Caries Detection Using Near-Infrared Transillumination:

Adding Objectivity to Diagnosis to Save Tooth Structure

Authored by Parag Kachalia, DDS

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Caries Detection Using Near-Infrared Transillumination: 

Adding Objectivity to Diagnosis to Save Tooth Structure

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About the Author

Dr. Kachalia is the vice chair of simulation, technology, and research and a team leader within the University of the Pacific’s aesthetic rehabilitation program. He is a Fellow of the American Dental Education Association’s leadership institute and American College of Dentists. He lectures extensively in the areas of diagnostics, technology and reconstructive dentistry and maintains a private practice in San Ramon, Calif, with his wife, Dr. Charity Duncan. He can be reached via email at pkachalia@pacific.edu.

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INTRODUCTION

New dental technologies are allowing clinicians to determine diagnoses more objectively. Each technology in our office can add to the compendium of facts that is needed to treat each patient as an individual, leading to predictable and more efficient treatment. Typically, most dentists have utilized a combination of visual and radiographic assessment to arrive at a diagnosis. The shortcoming of using just these 2 modalities is that some conditions, like certain forms of caries, are not evident at first sight, or even on radiographs. The purpose of this article is to look at the clinical implementation of a modern caries detection device (CariVu [DEXIS]) that uses near-infrared transillumination technology to give a view of carious lesions even at their earliest stages, on both occlusal and proximal surfaces.

CariVu is different than other caries detection devices that have been on the market for many years. Its near-infrared transillumination technology makes enamel appear transparent, while the lesions appear as dark areas. The images appear similar to radiographic images, showing both the tooth structure and the actual structure of the carious lesion in dark and light values. With radiographs, we are taking images of 3-dimensional teeth and putting them in a 2-dimensional plane. As a result of this, the clinician must make educated guesses about the true location of caries and cannot be certain of the location. However, the clinician can position the CariVu to see the tooth in varying angles within the live video stream and determine the location of the diseased tooth structure volumetrically.

With the CariVu technology, the clinician can discover caries in areas that are difficult to detect. Before this device, caries detection devices could help to find occlusal caries and the presence of accumulated dental plaque, but no device on the market accurately assessed the proximal surface of the tooth. CariVu diagnostic images have a very high detection accuracy, with one study showing an interproximal dentin caries detection rate of 99%.1 If the dentist can find caries very early, even too early to see on a radiograph, management techniques can be utilized to prevent it from getting worse or to restore it in the most conservative way possible. Of course, the clinician has a number of diagnostic technologies in the office, and radiographs are still a necessary part of the process; however, in many cases, the frequency of exposing radiographs can decrease when CariVu technology is used. On periodontally stable patients, bite-wing radiographs have been primarily exposed to determine if proximal caries are present. CariVu allows the clinician to visualize the proximal surface without using ionizing radiation.

Let’s now look at a couple of real-world case examples.

CLINICAL CASE 1

In this first case example, the patient was approximately 17 years of age and presented with a relatively healthy dental history. Her forward-thinking parents wanted to maintain their teenager’s oral health. As a part of a routine examination, radiographs (GXS-700 [Gendex Dental Systems]) were taken. The left bite-wing radiograph showed a potential problem on tooth No. 14 (Figure 1). A resin-based sealant, placed approximately 8 years ago, was present on the occlusal and lingual surfaces (Figure 2). No other issues were present on visual examination. The preoperative radiograph demonstrates enamel breakdown on the mesial proximal surface of tooth No. 14. On the radiograph, the lesion appeared to be within the enamel only, just shy of the dentino-enamel junction (DEJ).

If only the radiograph had been viewed and assessed, one might have just monitored this restoration. However, upon seeing the CariVu image, there was more to the story. The CariVu image demonstrated a mesial proximal gray area that extended from the enamel to the dentin (Figure 3). The gray area is indicative of breakdown, helping the clinician visualize the buccal to lingual extent of the carious lesion and allowing for a conservative preparation form. The image clearly showed a Class 2 lesion on the mesial proximal surface toward the buccal aspect. After viewing the CariVu image, the parents were comfortable with the...
recommendation to conservatively open up the tooth.

It is very important to catch decay early in a person of this age. This patient came into the office right before going away to college. In the author's experience of being located in an upper-middle class area, most children's dental health is relatively good until they go away to college. While at home, the parent(s) usually cover dental expenses, make regularly scheduled appointments for any children, and treat issues as they come up. During the college years, dietary and hygiene habits tend to change for the negative, and overall oral health can diminish. They often come back around 21 years of age with decay that has progressed, requiring more invasive treatment. So, another benefit of using CariVu is knowing the extent of the caries.

In this case, after opening the tooth, the lesion did extend right to the DEJ, just as the image had shown (Figure 4). Using the CariVu image as a guide, one knows exactly where to prepare the tooth and a conservative preparation form can be maintained. The area of caries (Figure 5) was restored using bulk-fill composite material (SonicFill [Kerr]), and the preparation was confined to the area of disease only (Figure 6).

Because they were so impressed with the images, the parents asked if CariVu could be used instead of radiographs. On 12- to 18-year-old patients, it is the author's opinion that if the patient doesn't have periodontal disease, there is a valid argument to be made that CariVu may be all that is needed in certain cases. Of course, radiographs are a necessary part of diagnosis, but taking CariVu images at certain intervals can reduce potential radiation exposure to younger patients. Using CariVu increases the clinician’s objectivity, adding another layer beyond the eyes and the radiograph.

**CLINICAL CASE 2**

In this case example, the patient had moved away about 2 years previously and then returned for a checkup visit. Standard radiographs were taken, and occlusal caries was noted during the clinical evaluation of the bite-wings (Figure 7).
proximal surface of tooth No. 30 and the distal proximal surface of tooth No. 29 showed a slightly overlapped contact. At this angulation, no caries progression was evident at the DEJ of either of the overlapped surfaces. Upon visual examination, a failing restoration was noted on tooth No. 30 with minor cracks extending from the mesial, lingual, and distal surfaces to the existing restoration. Discoloration was also noted toward the lingual, distal, and buccal portions of the existing restoration. Tooth No. 29 also demonstrated significant widening of the distal fissure, an increase in mesial and distal pit depth, and discoloration. The occlusal surface of tooth No. 28 also showed a slight widening of the distal pit and fissure with minimal increase in depth. The patient was asymptomatic.

Rather than exposing the patient by taking another
radiograph, Carivu images were taken to further investigate the slight overlap between teeth Nos. 29 and 30 on the radiograph. From the radiograph, one would have not seen that the distal of tooth No. 29 had caries. The Carivu image of the distal occlusal surface of tooth No. 29 and mesial surface of tooth No. 30 showed that tooth No. 29 demonstrated a significant dark area indicative of distal proximal caries (Figures 8 and 9). No significant areas of concern were evident on the mesial of tooth No. 30. The Carivu image of tooth No. 30 showed darker areas near the distal-buccal extension of the existing restoration as well as toward the axial standpoint of the distal marginal ridge (Figure 10). This indicated areas of potential leakage that should be examined further upon restoration removal. No major issues were noted in the areas that appeared to show minor cracks visually.

The patient was scheduled for a buccal-occlusal-lingual restoration on tooth No. 30, a distal-occlusal on tooth No. 29, and conservative occlusal restoration on tooth No. 28. On tooth No. 30, the area of decay was right where Carivu showed it was. On No. 29, the distal-proximal lesion was conservatively entered, and the decay was right at the DEJ (Figure 11). Without the use of Carivu technology, the author would not have treated that caries until at least a year later, when a new set of radiographs would have been taken (if the patient even came back at the requested time). The case was restored using the SonicFill 2 (Kerr) composite resin system (Figure 12). In this case, even if the contact were opened up, it would not have been possible to see the extent of the caries since there was no evidence that the caries had progressed to the DEJ. The initial preparation form clearly shows the presence of diseased tooth structure on the axial wall and gingival floor.

Another interesting aspect of this case was that tooth No. 30, upon clinical examination, showed initial mesial and distal fractures extending on the mesial and distal marginal ridges as well as out to the lingual. These did not extend axially across the pulpafloor. A minor lingual fracture without any widening was noted toward the lingual groove, and caries was present near the area where the distal-buccal extension of the prior restoration was removed (Figure 13). Sometimes a clinician wonders if the fracture is going deeper on the tooth than can be seen. When there is a true fracture, Carivu shows darkness at the juncture on either (or both) sides of the fracture line. The completed minimally invasive restorative work can be seen in Figure 14. It is important to note that, with Carivu, it could be seen that the fractures were confined to the marginal ridge areas. Having and using Carivu prevents guesses that could otherwise lead to more aggressive treatment.

**CLOSING COMMENTS**

While Carivu does not replace radiographs, it is an important adjunct in some cases. Furthermore, this technology can reduce the number of radiographs taken. For example, we may not have to re-expose an area if a contact overlaps on a bite-wing radiograph. The area can simply be scanned with the Carivu, and the practitioner can assess the occlusal and proximal surface. One significant advantage is that this technology can give the clinician a greater sense of where the actual caries is, and, in addition, the buccal-to-lingual extent that cannot be visualized on a radiograph. If surgical intervention is needed, with Carivu, the clinician does not have to make an educated guess of where the bur should penetrate the marginal ridge to gain access to the proximal caries. Instead, the doctor knows exactly where to go by looking at the obtained image.

The cases presented herein demonstrate that the visualization achieved with Carivu can lead to a more objective diagnosis of caries and fractures, ultimately leading to the most conservative treatment possible. In many cases, the treatment may simply be putting the patient on a remineralization protocol. We can use the multiple layers of data from radiographs, visualization, and Carivu to combine all of the facts into a comprehensive diagnosis. With the understandable images generated by Carivu, our patients can take a greater part in their treatment plans. It also is important to note that patients appreciate the nonionizing approach to caries detection. They can readily understand the fact that if a lesion is diagnosed early, the carious process can potentially be reversed.

In summary, the implementation of this nonradiation, near-infrared technology allows the clinician to be more exact in diagnosis, more proactive in patient education, and more precise in caries treatment.◆

**Reference**

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1. While other caries detection devices have been on the market for many years, CariVu (Dexis) is different. Its near-infrared transillumination technology makes enamel appear transparent, while the lesions appear as dark areas.
   a. True        b. False

2. With radiographs, we are taking images of 3-dimensional teeth and putting them in a 2-dimensional plane. As a result of this, the clinician must make educated guesses about the true location of caries and cannot be certain of the location.
   a. True        b. False

3. According to this article, the clinician has a number of diagnostic technologies in the office, making radiographs an unnecessary part of the process.
   a. True        b. False

4. When there is a true fracture, CariVu shows darkness at the juncture on either (or both) sides of the fracture line.
   a. True        b. False

5. One significant advantage is that this technology can give the clinician a greater sense of where the actual caries is, and, in addition, the buccal-to-lingual extent that cannot be visualized on a radiograph.
   a. True        b. False
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Please check the correct box for each question below.

1. ☐ a. True ☐ b. False

2. ☐ a. True ☐ b. False

3. ☐ a. True ☐ b. False

4. ☐ a. True ☐ b. False

5. ☐ a. True ☐ b. False

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