THE DENTAL ADVISOR™

Improving Patient Care Through Research & Education

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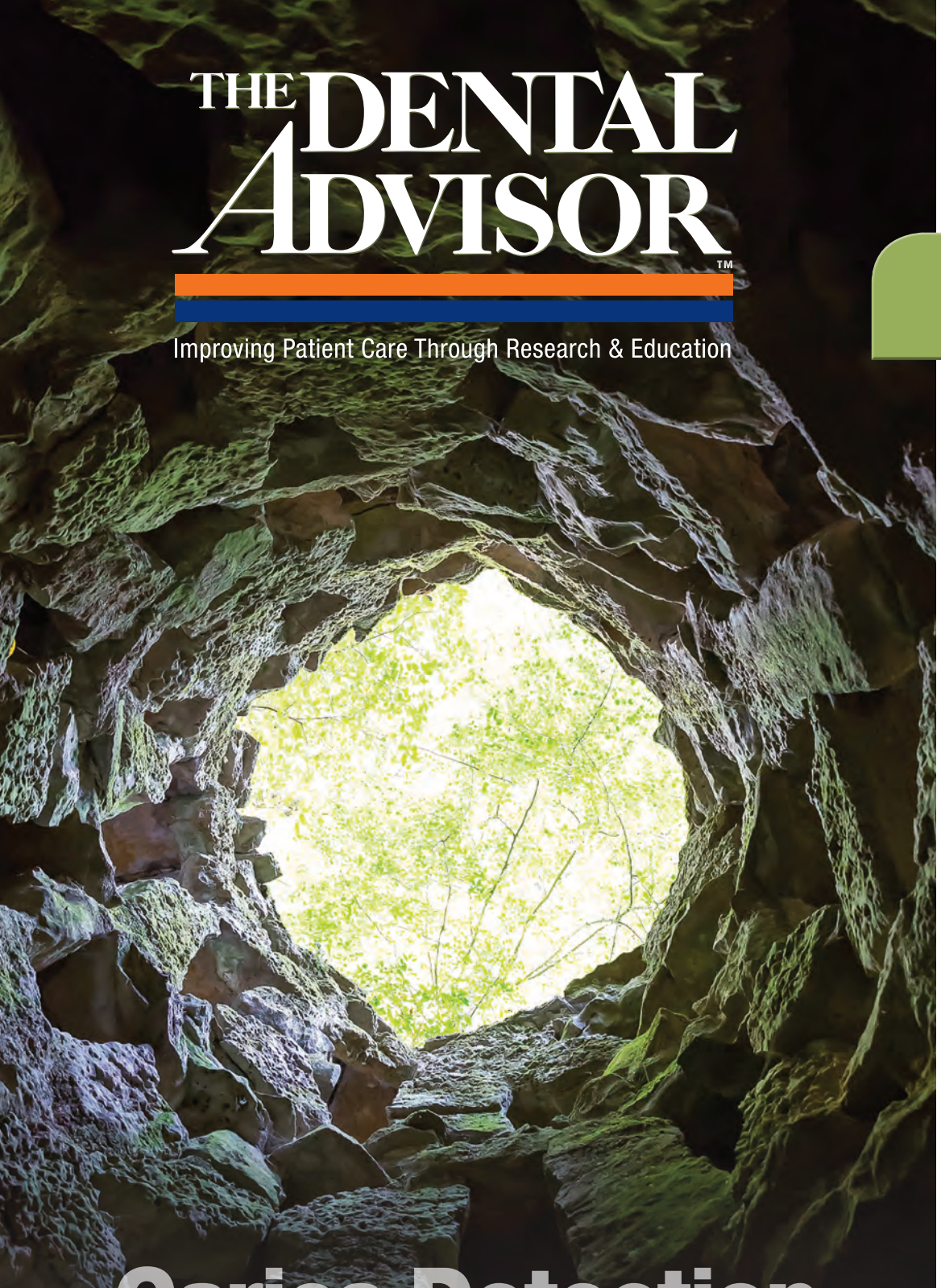

Caries Detection & Assessment

Alongside a clear need for accurate and early caries detection, there is a continuing trend towards minimally invasive dentistry. Being able to accurately assess the depth of a caries lesion, and whether or not the caries lesion is active, is key for determining what preventive care or treatment is necessary to meet specific patient's needs.

Early caries lesions are reversible and remineralization can be promoted through the use of preventive products. In addition, the ability to monitor progression, arrestment or reversal of caries over time allows assessment of the efficacy of individualized professional and home care therapies, and whether further future treatment may be necessary. This issue of THE DENTAL ADVISOR reviews the characteristics and properties of adjunctive caries detection devices.

MAIN TOPIC

Caries Detection & Assessment 2

CLINICAL EVALUATIONS

Qualitouch Blue Nitrile Left/Right Fitted Gloves 9

HemoCell Topical Hemostatic Gauze Dressing 10

EDITORS' CHOICE

Admira Fusion (Nano-hybrid Direct Restorative) 11

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RATINGS:

Excellent	+ + + + +
Very Good	+ + + +
Good	+ + +

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Please send inquiries and address changes to:
THE DENTAL ADVISOR,
3110 West Liberty, Ann Arbor, MI 48103
Call: 800.347.1330 - 734.665.2020
Fax: 734.665.1648
Email: info@dentaladvisor.com
Website: www.dentaladvisor.com

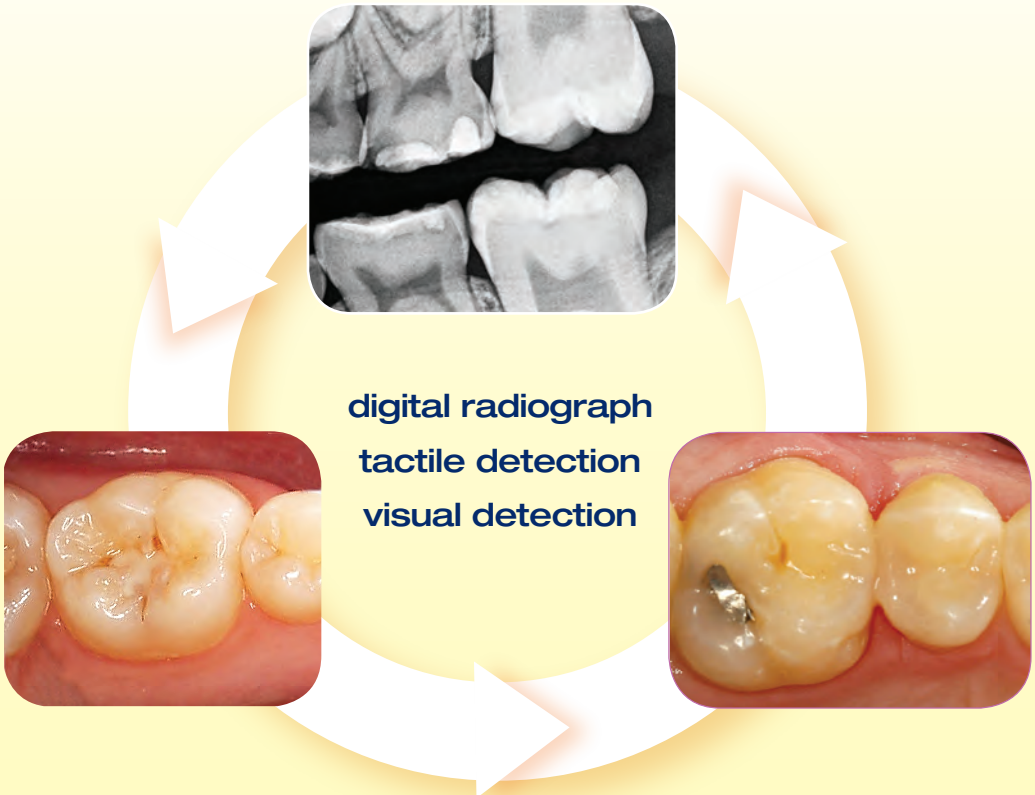
From the Desk of
Dr. Bunek, Editor-in-Chief

As dental practitioners, we have the challenge of identifying and diagnosing dental caries with consistency and accuracy. Standard methods utilizing radiographs, visual and tactile detection are limiting; often requiring removal and treatment of caries by the time they are detected. I myself have come to a point in practice where I am transitioning from putting out fires, to early diagnosis/prevention and practicing minimally invasive dentistry. Can the new caries detection devices serve as a significant aid for dentists like me in providing these services?

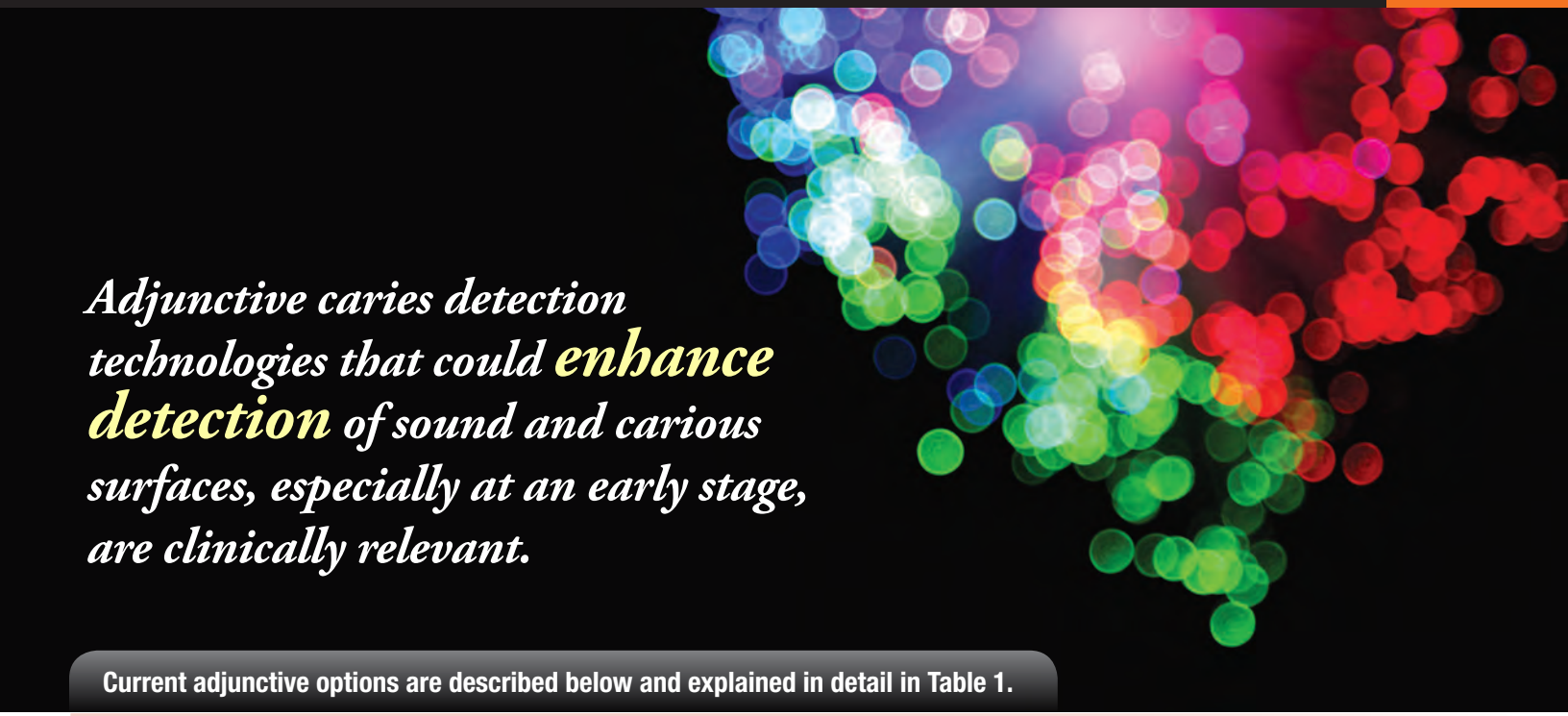
In this month's issue, our guest author, Dr. Fiona Collins, will discuss the current caries technologies and their roles in the practice of minimally invasive dentistry. She will describe individual devices and software applications and provide insight into which methods and technologies may work best as an adjunct in your practice. Dr. Collins is a published author and speaker on a variety of topics, including caries prevention and management. She is working with us on a variety of projects here at THE DENTAL ADVISOR and we welcome her expertise! As always, I welcome your comments and suggestions; you can reach me at drbunek@dentaladvisor.com.

—Sabiha S. Bunek

Standard caries detection methods



Caries detection and assessment by visual and tactile means, together with bitewing radiography, are still considered standard. Visual means have been found to be accurate in detecting sound surfaces, and in general less accurate in detecting early caries lesions. In addition, it is more difficult to detect early lesions on standard bitewing radiographs, and early occlusal caries is especially difficult to detect. Given that initial lesions in the permanent dentition in young patients are typically on the occlusal surface, the ability to detect these clinically is particularly relevant. It has also become more challenging to determine early caries on occlusal surfaces using standard methods due to changes in the appearance of some occlusal caries lesions. In these 'questionable occlusal caries' lesions, the surface is visually suspect but no evidence of caries is observed on radiographs.



*Adjunctive caries detection technologies that could **enhance detection** of sound and carious surfaces, especially at an early stage, are clinically relevant.*

Current adjunctive options are described below and explained in detail in Table 1.

Radiographs rely on density differences between sound and demineralized tooth structure. With digital radiographs, the image can be magnified for viewing and use of a software package ***(Logicon)*** aids caries detection by providing higher sensitivity and specificity, and assessment of the depth of lesions.

Fluorescence technologies rely on quantification of loss of fluorescence as a result of demineralization, or on increased fluorescence associated with carious enamel/dentin, bacteria, and bacterial porphyrins ***(DIAGNOdent pen, Cam-X-Spectra, SoproLIFE/SoproCARE, Midwest Caries ID).***

Transillumination relies on light scattering and greater absorption in demineralized tissue, resulting in a visibly darker appearance ***(DIAGNOcam and CariVu).***

Photothermal Radiometry and **Light Luminescence** ***(Canary System)*** delivers pulsed laser light that once delivered to the tooth results in heat measured by photothermal radiometry and luminescence; heat signals increase as lesions are larger, and luminescence decreases.

Table 1. Adjunctive technologies used for occlusal and proximal caries detection.

Adjunctive Method	Device	Manufacturer	Type of Technology	Detectable Surfaces
Logicon	BW software program	Carestream Dental	Computer-aided diagnosis, highlighting caries lesions on radiographs	Proximal
Fluorescence				
	Cam-X Spectra	Air Techniques	405 nm blue-violet light	Accessible surfaces
	DIAGNOdent pen	KaVo	Red light at 655 nm	Accessible surfaces
	Midwest caries ID	DENTSPLY Professional	635 nm and 880 nm red-infrared light	Accessible surfaces Non-stained enamel caries.
	SoproLIFE/ SoproCARE	Acteon	Diagnostic mode: blue light at 450 nm	Accessible surfaces
Transillumination				
	CariVu	DEXIS	Near infra-red light surfaces	Proximal, occlusal
	DIAGNOcam	KaVo	Infra-red at 780 nm	Proximal, occlusal
Photothermal Radiometry and Light Luminescence	Canary System	Quantum Dental Technologies	Pulsed laser light delivered, absorbed and converted into heat and luminescence	All surfaces, all lesions up to a depth of 5 mm

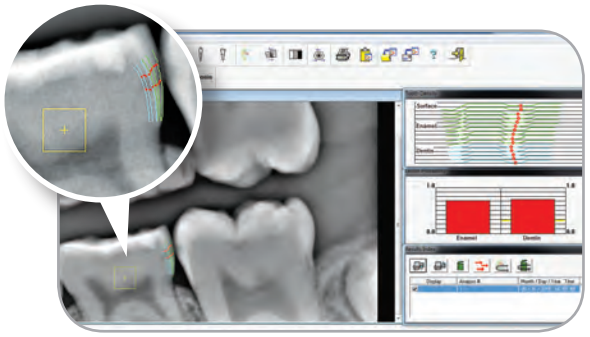
Interpreting data output

Results are delivered to clinicians in various formats. As caries detection methods have evolved from visual to light detection, numerical readout and computer software assist the user in assessing severity of caries.

Table 2. Reporting of Results

Device	Manufacturer	Display of Data	Archiving
Cam-X Spectra	Air Techniques	Visual on screen, numerical values from 0 to 4 reflecting level of porphyrins.	Yes
Canary System	Quantum Dental Technologies	Visual on screen, canary number 0 to 100, optional printed reports for patients	Yes
DIAGNOcam (DIFOTI)	KaVo	Visual on screen	Yes
CariVu	DEXIS	Visual on screen	Yes
DIAGNOdent pen	KaVo	Numerical value (0 to 100), optional audible tone,	
Logicon	Carestream Dental	Computer screen, carious areas marked. Magnification.	Yes
Midwest caries ID	DENTSPLY Professional	Visual on screen, progressive audible beeping	No
SoproLIFE/SoproCARE	Acteon	Visual on screen, color coding, magnification, intra-oral images	Yes

Examples of adjunctive caries detection devices



Note analysis of proximal caries, in primary molar: green (enamel) and blue (dentin). Software indicates changes in tooth structure density.

Logicon
(Carestream Dental)

Logicon is a computer software package that uses logarithms to indicate carious lesions, including those in enamel only. The programs gives a visual indication of the depth and presence of enamel caries and dentinal caries. Images

Photo courtesy of Acteon

SoproLIFE/SoproCARE
(Acteon)

SoproLIFE in caries mode and ***SoproCARE*** provide visual images. In 'daylight mode,' a white LED light produces an intra-oral image. In 'diagnostic mode,' a fluorescence score and image are produced with green indicating sound tooth structure and red representing caries. Images are archived.

The Canary System (Quantum Dental Technologies)

With the ***Canary System***, photothermal radiometry and light luminescence signals are converted into a Canary Number indicating the depth of the lesion. This technology also detects caries under sealants and restorations. Images are archived.

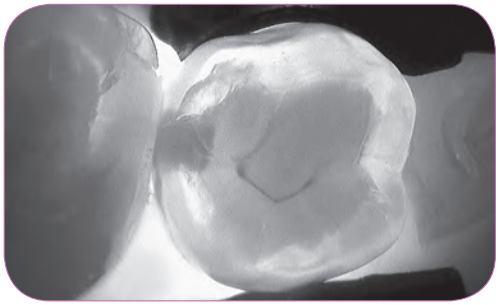


Photo courtesy of KaVo

DIAGNOcam (KaVo)

DIAGNOcam uses transillumination. Since more light is scattered and absorbed in demineralized areas, the result is that areas of demineralization are darker on the image than sound tooth structure. Images are archived. This technology can also be used to detect cracks.

Determining clinical efficacy

- ***Sensitivity*** *represents the likelihood of a device accurately identifying caries, without false negatives.*
- ***Specificity*** *represents the likelihood of a device accurately identifying sound tooth structure, without false positives.*

Caries Detection with Traditional Radiographs

	Sensitivity	Specificity
Occlusal surface		
Enamel caries only	30%	76%
Dentinal caries	53%	83%
Proximal surface		
Enamel caries only	41%	78%
Dentinal caries	38%	95%

Source: Bader et al. J Dent Educ. 2001;65(10):960-8.

The more specific and sensitive a device is the less likely it is that a surface will be identified incorrectly as sound or carious, resulting in potential under- or over-treatment. Looking beyond this, given that enamel caries is less likely than dentinal caries to be detected by traditional methods, it's important that adjunctive devices have the potential to detect early and accurately. Therefore, a device should have high specificity and sensitivity in enamel caries detection on occlusal and proximal surfaces.

Sources of false positives

Some adjunctive caries detection devices are sensitive to clinical conditions. Staining, plaque, calculus, mineralization defects, moisture, adjacent restorations or sealants, and use of a prophy paste containing blue dye can variously result in false positives depending on which device is being used. It is important to be aware of this and to ***make sure the clinical site is free of sources of interference.*** In the case of restorations or sealants, be aware that detection at that site may be inaccurate if using certain technology.

Is adjunctive caries detection technology worth the investment?

This technology is useful as a patient education tool; however, in order to be of value, it needs to detect caries more accurately and reliably than standard techniques (especially for early lesions), and have the ability to determine if the caries lesion is active or arrested. You may also want to consider how well your office adapts to new technology/learning curves before deciding to purchase a device.

Caries detection devices: factors to consider

- High level of specificity, sensitivity and overall accuracy for early and advanced lesions
- Specificity, sensitivity and overall accuracy higher than traditional methods when measured against benchmarks
- Type of surface that can be assessed
- Ability to detect caries adjacent to and under restorations and sealants
- Determination of caries activity
- Objectivity, no subjective interpretation required
- Caries assessment within preparations
- Technology not sensitive to clinical conditions
- Ability to archive results and track over time
- Visualization of results and intra-oral images for patient education
- Ease-of-use and user-friendly display of results
- Company support and training

International Caries Detection and Assessment System

There are several methods to perform visual and tactile caries detection and assessment. Originally, a mirror and sharp explorer were used, with the sharp explorer used to investigate 'sticky pits and fissures.' Using an explorer in this manner can cause iatrogenic damage. More recently, caries detection and assessment systems have been suggested. The International Caries Detection and Assessment System (ICDAS) is the result of a collaborative international initiative.

ICDAS offers a methodology for the visual and tactile assessment of caries lesions for both occlusal and smooth surface caries. It also includes guidance on the clinical assessment of caries activity. ICDAS recommends tactile assessment *without* using the sharp end of an explorer. On smooth surfaces, tactile assessment will detect rough vs. smooth surfaces to help assess caries activity. The diagram below shows the stages of occlusal caries on clinical images and the definition of the corresponding score can be found in the table. In order to be adept at this system, training is required. The accuracy of this system has been validated through comparisons of visual assessments of carious teeth and histology sections of the same teeth, and found to be accurate for early and advanced caries detection.

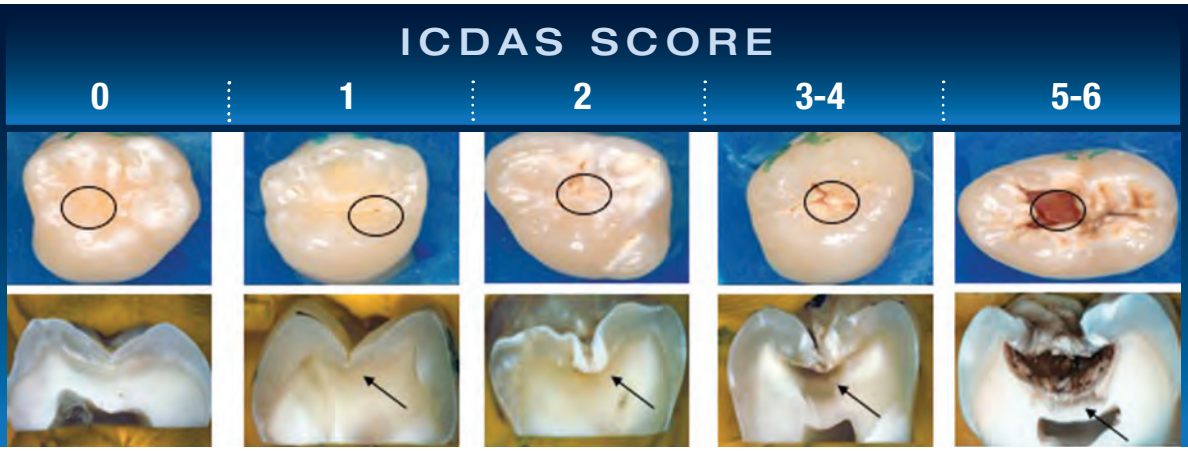


Diagram courtesy of Dr. Andrea Zandona

Code Definition (description of tooth status)

0-Sound tooth surface
1-First visual change in enamel
2-Distinct visual change in enamel
3-Localized enamel breakdown due to caries with no visible dentin
4-Underlying dark shadow from dentin (with or without enamel breakdown)
5-Distinct cavity with visible dentin
6-Extensive distinct cavity with visible dentin

Looking Ahead

The ***Calcivis***® Caries Activity Imaging System is a promising new technology that detects caries activity by measuring the level of calcium ions at the tooth surface. It combines a sensitive intraoral camera and precise delivery of a disclosing solution, containing a photoprotein, onto the tooth surface. When the photoprotein binds calcium ions, a blue light signal is emitted that is proportional to the amount of calcium present. This chemiluminescence is then interpreted by the software to produce a 'demineralization' map of the tooth that is based on caries lesion activity, differentiating it from technologies that do measure the presence of lesions but not caries activity. Research and clinical trials have been conducted prior to submission for clearance in 2017. Another new product is based on ultrasound technology. The ***ClearView SCAN*** from S-ray is used with the complementary ClearView CARIES software that enables diagnostic interpretation of the scan for the detection of caries lesions. This product is currently in development.

Caries detection and determining the extent of caries lesions and activity continues to be challenging. More recently introduced adjunctive technologies can be used adjacent to restorations and sealants, and detect lesions under either or both of these. New technologies continue to be developed.

ABOUT THE AUTHOR

Fiona M. Collins, BDS, MBA, MA

Dr. Collins is a published author and speaker on infection control, the caries prevention and management of erosion, sensitivity, biofilm, tobacco cessation, and materials. She has presented in North America, Europe, the Pacific Rim and the Middle East, and as a faculty member at OSAP Boot Camps. Fiona is a consultant for THE DENTAL ADVISOR, CE editor for Dental Learning and editor for Dental World. Dr. Collins is a member of the American Dental Association, the American Association of Dental Research, the Chicago Dental Society, and the Organization for Safety, Asepsis and Prevention (OSAP). She is the ADA representative to AAMI, a member of ADA Standards working groups and a Fellow of the Pierre Fauchard Academy. Dr. Collins graduated as a general dentist from the University of Glasgow in Scotland, and holds an MBA and an MA from Boston University.