

Not your father's dentistry

Within the next five years or so, a gaping hole in oral health care will be filled, so say a number of dental educators and researchers leading the charge for minimally invasive care. Some, in fact, question the ethics of following the traditional "drill and fill" model of dentistry now that the bacteria that cause caries can be detected earlier and treated with antibacterial agents, and early carious lesions can be reversed—all without surgical intervention. Though the question remains whether the dental profession will adapt in a timely fashion, several recent innovations and a number of upcoming technologies hold promise for a smoother transition to this new paradigm.

[By Dennis Spaeth](#)

In 1896, Dr. G.V. Black predicted the demise of his own legacy to dentistry—extension for prevention, the very roots of modern dentistry that he fathered. Black suggested that dentists one day would be "engaged in practicing preventive, rather than reparative, dentistry." Now, it's not as if he held Nostradamus-like abilities, but Black—who spent years studying dental pathology and bacteriology—envisioned a day when the profession would understand the etiology and pathology of caries well enough "to combat its destructive effects by systemic medication."

Well, a century has come and gone, and the profession is still waiting for the new modern dentistry, right? Don't bet your malpractice insurance policy on it. Not only is it possible to use a combination of antibacterial agents and topical fluoride treatments to both halt and reverse caries, some argue that this is the new standard of care.

And that's just the entry to a whole new paradigm for dentistry: minimally invasive care. Sure, you can still practice what you learned in school for carious lesions that still require restoration—just not so much that whole extension-for-prevention concept fostered by Black in the 1800s. Today's dentistry allows you to conserve more healthy tissue than ever before. Actually, this day likely arrived about 10 or more years ago with the advent of adhesives, suggest federal health officials.

"In future years," noted a U.S. Public Health Service document published in January 1993, "the restoration of cavities will cease to be the mainstay of general and pediatric dentists. Treatments emphasizing conservative and preventive approaches should be expected. New adhesives and more durable plastic restorative materials that are currently available allow for increasing use of minimally invasive procedures that are more preventive than restorative. Preventive rinses allow remineralization of early lesions on tooth crowns and roots and should be used increasingly."

In 1997, Dr. Harold C. Slavkin, then the director of the National Institute of Dental Research (now National Institute of Dental and Craniofacial Research), echoed the sentiments. "We are now faced with the possibility that the ways in which we approached the solution to these oral and craniofacial health problems in the past have now been surpassed by a logic that has its roots in the intersection of cell and

molecular biology, information sciences, mathematics, bioengineering, and materials and implant science.

"The quest for us now," wrote Slavkin, "becomes the design and fabrication of biological solutions to the oral health problems that we face in the clinic on a daily basis. And ... the application of biological approaches to restorative dentistry in the repair of tooth structure destroyed by the infection from *Streptococcus mutans*."

Researchers from across the country, in fact, have spent the better part of the last two decades building the scientific foundation for minimally invasive dentistry. So even if you missed the death knell for Black's "modern dentistry," researchers and clinicians contacted by Dental Practice Report—from Pennsylvania and Maryland to California and Oregon—are prepared to guide you through this paradigm shift and provide you with some perspective on the myriad technologies and products available today and those just around the corner that promise to make the transition easier.

the new paradigm

Researchers from the University of Michigan School of Dentistry proclaimed in the January 2003 issue of the Journal of the American Dental Association that "the management of dental caries has evolved from G.V. Black's 'extension for prevention' to 'minimally invasive.'" The researchers, Drs. Carol Anne Murdoch-Kinch and Mary Ellen McLean, cited as evidence of this shift new dental restorative materials, improved dental adhesives and a growing understanding of the caries process.

Even Black's caries classification system seems destined for the scrap heap in this new brand of dentistry. "Traditional cavity preparations were designed at a time when carious lesions usually were diagnosed at a more advanced state than are the incipient lesions dentists detect today," noted Murdoch-Kinch and McLean.

Now, the JADA article was not a plume of white smoke above the Sistine Chapel indicating the official arrival of a new standard. Actually, if they did that sort of thing, you might have noticed it five or more years ago when a number of dentists began practicing minimally invasive dentistry. The problem is the majority of dentists think this is still a futuristic concept.

So says Dr. Stewart Rosenberg, of Laurel, Md., who co-founded the World Congress of Microdentistry, which was formed about five years ago by a number of clinicians, researchers and educators from around the world to facilitate a better understanding of the minimally invasive approach to dental care.

"Minimally invasive dentistry has always been the goal of dentistry," Rosenberg explains, "but nobody ever made an attempt to practice it. Everybody said they wanted to practice minimally invasive dentistry, but what did we do for the vast majority of time I've been in practice (since 1966)? We waited until there was a big hole in the tooth and then we filled it.

"And that's still what's being taught in dental schools," says Rosenberg.

That point is not lost on Murdoch-Kinch and McLean. "Some dentists still find it

difficult to change their mindsets ... and are continuing to cut large, traditional preparations. This apparent lag in adoption of new clinical practices based on scientific evidence is supported by the recent finding that 72 percent of states allowed a lesion confined to enamel to be restored as part of the requirements for clinical board examinations," the Michigan researchers observed, citing a September 2001 article in *Critical Reviews in Oral Biology & Medicine*.

That article posed the question, "Is it time to change state and regional dental licensure board exams in response to evidence from caries research?" The authors conducted a survey to learn whether Class 2 tooth preparations for carious lesions with radiolucencies confined to enamel were allowed for state and regional exams. They found that 33 states allowed teeth with either an E1 or E2 lesion to be restored. Only 12 states did not allow such lesions to be surgically treated.

In fact, there are those who question the ethics of allowing a restoration of any early carious lesion, let alone one for a board exam. Among them is Dr. Doug Young, associate professor in the Department of Diagnosis and Management at the University of the Pacific, San Francisco, School of Dentistry. If dentists still must be tested on whether they have the necessary skills to perform a restoration on an early carious lesion, "perhaps they should be done on a typodont, not a human being because of the ethics involved," says Young, who is spreading the word about a caries risk assessment system developed in California that would allow dentists to identify the risk of caries much earlier and treat it non-surgically.

State dental boards, continues Young, are still testing on the G.V. Black preparation design. "That is a huge concern because ethically some of these lesions that are being accepted for the board should not be drilled at all knowing what we know now about remineralization."

To Rosenberg, modern dentistry and its extension-for-prevention philosophy has always meant "extension for ruining teeth." Rosenberg hopes to help change that mindset as the current president of the World Congress of Microdentistry. "We don't have to over-prepare teeth," he observes.

Dentists who practice minimally invasive care, explains Rosenberg, treat dental disease as a bacterial infection. They use early caries detection devices such as DIAGNOdent (KaVo America Corp.) or caries indicator dyes (which will be addressed in the October issue); they use antibacterial agents such as chlorhexidine to bring down the level of streptococcus mutans, and then fluoride treatments to remineralize early carious lesions. For the lesions that require restoration, these dentists use microburs, air abrasion and hard-tissue lasers. "Selective caries removal" is the new buzz phrase.

"Using these wonderful technologies, like the Biolase YSGG laser (Waterlase®), we can treat teeth and tissues minimally invasively without trauma, without pain and often without anesthesia," adds Rosenberg. "So we really have a tremendous number of technologies that exist now that we didn't have that are literally changing the face of dentistry worldwide."

"I think the more tools we have at our disposal, the better off we are to do the best dentistry we can do," continues Rosenberg. "There are times that on one tooth I will use the laser, air abrasion, a bur and a spoon excavator. You need to have all these things."

As convinced as some in dentistry are that minimally invasive dentistry will become the standard of care within the next five years, others like Dr. V. Kim Kutsch, of Albany, Ore., aren't so sure. A founding member and the first president of the World Congress of Microdentistry, Kutsch says he "strongly believes" this new approach will become the standard of care in dentistry, "but it may take 10 years or more to penetrate the profession on a large scale."

Already, observes Kutsch, "minimally invasive care is a standard of practice in a growing number of practices in the United States." Optimistically, Kutsch adds he believes dentists will be proactive in adopting this new paradigm because it is ultimately in the best interest of patients.

Plus, he says, technological innovations are making it easier than ever for dentists to practice minimally invasive dentistry. "From a technological standpoint," he says, "all the materials and technologies that have been developed in the last 10, 12, 13 years and continue to be developed have just made it a lot easier and a lot more sensible for us to practice minimally invasive care."

Among the innovations that may prove particularly beneficial to minimally invasive care are a number of new and expanded uses of lasers, new bur designs and a caries intervention and prevention system developed in California called Caries Management By Risk Assessment (CAMBRA). Of these developments, Kutsch says he's most excited about CAMBRA.

cambra

Already using the system in his own office, Kutsch says, "I get to the cause of the disease, instead of just treating the symptoms," he says. "When you're focused on just treating the symptoms surgically, which traditionally is what we've done in dentistry, you never catch up. You never get ahead."

The byproduct of a consensus conference held in April 2002 in California, CAMBRA allows dentists to "get in at a much earlier stage of decay," says John Featherstone, Ph.D., chair of the department of preventive and restorative dental sciences at the University of California, San Francisco School of Dentistry.

Featherstone, who organized the conference, published a consensus statement on CAMBRA in the March issue of the Journal of the California Dental Association. Characterized as a set of recommendations and guidelines for practical caries intervention and prevention, CAMBRA essentially involves a more involved patient health history form specifically geared to help determine a patient's risk of caries, a test to measure the level of cariogenic bacteria in the patient's mouth and a set of recommendations for caries control and management.

According to the consensus statement, the diagnostic screening process begins with the usual examination. That is followed up with a series of questions from the caries risk assessment form to obtain the maternal dental history, the oral health of the entire family, the socioeconomic status of the family and the frequency of ingestion of fermentable carbohydrates. "High-fructose corn syrup is the major sweetener in the United States," the consensus statement notes. (Visit www.cdafoundation.org/journal/ for the form.

If indicated, the office then may need to measure the level of bacteria in the patient's mouth. Currently, there is only one such test available, says Featherstone. That is the Ivoclar Vivadent Caries Risk Test (CRT), which includes the bacteria two-in-one dip-slide test that permits both lactobacilli counts in saliva as well as mutans Streptococci counts in saliva or plaque to be measured on the same slide. Though the saliva sample can be gathered easily enough for the test, results are not available for 48 hours.

Levels of mutans streptococci of 10⁵ cfu/ml and lactobacilli of 10³ cfu/ml and above are considered high risk.

Then, if indicated, the office may need to test the patient for salivary dysfunction to help pinpoint the cause of the cariogenic bacteria found in the mouth or to learn why there's been a sudden increase in carious lesions.

"If bacteria levels are low," says the consensus statement, "any early carious lesions detected may be treated and reversed by employing topical fluoride treatments. If the bacteria levels are high, an antibacterial agent is necessary, followed by fluoride treatments."

Featherstone notes that chlorhexidine gluconate, available via prescription only, is used twice daily for a two-week period every two to three months. For high-risk patients, this therapy continues for about a year. Chlorhexidine, however, isn't as effective against lactobacilli, so this is one area where new innovations would be welcome, suggests Featherstone.

HealOzone from CurOzone U.S.A. Inc. may be one such alternative available in this country within the next five years. Though only available overseas now, HealOzone uses ozone gas to treat carious lesions, and it has been shown to effectively reverse both fissure and cervical caries with no pain for the patient. (See "Ozone lands overseas," in related links below.)

Another alternative, though not thoroughly proven yet, is povidone iodine. This can be applied in the dental office and has been shown to reduce the levels of lactobacilli as well as mutans Streptococci, says Featherstone.

In his practice, Kutsch notes that he's experimenting with Betadine® as an alternative to chlorhexidine. "As long as the patient is not allergic to iodine, it kills caries-causing bacteria on contact," he reports. "So a one-minute rinse, based on preliminary research, kills all bad bacteria for three to four months."

"We had been using chlorhexidine twice a day for six weeks, which requires a lot of patient compliance," explains Kutsch. With Betadine, he adds, it's a one-minute rinse in the dental office and the patient is set for three months. "That gives me a three-month window to begin managing the caries in the patient's mouth."

Antibacterial treatment then is followed by topical fluoride treatments to promote remineralization and prevent demineralization. This includes fluoridated drinking water, fluoridated toothpaste or gels, over-the-counter fluoride rinses, as well as professionally applied topical fluoride varnishes, foams, gels, acidulated phosphate fluoride and stannous fluoride. Prescription, high-concentration fluoride gels and toothpaste are available for high-risk patients, especially in adults for root caries.

While CAMBRA identifies three pathological factors that may put a patient at high risk for caries, not all three need be present, adds Featherstone, noting that the entire CAMBRA process requires the dentist's clinical judgment to determine a patient's level of risk.

Young, who will be lecturing on CAMBRA at the fourth Annual World Congress of Microdentistry in August at the Sheraton Wall Centre in Vancouver, B.C., says a caries risk assessment is simply weighing the bad factors, such as cariogenic bacteria, poor dietary habits and salivary dysfunction, against healthy oral health indicators like normal salivary function and a number of remineralization and protective treatment options.

And as not everyone who has cariogenic bacteria ends up with decay, says Young, the caries risk assessment becomes a critical tool to help a dentist determine what might be happening in a patient who suddenly begins developing a number of carious lesions. Even if the cariogenic bacteria levels have remain unchanged, he adds, "obviously there are other things going on.

"It's the balance in each individual that's different that you have to assess before you start drilling a tooth."

Featherstone, citing a case from the UCSF dental clinic, explains how CAMBRA works in practice: A woman in her 20s, attending college for a couple of years—a very driven person—was referred to the dental school clinic by her general dentist, who was at a loss to understand why she was suddenly having new decay when she hadn't apparently had any decay in the past. She had one cavity and a number of others just getting started. The clinic conducted a caries risk assessment, beginning with the Ivoclar Vivadent Caries Risk Test. The clinic discovered that she had a very high level of all of the caries-producing bacteria in her mouth.

Next, the clinic performed a saliva flow rate test. When that turned out normal, the clinic then asked the patient about her diet. "She was forever snacking," says Featherstone. "So she had two out of three caries risk factors."

Plus, while the patient had reasonable oral hygiene habits, they weren't the best. "So we began treating her by putting her on chlorhexidine for two weeks to bring down the bacteria levels," Featherstone says. Next came a high dose of fluoride gel for the following few weeks. Then back to chlorhexidine for another week, and then back on fluoride. Then the clinic restored the one carious lesion while the other early carious lesions had been remineralized thanks to the fluoride treatments.

"We took care of her lesion, her bacteria are down and her fluoride use is up," concludes Featherstone. "And she's modified her diet and she is under control."

While Featherstone isn't ready to proclaim CAMBRA a new standard of care, he suggests that all dentists should follow this protocol from an ethical standpoint. Not only will the legal system drive that, he says, but conserving as much healthy hard and soft tissue as possible has always been the goal of dentistry. And it is accepted that doing so generally is in the best interest of the patient.

And at least one dental negligence attorney has been successful in winning cases against dentists who don't currently practice the caries risk assessment and

treatment process now formalized in CAMBRA. In fact, periodontist and attorney Edwin Zinman of San Francisco is emphatic that all dentists should practice caries risk assessment, intervention and prevention because "it was, is and will be the standard of care."

smartprep

Whereas CAMBRA could be viewed as non-invasive, suggests Dr. Daniel W. Boston, associate professor and chairman of the restorative dentistry department at the Temple University School of Dentistry in Philadelphia, dentists still need help practicing minimally invasive care once the decision has been made to restore a tooth. That's what led him to invent a polymer instrument that reportedly is incapable of harming healthy dentin.

S.S. White Bur Inc.'s SMARTPREP Instruments, unveiled at the Chicago midwinter meeting in February, are designed to remove caries, but leave healthy dentin intact. The single-use polymer instrument breaks down when it comes in contact with healthy tooth structure.

"I think minimally invasive dentistry is on all dentists' minds these days, trying to minimize removal of healthy tooth structure," says Boston. "Also, there's an interest in knowing when do you have all the caries out—not wanting to over-prepare and not wanting to under-prepare."

Boston also developed S.S. White's Fissurotomy® burs, which allow dentists to cut a smaller access to carious lesions. "The bur is designed for the specific task of opening fissures when indicated," he notes. "Within the fissure, you don't have to do a standardized preparation where you'd cut the entire fissure away and make a large preparation for an amalgam. You can treat every millimeter of the fissure according to the pathology that's present."

co2 laser

Though not currently available, a CO2 laser developed by UCSF's Featherstone is another selective caries removal system capable of removing decay without harming healthy tooth structure. The laser heats up the caries within the tooth, vaporizes the decay and then allows the tooth to resolidify, he explains.

When Featherstone first began working on the laser in the early 1980s, the goal was to develop a laser that could be used to prevent decay, "that we could alter the composition of the mineral in the teeth, particularly the enamel, and make it much more resistant to acid.

"What the laser does is heat up the surface of the enamel a few microns deep to about 1,000 degrees Celcius for a period of about a microsecond, and then it cools down until we hit it with another pulse," continues Featherstone. "And we recently did a safety study that showed that the amount of energy that we're putting in does not detrimentally raise the temperature in the pulp and doesn't damage the tooth.

"So if you get your conditions in the mouth just right," he concludes, "you can heat up the surface of the tooth so the next time acid comes around it can't dissolve that." This would be particularly helpful on occlusal surfaces, he adds. "If we could

go right to a particular pit where there's some early decay, blast that with a very fine laser beam at exactly the right wavelength with exactly the right conditions, what that will do is actually melt together the decayed mineral and it will cause the decay to evaporate and come out as a plume."

Expect to see this caries removal laser available within five years. As a preventive tool, however, more long-term research will be required, says Featherstone.

calculus laser

Another hard-tissue laser that could be available within three to five years promises to remove calculus but not healthy tooth structure by focusing on the absorbency of calculus, explains Dr. Peter Rechmann, also a professor at the UCSF dental school. There is a natural difference between the absorbency of bacteria and that of healthy tooth structure, he says. "This new blue laser is exactly absorbed by bacteria," reports Rechmann, "so only bacteria will be ablated. As soon as bacteria and calculus are gone, the ablation stops."

Though there is no feedback mechanism built into the laser, Rechmann says a doctor will know the laser has completely removed decay when the "tick, tick, tick" of the ablation sound stops. "As soon as the bacteria are gone," he says, "you hear nothing anymore." Ablation also produces bubbles from the microexplosions that occur when the laser beam hits decay and vaporizes it. "So, no bubbles and no sound, it's done. It's clean."

The laser, he adds, can be used to get into the sulcus and clean it without removing healthy cementum. So it could be used as a maintenance tool, suggests Rechmann.

new laser uses

While the caries and calculus removal lasers are not yet available, at least one existing hard-tissue laser on the market recently received FDA approval for apicoectomies—the Waterlase® system (Biolase Technology Inc.).

Expect more such approvals in the coming years, suggests Dr. Eric S. Bornstein, of Natick, Mass. Bornstein, who owns two dual wavelength lasers (Er:YAG/Co2) and two 830nm diode lasers from OpusDent USA, uses the erbium lasers to do full apicoectomy procedures, "from flap design to bone ablation to cutting off the root tip."

In fact, he's been using erbium lasers to do bony surgery for more than two years. "And with tremendous success," adds Bornstein. "It's much less invasive than using a high-speed bone bur and much safer ... than a large round bur spinning at 250,000 rpm. In two years of doing these procedures, I have yet to have one mishap."

With the erbium laser, he says, bacteria in the path of the beam are vaporized as you cut through bone. That's much better than "putting a high-speed instrument on the tissue and basically just spinning the bacteria around."

Though lasers have yet to capture a wide audience in dentistry, Bornstein suggests that could change as dentistry adopts a more minimally invasive approach to dentistry. Within five years, he says, "I think lasers are going to be ubiquitous in

dental offices across America."

One of the obstacles to widespread use of lasers, he adds, is the perceived educational curve. To pick up a laser and use it effectively, Bornstein says, dentists think "they suddenly have to get a degree in quantum mechanics. And that isn't necessarily the case. If you start with one laser, say a diode soft-tissue laser, and you become comfortable with it, then you can move up to another laser, like a hard-tissue laser."

Just don't jump in all at once, he suggests. Dentists who have tried that "end up burning tissue or not getting the reaction they were looking for [and they] get frustrated. And sometimes they will put these big expensive machines in the corner and not use them."

Posted by dentalproducts.net. Originally published in the July 2003 Dental Practice Report. Copyright 1999-2005 Advanstar Dental Communications.