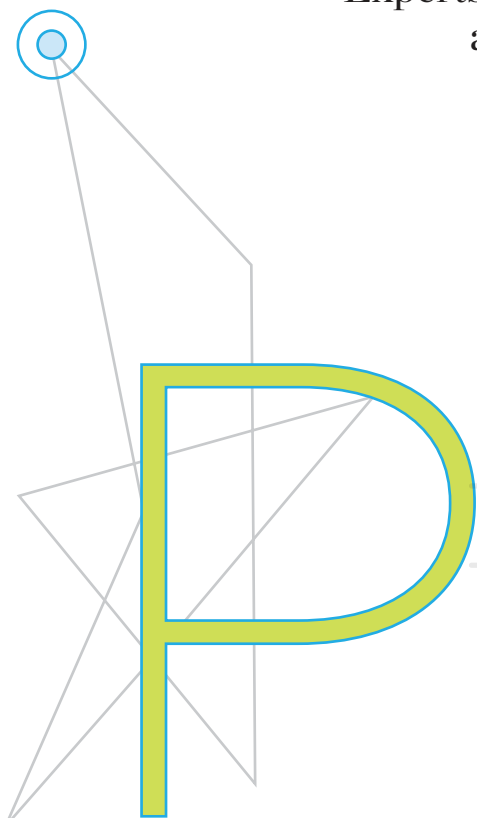




THE 2012

# TECHNOLOGY ISSUE

Experts report on the latest advances in 14 categories from CAD/CAM and cone beam to digital impressioning and radiography.



Patients not only understand and appreciate advances in modern technology, they have come to expect them wherever they go—including the dentist's office. Dentistry, like every area of healthcare, continues to evolve with the digital age. New and improved technologies are constantly being

developed and introduced that offer oral healthcare professionals better tools and materials to help them provide enhanced patient care and meet today's higher patient expectations.

This month, we are pleased to present our 2012 Annual Technology Review. We asked key opinion leaders in 14

major technology categories—CAD/CAM Materials, CAD/CAM Laboratory Services, Caries Detection, Cone Beam, Digital Impressioning, Digital Radiography, Handpieces, Implant Guidance, Intraoral Cameras, Lasers, Dental Microscopes, Oral Cancer Detection, Salivary Diagnostics, and Shade Matching—to give an overview of what's new now and what's on the horizon in their respective category, as well as share their thoughts on what may influence technology integration and adoption throughout the profession, such as more accurate diagnoses and treatment plans as well as savings in both time and materials. They also offer compelling reasons for integrating these technologies into your practice. Whether it's better materials, better diagnostic ability, or better equipment, all of the technologies presented here warrant thoughtful and thorough consideration in order to maximize the benefits for you, your practice, and your patients.

*Introduction by Lisa Neuman*

# The New Dental Laboratory

BY CHRIS BROWN, BSEE

Dental laboratories are in transition. While a majority of laboratories are still providing quality restorations using traditional methods and materials, more and more are making the transition to digital workflows.

It's not easy for every laboratory to make the transition. The capital investment can be significant. There is a steep learning curve associated with the new equipment, tools, and workflows. Even the most skilled technicians need some time to become proficient and productive. This is also a major departure from traditional fabrication processes, unlike anything most laboratory technicians are used to. While it is challenge to embrace and adopt the new technology and new materials, the laboratories that do quickly discover the benefits once the learning curve has been mastered. They include better accuracy and consistency, greater productivity, additional material options, new manufacturing partners, and—quite often—new products.

## Complete Outsourcing

Complete outsourcing is essentially a no-cost entry point for dental laboratories into the digital workflow. They can partner with milling centers or mega-laboratories that have already made the capital investment in CAD/CAM. It allows the laboratory to focus on business relationships, growth opportunities, and final customization or characterization of restorations.

## CAD Software

CAD software, which ranges from \$4,000 to \$8,000, is the next lowest cost option for dental laboratories. It gives laboratories the opportunity to accept digital impression cases from doctors and design restorations.

**Products:** *Porcelain-fused-to-metal via wax printing/milling, porcelain-fused-to-zirconia, porcelain-fused-to-alumina, provisionals, full-cast metal or pressed-ceramic via wax printing/milling, milled full-contour restorations.*

## Model Scanner/CAD Software

The model scanner/CAD software configuration is the most common solution for laboratories. It enables labs to accept digital impressions or scan their own poured models. Special software modules are available—typically at an additional cost—to design custom implant abutments and removable frameworks and to virtually build models from digital impressions or scanned impressions. There is a mixture of closed and open-architecture systems available. Closed-architecture systems may limit or restrict which materials or products are available to the laboratory. Even some systems frequently considered open-architecture platforms can be restricted by the reseller so that cases can only be sent to a specific milling center or manufacturing partner. The cost to laboratories ranges from \$10,000 to \$30,000.

**Products:** *Same as above plus custom implant abutments, removable frameworks, working/solid models, and diagnostic models.*

## Model Scanner/CAD Software/ CAM Equipment

In the past, the purchase of model scanner/CAD software/CAM equipment has only been an option for milling centers. It offers the same benefits as the model scanner/CAD software configuration, but adds computer-aided manufacturing capabilities. The investment cost is high—typically \$75,000 to over \$100,000; however, some lower-cost milling systems that have been recently released in the \$30,000 to \$50,000 range show promise for milling wax, zirconia, and nano-resins. Printers are available for printing wax patterns, resin models, and surgical guides. Manufacturing apparatus such as the types found in milling/production centers typically require dedicated staff to maintain and operate the equipment.

**Products:** *Same as above plus surgical guides.*

## Growth Areas in 2012

CAD-based custom implant abutments are becoming extremely popular. Milling and production centers can produce custom abutments at very competitive prices. Laboratories can simultaneously design full-contour crowns or crown-and-bridge substructures while designing the abutment. Abutments can be designed to be anatomical, with retentive contours, and do not need to be scanned before designing the crown. This improves turnaround time within the laboratory and generally results in better fits between the abutment and the crown.

Scanning of traditional impressions and model printing shows considerable potential. However, there are inherent limitations for scanning undercut areas of impressions in anterior cases. For posterior cases, it is less of an issue and shows considerable promise, as model printing systems or milling systems are being put into service by larger laboratories and milling centers.

With the improved esthetics and shading systems, full-contour zirconia is gaining popularity. In addition, new milled ceramic materials are also being released this year. These milled restorations are paving the way for laboratories to offer model-less restorations. Model-less is not an option for layered, pressed, or cast restorations. The accuracy and precision of CAD software and milling systems is making it possible for milled full-contour restorations to be produced without the need for a model.

Restoration design services are an untapped market. Laboratories should be offering design services for their doctors who have purchased chairside CAD/CAM systems. Once the case has been scanned at the clinic, the digital case file can be transferred to a laboratory design station. A technician can then design the case and forward it back to the clinic for milling. It may require special software from the chairside CAD/CAM system manufacturer and arrangements with the laboratory, but it is definitely a viable option for dentists seeking to get the most out of their investment.

Digital dentistry continues to evolve. Laboratory integration of digital workflows is certain to provide new opportunities for both doctors and laboratories alike.

# Cone Beam CT

BY DALE A. MILES, DDS, MS

It is nearly impossible to be unaware of the enormous impact cone beam CT (CBCT) technology has had on the dental profession in the past few years. This digital imaging technology can truly be defined as disruptive in a good way. Its positive impact and rapid adoption can be explained by its many applications for everyday dental tasks. Clinicians who do root canals, implant surgery, restore implants, extract third molars, perform any orthodontic procedures, or have patients who snore or have temporomandibular joint disorders or sinus pain, have likely investigated or will investigate the advantages of this imaging modality.

## Great for Dentists

CBCT imaging enables the practitioner to examine thin-slice (0.1 mm or less) 2-dimensional (2-D), grayscale data in three anatomic planes of section, instead of using conventional radiographs in an effort to represent 3-D data on 2-D images. The difference is like night and day. In addition, CBCT scan data can also be used to examine an anatomical region or characterize pathology in 3-D color. This type of radiographic examination was never before available to dentists, who previously lived in a flat, gray world of shadows, which they tried to interpret, sometimes with questionable success.

For example, dentists can try to recall all the ways they tried to examine the temporomandibular joint condyle for simple changes associated with osteoarthritis. They used panoramic images, tomographic images, transcranial images, and other plain film techniques with little success. Now they can have condyle images in glorious 3-D color as well as thin-slice, extremely accurate grayscale images instead of 3-mm “cuts,” which left them guessing at the changes on the condylar surface, and even the position of the condyle in the glenoid fossa. Figure 1 and Figure 2 show comparative images for this argument, clearly making the point that these images would benefit the clinician.

## Great for Patients

How will the patient benefit from CBCT imaging? While not as obvious as the applications above, with more precise measurements, more accurate diagnoses, more confidence in their dentist's decision-making, patients, too, have much to gain from CBCT technology. For instance, there will be less morbidity with implant procedures because of the ability to determine precise measurements of available bone before reaching the sinus or the submandibular salivary gland fossa. The chance of perforating the inferior alveolar nerve is virtually eliminated by accurate measurements and surgical guides made from CBCT data. The assessment of the relationship of the inferior alveolar nerve to an impacted third molar is made simple and accurate so that the data can be shown graphically to the patient while discussing their potential risk of nerve

damage. They can actually see the difficulty involved in the extraction. They are also less likely to sue after having been presented with an accurate assessment, a clear picture of their specific problem, and a better informed consent prior to the procedure. Furthermore, the low-dose CBCT procedures involved in implant cases eliminate the need for conventional CT with the associated increased costs, increased radiation dose, and potential scheduling problems.

### Great for the Profession

How does the profession benefit from CBCT? For one thing, the author believes CBCT leads to more efficient communication between general dentists and dental specialists. When both parties can see accurate detail of the potential problems that might arise during a procedure, both parties can better appreciate the complexity of the case. For example, many clinicians refer simple endodontic procedures to an endodontist because they do not like performing them. Typically, only a periapical radiograph accompanies the patient referral. Because many endodontists now use CBCT, they can characterize the root morphology, number of canals, and lesions of endodontic origin arising from lateral canals in a more graphic way to show why the root canal procedure may have failed. The dentist using only 2-D grayscale films or solid-state images could not possibly see a residual periapical problem on the palatal root of the upper first molar. CBCT allows the endodontist to identify such reasons for failure and communicate this to the dentist in a more precise manner. Even the ability to see slice grayscale data in thicknesses of 0.1 mm is improved using CBCT compared to conventional radiographic techniques for discovering residual apical problems. Better communication ensues between the dentist and the specialist.

Another area that benefits the profession is in the referral of patients to their primary care provider or a medical specialist when a serious or potentially serious medical condition is found on routine CBCT volumes. As a result of this information, dentists are likely to send more patients for evaluation of hypertension, stroke risk, and diagnosed or uncontrolled type II diabetes mellitus than they ever did before.

Given that dentists using CBCT are now likely to discover significant radiographic findings involving medical conditions more often, they must be prepared to refer patients with such findings to their primary care provider and/or an internist for additional clinical evaluation. More often dentists will find themselves writing the following statement in their referral letters or on their CBCT reports to be sent to their medical colleagues: *This patient has been referred to you as their primary care provider for evaluation of hypertension and stroke risk as well as possible dysglycemia or serious renal problems.* While some clinicians may find this cumbersome, in actuality, this intervention will help solidify a close professional relationship with their medical colleagues and is likely to enhance the dentist-patient relationship. More importantly, it will help identify patients with significant problems related to hypertension, diabetes, and even renal disorders much earlier.

## Caries Detection Tools

BY JOEL BERG DDS, MS

Improvements in dental caries detection technology continue to be made. Whereas 20 years ago there were few, if any, advanced technologies present in the marketplace, today there are a dozen or more products making claims that they can detect caries lesions, some at a far earlier stage than visual examination or radiography.

The need to detect caries lesions specifically and to assess caries risk in a patient globally could not be greater. As caries rates in preschoolers continue to rise in the United States, and as the world brings more refined sugars into its diets, it appears there will be a worldwide climb in early childhood caries rates. Given that less than 5% of children actually receive a dental examination in a dental home by their first birthday, as recommended by the American Academy of Pediatric Dentistry and the American Dental Association, we need to partner with colleagues in the healthcare profession as a whole to screen children who use other venues for healthcare at a young age, and direct those at highest risk to a dental home for caries management early and often. Caries assessment tools that gather environmental and historical data, perhaps along with bacterial tests, will elicit the most information regarding patients at risk for manifesting caries lesions, but not perfectly. There is a high degree of false-positives with some of these methods that are commonly employed. In order to benefit those patients most needing caries management, the dental profession needs a method of precise, specific identification of those at risk for tooth decay.

This author believes that increased *specificity*—while retaining good *sensitivity*—of caries lesion “prediction” will be best realized through the use of new technology. It will be because of the continued development of currently available or developing

technologies that a patient will be scanned when the earliest stages of the disease process can be detected. If a baby who goes to the pediatrician for a 1-year well-baby visit could get the emerged primary teeth scanned for early disease (disease that would be clinically undetectable), we might be able to isolate that segment (perhaps a large segment in some populations) not only at risk, but already exhibiting disease in the earliest stages, before it has extended into clinical disease requiring surgical intervention.

Several technologies either currently exist or are under development for a specifically targeted product that might be perfected into a device that could examine the lingual surfaces of primary incisors at age 1 year or younger to “look” not at only risk, but for the clinically undetectable early signs of disease. Currently marketed technologies include laser fluorescence, LED examination of enamel contiguity, electrical conductance (impedance), digital fiber-optic transillumination, infrared or near-infrared assessment of mineralization or biofilm activity, and several others. These technologies are used in products that often make claims without clinical evidence.

Where there is clinical evidence available, it has been found that the detection ability of many devices thus far is highly sensitive but yet not adequately specific. It is hoped that these technologies can and will be further developed within the specific scenario of early childhood caries, so that a reliable, sensitive, and specific device can be created. Such a device would “see” the early stages of caries in a young child (or even an adult) that would not require immediate treatment but, through carefully performed clinical studies and documentation, would predict a continued caries process in that patient.

The series of clinical circumstances that ultimately lead to early childhood caries that manifests as lesions in an 18- to 24-month-old child likely exists at the 1-year well-baby visit, when the lesions are still too small to be clinically visible. A new device that would solve this problem will benefit millions of children in this country as well as in developing countries, where there are far too few dentists and where the risks of caries disease in children will lead to a significant health crisis if this path is left unaltered.



# New Options in CAD/CAM Materials

BY GREGG A. HELVEY, DDS

Digital dentistry is contributing more and more to the day-to-day operations of a dental practice. In particular, CAD/CAM technology has increased the efficiency of restoration delivery. Whether the restoration is fabricated chairside or in the laboratory, digitally scanning the prepared tooth provides a proficient means of creating a virtual model and a milled restoration without having to compensate for all of the tangibles associated with the traditional gypsum model and die. Variables can range from expansion and contraction value differences of the various materials to the cross-contamination of the burs when finishing the different metal substructures. The compensations that need to be made during fabrication of the traditional ceramo-metal crown make this process “technique sensitive.” As computer technology improves, dental laboratories are reporting a decrease in the demand for ceramo-metal crowns and an increase in all-ceramic restorations. A large majority of these all-ceramic restorations are made using a digital scanning process and computerized milling of a monolithic ceramic block. The materials available for these CAD/CAM systems have also expanded.

Initially, there were only a few choices starting with the VITALOCS Mark II<sup>®</sup>, (Vident, [www.vivadent.com](http://www.vivadent.com)) which was designed specifically for CAD/CAM and has been used for over 25 years. It is a monochromatic, fine-particle feldspar ceramic with a crystal size ranging between 5  $\mu\text{m}$  and 10  $\mu\text{m}$ . The ceramics available when this material was introduced were in the range of 200  $\mu\text{m}$  to 300  $\mu\text{m}$ .<sup>1</sup> The decrease in particle size makes the material better able to resist machining damage during the milling process. IPS Empress<sup>®</sup> CAD (Ivoclar Vivadent, [www.ivoclarvivadent.com](http://www.ivoclarvivadent.com)) is another millable ceramic block that has

a distinguished track record. This material is based on the IPS Empress Esthetic press-ceramics containing 45% by weight of leucite in a feldspathic glass matrix.

In the 1990s, 3M ESPE ([www.3mespe.com](http://www.3mespe.com)) introduced a composite block based on the restorative material Z100<sup>™</sup> and was capable of milling inlays, onlays, and crowns. The advantage of using this composite material over a porcelain version is the handling of the milled restoration during the try-in stage, eliminating hydrofluoric acid treatment of the bonding surface, and the lack of wear of the opposing dentition.

The esthetics of millable blocks was elevated with the introduction of tri-layer blocks that have layers of increased chroma and decreased value. Intended for use in the anterior region, these blocks eliminate the monochromatic shade and decrease the need for chairside staining. Recently, Vident launched a new line of layered ceramic blocks that represent an actual tooth where the layers are composed of an internal dentin shade covered by an enamel shade.

In 2006, a partially crystallized lithium-disilicate ceramic block (IPS e.max<sup>®</sup>, Ivoclar Vivadent), also called “blue block” due to the color of the block during milling, was introduced. This ceramic material represents an increase in flexural strength by 170% over the leucite-reinforced ceramics.<sup>2</sup> It is milled in the lithium-metasilicate state and then fired in a two-stage porcelain furnace for 20 minutes, rising to a temperature of 840°C to 850°C. The gradual rise in temperature allows for a controlled growth of crystals, accounting for the increase in flexural strength to 360 MPa.<sup>3</sup> This ceramic can be used for inlays, onlays, veneers, and crowns.

The newest addition of milling blocks is Lava<sup>™</sup> Ultimate CAD/CAM Restorative from 3M ESPE. According to the manufacturer, this material is a combination of ceramic and resin and uses a new nanoceramic technology. Combining the best aspects of composite and ceramic, it has the fracture resistance of a composite and the polish retention of a ceramic. The restorative material is heat-processed during the manufacturing process, which eliminates any post-milling conditioning. It has a much lower flexural modulus compared to the leucite-reinforced materials, which means it has stress-absorbing qualities, which could be desirable for implant restorations.

There are also provisional materials supplied in larger size blocks that can be used for long-term situations. These blocks, CAD-Temp (Vident) and Telio CAD (Ivoclar Vivadent), are available in a variety of shades and sizes.

The choice of different materials for CAD/CAM restorations is expanding, which allows the clinician greater opportunities to use this technology. Whether the restoration is fabricated chairside or in the laboratory, digital technology is proving to be more of a dominant method in restoring teeth.

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# Electronic Shade Matching Update

BY CHAD J. ANDERSON, DMD

Wouldn't it be great to have a small cordless handheld device that could read all the visual attributes of a tooth so that a restoration could be made to match exactly 100% of the time regardless of environment and lighting conditions? While such electronic shade matching is not here yet, advances are being made so that one day this may happen.

## Gone Today: X-Rite and Olympus

Although electronic shade matching may seem current and high-tech—which it is—there has been some stagnation in the area of research and development of these devices for the past several years. This can be attributed to the economy, and, subsequently, from the companies that were making and supporting these products.

As of this writing, the two biggest companies involved in electronic shade matching—X-Rite and Olympus—have effectively ceased their involvement in dentistry and pulled their electronic shade-matching devices from the dental market. Admittedly, these two players were just dabbling in the dental market, seeking additional profits by modifying existing technologies to fit the needs of dentists and laboratories. (X-Rite's business focus is publication, graphic arts, and industrial/commercial paint-matching applications; Olympus's core business is in photography and scientific instrumentation.) In the end, developing and maintaining support for these devices and their specificity to the dental market did not make business sense for those companies.

## Still Standing: Spectro Shade Micro

Still on the market is the Spectro Shade Micro<sup>™</sup> (MHT, [www.mht.ch](http://www.mht.ch) [distributed by Clon 3D, [www.clon3d.com](http://www.clon3d.com)]), which has a combination digital color imager (digital camera) and spectrophotometer. The advantage of this device includes the ability to acquire polarized images and use them for color analysis calculations and comparisons with several shade guides as well as coarse and fine-color shade mapping. The Spectro Shade Micro allows the user to send this data via e-mail to the laboratory and the ability to overlay the clinical image with a color map.

## Something New from VITA

Some innovation in color matching was recently introduced by the most recognized company in dental shade matching, VITA ([www.vita-zahnfabrik.com](http://www.vita-zahnfabrik.com)). In November 2011 they began selling their new VITA Easyshade<sup>®</sup> Advance, which is a modification of the easy-to-use and popular VITA Easyshade<sup>®</sup> Compact.

The Easyshade Advance is the same portable handheld spectrophotometer as the Easyshade Compact, but with a few subtle improvements. The first and most



significant is the ability to select the best shade match to VITA's CAD/CAM VITABLOCS. This is an intuitive addition to the existing features, because those practices that are adopters of CAM/CAM restorations have an affinity for other high technologies such as electronic shade matching. The Easyshade Advance continues to give shade matches to the VITA classical A1-D4, VITA classical A1-D4 with Bleached Shades, VITA Linearguide® 3D-MASTER, VITA Toothguide 3D-MASTER®, and the VITA Bleachedguide 3D-MASTER®. Between these shade guides, the vast majority of the possible natural tooth colors can be matched. The second major improvement VITA made was an increase in the memory storage capabilities from 25 to 30 tooth-shade measurements. Although these are slight improvements, they make the device usable to those practices currently using VITABLOCS.

However, unlike the Olympus, X-Rite, and MHT systems, The VITA system also does not have the capability to take a photographic image. A significant feature the author would like to see added to the Easyshade Advance is a stump shade guide. With the significant increase in the use of all-ceramic restorations and the addition of CAD/CAM blocks, it would be intuitive to provide stump shade guide data. This would provide the critical underlying stump color that a laboratory technician needs when creating an all-ceramic restoration. On the VITABLOCS setting, there is a built-in function to determine how the underlying stump color will affect the final restoration, and a calculation is made to select the correct block. VITA maintains that feature was included in the new version because stumps of most prepared teeth are too small to accurately determine the shade.

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## Conclusion

Given that both Olympus and X-Rite are no longer providing electronic shade-matching devices, there are fewer options to choose from when looking for an electronic shade-matching system. The most recently improved system is the VITA Easyshade Advance, which provides only shade matches to its own shade guides and does not offer stump shades or the ability to take a photographic image.

Even with the departure of two of the biggest companies involved in shade matching and some stagnation in the development of available products, there are still some very good options for electronic shade matching.

# Making Oral Cancer Screening the Standard of Care

BY DENNIS M. ABBOTT, DDS

Sixty-three percent of those polled... 4 out of 5 dentists recommend... an acceptance rate of only 9%...”

We are bombarded with statistics like these everyday, but rarely do we slow down to really consider their meaning. So, stop. Take a moment, and consider the following: 1 in every 93 people will be diagnosed with cancer of the oral cavity and pharynx during their lifetime.<sup>1</sup> One in 93. Think about how many friends you have on Facebook, how many patients you see in a week, or how many people were in your high school graduating class. Chances are, oral cancer will touch your life sometime, somewhere.

Unfortunately, most oral cancers are *not* detected early. The majority of cancerous lesions are found after metastasis has occurred when the 5-year relative survival rate is less than 35%.<sup>1</sup> Early detection, however, significantly improves the chances of a successful outcome. When oral cancer is detected and treated early, the 5-year relative survival rate increases to more than 82%.<sup>1</sup> These statistics send the message loud and clear: early detection saves lives. The fact is, most people who present with advanced oral cancer were not *screened*. Screening is looking for cancer *before* a person has symptoms.<sup>2</sup>

By the time symptoms appear, it is likely the cancer has begun to spread. As dental professionals, we are on the frontline in the battle against oral cancer. We, better than anyone else, understand what “normal” looks like in the mouth. Although an oral cancer screening is not required by most state dental boards, the American Dental Association<sup>3</sup> and the American Cancer Society<sup>4</sup> recommend an oral cancer screening as part of every periodic dental examination. Sadly, published studies state less than 15% of those who have visited a dentist report having had an oral cancer screening.<sup>5</sup>

The association of the human papilloma virus (HPV) with oropharyngeal cancers has changed the demographics of the at-risk population. Oral cancer is no longer just a disease that affects older men who smoke and drink, although age, gender, and alcohol and tobacco use continue to be risk factors. The HPV-positive group is the fastest-growing segment of the oral cancer population,<sup>6</sup> and this new etiology broadens the scope of the population that should receive regular, annual oropharyngeal cancer screenings.

The truth is that dentists and hygienists are in a position to make a difference in the oral cancer mortality rate in the United States by making an oral cancer screening part of each periodic examination. Patients should be told that they are being screened for oral cancer. Doing so lets the patients know that you sincerely care about their health and increases awareness for patients to self-monitor at home in between visits to your office.



An effective oral cancer examination can be completed with a piece of gauze, a tongue depressor, a good light, and a few minutes of your time. Two great resources for conducting an effective screening can be found at the Oral Cancer Foundation's website (<http://oralcancerfoundation.org/dental/screening.htm>). There are many adjunctive screening tools on the market today to help the dental professional differentiate between normal and abnormal tissue using a variety of advanced technologies, but these alone cannot substitute for the visual and tactile examination. These tools aid in the discovery of the atypical. Diagnosis comes after analysis under a microscope.

Suspicious lesions should not be “watched.” Suspected oropharyngeal cancer or an abnormality that does not resolve within 2 weeks should be biopsied for histological evaluation. Dental professionals can make a difference in the fight against oral cancer. Early detection increases the likelihood of a successful outcome. Commit to making an oral cancer screening part of the standard of care in your office. Tell your patients they are receiving an oral cancer screening. Educate your patients about oral cancer. Look. Feel. Discover. Diagnose. Be a hero. Save a life.

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# Computer-Guided Implant Surgery in Contemporary Practice

BY BARRY P. LEVIN, DMD

As in many fields of medicine and dentistry, technology often exceeds the rate at which science can substantiate its implementation in patient care. Often manufacturers present new technologies to clinicians with promises of higher profit margins, better ease of use, and greater personal satisfaction. The use of computer-guided implant placement has made implant placement appear easy and cost-effective, virtues that can be very attractive to novice and inexperienced surgeons.

With that said, clinicians can search the dental literature and find a significant number of in vitro and in vivo studies that have demonstrated that when used in appropriate situations, computer-guided implant surgery can improve surgical outcomes. The additional safety guided surgery provides when navigating vital anatomic structures can be a true virtue of this technology. When dealing with complicated cases in which implant insertion requires proximity to the maxillary sinus, inferior alveolar canal, adjacent roots, or lingual concavities, the precise manner of osteotomy preparation and implantation can be invaluable. Many of the adverse events pertaining to morbidities and permanent injuries that have been reported in the literature can be avoided.

Certainly, the clinical skills required to manage unexpected complications cannot be overlooked in any surgical procedure. Although these procedures are planned digitally—which requires CT-scan acquisition (often cone-beam CT [CBCT]), a proprietary implant-planning software, and guide fabrication—accuracy is only as good as the technology allows. Most studies

demonstrate a margin of error for all commercially available systems. These margins often reveal 1 mm to 2 mm of inaccuracy. This often proves to be as accurate as conventional—ie, non-guided surgery—performed by an experienced surgeon. This margin is normally built into the guide fabrication, with a “safety zone” taken into consideration in the planning stage.

When osteotomy preparation is performed with a computer-generated guide, it is within reason to anticipate that unwanted complications may occur. These include perforation of thin cortical plates, sinus perforation, nerve-encroachment, or contact with adjacent root surfaces. It would then seem reasonable to require intraoperative radiographs and that the surgeon be skilled in flap management, bone augmentation, and the ability to modify implant positioning—all of which invalidate the claim that guided surgery is for the novice.

Another application of computer-guided implant surgery is for implants being inserted without reflection of a muco-periosteal flap, or flapless placement. The literature does report on the inaccuracy of flapless placement on anatomic models, even when clinicians are afforded CT scans to visualize the recipient bed of the implant being placed without reflection of artificial mucosa. There are numerous reports of shorter intraoperative times, minimal pain and swelling, and greater patient acceptance when flapless procedures are compared to conventional implant placement. There is no question that postoperative morbidity can be related to the time of surgical procedures and extent of tissue manipulation. The accuracy of implant placement can make flapless implant placement appropriate in specific situations. The principles of implant therapy, however, cannot be overlooked.

It should be confirmed that the recipient bed meets several criteria before electing this modality. First, it should be confirmed that the implant flaplessly placed with a computer guide be surrounded with bone of a minimal thickness of 1.5 mm to 2 mm to optimize long-term soft-tissue maintenance. A band of keratinized mucosa on the facial and lingual/palatal aspect of the implant should also be present to minimize future peri-implant mucositis and inflammatory bone loss. The same criteria regarding surgical safety, which was mentioned earlier, should be respected as well. It is important to note that, at any point during the procedure, the need to elevate a soft-tissue flap and hard/soft-tissue augmentation may present itself. If the operator is not skilled and comfortable diagnosing and treating these types of complications, it is best that the case be referred to a formally trained dental surgeon.

It is also worth mentioning that there are additional costs associated with computer-guided implant placement. Because the expense of scanning appliances, surgical guides, and planning software can be significant, the value of guided surgery in each specific case must justify the extra costs for the patient.

The accurate placement and minimal invasiveness computer-guided surgery offers should be viewed as benefits. As a modality, it should be viewed as an adjunctive surgical procedure and not be routinely used for all placements. When the virtues it offers can enhance patient outcomes, guided surgery can be a valuable technology for surgeons in their practices.

# Cellular & Salivary Diagnostics

BY SCOTT D. BENJAMIN, DDS

To paraphrase a statement made by a friend and colleague, Dr. David Wong, associate dean at UCLA, one of the most laudable goals for any human being is to prevent disease for a large number of people. As dentists and the dental profession moves toward the medical model of preventive healthcare management by assessing, diagnosing, counseling, and healing, this philosophy should be guiding our course of action.

Oral healthcare is progressing beyond the past philosophy of observing a situation or condition until it requires surgical or restorative intervention. Practitioners now have the ability to have a proactive approach of collecting information whether it is data, cells, or even genetic information before a condition or health concern is apparent or has even occurred. The fact is that dental caries is the most common infectious disease known to humans and periodontal diseases are still highly prevalent, affecting up to 90% of the adult population.<sup>1</sup> These are embarrassing statistics to the dental profession. However, with the use of salivary testing, cellular collection and evaluation, and stem-cell banking, dentistry can now truly make the statement that we are a proactive and preventive profession.

The dental pulp of both primary and permanent dentition contains an abundant supply of an individual's undifferentiated stem cells. If these stem cells are properly collected, prepared, and stored (often referred to as stem-cell banking) in the future they may be able to provide the genetic code for tissue regeneration and other information as medical science progresses. As dentists we are ideally positioned to be the pathway to the collection of these potentially invaluable cells.

Human saliva contains human DNA as well as bacterial and viral DNA, and the same genetic information found throughout the body is also found in saliva, making it ideal in testing for various systemic conditions. Whole saliva is composed of fluids from major and minor salivary glands, gingival crevicular fluid, epithelial and immune cells, and food debris. Salivary evaluation and diagnostics has become a reality; patients rinse with specialized solutions and expectorate into a funneled collection tube that is processed and analyzed at a medical laboratory. Because of the simplicity and noninvasive nature of salivary collection and testing, these screening modalities strongly appeal to clinicians.

A survey of almost 2,000 practicing dentists reported that 87% were receptive to noninvasively collecting saliva and submitting the sample for a diagnostic evaluation and were willing to integrate this procedure into their clinical practice.<sup>2</sup>



Saliva, especially whole saliva, can be easily collected from the patient in a completely noninvasive manner and evaluated at the laboratory to help accurately determine the patient's present health status and their genetic susceptibility to and inherent risk of periodontal disease, as well as many other systemic conditions, including diabetes and various forms of cancer. By combining and interpreting the information obtained through clinical assessments, radiographic findings, and salivary, cellular, and DNA analysis, clinicians can obtain a more accurate evaluation of the patient's health status today, and possibly in future, which in turn assists in more individualized counseling, management, and effective treatment.

Saliva is shown to harbor bacteria, viruses, and proteins that can be tested. Simple salivary tests can also identify the type and concentration of pathogenic bacteria that are known to cause periodontal disease. This noninvasive collection method also can be used as a screening tool to help detect various viruses and especially identify patients who might be at an increased risk for oropharyngeal cancer, as well as to help develop the appropriate referral and surveillance recommendations.

By properly incorporating noninvasive screening procedures such as salivary diagnostics and cellular collection into the practice's armamentarium, many of these concerns can be addressed. These methods not only give the dental clinician the ability to provide a higher standard of care, it also increases the patient's understanding of the tremendous overall value of comprehensive dental care. More specifically, the clinical procedures and science of these procedures can have a positive impact on patient overall health outcomes with minimal to no health risks and financial concerns for everyone.

It has been reported that more than 70% of Americans regularly visit an oral healthcare provider, approximately 30% more than our medical counterparts.<sup>2</sup> This allows for significant opportunities for dental clinicians to engage in the early detection of life-threatening conditions. However, it is imperative that we understand the consequences of these discoveries and learn the proper communication skills and develop the appropriate referral pathways for the management of our findings.

Today, the use of salivary analysis is predominately for periodontal disease and peri-implantitis. Integrating salivary testing, cellular collection, and stem-cell banking into the dental practice can be beneficial to our patients today as well as in the future as science and medicine advances. These measures will become even more valuable as their benefits will become much broader. As salivary diagnostics is fully integrated into dentistry, it presents an opportunity to advance dentistry into primary healthcare. As healthcare providers, we can use these valuable procedures to enlighten our patients to connection between oral and systemic health by collecting, testing, and evaluating the fluids and cells in our area of expertise, the oral cavity.

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## Lasers in the Dental Office

BY ARTHUR B. LEVY, DMD

Lasers in dentistry in the United States were introduced in the mid-1990s with the Food and Drug Administration clearance of an Nd:YAG laser, the first such instrument designed specifically for soft-tissue treatments in general dentistry.

Over time, as more lasers came to market, more uses became recognized—from periodontal therapy to cavity preparation, from postsurgical tissue welding, to relief of intramuscular spasms. At the 2012 conference of the Academy of Laser Dentistry (ALD), lectures featured laser uses in every area of dentistry.

Lasers have proven to be an invaluable and patient-friendly treatment approach, with the ability in many cases to treat inflammation by removing inflamed tissue while sealing the tissue and resulting in a clean, nonbleeding wound. Compared to conventional treatment, laser therapy can often be done with less anesthesia and fewer postoperative complications. The course of healing is often more comfortable and typically requires less medication. The proper use of such lasers is one way that dentists can achieve the goal of providing the best, yet least invasive, treatment for their patients.

Laser uses depend on the wavelength of the active medium that generates the laser energy. Different molecules, called *chromophores*, absorb light differently. For example, some lasers are selectively absorbed by pigmented tissue while others are absorbed by water. This can enable lasers to literally pass through clear fluids, treating and dissolving inflamed tissue on the surface without affecting healthy tissue. One of the cardinal signs of inflammation—redness—allows laser treatment to be clinically effective due to this selective absorbance by particular chromophores. Lasers such as the diodes, carbon dioxide, and Nd:YAG, are selectively absorbed in components of the soft tissue to accomplish such effects as cutting, ablation, and hemostasis. In contrast, the erbium family—including the Er:YAG and Er,Cr:YSGG—is selectively absorbed by water in the cells. This enables such lasers to explode the water in the cell; the enamel debris is then washed away from the tooth with water coolant during the process of cavity preparation. Actions such as these, which are the basis of conventional laser therapy, are often referred to as “hot laser” applications, because they depend on the laser's thermal effect.

Varying the laser power and changing the pulse rate of the laser beam can control the amount of thermal energy delivered to the target tissue. Without attention to heat management, the surrounding tissues can be heated beyond a safe level, causing damage to healthy tissue surrounding the treated area.

The use of biostimulation lasers or healing lasers—often referred to as “cold lasers”—has expanded as therapists and patients use them to enhance the body's

healing power at a cellular level. Such technology has been adapted in dentistry to enhance healing and reduce pain during and after dental procedures. Biostimulation has also been used in the treatment of musculoskeletal disorders and inflammatory diseases. The worldwide growth of cold lasers has stimulated research into such areas as laser-induced healing, bone growth, and anesthesia. The acceptance of these therapies—used in physical therapy and sports for chronic and acute musculoskeletal pain—has been widely recognized for many years in physical medicine.

The decision to use a laser is often an emotional one, as all dentists want to treat patients using the most effective, patient-friendly, and caring method available. The decision of which laser to use for a given condition involves a thorough understanding of laser physics, control panel settings, and tissue type, as well as the desired treatment outcome on a case-by-case basis.

While the decision of which laser to purchase can be daunting, the Academy of Laser Dentistry was founded in 1993 to help dental professionals make these decisions. Its mission is to improve the health and well-being of patients through the proper use of laser technology. The Academy provides an unbiased view relating to wavelength or manufacturers. It strives to be independent and supportive of free and open discussion on the efficacy of all types of lasers and techniques. It actively supports education and research through its annual conference, certification programs, publications, and other activities.

In addition, the Academy helps clinicians understand the many factors that go into laser therapy and provides a “try before you buy” opportunity in educational settings, under the supervision of laser experts. This hands-on approach to a laser education enables any practitioner to learn about, compare, and evaluate lasers prior to purchase.



# The Dental Operating Microscope

BY DONATO NAPOLETANO, DMD

The dental operating microscope (DOM) is perhaps one of the most valuable technologies available in dentistry today. In addition to having multiple levels of magnification available at a turn of a dial and superb shadow-free illumination resulting in increased visualization, increased diagnostic capability, and an increased level of precision when executing various dental procedures, the DOM can also be an invaluable tool when it comes to patient education through its digital documentation capabilities, and perhaps most importantly, allowing the clinician to operate in a comfortable, ergonomically friendly upright postural position resulting in reducing strain and fatigue to the eyes and musculoskeletal system.

This article will focus on how to efficiently implement and successfully integrate DOMs into daily practice, and is therefore dedicated to the increasing number of dentists who are either contemplating or have recently purchased a DOM and are interested in learning how to use it efficiently, proficiently, and to its fullest potential. This article may also be helpful to those dentists who have purchased a DOM some time ago but are not using it as routinely as they desire.

While the learning curve in operating with a DOM can seem challenging and somewhat frustrating at times, formal training can significantly reduce the time needed in successfully integrating them. But for those who desire to start out on their own, following and practicing the few basic guidelines presented in this article may be helpful to some during the initial phases of the integration process.

While the integration time will obviously vary between operators, once the DOM is fully integrated, the operator will likely wonder how they worked without one. One's ability to diagnose problems will dramatically improve. Areas of the mouth or a specific tooth that were previously difficult to visualize (even in patients with restricted access) will become very easy to see and operate in. A patient's trust level and acceptance of treatment recommendations will likely increase significantly if the DOM is equipped with digital documentation capabilities. Finally, and perhaps most importantly, the clinician will be operating in a very comfortable (upright) postural position, and at a level of precision he or she never imagined possible (Figure 1 and Figure 2).

All of these attributes will ultimately have a significant impact on productivity and profitability, but clinicians should realize that this does not happen overnight, and that the essential ingredients to integrating any new procedure or technology are *patience, practice, and persistence*.

## The Basics of DOMs

### Location

If the DOM is not positioned or mounted in an area of the operatory that does not allow for easy access, it will simply not be used. It is, therefore, critical that the DOM is physically located where it can be easily and efficiently maneuvered into the operating position.

### Par-Focusing

Par-focusing a DOM simply means "tuning" it to the individual user's eyesight. It is a simple procedure that is explained in a DOM's owner manual that only takes a few minutes to do and should be done periodically. The importance of par-focusing the DOM is basically two-fold: first, it helps to ensure that the DOM stays in relative focus when changing levels of magnification without having to move the DOM up or down significantly to bring the operating field in focus; second, it helps to ensure that photographs taken with an integrated still camera are in focus. When a DOM is not par-focused correctly, an image that is in focus to the operator when looking through the oculars may actually be out of focus to the camera.

### Positioning: Chair, Microscope, Patient, and Mirror

Unfortunately, learning how to effectively position the DOM so that the operating field or target tooth can be visualized is something that cannot be effectively taught in a short article. Some will find formal training helpful, and some will learn it through practice, patience, and persistence.

When the author teaches beginners how to operate with a DOM, there are a few basic yet critical process steps of which the user must be aware, or it will be very difficult to successfully integrate a DOM no matter how much patience, practice, and persistence are applied, resulting only in much frustration.

The most important things to be mindful of when learning how to position a DOM is that in addition to the DOM itself, the positions of the patient chair, the patient's head, and the mirror also need to be considered when trying to visualize the operating field or a target tooth. Here are five guidelines that some may find helpful in implementing their DOMs.

**Keep the chair height low.** When working with loupes or unassisted vision, many clinicians tend to recline the back of the chair and also raise the chair height to bring the operating field closer to them. When working with a DOM, it is preferable to recline the back of the chair and not raise the chair height much, if at all; the reason being that if the chair height is raised too high, the body of the DOM will also need to be positioned higher in order to focus on the operating field. While most DOMs come equipped with inclinable binoculars, the author has seen some operators raise the patient chair so high that they are not able to comfortably reach the eyepieces even when the binoculars are fully inclined to their most downward position.

**Once reclined, have the patient scoot up on the chair.** When the back of the chair is first reclined,

the patient's body tends to slouch downward on the chair, positioning their head further away from the operator. Therefore, once the chair is reclined, the patient should always be asked to scoot their body up on the chair. This will bring the patient's head closer to the operator, which in turn allows for the DOM to be positioned closer to the operator so that the operator does not need to tilt his or her head excessively forward to reach the oculars. Most DOM manufacturers have an optional attachment called an extender (which the author highly recommends), which brings the eyepieces out closer to the operator and further reduces the amount of forward neck tilt needed to reach the oculars.

**Use the DOM on every patient.** With the exception of removable prosthodontic visits, the DOM should be positioned in place and used on virtually every patient. During the initial phases of DOM integration, the most time-consuming aspect is just getting the DOM into the "ready" position efficiently. Practice will significantly decrease the amount of time needed in getting the DOM into the operating position.

**Move the patient's head around often.** When the author watches beginners trying to visualize a target tooth, many will tend to move, rotate, or tilt the DOM around in positions that are not ergonomically friendly to the operator. Remember that in addition to the DOM, the patient's head can move too. Effectively visualizing all areas of the mouth often requires a combination of moving (tilting and rotating) the DOM, the patient's head, and the mirror. When trying to visualize maxillary posterior teeth, for example, having the patient tilt his or her head back (chin up) will help increase visibility. A slight rotation of both the patient's head and the DOM may also be required at times. For example, when trying to visualize a posterior tooth in the left arch, a slight rotation of the DOM and the patient's head to the left will be helpful, assuming the operator is working from a near 12 o'clock position which, in the author's experience, is the best position to work from when using a DOM.

Once positioned, use the DOM through as much of a procedure as possible. If difficulties arise intraoperatively, it is perfectly fine to push the DOM aside and continue with loupes if needed. Once a preparation is completed, take out the DOM again to inspect the preparation. Chances are that an area of a preparation requiring some refinement will be detected.

### The BotDOM Line

If the operator patiently and persistently practices getting the patient chair, the DOM, the patient's head, and the mirror properly positioned, the amount of time required in accomplishing this task will gradually but significantly decrease and become second nature. If the operator makes an effort to start every procedure with the DOM, in time more and more of the procedure will be executed with it until the need to push it away is no longer desired, once the operator sees firsthand what they have been missing—namely, superb visualization of the operating field while working in a comfortable postural position.

# Dedicated Digital- Impressioning Systems

BY BRIAN K. SCHRODER, DDS

Available to the dental profession since 2007, dedicated digital impressioning systems—not to be confused with CAD/CAM systems—are designed to replace impression materials and gypsum die stone in the fabrication of indirect fixed restorations. The procedural mechanics of these systems are data capture, data storage, data manipulation, model manufacturing, and restoration fabrication.

The systems capture digital data through the use of a wand that is strategically placed intraorally over the surfaces being “impressed.” Depending on the system, there are two differing technologies used for data uptake. To generalize this highly precise data capture, one technology uses a series of “still” reflective image captures that are then merged together by the computer software to create the entire 3-dimensional (3-D) replica. The other technology uses continuous video image capture, building the 3-D replica in real time. Some of the systems require a light application of titanium-dioxide powder to create points of reflectivity; others do not.

All of the available systems capture replicas—or scans—of the oral cavity that are digitized and stored in a chairside computer. Using the Internet, this data can then be moved electronically to dental laboratories equipped with the software needed for data manipulation. These software programs allow dental technicians, on a computer monitor under high magnification, to mark restoration margins, choose the style of articulation (quadrant or full arch), set die cuts, ditch dies, and articulate models. This manipulated data is then moved electronically to a model-manufacturing facility.

Again, depending on the system, either milled polyurethane or stereolithography is used in model manufacture. The milled polyurethane technique is essentially a subtractive process involving the use of burs, following the aforementioned computer design, to mill an exact model from a solid block of the material. Stereolithography is an additive process using stacked layers of photosensitive resin. Each micro-thin layer is laser-polymerized, one atop the other, until the model is completed. In each of these techniques, the resulting model is dimensionally accurate and highly resistant to subsequent changes during the fabrication of the restoration. The accuracy and durability of these resin replicas is largely responsible for the consistently accurate final restorations produced.

Using a process termed *parallel manufacturing*, which is unique to digital dentistry, the electronic data can be used to design restorations or restoration substructures, each to be completed before the restoration is ever matched to its model. Examples of this technique are milled wax patterns for gold restorations as well as zirconia-based restorations.

Dedicated digital-impressioning systems do not require changes in any of the procedures required for using impression materials up to the point of taking the scan. Isolation, preparation, and retraction can remain the same. Because these systems replace the gypsum dies on which indirect restorations historically have been fabricated, the models can be used in any way that the conventional models have been used. Everything from single-tooth restorations to full-arch reconstructions is possible. Semi- and fully adjustable articulation is possible. Any restoration that can be fabricated indirectly—cast, pressed, or milled; gold, lithium disilicate, or zirconia; full- or partial-coverage—are all within the capabilities of digital-impressioning systems.

The benefit of this digital-data capture and manipulation is the elimination of distortion of the replication of the oral condition resulting in more accurate restorations. It is essential to note that the use of digital systems is not a replacement for excellent technique because the computer can only replicate what it can “see.”

As with any digital technology, the incorporation of any digital-impression system into clinical practice requires mastery of its learning curve. A passionate desire for change and growth is essential.

# It May be Time to Go Digital

BY MARTIN JABLOW, DMD

Digital radiography has become the norm for many dental practices in the United States. Digital images provide better diagnostics for the dentist, improved patient education, and an easier way to communicate between general dentists and specialists. The cost of acquiring digital radiography hardware has decreased, and the software is easier to use, saves time, and is environmentally friendly. All of these benefits have contributed to its rapid adoption.

## The Hardware

Two types of digital radiography hardware used in dental offices: phosphor plates and sensors. Phosphor plates are very similar to film, and office staff can use the same hardware and techniques with which they are already familiar when taking the image. The image is acquired from the radiograph head and the plate absorbs the energy. The image is then placed into a scanner, which can be considered a digital developer. The image is scanned and transferred to a computer monitor. Processing the image is much faster than conventional film-based developing. The cost of a scanner is in the \$10,000 to \$20,000 range. Sensors connect to the computer wirelessly or via a USB cable; they produce the image directly and do not require the additional step of scanning. Sensors do require special holders, as they do not accept the standard Rinn holders. Sensors produce images faster than phosphor plates and the images are more detailed compared to a phosphor plate. Depending on the practice, multiple sensors may be necessary to cover all of the radiography needs. Sensors can be transported between treatment rooms and plugged into the operatory computer.

The decision about which digital radiography system to choose depends on the dentist’s budget and office needs. Like everything else in the world, there is no perfect system, so it is important to have the images demonstrated using the office’s existing x-ray heads to ascertain real-world results.

While both systems produce diagnostic images, there are differences in quality. The sensors produce a sharper image. At the maximum resolution settings, phosphor plates can produce 15 to 20 line pairs per mm (lp/mm); sensors can produce 25 lp/mm. The quality of phosphor-plate images is lower than those of a sensor, but the human eye cannot distinguish above 12 lp/mm.

Also to be considered are the associated costs. Phosphor plates can be scratched, and they deteriorate over time. The plates will need to be replaced over time, but the cost for a new phosphor plate is only about \$20. Sensors do not have to be replaced, but many offices opt for insurance coverage in case a sensor breaks or is damaged, because the cost of a new sensor can be exceed \$5,000 without insurance.

For those who take analog panoramic films, a larger phosphor plate may be used to replace the panoramic film—in essence, converting an analog to a digital panoramic machine. The cost of a phosphor-plate scanner that takes panoramic size films is closer to \$20,000. Digital panoramic machines produce the best images and start at \$25,000. There are also digital panoramic machines that can be upgraded to add cephalometric and cone-beam three-dimensional imaging.

When determining the size of sensors or phosphor plates needed, it is important to consider sensor sizes

and the patient population to ensure the ability to take radiographs on all of a practice's patients. Most offices use the #1 and #2 size sensors or plates. There are also sensors that are between sizes to reduce the need for two sensors. Because it is also important to have a redundant system, having two sensors or a sensor and phosphor-plate system makes it possible to continue working in the event of a hardware failure.

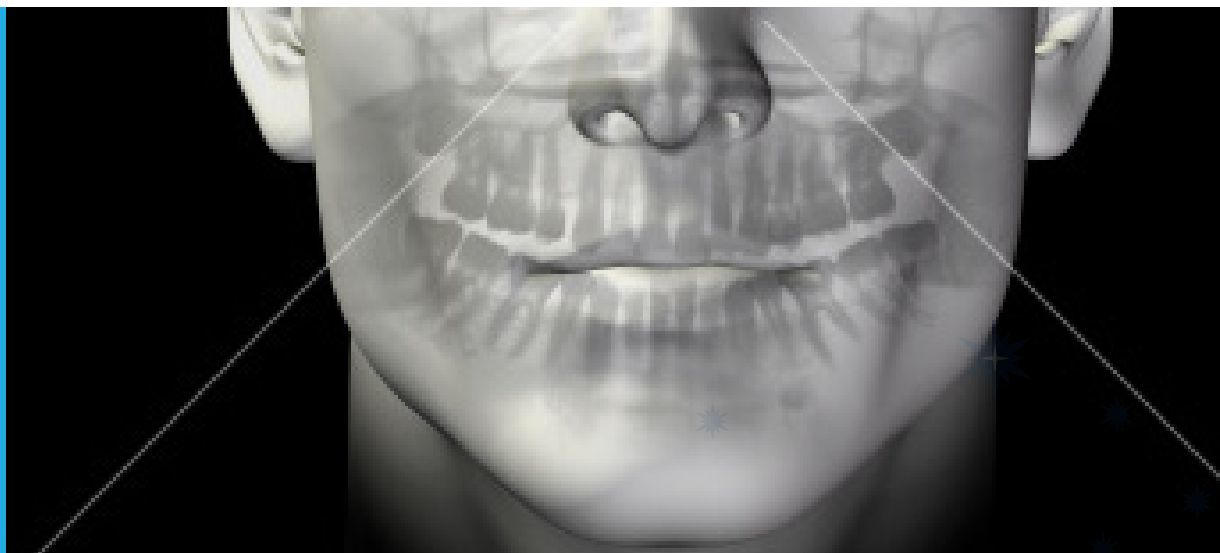
#### The Software

Determining the best imaging software to use may be

more difficult than determining the hardware. The office's current practice-management software may impact this decision. Certain hardware and software packages may integrate directly with existing practice management software. The practitioner need not be overly concerned about going outside the tight integration. All imaging software packages bridge to existing practice-management software. The author recommends seeking the most suitable imaging features and flexibility, while weighing the wisdom of being tied to a specific vendor. Most vendors will make an effort to integrate the existing practice hardware, but this may prove problematic when selecting new hardware in the future. Ease of use along with the ability to share imaging must be considered.

#### The Time is Now

Digital imaging is here and now. There is no reason to delay upgrading. No longer need there be loose radiographs in a chart or, worse yet, lost radiographs. Images are always available in the digital chart along with being of archival quality. There should be no fear in investing in these technologies, as the software and hardware are continually updated for better imaging. A purchase today will not make an imaging system obsolete any time soon. It is best to base purchasing decisions on the practice's needs, budget, and type of integration, with the input of staff members likely to be using it most.



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PROOF—NOT FOR PUBLICATION

# Rotary Handpieces are Here to Stay

BY SCOTT D. BENJAMIN, DDS

While the use of rotary instrumentation for various dental procedures reportedly dates back as far as 9,000 years ago, the basic concepts for both the pneumatic and electric handpieces were originally introduced to dentistry in the mid to late 1800s. However, it was not until 1957, when the Dentsply Company manufactured and distributed the Borden Airotor, that the “high-speed handpiece” was introduced and made commercially available to mainstream dentistry, and approximately 30 years ago the first electric dental motor and handpiece were made commercially available; around the same time, handpieces with smaller heads and illumination were being introduced that would allow improved access and visibility. It seemed that handpiece technology was evolving in several divergent directions at once, trying to solve the many separate and unique issues that each and any situation may present.

It has always been a desire of clinicians, manufacturers, and patients alike to improve the functionality and comfort of the “dental drill.” Despite major developments and refinements in laser technology, micro air abrasion, and other cutting technologies, rotary instrumentation is still the mainstay of today’s dental treatment modalities.

While the majority of handpieces used today are still rotary instruments, they have changed dramatically in recent years and are still undergoing constant enhancements and refinements. In addition to preparing natural dentition to accept restorative material, handpieces are being used routinely for an almost infinite range of procedures, from endodontic file manipulation to osteotomies and placement of implant fixtures. The need for the efficient removal of old restorations has become more common. Cutting through porcelain-fused-to-metal crowns and the tougher new metals, such as zirconia, are placing new demands on handpiece performance.

Each practitioner has their own considerations and priorities of what features an ideal handpiece should have, and even that varies with each situation and procedure. Nearly all practitioners desire an ergonomically well-balanced handpiece with accurate speed control that runs smoothly and free of vibration, as well as be able to withstand multiple sterilization cycles with minimal maintenance. Other almost universally desired characteristics are that they are lightweight with a small head and bright illumination that allows for good visibility and access, yet are still powerful enough with “no stall” torque and multiple spray ports. As in the past, recent changes have been primarily focused on these concerns as well as considering infection-control issues.

The power of electric handpieces has helped address some of these challenges but, initially, the increased weight, head size, and change in the tactile feel led to a slow adoption rate. New ergonomics and

head designs are enabling improved balance, visibility, and access without a reduction in power. The control unit can be either an integrated component built into the treatment center or it can have a separate control box. Today, almost all of the electric handpiece manufacturers have a model that can be adapted or “retro fit” to the standard dental delivery unit, which runs from the same foot controller. The use of an external control box simply requires connecting the standard 4-hole handpiece hose adapter (which normally connects to the handpiece) and a standard electric outlet for the power supply to the box.

The precision metal-to-metal gear mechanism of the electric handpiece can create a substantial increase in power and a rigid tactile feel compared to the rubber o-ring-supported turbine of a traditional standard pneumatic handpiece. This increased cutting efficiency assists in creating smoother margins with less crazing and microfractures.

One of the newest innovations that substantially enhanced the performance of handpiece systems is a turbo-boost system that combines the power and efficiency of an electric handpiece without sacrificing the access, light weight, and familiar comfort of pneumatic handpieces. These air-driven handpiece systems deliver the best of both handpiece systems by automatically optimizing the delivery of power in response to load, offering superior performance and precision while reducing (if not eliminating) speed and torque fluctuation, bur deflection, and chattering.

This is accomplished by using a controlling mechanism with sensors that monitor the torque load that would normally cause a decrease in rotation speed of the turbine and dynamically regulates the drive air pressure to provide consistent rotation of the turbine, maximizing cutting efficiency. This enables the performance and torque of an electric handpiece with the comfort features of a pneumatic.

Another new unique feature that is now available is a handpiece with an electric generator in the handpiece itself that runs off the drive air and provides sufficient to power the embedded LED light, providing a bright light without the need for a separate electrical connection or power source.

Enhanced infection-control procedures have placed new demands on handpiece technology. Ability to withstand the thermal cycling, complications with lubrication, more demanding workflow processes, as well as the sheer number of handpieces required for a practice were just a few new challenges that had to be faced of repeated sterilization without sacrificing performance or lifespan. This has led to the development of new turbine designs and materials such as ceramics that can endure these challenges.

Despite dental rotary handpieces being one of the oldest dental technologies, it is constantly improving to rise above its past weaknesses. Rotary instrumentation has and will continue to be the mainstay of dental preparation systems and will not be replaced in the foreseeable future. With today’s advanced materials and detailed procedures, the need for quality preparations and its instrumentation has never been more important. The practitioner needs to evaluate the benefits of all styles of handpieces available and make the appropriate selection for their particular needs and practice techniques.

# Dental Camera Update

BY EDWARD A. MCLAREN, DDS, MDC

Clinicians weighing the pros and cons of the various dental photography options available should first consider their intended use of this important documentation and communication tool as well as their own desire and ability to use its features. Briefly, intraoral cameras are best limited to patient communication, and point-and-shoot cameras are adequate for that and taking basic images. However, the author’s clear preference is for a well-chosen single lens reflex (SLR) digital camera, which offers video plus the least amount of distortion and highest image quality.

## Intraoral Cameras

Intraoral cameras are small, light, and convenient, and there are some very nice chairside systems on the market today. Prices have come down and their image quality is exceptional. They enable the dentist to quickly zoom in and demonstrate problems, such as caries or cracks, or a procedure, and they don’t require focusing because they usually have autofocus. They are the way to go for simply sharing information. However, in the author’s opinion, their limitations outweigh these benefits for a practice with more extensive communication needs because of what they cannot do—eg, take the portraits required for smile design or other esthetic procedures—compared to digital cameras.

## Digital Cameras

For this reason, the author is focusing on digital cameras for dentists with higher-end photography needs. Within this category, the options are point-and-shoot cameras, and single lens reflex (SLR) cameras. The point-and-shoot cameras range between \$1,500 and \$2,000; SLRs are slightly more expensive—\$2,000 to \$2,200, but offer many more options.

## Point and Shoot

The advantages of point-and-shoot cameras, such as those offered by market leaders including Nikon, Canon, and Sony, is that they take excellent basic images, can be easily mastered, and are somewhat less expensive than SLR systems. They are appropriate for quickly capturing a picture and color. However, they have limited capabilities. Because their focal aims are fixed, some images are distorted, and there is no ability to custom position the flashes to acquire good color information and surface detail.

## DSLRs

The author believes it is the SLR digital cameras that are best suited for dental use. Both Nikon and Canon offer SLR digital cameras with a flash system that allows one to customize and easily move flashes into slightly different positions, which is especially advantageous

for reproducing the level of translucency in a tooth. This technology also affords direct communication with the laboratory as well as the patient in real time.

This year's models are more affordable and user-friendly than earlier models. Both the Nikon D7000, which the author uses, and the comparable Canon 60D offer a couple of the features that were in the point-and-shoot camera. Both include pre-user-defined settings, which means every camera parameter can be set in advance without the need to scroll through the settings, and they can be pre-set for more than one user. The author uses two different pre-settings—a portrait setting for close shots and a macro setting for longer shots.

This year's models also have an enormous increase in pixel number. This is generally unnecessary because the number of pixels needed for an 8.5-inch x 11-inch print or a 22-inch computer screen is under 6 million pixels. However, the pixel increase is beneficial in providing good detail when zooming in on a particular tooth in a wide view picture.

Although the most important file format—the one required by most of the academies—is RAW, there are three choices: RAW, TIFF, and JPG. Color images should be shot in RAW. This is especially important for images to be subsequently transferred to a laboratory for color interpretation.

Another improvement that facilitates communication with patients in particular is the ability to immediately share images with patients to make them

aware of problems and motivate them to accept recommended treatment through wireless transfer of images from the camera to a computer or tablet using an Eye-Fi Pro X2 card (Eye-Fi, Inc., [www.eye-fi.com](http://www.eye-fi.com)), which is a secure digital (SD) memory card and wireless router in one.

### Conclusion

In the author's opinion, the main objective of dental photography is communication, and the clear choice for maximizing this ability is SLR. Nearly anything that can be done with intraoral cameras can be done with SLR cameras, which have high-definition video, and, with improved ease of use, their superior image quality compared to point-and-shoot cameras should not be overlooked.



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