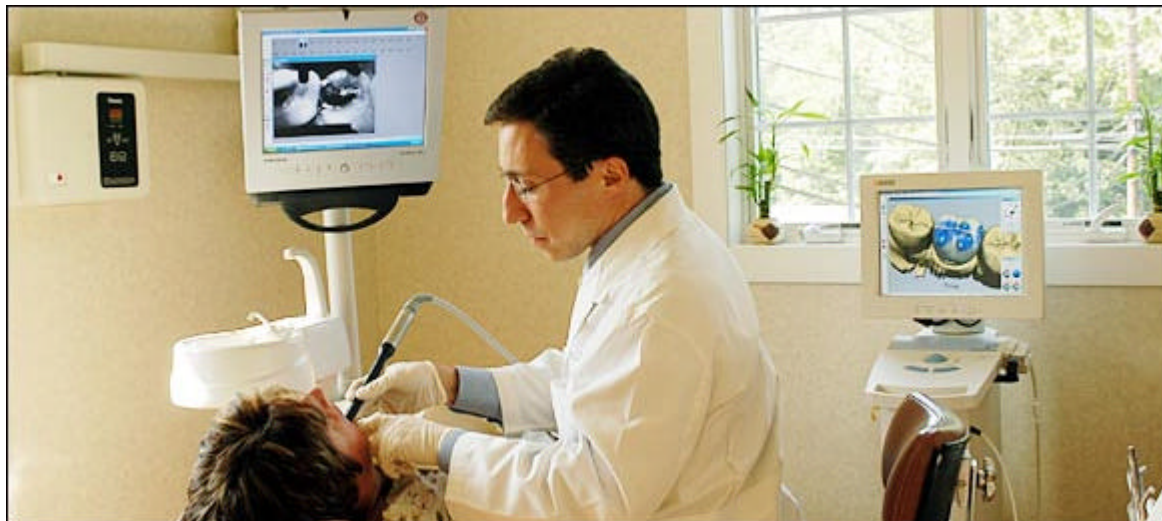


Say Ahhh (and Watch the Monitor)



Philip Greenberg for The New York Times

EARLY WARNING - Using a dental imaging system, Dr. Andrew Spector can discover problems that might be missed by traditional X-rays or visual examination.

By JESSIE SCANLON

Correction Appended

HAWORTH, N.J.

YOU sit down, you open your mouth, you say "ahhh." The dentist leans down and peers in, metal probe in one hand, angled mirror in the other, and starts poking.

That scene plays out in dentists' offices every day. But when Kevin McMahon sank into the chair in Examination Room 4 at Dr. Andrew Spector's office here for a routine checkup, the process was a bit different.

Ilene Levine, the hygienist, reviewed Mr. McMahon's chart and images on her flat-panel display, then reached for a wandlike device called a Difoti. She positioned it above each tooth in turn. As she did, light passed through the enamel in a process called transillumination. Any cavities or other irregularities altered the light pattern, and the information was captured by the wand's sensor - a charge-coupled device, the kind used in many digital cameras - and

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transmitted to a display that she and Mr. McMahon were watching.

"This is one we need to monitor," Mrs. Levine said, pointing to what looked like a black-and-white photograph of a molar with an old silver amalgam filling. Shielded by the metal, the new decay would have gone undetected by X-rays.

The Difoti (the name is an acronym for digital imaging fiber optic transillumination) is one of a range of new digital technologies that are helping to close what Dr. Spector calls the diagnostic void. "Now we're catching problems sooner," he said - for example, when a cavity is too small to be seen by the naked eye or even picked up by a traditional X-ray. "These days kids have fewer cavities, and adults aren't ending up with major crowns."

Lasers, sonar, digital radiography and rapid manufacturing are making dental work more efficient, less painful, and of better quality. Even offices that have not made the switch to digital radiography are starting to scan their X-rays; the digitized images can be stored electronically and sent easily to specialists or insurance companies.

Moreover, companies like Logicon, a division of Lockheed Martin, and Trophy, now owned by Kodak, have introduced software that can enlarge and enhance images for specific detection tasks. "It's the difference between radio and television," Dr. John Flucke, a dentist in Lee's Summit, Mo., said of the collection of new tools. "The technology allows practitioners to see what we used to ascertain by experience and feel."

Some dentists also say that imaging technologies play an important role in their relationship with patients. The buzzword is "co-diagnosis," and the idea is that patients will gain a better understanding of their periodontitis if they can see it on a wide-screen monitor. (Hence Mrs. Levine's narrated walk-through of Mr. McMahon's mouth.) Though many patients would rather forgo the viewing pleasure, the premise is that they will be more willing to go ahead with a root canal if they have witnessed the sorry state of the root.

Another advantage of these powerful detection and imaging techniques is that they can sometimes help to reduce the discomfort of examinations and treatments. The drill, the workhorse of dentistry for more than a century, may not disappear, but several companies are hoping to sideline it.

One alternative is the soft-tissue laser, which Dr. Paul Feuerstein, a dentist in the Boston area and the technology editor of Dental Economics, calls "the big boy of minimally invasive tools." First used for whitening, diode lasers are increasingly being used to shape the gum line and treat gum disease because they are much kinder to the tissue than a

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L. G. Patterson for The New York Times
DIGITAL TWEAK - Dr. John Flucke can create a crown in minutes with a device that displays a model on a monitor, then mills it to the dentist's specifications.

scalpel, and patients require no anesthetic when they are used.

Dr. Larry Emmott, a dentist and technology consultant in Phoenix, had a patient with chronic gum disease who was not responding to traditional treatments. "The periodontist we'd been collaborating with on the case said she'd just have to get dentures," he recalled. Instead, Dr. Emmott successfully treated the problem by cutting away the infected layer with a soft-tissue laser.

Then there is the Cerec 3, a two-foot tower with a swiveling monitor and a small keypad, which aims to make getting a crown a less daunting prospect.

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The standard crown procedure involves a couple of anesthetized hours during which the dentist drills away 30 percent of a tooth, takes an impression and cements on a temporary crown. Then there is usually a two-week wait for a lab to produce the crown, and another afternoon of numbness and drilling when it is attached.

Cerec, enhanced by a new 3-D software package introduced earlier this year by Sirona, lets dentists preserve more of the original tooth structure and create a crown while you wait.

For Michele Shafer, whose home is an hour and fifteen minutes from Dr. Spector's office, that meant making only a single trip for a crown; she spent more time in her car than in the chair.

Dr. Spector began Mrs. Shafer's procedure with an injection of anesthetic through a digital syringe that slows the flow of medication when it senses pressure, thereby making the injection almost painless. He used the Cerec infrared camera to create an optical impression of the original tooth.

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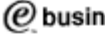
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That step replaces the green paste and uncomfortable metal trays that are typically used to make an impression.

Dr. Spector then removed the diseased tissue and took a second image, which the Cerec combined with the first to create a rough 3-D model of the crown on the screen. Using a trackball, he tweaked the design, smoothing contours and adjusting the fit. He then sent the data to the milling chamber, which produced the crown in 17 minutes.

Not only is the process more convenient than waiting for the lab, Dr. Spector said, it also produces a stronger crown. Instead of enamel, the crown is made of compressed porcelain "40 percent stronger than what a lab can press," he said. "And the material has the same properties as enamel - it wears away at the same rate, and it has the same thermal coefficient, so when you drink hot coffee it will expand just as much as the teeth around it." It leaves more of the original tooth intact because the material can be cemented directly to the tooth with no metal interlayer.

"No one loves getting a crown," said Dr. Jeffrey Katz, a San Francisco dentist. "They hate the Novocain. They hate the goeey stuff. This transforms the whole experience."

"The biggest thing for me is the control," said Dr. George Maryniuk, a prosthodontist in Brookline, Mass. "My father was a lab technician, and I have high expectations. Now I'm guaranteed to get the results I want."

But with its \$100,000 price tag, the Cerec does not make sense for every practice. The math works out for Dr. Maryniuk, who was paying \$5,000 a month in lab expenses, most of which Cerec eliminated, and now pays \$2,000 a month to the Cerec leasing company. The machine reduces his costs for a crown, for example, to \$30 from the usual \$200 and saves him the expense of second appointments.

That savings will have no effect on the patient's pocketbook, because dentists depend on the margin to cover their Cerec payments and the other myriad overhead costs of a high-tech office. For instance, a digital X-ray machine costs some \$18,000, compared with about \$4,500 for a conventional one, but dentists don't charge any more for the service, and insurance companies don't make a distinction.

"When I get a claim form for a crown, I don't know if it was lab-processed or Cerec," said Max Anderson, the national oral health advisor for Delta Dental, one of the nation's largest insurers. In the system, a crown is a crown. Most insurers don't even cover new diagnostic services like the Difoti, meaning that the dentist must somehow absorb the \$6,495 cost.

So dentists must analyze their needs before investing in the machines. A dentist who does few crowns or other restorations might be better off sticking with the labs, many of which are starting to use the Cerec technology. In any case, in an already capital-intensive

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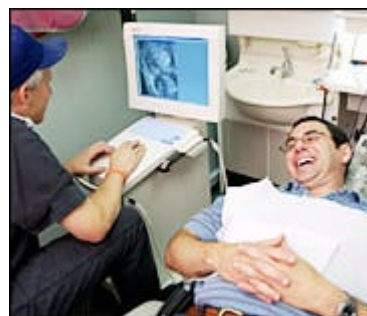
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business, the new devices put pressure on the bottom line.

That in turn could be leading to some unnecessary treatments. "The question is, does a dentist make the same clinical decisions when he has a \$20,000 machine to pay off," Dr. Anderson cautioned.

Aided by their digital cameras, Dr. Feuerstein said, some dentists are selling cosmetic procedures that they might not have suggested before. "It's like the extreme makeover reality shows," he said. "Dentists will take a patient with 'ugly' teeth and show them what they could look like with facades and laser-shaped gums."

On balance, most dentists view the new dental technologies as a positive force. "Today, cavities are a universal disease," said Dr. Frederick C. Eichmiller, director of the Paffenbarger Research Center of the American Dental Association. "In the future, it won't be." Dr. Eichmiller and his team in Gaithersburg, Md., are developing toothpastes and rinses that will help teeth repair themselves, as skin or bones do. They are also working on "smart fillings" that will detect decay and release a healing mixture of minerals.

What will that mean for the high-tech dentist? "Remember," Dr. Katz said, "the goal of dentistry is to put ourselves out of business."

Correction: Sept. 6, 2003, Saturday

An article in Circuits on Thursday referred imprecisely to a high-tech dental tool, Cerec, which is used to create crowns. Its basic technology was developed in the early 1980's, and a machine on which it is used in many dentists' offices, the Cerec 3, has existed since 2000; Cerec 3D is the latest software for it, introduced this year.

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