

# TECHNOLOGY

## INTEGRATION

*The why, the how, and the now.*

### Digital Caries Detection

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One of the more popular phrases in dentistry today is *minimally invasive dentistry*. It is a very appealing concept and a desirable method of performing restorative dental procedures. However, for dentists to perform minimally invasive restorative procedures, dental caries must be diagnosed at its earliest stages of development. What used to be the standard for caries detection—x-ray film and an explorer—is no longer acceptable, considering the advanced dental technology available today. In fact, in an interview with the authors, Dr. Paul Vankevich, assistant professor of oral diagnosis/oral medicine at Tufts University of Dental Medicine, asserted that the aggressive use of a dental explorer can "create cavitation where cavitation does not exist" through the passive transfer of *streptococcus mutans* bacteria from site to site and the forceful transfer of caries and caries-causing bacteria from enamel to dentin. This article will discuss digital dental technologies that not only enhance dentists' ability to diagnose dental caries at its earliest stages, but also elevate our credibility with patients. Credibility is important for dentists with newer practices, and the use of this technology may increase overall patient confidence. At the same time, experienced dentists can use this technology to increase or establish confidence from their patients. For many dental professionals, digital dental technologies have come to be accepted as the standard of care for our patients. This standard of care promotes the performance of minimally invasive dentistry, which is, according to Dr. Vankevich, "inoculation and remineralization versus surgical intervention."

#### CARIES DETECTION TECHNOLOGY

An increasing number of dental professionals are choosing to use digital radiography over conventional x-ray film as a tool in diagnosing dental caries.<sup>1</sup> For years, x-ray film was instrumental in the thorough examination of possible lesions. It was the only tool available. However, digital radiography has proven to be superior to film in diagnosing even the smallest carious lesions because of its ability to enlarge, enhance, contrast, and even colorize an x-ray image through advanced imaging software.<sup>2</sup> Simply stated, there is no comparison between a 1-inch X 1.5-inch film on a light box vs a digital image enlarged to the size of a computer screen. Early

stages of decay are more visible through an enlarged digital radiograph, allowing for earlier detection and minimally invasive dental treatment. There are two types of digital radiography: direct and indirect. Indirect digital radiography uses phosphor plates (Figure 1) that acquire a radiographic image. These plates must then be processed through a scanning device (Figure 2A and Figure 2B), and the digital radiographic image is transferred to the computer screen. Direct digital radiology uses sensor technology. The sensor captures the radiographic image and transfers it directly to the computer screen. Indirect digital radiography produces an image faster than film, but not as fast as direct digital radiography. However, both systems produce an enhanced radiograph, superior in every way to x-ray film in the diagnosis of early caries.<sup>3</sup> Currently there are four indirect digital radiography systems on the market and over 20 direct systems from a variety of dental manufacturers. The system chosen, direct or indirect, is a matter of personal choice, as there is no difference in the quality of the radiographic images. Ultimately, digital radiography is very cost-effective for dental practices, and time efficient for dentists and patients. Also, digital radiography requires less radiation exposure than traditional x-ray film to capture an image, which is in everyone's best interest.<sup>4</sup>

Another excellent technology in caries detection is the intraoral camera (Figure 3),

which the authors believe is the most undervalued and underused technology in dentistry. The intraoral camera should be used for every patient appointment, every examination, and every tooth. Only an intraoral camera can produce a screen-sized digital image of a tooth or teeth. Visual detection or even suspicion of early dental caries is enhanced from this digital image (Figure 4). It is this suspicion of possible decalcification or early decay that leads to further investigation using additional dental digital diagnostic technology. Naturally, an enlarged color digital image on a computer screen enhances a provider's diagnostic abilities, especially when compared to the naked eye. It is also very important to visually illustrate and educate all patients about their dental health. Show a patient what you see, what makes you suspicious, and what you intend to investigate further. There are over 25 different intraoral camera systems available in today's dental marketplace. Some features to look for when selecting an intraoral camera are the focusing mechanism (lens), depth of field, image quality, and capturing mechanism (foot or handpiece). An intraoral camera is extremely cost-effective: some can be purchased for as little as \$3,000. In the author's opinion, no dental practice should be without an intraoral camera.

Caries risk assessment has always been an important element of early caries detection and minimally invasive dentistry. In fact, risk assessment has become the standard



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of care for most practices. What is new in the technology? The CariScreen® (Oral Biotech, Albany, OR) caries susceptibility screening system (Figure 5) is now available to determine the level of a patient's caries risk. This chairside technology uses the CariScreen meter and the CariScreen Swab to measure the adenosine triphosphate (ATP) level in the oral biofilm. The higher the level, the higher the patient's risk. The CariScreen swab is used to collect samples from a patient's teeth, which are then placed in the CariScreen testing meter. The digital screen shows the ATP level and in a matter of seconds searches the biofilm for all aciduric/acidogenic bacteria that

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Figure 1. DenOptix phosphor plates (Gendex, Lake Zurich, IL).



Figure 2A. ScanX\* unit (Air Techniques, Melville, NY).



Figure 2B. CMOS digital sensor.



Figure 3 Digital intraoral camera.



Figure 4 Intraoral camera image of internal cracks.



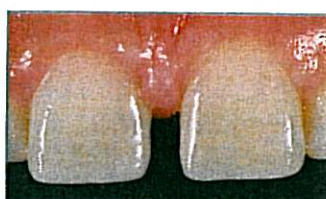
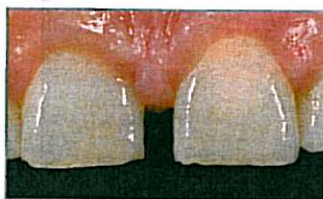
Figure 5 The CariScreen system.



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Up to this point, this discussion has focused on technologies that aid in diagnosing dental caries. These digital technologies are a vast improvement in detecting decay at its earliest stages so that patients can be treated in the most minimally invasive manner. Now, the discussion concentrates on technology that can be more definitive regarding the presence of caries. Although laser and LED fiber optic caries detection devices have been available for several years, they are not used in dental practices as much as they should be. These caries detection technologies are also the standard of care for diagnosing the presence or absence of decay in today's dental practice. The previously discussed technologies of digital radiography, intraoral cameras, and caries risk assessment products all enhance the ability to detect possible decay or caries. Laser or LED caries detection will provide a more definitive answer in greater than 90% of cases.<sup>5</sup> The sooner there is a confirmed diagnosis of caries, the more conservative the treatment required. Also, if decalcification of natural tooth structure is diagnosed before decay begins, the most conservative treatment of all can be initiated: prevention or remineralization. Dentists agonize over whether to open up a suspicious tooth, not open it, or just "watch it." If a tooth is opened up and no decay is present, that tooth was treated unnecessarily. Making diagnostic "guesses" is not in any patient's best interest. While a dentist "watches" a tooth, most likely it will progress to decay until examined 6 months later.<sup>6</sup> By that time minimally invasive dentistry will probably not be an option. If dentists truly are going to be as conservative as possible and practice minimally invasive dentistry, they must be diagnostically correct more than 90% of the time and as early as possible. Today's digital caries detection technology can remove the doubt from treatment decisions, whether restorative or preventive, with respect to hidden caries, questionable stained grooves, or any other suspicious-looking tooth surface.

For several years DIAGNOdent classic (KaVo Dental Corporation, Lake Zurich, IL) and DIAGNOdent pen (KaVo Dental) (Figure 6) have used laser technology to provide greater than 90% accuracy in detecting occlusal lesions (not detectable with an explorer or radiographs) in the most reliable and non-invasive method possible.<sup>7</sup> In addition, this technology enables providers to eliminate doubt as to whether caries is actually present at a specific occlusal site. This conservative approach not only will build confidence with patients, it is very easy to use. A DIAGNOdent probe is placed on the dry surface of the tooth to be evaluated. It emits a laser light at a

wavelength of 655 nm that measures laser fluorescence within the tooth structure. Healthy, non-carious tooth structure exhibits little to no fluorescence. Altered tooth structure, bacteria, and caries will fluoresce and display a digital reading on the monitor. The greater the presence of bacteria and caries, the higher the digital number display. Digital display scales may indicate no decay or bacteria, requiring no treatment; very little bacteria, requiring conservative preventive treatment; or a more moderate amount of bacteria and caries, which requires the most conservative restorative treatment possible. If decay is present, an alarm sounds: the greater the amount of decay, the louder the sound.

Newer to dentistry is the Midwest Caries I.D.<sup>TM</sup> caries detection handpiece (DENTSPLY Professional Division, Des Plaines, IL) (Figure 7). This LED and fiber optic technology aids in the detection of caries in pits and fissures and interproximal areas of posterior molars and premolars that have not been restored. It can be used in both a wet and dry environment. Because light reflects off an altered enamel prism, when this handpiece light penetrates natural tooth structure (up to 3 mm), it detects changes in the enamel. If no caries is detected, a green light will appear on the handpiece. If caries is present, a red light, as well as a beeping sound, will indicate that result. The Midwest Caries I.D. is 92% effective in detecting occlusal decay and 80% effective in detecting interproximal decay in unrestored molar teeth.<sup>6</sup> Again, if the dentist suspects possible enamel decalcification or the presence of dental caries, it is possible to take the guesswork out of the process by using this digital technology for a more definitive diagnosis.

## CONCLUSION

In today's dental practice, the use of digital caries detection technology is the only way to maintain and provide the standard



Figure 6 DIAGNOdent laser caries detection.



Figure 7 Midwest Caries I.D. LED caries detection device.

of care for patients with respect to minimally invasive dentistry in both the diagnosis and treatment of dental caries. The earlier decalcification or decay is diagnosed, the more conservative the treatment, whether it is restorative or preventive. This technology also eliminates the guesswork in diagnosis, thereby building the confidence and trust that patients deserve.

## REFERENCES

1. Goldstein R, Garber D. Evolving dental tech-

nologies... a new level of patient care and communication. *Dent Today*. 2007;26(9):66-70.

2. Jablow M. Implementing digital radiography into your practice. *Inside Dentistry*. 2008;4(3):88-90.
3. Emmott L. Digital radiography, 6 benefits of the technology. *Dental Products Report*. 2008;42(1):30-31.
4. Lamichane M. Digital radiography update. *Dental Compare*. 2008. Available at: [www.dentalcompare.com/spotlight.asp?spotlightid=5](http://www.dentalcompare.com/spotlight.asp?spotlightid=5). Accessed April 1, 2008.

lightid=5. Accessed April 1, 2008.

5. Bader JD. Systematic reviews of selected dental caries diagnostic and management methods. *J Dental Educ*. 2001;65(10):960-968.
6. Newton A. Identify, prevent and restore. Minimally invasive dentistry is on the rise. *AGD Impact*. January 2008. Available at: [www.agd.org/publications/issue/?PubID=4&issID=643](http://www.agd.org/publications/issue/?PubID=4&issID=643). Accessed April 1, 2008.
7. Hyman M. The evidence that defeats doubt. *Dent Today*. 2008;27(1):68-69.

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