Update on detection and management of caries

■ Ability to detect caries beneath sealants and around the margins of composite restorations among benefits of system reported during the annual scientific sessions of the International Association for Dental Research in Iguaçu Falls, Brazil

At the IADR (International Association for Dental Research) in June 2012, new research findings were presented on The Canary System's ability to detect caries beneath sealants and around the margins of composite restorations.

The sealant study involved examining 28 extracted human molars and premolars which contained 103 potential healthy and carious pits/fissures on their occlusal surfaces, as determined by ICDAS II (visual scoring criteria). After scanning marked pits/fissures with The Canary System and DIAGNODent, teeth were sealed with 3M™ ESPE™ Clinpro™ sealant. Following sealant placement, teeth were re-scanned at the same sites with The Canary System and DIAGNODent. Using polarized light microscopy (PLM), the sites were scored as 'carious' or 'non-carious'. With PLM as the gold standard, sensitivities/specificities before sealant placement were:

The Canary System (0.92/0.70);
DIAGNOdent (0.41/1.0); and
ICDAS II (0.77/0.90).

After sealant placement, the fissures were scanned and sensitivity/specificities were:

The Canary System (0.83/0.79); and
DIAGNODent (0.64/0.46).

The investigators concluded that The Canary System could "see through" sealants and detect caries at least 83% of the time, which was much better than visual examination or DIAGNODent. Canary readings greater than 20 indicated the presence of a carious lesion beneath the sealant.

The second study involved detecting caries around the margins of composite restorations. Five extracted molars with large carious lesions were selected. Caries was removed from the tooth leaving a small area of caries 1 mm below the surface of the tooth. A condensable composite restoration was bonded into place and 74 areas along margins of the five restored teeth were scanned. The Canary was able to detect the lesions in all of the areas scanned.

This study was able to validate the findings from our case studies that The Canary System was able to detect caries along the margins of composite and amalgam restorationsii. Restoring caries around restorations is one of the most common reasons for the replacement of fillings. Being able to find secondary caries early means one can repair rather than replace restorations. The Canary System is the only tool available now to dentists to detect caries around all visible margins of restorations.

The Canary System directly assesses the status of the tooth by using PTR-LUM 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 measures four signals:

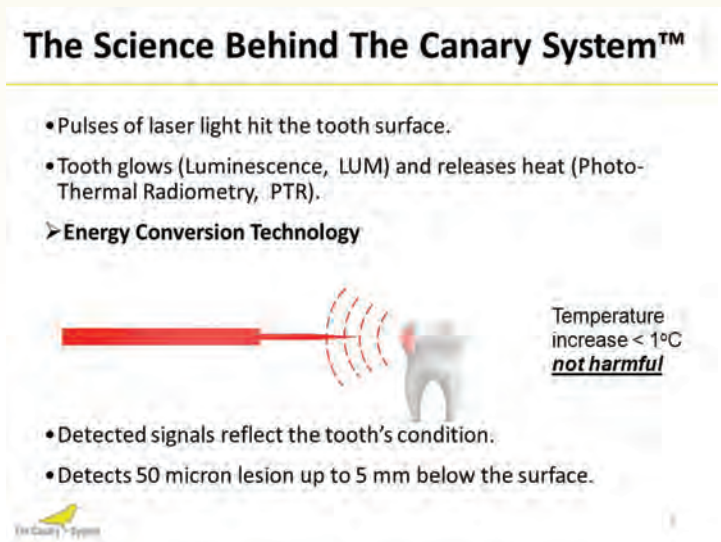
1. The strength or amplitude of the converted heat or PTR signal;

2. The time delay or phase of the converted heat or PTR to reach the surface;

3. The strength or amplitude of the emitted luminescence (LUM); and

4. The time delay or phase of the emitted luminescence (LUM).

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 tooth structure. The system is so sensitive it detects very small changes in temperature (less than 1 to 2 degrees Celsius), much less than that generated by a conventional dental curing light and imperceptible to the patient.



REPEATABLE MEASUREMENT

The Canary Number is created from an algorithm combining these four signals and is directly linked to the status of the enamel or root surface crystal structure, not from measuring the level of fluorescence from bacteria or bacterial by-products.

The Canary Number ranges from 1 to 100 with lower numbers (under 20) indicating healthy tooth surface. Shifts in The Canary Number indicate changes within the crystal structure of the tooth. Using this simple numbering system allows the clinician to communicate with their patients and easily explain the evolution or changes in caries lesions (Fig. 4). It also allows patients and clinicians to track progress of remineralization of early lesions and the outcomes of various preventive measures.

Research has demonstrated that PTR-LUM technology used in The Canary System can detect:

- Occlusal pit and fissure caries[iii,iv,v]
- Smooth surface caries[vi,vii]
- Acid erosion lesions[viii ix]
- Root caries[x, xi]
- Interproximal carious lesions[xii,xiii]
- Demineralization and remineralization of early carious lesions[xiv,xv,xvi xvii]

PTR-LUM technology enables clinicians to detect small early lesions in the order of 50 microns and in depth up to 5 mm below the tooth surface, even in the interproximal regions of teethxviii. It provides a repeatable measurement that is linked to the status of the enamel or root surface under examination.

The Canary System has been studied in two Health Canada approved investigational trials. The first trial[xix,xx] involved 50 patients and confirmed the safety of the system along with the ability to detect carious lesions and white or brown spots on both wet or dry tooth surfaces and the ability to detect lesions on tooth surfaces with moderate stain. Patients in this first clinical trial, which was completed in early 2010, have continued to be seen in clinical practice with no adverse events associated with this trial or the use of The Canary System.

The second clinical trial finished enrolment in May 2011. The trial involved 98 patients seen at four trial sites over a nine-month period. This trial again confirmed the safety of The

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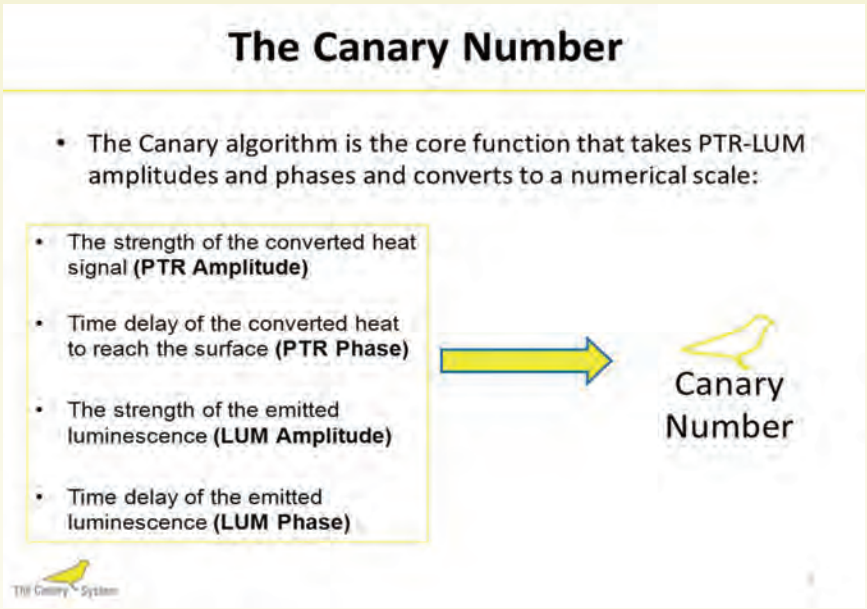

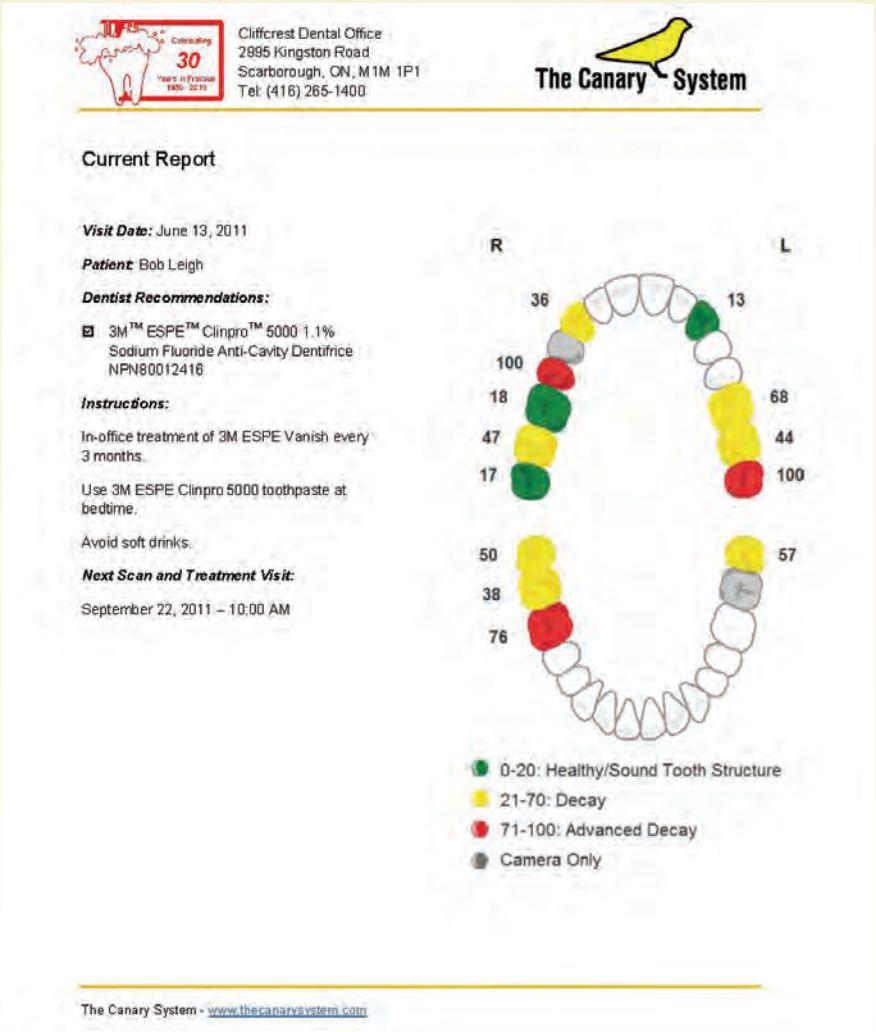

Canary System. Preliminary analysis showed excellent correlation with ICDAS (a visual ranking system). Efficacy in the context of this trial is considered the ability of the investigational device to detect dental caries. The secondary objectives of this study were to develop a treatment scale that correlates to lesion size, explore the ability of the investigational device to detect caries and erosion lesions, and monitor changes in lesion size in response to various therapies.[xxi xxii]

CARIES DETECTION IN CLINICAL PRACTICE

Dental caries is a disease that involves the breakdown of tooth structure by exposure to acids produced by bacteria. Caries detection and monitoring involves looking for changes in structure of the tooth surface—changes in the crystal structure of the enamel and root surface, which would indicate disease progression. The Canary System is linked to changes in crystal structure and can be used to assist in the diagnosis of caries in clinical practice. As with all detection systems, the final step in the process is how we, as trained professionals, interpret the results. Diagnosis of caries involves using the results obtained from these systems and integrating this with our knowledge of the dental history of our patients.

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