patients and find a method to integrate the technology into clinical practice in a cost-effective manner. The Canary System is designed to allow a clinical practice to enhance their traditional caries detection and treatment programs by finding lesions not seen with conventional methods. It also allows the practice to build a remineralization / preventive program where The Canary System can monitor changes in the lesion development. The Canary System engages patients in their care and extends the options for the treatment of dental caries. From remineralization to restoration, The Canary System can detect and monitor treatment. ■

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.

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