

# CBCT Technology: What Will the Future Bring?

by Jordan Reiss

Since its initial FDA approval in 2001, cone beam computed tomography (CBCT) has evolved at an impressive rate in the dental field. In 2012, CBCT units were installed in approximately six percent of dental practices and clinics. An iData Research<sup>1</sup> report on the U.S. market for dental imaging devices estimates that this number is expected to increase to 13 percent by the end of 2015.

No one really understood where 3D imaging would go when it first came out. Compared to today's technology, the first few systems (there were only four CBCT systems approved for sale in 2003) had lower resolution, less functionality, higher doses and fewer options in terms of field of view, 2D compatibility and interoperability with third-party programs. There are now more than 50 CBCT systems to choose from, many of which have made large strides in these areas.

Initially, market demand was for the largest field of view possible and manufacturers raced to meet this need. During the first five years, most systems were priced from \$200,000 to \$300,000 and lacked 2D functionality, making them inaccessible and ill-suited to the general market. Starting in 2008, in what came as a surprise to many in the industry, endodontists showed a strong interest in using CBCT. This fueled a greater demand for systems that could produce the high-resolution images needed to capture endodontic details.

There were now two very disparate systems on the market—dedicated, large field-of-view CBCT units and high-resolution multifunction systems—and the demand began to shift to single systems that could incorporate both functions. It was this demand

for flexibility that drove the market to our current state, in which multi-modality systems with 3D and 2D, including panoramic and cephalometric options, are desired.

Over time more specialties—and general practitioners—have started to incorporate CBCT into their practice. When orthodontists showed interest in taking advantage of CBCT, there was a high demand for low-dose systems. Because children are 30 percent more susceptible to dose,<sup>2</sup> dosimetry became of utmost importance when developing new CBCT solutions.

In looking at how CBCT technology has expanded in such a short amount of time, we can make some educated predictions about what the dental field can expect within the next five to 10 years. The demands from the dental market combined with advances in technology will greatly shape that evolution.

## Prices Will Decrease While Breadth of Features Increase

When any type of technology comes out, adaptation goes through three stages: innovators and early adopters, early majority and late majority. In the beginning, cost is always a concern. As the industry improves, the volume increases and market acceptance goes up—driving costs down. This means that manufacturers are able to offer more features at an ever-decreasing price, which means customers get more for less.

This is most evident in the computer industry. Think about the computer (probably a desktop) you used a decade ago—it was more expensive and had fewer features than the tablet you're using today. This technological principle applies to CBCT as well. The price of systems will either decrease in the next five to 10 years, or you will get more features for a consistent price.

For some, this has been a reason to stay on the sideline. Yet prices have come down to levels that are well into the early majority stage—making this a prime time for doctors to enter the market.

### Sensor Technology Will Keep Improving

Just as with cameras or other digital imaging devices, there are a number of sensors used in CBCT machines. As CBCT has matured, fewer units are using the “old-school” charge-coupled device (CCD) with image intensifiers. Now thin-film transistor (TFT) and complementary metal-oxide semiconductors (CMOS) are more widely used, but in different capacities.

In the quest to find the optimal field of view, there will be a convergence as technology gets better. Over time large sensors will become more affordable and will have the high resolution previously relegated to smaller sensors. At the moment, however, large sensors just aren't able to capture the same high-quality images that are possible with smaller sensors.

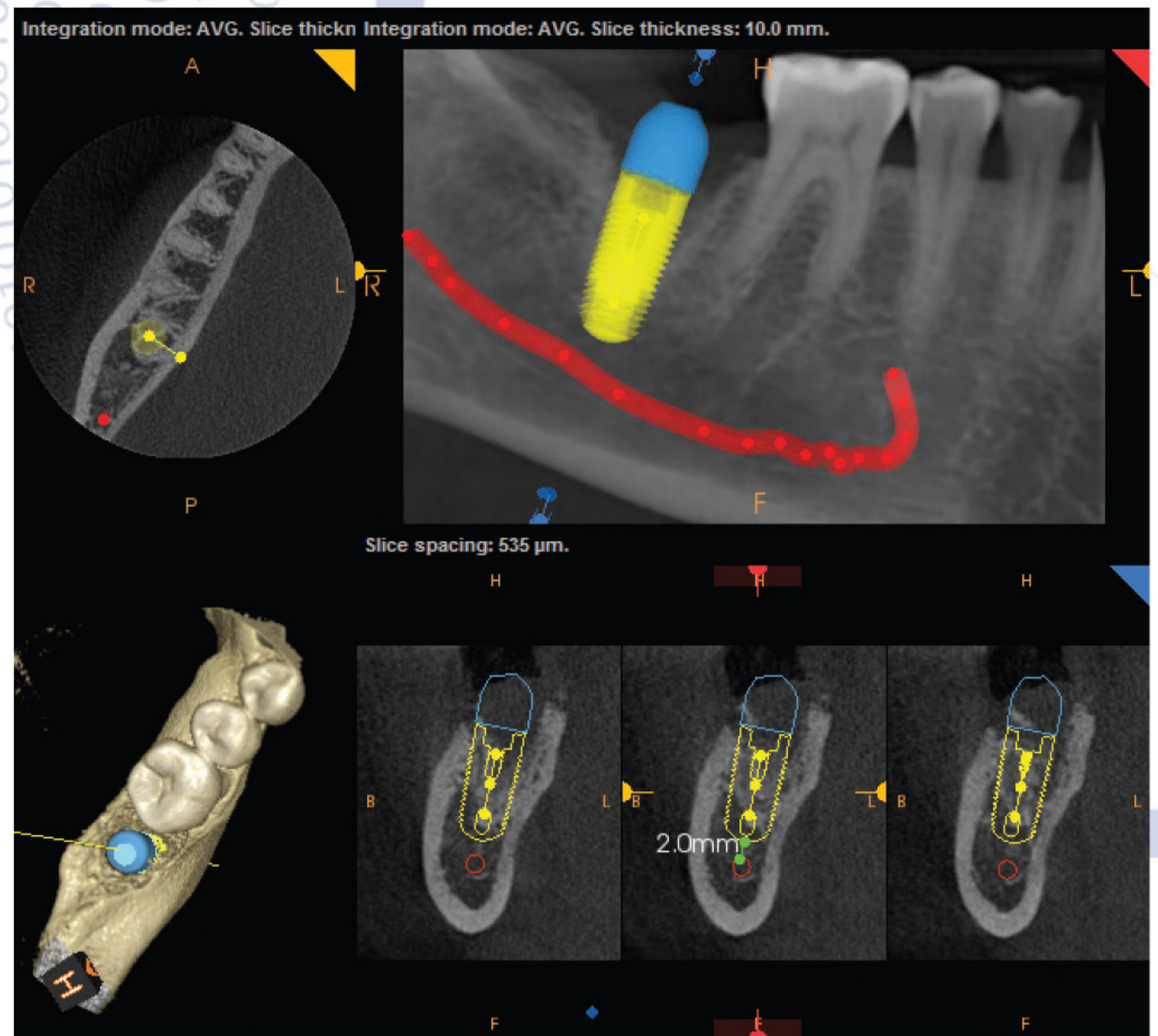
Today, CMOS is great for maximizing resolution while minimizing dose, but has limited capability for large fields of view. TFT plates are appropriate for larger images, which is why there are different families of imaging systems. CMOS sensors currently receive the most investment and—as technology grows—will be available in larger fields of view with the necessary resolution for conservative and restorative dentistry.

### Dental Practitioners Will Become Better Educated

Right now, there is a CBCT education gap between early adopters and dental students. Many of the first clinicians to integrate CBCT into their practice had to learn by trial and error or actively seek out education from the manufacturers. They have become well informed through experience.

At the moment, universities are slow to incorporate CBCT systems into their facilities, with some schools incorporating only one unit for many students. According to a study on CBCT in dental education,<sup>3</sup> 89 percent of the responding U.S. dental schools reported having a CBCT unit in their facilities; however, only 18 percent of dental schools stated that they trained pre-doctoral students in cone beam scan acquisition. In addition, only 27 percent said pre-doctoral students were taught how to interpret the scan. Over time, universities will adapt and there will be more practitioners educated on 3D use—thereby driving more demand and innovation.

As doctors continue to use CBCT, they discover that there is more they can learn and that there are other ways to incorporate the



technology into their practice. Recently, we have seen an increased interest in areas such as TMJ analysis, airway evaluation, sleep studies and radiographic stents, driven by the growth of 3D imaging.

### More Regulations Around CBCT Images

Three-dimensional imaging has traditionally been the realm of radiologists, as they were the only ones who could reliably interpret CBCT scans and translate the information for dental practitioners. Now, with CBCT implementation in dental practices, dentists are performing daily tasks once relegated to radiologists at imaging centers.

This will trigger some regulatory reaction. The American Association of Endodontists (AAE) and the American Academy of Oral and Maxillofacial Radiography (AAOMR) have issued a joint statement on the use of CBCT in endodontics. This phenomenon has not been limited to the United States; the dental association Sedentext in Europe has released very strict standards on CBCT, and Health Canada has developed specific regulations on incorporating CBCT into dental practices. We may also begin to see more states, such as New Jersey and Michigan, issue their own guidelines.

As CBCT imaging expands to a greater number of users, the American Dental Association (ADA) will likely influence more regulations and standardization regarding what is found in 3D images. To prepare for this, practitioners in the market for a CBCT unit should seek systems from manufacturers who already have documentation and reporting tools that will accommodate these new regulations as they arise.

### Applications Will Become More Creative

CBCT is at the early stages of application. Over the next few years, practitioners will begin seeing software applications become more enriched. It's already happening with computer-aided design/

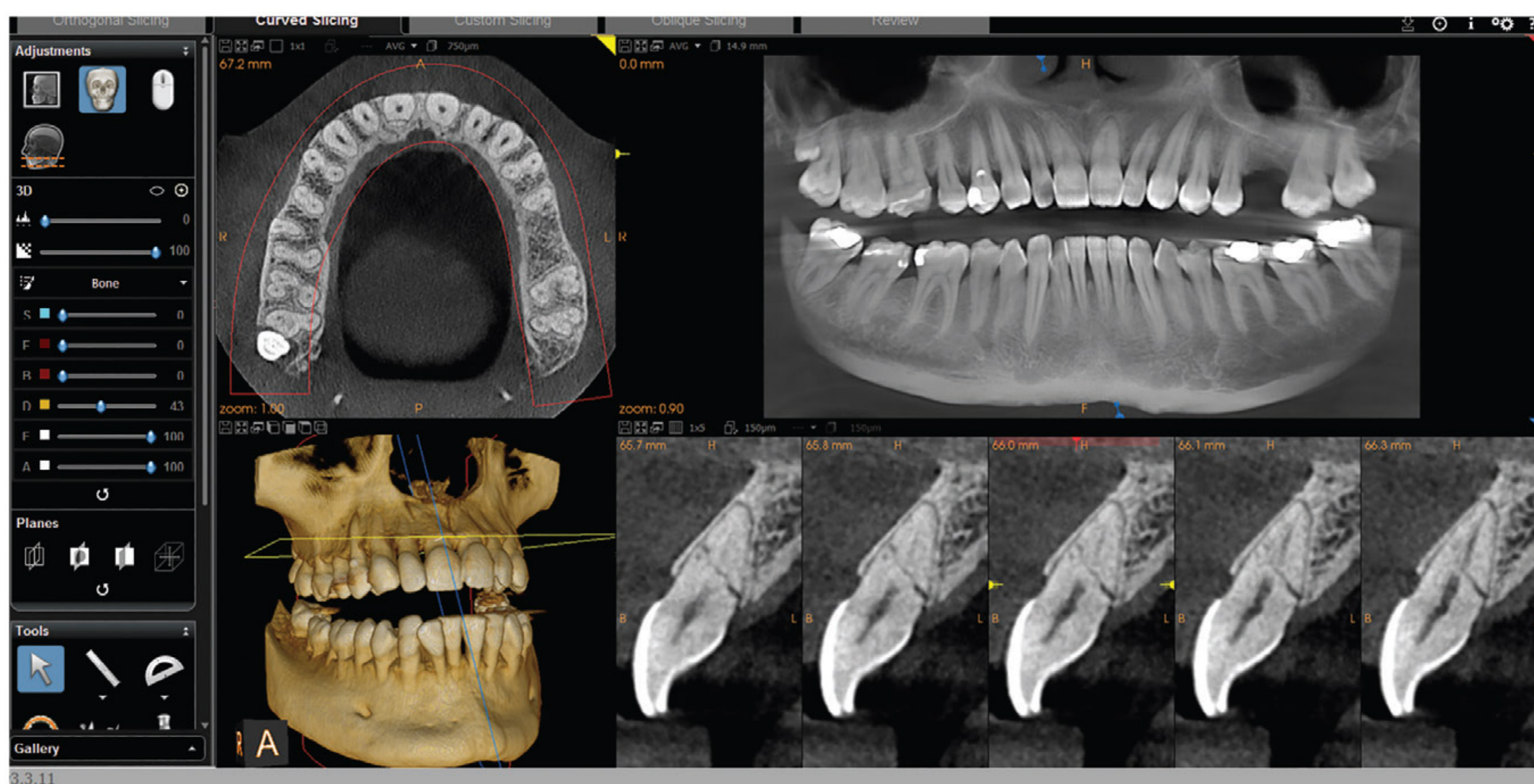
computer-aided manufacturing (CAD/CAM) technology and 3D implant planning. This will bring more capabilities, including virtual treatments, simulations and new possibilities for guided surgery, than are available now. CBCT will go beyond a static image to create something tangible.

Other applications on the horizon include the ability to incorporate a video element to reproduce occlusion and the movement of the arches. This will provide more advanced information on occlusion for restorative cases, such as how TMJ movement affects placement of implants and bridges. CBCT will also merge with orthodontics in combination with models, allowing orthodontists to better predict future growth.

Reconstruction algorithms will also continue to improve, resulting in better, more functional images. Carestream Dental has focused on redefining the 3D rendering, so the image looks more real with each iteration of the software. The benefit to this application is that it greatly facilitates patient education and understanding of the diagnosis and proposed treatment; ultimately increasing case acceptance.

### Will Replacing a Full Set of Dental X-Rays with a CBCT Unit be Possible?

Panoramic X-rays will always have a place in the diagnostic arsenal. When you take a panoramic X-ray, what you see is what you get. With CBCT, the cone-shaped radiation beam is converted via an FDK algorithm to a sine curve representing planar images, and as a result there are very different attenuation issues and patterns than in 2D imaging. This makes some diagnosis, such as caries detection, unreliable in 3D.



On the other hand, panoramic X-rays have problems with superimposition and magnification, making CBCT the more accurate imaging modality. CBCT also allows for a more comprehensive, high-level overview (in some cases at a lower dose to patients). There are benefits to each, which means it may be limited to special indications for the foreseeable future.

### What Should Doctors Look for in a CBCT system?

Doctors would be wise to look back at past innovations in dentistry when incorporating new technology into their practice. For example, when dental practices first began using computers to run the front desk, there were hundreds of practice-management software options. Today, only a few major companies are still standing. Doctors should look at CBCT manufacturers and evaluate potential for the future.

Finding a system that is flexible and meets a practice's current needs is also important. Before speaking with a sales representative, you should make a list of the core reasons why you want CBCT right now—not at everything else you could do in the future. Is it for implants? Endodontics? Orthodontics?

Sales representatives will highlight their system's bells and whistles, which may make you interested and draw you in. But in reality, you are more likely to benefit from CBCT technology if you stick with your core competencies, because those are things that have worked for you and will continue to work for you down the road. One should also look for manufacturers who are able to update their systems.

CBCT is an exciting technology that has allowed for diagnosis and treatment planning to grow in a way that was unexpected. There

is no reason for doctors to wait to harness this technology when it already provides so much comfort, efficiency, patient confidence and return on investment to the practice. ■

#### References

1. iData Research. (2013) U.S. Market for Dental Imaging Devices. September 2013.
2. Ludlow, J.B., DDS, MS, FDS RCSE (2014). Dosimetry of CS 8100 CBCT Unit and CS 9300 Low-Dose Protocol. Unpublished manuscript.
3. Parashar, V., B.D.S., D.D.S., M.D.Sc., Cone Beam Computed Tomography in Dental Education: A Survey of U.S., U.K., and Australian Dental Schools. *Journal of Dental Education* November 1, 2012 vol. 76 no. 11 1443-1447

Want to learn more about CBCT? Ask questions on the Dentaltown message board on [dentaltown.com](http://dentaltown.com)

### Author Bio



**Jordan Reiss** has a decade of dental industry experience and has focused exclusively on CBCT systems and associated 3D software since 2006. He's the U.S. sales director, 3D Imaging, for Carestream Dental. Reiss conducts webinars, hands-on training seminars and speaks nationally about 3D imaging. He's also worked as a manager for the management and consulting companies KPMG Consulting and BearingPoint. Reiss has an MBA from Vanderbilt University.