

# Mapping occlusal decay: The puzzle is solved



Figure 1. Spectra Caries Detection system (Air Techniques).

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*“These cases show clinically that the Spectra Caries Detection system’s readings correspond to the severity and extent of decay...”*

**T**he management of dental decay, its detection, assessment and treatment is one of the cornerstones of dental practice. The dentist and hygienist spend each work day dealing with the results of the caries process and yet until recently, we have not had a scientific, accurate, reproducible and clinically significant way to detect the extent and severity of the damage. This situation is the most problematic on the occlusal surface where decay can lurk undisturbed in pits and fissures, causing significant breakdown of enamel and dentin before it is detected.

## The puzzle

**T**he occlusal surface is a network of pits, fissures, ridges and valleys that offer excellent attachment areas for bacteria and plaque. Enamel is porous, allowing for even greater infiltration of bacteria and bacterial products. Demineralization occurs in response to the acid production of oral bacteria. Hydroxyapatite crystals are first dissolved from the subsurface of the tooth. Then the breakdown works itself both up to the tooth surface, as well as towards the DEJ.

If so much of the early damage is under the surface and is invisible, how then can the dental professional detect and judge the extent or severity of the decay?

The accepted standard for occlusal caries detection has, until recently, been visual and tactile. Unfortunately, visual inspection is inconclusive since so much occurs below the surface.

Tactile inspection with an explorer is even more problematic. Explorers can cause damage to the integrity of the enamel surface. Remineralization can sometimes reverse the caries process but it requires an intact surface layer. The physical penetration of the surface with an explorer converts a subsurface lesion to a frank cavity with no hope of caries reversal.<sup>1,2</sup>

Radiographic detection of occlusal decay is not much better. X-rays are very effective in determining interproximal decay because the tooth narrows at the interproximal. The centre of the tooth is much wider. When the X-ray penetrates the centre of the tooth, the high radiopacity of intact enamel can cover up the evidence of early tooth breakdown (Figure 2). X-rays show occlusal decay only when the damage is severe and much of the tooth is affected.

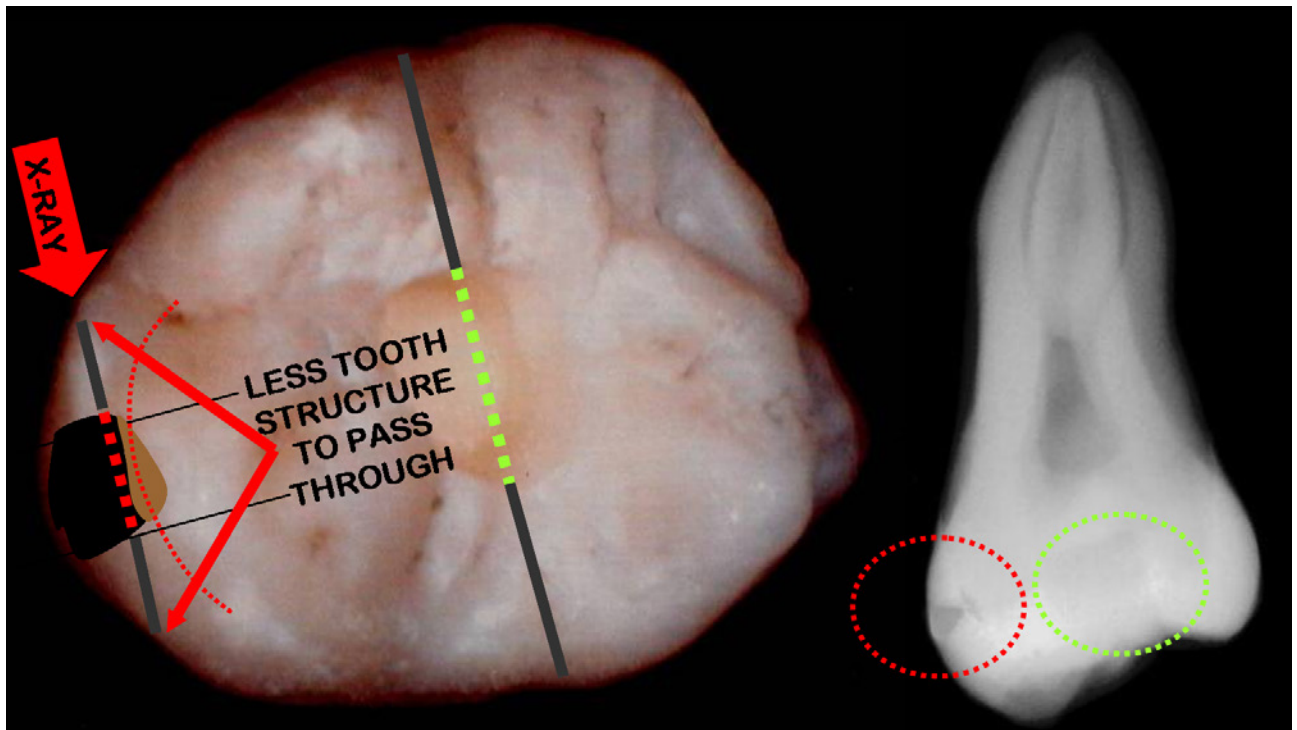


Figure 2. Radiographs are ineffective for occlusal decay. The radiopacity of the BLi width of intact enamel masks early decay. The interproximal area is narrower so X-rays are effective.

### Solving the puzzle: The wish list

The first requirement of an ideal caries detection system is that it be a scientific instrument with accurate, reproducible results that reflect the clinical situation. Second, the instrument should map the tooth surface and show the location of decay as well as its severity.

Third, there should be a means to easily visualise and differentiate the full spectrum of caries, from early enamel demineralization to deep dentin caries. This can be provided by a colour scale. Finally, there should also be a reproducible numeric scale that can monitor improvements or further breakdown. The values can be used for tracking the lesion or to demonstrate the situation to the patient. An objective scientific system is ideal for patient education and trust.

### The puzzle solved: The science

The dental scientific community has been attempting to provide an ideal caries detection system for some time. Several products have become commercially available and have provided an adequate service. Very few have come close to fulfilling the wish list enumerated above.

A recent entry into the field, the Spectra Caries Detection system (Air Techniques, USA) (Figure 1), is finally closing in on all the requirements of the ideal caries detection system.

Changes in tooth fluorescence have been used to detect early tooth surface caries since the 1980s.<sup>3</sup> Although oral microorganisms are not known to fluoresce, several produce orange-red fluorophores as by-products of their metabolism.<sup>4</sup> This fluorescence becomes a good marker for the zone of bacterial invasion into enamel and dentin.<sup>5</sup>

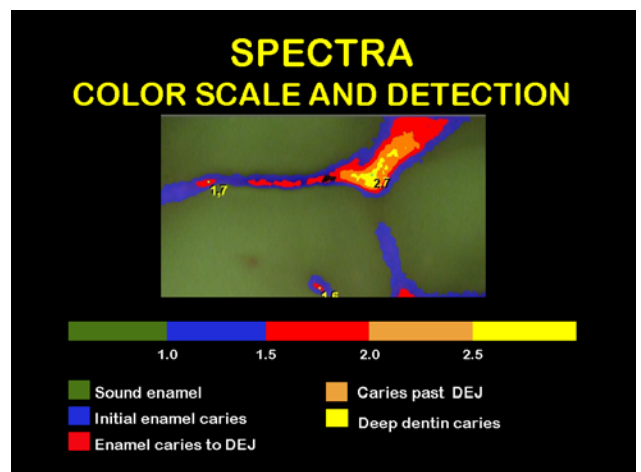


Figure 3. Colour map and numeric scale for Spectra.

When the tooth absorbs light at 405 nm, healthy enamel will fluoresce green while caries invaded enamel and dentin will fluoresce red. The intensity of red fluorescence can be analyzed and quantified. A map and scale of fluorescence intensity can be used to show caries location and severity (Figure 3). This is a real-time image of the entire occlusal, facial or lingual surface so there is no need to take multiple point readings which can be very time-consuming and technique sensitive.

The Spectra system provides colour images and numbers to show the dentist and patient the severity and extent of the lesions. The colour map is good for visualization while the number is essential for reproducibility and tracking. A value of less than 1.0 signifies healthy enamel, 1-1.5 an early enamel lesion, 1.5-2.0 an advanced enamel lesion with some dentin involvement and over 2.0 an advanced enamel lesion with significant dentin involvement. Both the image and numerical data can be saved and used

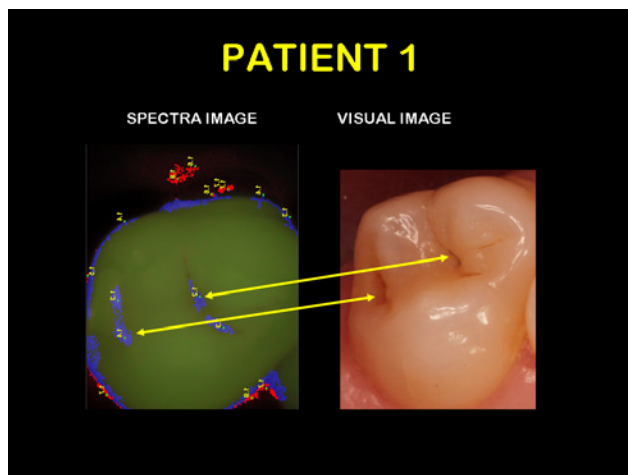


Figure 4. Case 1: Spectra image and visual image (Spectra numbers are mirrored because the visual image was taken through a mirror and Spectra's direct orientation has to be correlated with this reversed image).



Figure 5. UL Decayed molar UR Fissurotomy bur (SS White Burs) removes incipient decay LL Minimally invasive preparation LR Preparation bonded with Beautibond (Shofu).



Figure 6. UL Beautiful Flow Plus (Shofu) placed UR Restoration polymerized LR Restoration polished with Jazz Supreme (SS White Burs) LL Completed conservative restoration.

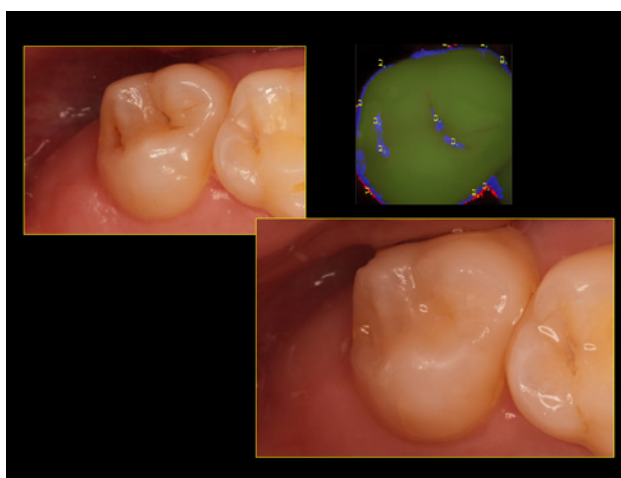


Figure 7. Patient 1: Initial lesion and completed restoration. Initial Spectra image.

### Case 1

This patient has a history of minimal decay but had one molar where caries progressed quickly, necessitating an endodontic procedure and a crown.

The Spectra image shows readings of 1.2 to 1.4. This is in the zone of initial enamel caries. Owing to the patient's aggressive caries history, it was decided to proceed with a restoration.

1. A Spectra image is taken and correlated with the visual image (Figure 4);
2. A Fissurotomy bur (SS White Burs) is used to remove incipient decay in the enamel. The design of this bur ensures minimal tooth removal and no anesthetic is necessary. The tooth is bonded with Beautibond 7th generation adhesive (Shofu) (Figure 5); and
3. Beautiful Flow Plus (Shofu) with remineralizing giomer technology is placed into the preparation and light cured. The restoration is polished using a Jazz Supreme one-step polisher (SS White Burs) (Figure 6).

### Clinical cases

The following clinical cases were undertaken by the author to demonstrate the reproducibility and clinical significance of using the Spectra caries detection system. The comprehensive map of occlusal decay prepares the operator for what to expect during preparation. The specifically designed minimally invasive caries excavation tools and remineralizing flowable restorative materials ensure a proactive intervention approach to treating occlusal decay.

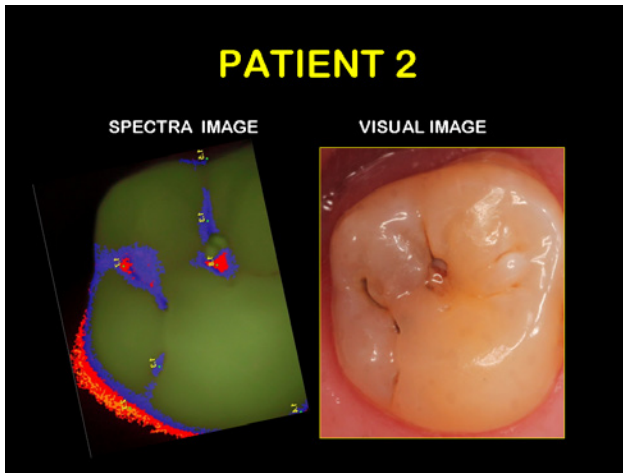


Figure 8. Patient 2: Spectra image and visual image.

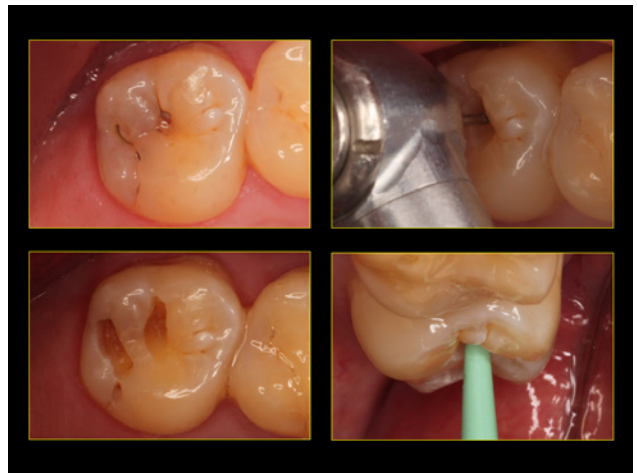


Figure 9. UL Decayed molar UR Fissurotomy bur opens the lesion LR Smart Bur II (SS White Burs) removes infected dentin LL Partial excavation of decay.

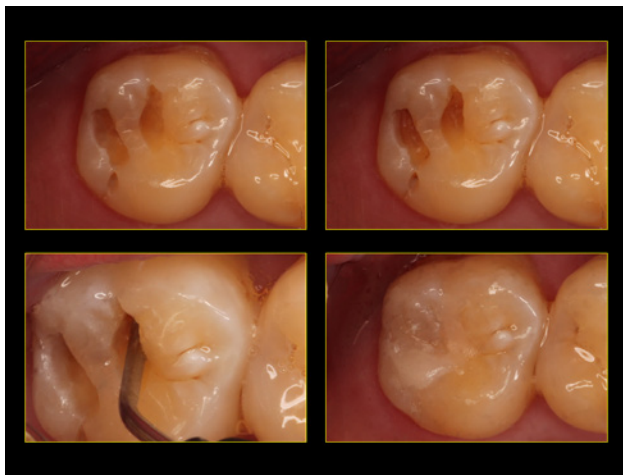


Figure 10. UR Partial excavation of decay UL Completed excavation of decay with Smart Bur II LL Beautiful Flow Plus placed LR Restored tooth prior to polishing.

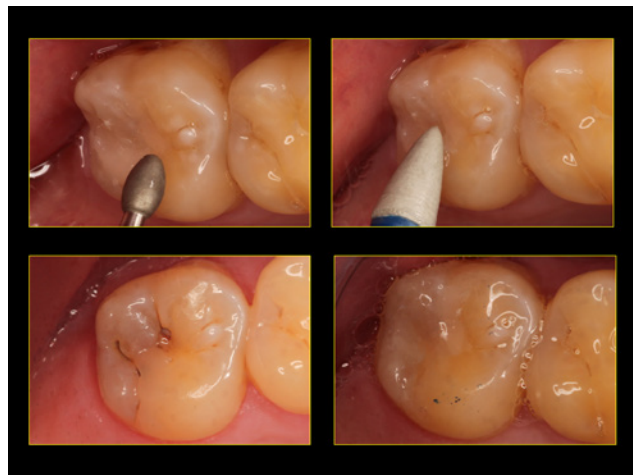


Figure 11. UL Restoration finished with ET bur (Brasseler) UR Restoration polished with Jazz Supreme polisher LL Initial lesion LR Completed restoration.

### Case 2

This patient has a history of high caries risk with many restored teeth. Spectra shows readings from 1.3 to 1.8. This is in the zone of pronounced enamel caries with potential dentin involvement.

1. Spectra image correlated with the visual image (Figure 8);
2. A Fissurotomy bur (SS White Burs) is used to open the lesion. Anesthesia is required since decay is past the DEJ. Infected dentin is removed with a Smart Bur II (SS White Burs), a polymer bur which is harder than infected dentin but softer than affected or healthy dentin. Hence it selectively and conservatively removes only unhealthy tooth structure (Figure 9);
3. The preparation is examined. The Smart Bur II (SS White) is utilized to remove the remainder of the infected dentin. The tooth is bonded with Beautibond (Shofu). Beautiful Flow Plus (Shofu) is placed into the preparation and polymerized (Figure 10); and
4. The restoration is finished with an ET bur (Brasseler) and polished with a Jazz Supreme one-step polisher (SS White Burs) (Figure 11).

### Case 3

This patient has a history of high caries risk and many restorations. Some restorations have become redecayed.

The Spectra image shows readings from 1.2 to 1.9. This is in the zone of pronounced enamel caries with probable dentin involvement. The Spectra image picks up the presence of decay around and within an old restoration.

1. Spectra image is correlated with the visual image (Figure 12);
2. A Fissurotomy bur (SS White Burs) is used to open the lesion. Anesthesia is required since decay is past the DEJ. The defective restoration is removed. The Spectra reading of 1.9 corresponds to deep caries under the defective restoration. Infected dentin is excavated with a Smart Bur II (SS White) (Figure 13);
3. Tooth is bonded with Beautibond (Shofu). Beautiful Flow Plus (Shofu) is placed into the preparation and cured (Figure 14); and
4. The restoration is finished with an ET bur (Brasseler) and polished with a Jazz Supreme one-step polisher (SS White Burs) (Figure 15).

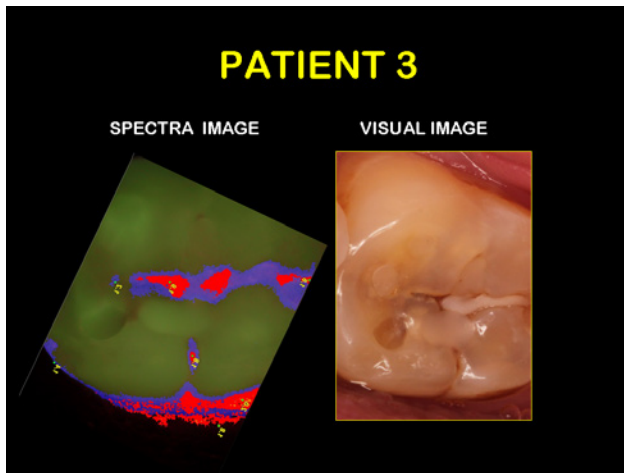


Figure 12. Patient 3: Spectra image and visual image.

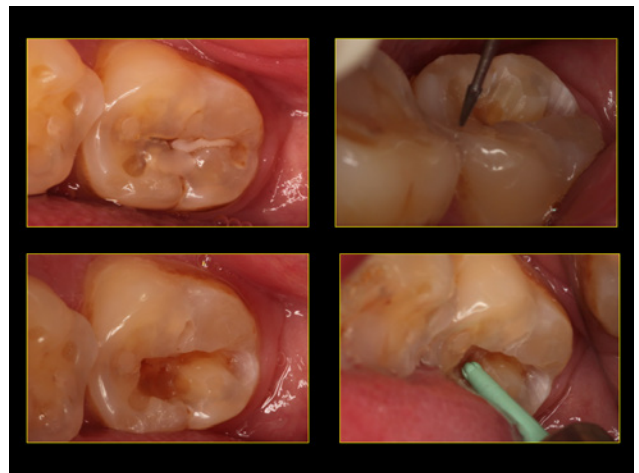


Figure 13. UL Molar with decay around and through a defective restoration UR Fissurotomy bur opens the lesion LR Infected dentin removed with Smart Bur II LL Completed preparation.

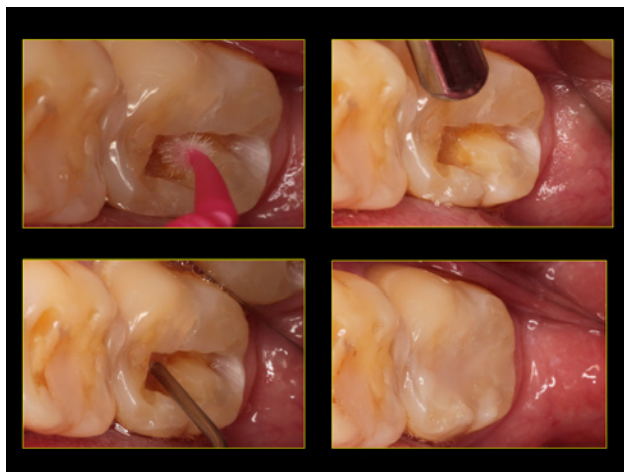


Figure 14. UL Preparation bonded with Beautibond UR Tooth dried LL Beautiful Flow Plus placed LR Restored tooth prior to polishing.

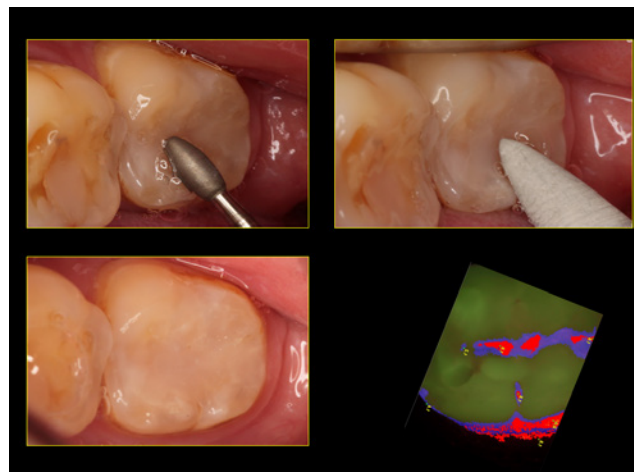


Figure 15. UL Restoration finished with ET bur UR Restoration polished with Jazz Supreme polisher LL Completed restoration LR Initial Spectra image.

These cases show clinically that the Spectra Caries Detection system's readings correspond to the severity and extent of decay. The occlusal surface is finally exposed to view with no hidden secrets. Defective restorations can be examined and evaluated. They can then be repaired or replaced. Incipient lesions can be treated with remineralization therapies and then re-evaluated. The dentist is now armed with a scientific method to map decay that is accurate, reproducible and clinically significant... The puzzle is solved!

## References

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## About the author

*Dr Fay Goldstep has been a featured speaker in the ADA Seminar Series and has lectured at the American Dental Association, Yankee, American Academy of Cosmetic Dentistry, Academy of General Dentistry and the Big Apple Dental Conferences. She has lectured nationally and internationally on Proactive/Minimal Intervention Dentistry, Soft-Tissue Lasers, Electronic Caries Detection, Healing Dentistry and Innovations in Hygiene. She has served on the teaching faculties of the post-graduate programmes in Aesthetic Dentistry at SUNY Buffalo, University of Florida, University of Minnesota and University of Missouri-Kansas City. She has been a contributing author to four textbooks and has published more than 60 articles. She is a Fellow of the American College of Dentists, International Academy for Dental-Facial Esthetics, American Society for Dental Aesthetics and the Academy of Dentistry International. She has been listed as one of the leaders in continuing education by Dentistry Today since 2002. Dr Goldstep is a consultant to a number of dental companies and maintains a private practice in Markham, Canada.*