Expert Opinions:
CBCT and Orthodontics

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This issue of Orthotown Magazine is focused on the rapidly emerging impact of Cone Beam Computed Tomography (CBCT) scans on the practice of orthodontics. The 3rd International Congress on 3D Dental Imaging, which took place June 2009, in Chicago, Illinois, provided the latest opinions by speakers from multiple disciplines on the various aspects of utilization of CBCT scans in dentistry.

Over the past six months, I have collected a huge volume of articles, position statements, white papers and more on this topic in anticipation of this issue. While I attempted to organize the information I was reminded of a quote by Jack Nicholson’s character in the movie, Something’s Gotta Give who said, “I have never lied to you. I have always told you some version of the truth.”

For this issue, I interviewed three oral maxillofacial radiologists (page 21) and two experienced orthodontists (page 28), posing the question: “How do you see 3D imaging impacting the practice of orthodontics going forward?” I hope you find their answers interesting and informative as we continue to get a grasp on this new technology and how to integrate it positively into our practices.
Oral Maxillofacial Radiologists' Perspectives

Have you seen 3D imaging improve over the past few years?

Hatcher: The first CBCT machine that arrived in the U.S. was a NewTom in 2001. We were all happy to have that machine because it was such an improvement over what we had prior. Now I look back at the images that came from that machine and I say, “Oh my goodness. Those are terrible!” That’s because the technology has improved since then. The most significant improvement has been in the hardware—the sensors improved. We've gone to the flat panels, which have a better signal-to-noise ratio—you get more good information and less bad information. They’re also light and easy to manufacture so they allow you to make the machines small, which makes it more convenient to have one in a general office. As they did that, the price was cut in half. Then right along with that the software was being developed, and that’s where the magic occurs. It allows us to go in and render the image so we can visualize it. Each company has its own software that comes with the machine but there are other companies producing software that has special applications for selected groups of people, like orthodontists. That’s made a huge difference.

Howerton: When the technology first came about, purchasers were interested in the largest field of view. However, issues began to arise such as the liability of recognizing findings outside of the maxilla and mandible. Then different states and groups, liability groups and insurance companies, decided that could pose a problem. So, manufacturing companies began moving towards producing machines with smaller fields of view. We are talking about quadrants of the mandible where the magic occurs. It allows us to go in and render the image so we can visualize it. Each company has its own software that comes with the machine but there are other companies producing software that has special applications for selected groups of people, like orthodontists. That’s made a huge difference.

Miles: The radiation dose to the patient has come down substantially. Overall dose is significantly lower than it was five years ago and certainly a whole bunch less than a medical CT. A typical medical CT will probably give you around 2,100 microsieverts, whereas a CBCT scan can give from anywhere to as low as about 12 to a high of 300-400 microsieverts. It is hard to talk about resolution because different manufacturers have native captures but they can dial down. The smaller the voxel, the higher the special resolution. Voxel size is for detailed examination of .2mm or less. That doesn't sound like a whole

Interviewees’ Bios

Dr. David Hatcher was an associate professor and chairman of the Division of Radiology for five years at the University of Alberta, Canada. He was also director of the Temporo-mandibular Joint Investigation Unit and Clinic while at the University of Alberta. He has faculty appointments at both the University of California-San Francisco and the University of Pacific Dental Schools. He has published many articles and lectured extensively to medical and dental organizations in the United States and Canada. Presently Dr. Hatcher is in private practice at DDI. David and his brother Tom provide CBCT services to the professions through www.beamreaders.com.

Dr. W. Bruce Howerton Jr. received a DDS degree from the West Virginia University School of Dentistry in 1985. He completed a Certificate in Endodontics in 1987 from The University of North Carolina School of Dentistry and practiced surgical and non-surgical endodontics in Asheville, North Carolina, for eight years. In 1999, he entered the UNC Oral and Maxillofacial Radiology graduate program and completed the Master of Science program. In addition to becoming an oral and maxillofacial radiologist, he became proficient in Web development and discovered novel forms of content delivery using authoring software. While serving on the faculty at the UNC School of Dentistry, he worked with the faculty, staff and students and aided in web development. Dr. Howerton became a Diplomate of the American Academy of Oral and Maxillofacial Radiology in 2003. Dr. Howerton opened Carolina OMF Imaging in 2004 in Raleigh, North Carolina, and currently has five offices across the state. From his years of surgical and non-surgical endodontic experience, Dr. Howerton is intimately familiar with the maxillo-mandibular complex. Together with the knowledge gained during his education at UNC and his experience with content delivery authoring software, Dr. Howerton excels at creating images using computer software and cone beam technology.

Dr. Dale Miles is a diplomate of the ABOM and ABOMR. He teaches at the University of Texas-San Antonio, and at the Arizona School of Dentistry & Oral Health, Mesa, Arizona. He lectures and publishes extensively.
What applications are you seeing 3D scans being used for in orthodontics?

Hatcher: Orthodontics covers more turf than any other specialty in dentistry. There’s a lot of anatomy that’s going to be visualized. Orthodontists might do a traditional pan-ceph for records, but if they spot something like an impacted cuspid or an asymmetrical mandible, they order up a CBCT for more information. People are now getting interested in other body parts like airways, and they’re looking to do more of a 3D assessment. There are other groups that are going all the way and using CBCT as their initial input records. These machines are capable of a lot and ultimately they will be the preferred imaging modality for orthodontics, but where we’re falling behind is in the knowledge of how to use the information. We have a lot of potential information that’s available to us, but we don’t know what to do with it. Improving the risk/benefit ratios and things we need to think about are going to be kind of in lock step to improve the ability to increase our knowledge about this. We need to come up with 3D norms so the orthodontists can better analyze and predict outcomes.

Howerton: Most orthodontists are interested in the exact location of impacted canines or other impacted teeth and their relationship to adjacent teeth and special anatomical areas like maxillary sinus, the nasal cavity or the mandibular canal. I think that is a big boom for the orthodontists. There are some third-party programs available that can be used to create a 3D supplementary image, which can be adjusted or sculpted. For instance, in the cephalostat you can remove the left side of the patient’s hard tissue so that you are looking at a true cephalometric image with no anatomical overlap. There are also third-party programs that are using the data to be imported and then 3D models can be created of the maxilla and mandible. The teeth can be separated from the models and the teeth can be moved as a pre-op in the place that the orthodontists would like them to be placed in ideally. That data can then be evaluated by machines to create orthodontic wires and brackets that are preformed.

Miles: The development of 3D orthodontic analyses is the primary goal, including virtual articulators. Because the reconstruction output is in a precise 1:1 ratio, there is also precise measurement for TADs (temporary anchorage devices) so that orthodontic clinicians and others won’t have to worry about violating a sinus space or the PDL next to a tooth. There’s also production of virtual models. However, absorbed X-ray doses must continue to be reduced so that the young orthodontic patient receives the least dose possible. That being said, I think the current machines probably subject the ortho patient to less dose than the “standard” orthodontic series of images – intraorals, panoramic, lateral cephalometric and sometimes frontal cephalometric and PA films.

The big question for a doctor is, “Do I buy a machine, or do I send this out to an imaging service?” Do you see any trending one way or another?

Hatcher: From what I’ve seen, the greatest density of imaging centers is on the West coast. Those who practice east of the Rockies don’t have a lot of choices. So if they want to have the CBCT capability, they’re going to have to buy one or think about setting one up as a community resource. Maybe a group of doctors would buy one and set it up. The problem with that is the doctors that do that typically don’t know how to use their machines correctly. Consequently, it costs them more than just a little bit of time. I think if they have an imaging center that’s near them, then I’d recommend that they use it. They should work with the imaging center to give them a work-up that they’re satisfied with.

Another hurdle is time management. Once you’ve made your commitment to 3D, you have to commit to look at them and go through it. For most doctors, that takes a lot of time and that time might start to compete with patient care or you start to run into longer days. A lot of the responsibility to improve workflow should be on the backs of the companies that produce the equipment, like the CBCT scanners and the software developers. If they had a clear idea about how orthodontists use these devices and the software, then they could script out routines. There’s a certain amount of time it takes to scan the patient, which is usually the least amount of effort in the whole system, but after the patient leaves, you’ve got that volume sitting on your computer. Somebody needs to look at it and extract all of the meaningful information. That can happen a couple ways. You can have a highly trained support person in your office who can do that; you can let them know what you want to see and they present the results to you. Or you can outsource this to people who will do it for you. If the clinician only has 15 minutes to devote to the imaging side of his practice, then we have to turn around and take this technology and streamline the workflow process so that it falls within that deadline. CBCT isn’t there yet.
Miles: I think it’s like the decision we make between buying or leasing a car. Some like the “no hassle” convenience and no maintenance of the prescription services. Others, I think because of “practice management guru” opinion, see a purchase as a good option – mostly because they then also “capture the fee.”

What about the options for training for orthodontists to learn how to incorporate this technology into their practice?

Hatcher: Early on, we did a lot of education related to cone beam so we could educate our users and what they were getting. As time went on, particularly when Imaging Sciences came along with i-CAT, it became both tactical for in-office utilization and usage. We found out since we were one of the first ones in the saddle. Everybody kept coming to us to see if they could get a course from us or hang out with us. So we decided to put on a series of courses – we did some for different machines – and basically they were hands-on courses. That’s what is missing out there right now – hands-on courses. We took an approach where we brought in different experts who had different things to offer. With our group here in Sacramento, Diagnostic Digital Imaging, I fulfill the role of radiologist, but we also have some unbelievably good technologists. Another part of our crew is the engineers – MMAs. They set up and install and network these machines in the offices and integrate tech into ortho offices. Over the years we started fielding all these questions like “Can you help me with this?” We found that the people who sold these machines did about a day’s worth of training, but you know how that goes. Owning these machines is not like a button-pushing exercise and out pops a perfect image every time that answers all questions. These machines have a lot of variables which you can tweak and play with but you have to know what you’re doing right up front. It’s kind of like playing a musical instrument – everybody can buy one, but not everybody can play one.

Miles: Some companies offer CE courses, but some of those recruit biased individuals – usually machine owners – to give their “experience” opinions. If you are going to adopt the technology, or are considering purchase options, you need to understand the following:

1. Principles of the image production
2. Multi-planar anatomy
3. In-depth knowledge of the software you will be using
4. X-ray dose to the patients
5. Your actual applications and patient “throughput”
6. Your potential liability

I have seen, heard and read about too many “sales pitches” and claims by manufacturers, users and even litigators that are inexact, imprecise and too inaccurate to safely tell a potential buyer/colleague that they can purchase any machine without impunity or consequences.

Do you see many orthodontists buying imaging machines or are they using an imaging service?

Howerton: There has not been a formal submission paper submitted to the American Academy of Oral Maxillofacial Radiology or to the ADA stating how this technology should be used or recommended to be used. Since there really are no rules or regulations on how the technology should be used it falls on the shoulders of the manufacturers and their marketing. Orthodontist consumers have to look at this technology and decide for themselves if they would rather use an imaging facility that is reputable or to go ahead and buy a machine. One of the dangers is if the machine is used for financial purposes just to scan every single orthodontic patient, then I think it is not the correct use of the technology.

Miles: I think that many orthodontists are purchasing. I get calls frequently asking my opinion about which machine to buy. I also see a lot of orthodontists at meetings when I’m guest appearing in a booth, who are there to make a purchase decision.

Do you see more orthodontists seeking training or sending scans out for OMFR reports?

Hatcher: Doctors who own these machines should take it as far as they can. With experience, you start to recognize normal patterns and things like that. You can use an OMFR to give you an inexpensive opinion. You can also use that as feedback to compare to what the clinician saw. To be honest, there aren’t enough OMFRs out there to handle this kind of volume. If there’s any legislation that requires an OMFR for every scan, it’ll be a bottleneck that will hurt.

Getting trained is time well spent. The problem right now is there aren’t a lot of options to get the training. Attorneys are saying you’re responsible for everything that’s in the jaw, but some are saying you’re not responsible for medical areas – but there’s no uniform consensus in the medical areas. The standard of care may be shifting. California’s leading defense attorney, Art Curley, is getting firmer on saying there are certain kinds of things that are difficult to defend unless you have 3D imaging. If you don’t do CBCT, you at least need to provide informed refusal.

Miles: Some are seeking training. However, as far as reporting – especially for orthodontists who require large fields of view...
For example, there is an obvious enlargement in the base of the skull that needs to be evaluated to determine if there is a significant pathology. The doctor must then decide how to handle this situation:

- **If a doctor feels he is qualified to read a scan, how much time is he going to have to spend doing that?**

  **Miles:** This happened to me. There was an oral and maxillofacial surgeon in town who was quite confident in looking at CT. When he purchased a cone beam scanner, I asked, “How many do you expect to do a week?” His initial response was “I don’t know” and then I asked, “How many a day? You are going to get real busy, do you think about five or six cases a day?” He said, “Oh yeah I think so.” So my question to him was rhetorical, “Do you mean to tell me you are going to take the time to go through 500-600 slices on three planes of section on 30 patients every week for your referring clientele?” There was a big long pause and he said, “Oh, I see what you mean.” Orthodontists and oral surgeons don’t make their money scrolling through all this data. If you have a busy practice, it is much more appropriate to refer it out. If you are only seeing one or two patients a week, that is a good chance to bone up on your education and read the scan. Educate yourself and look at the textbooks and see what you can see in there.

- **What is the understanding of liability, as it stands today, with trying to either read a scan yourself or send it out? How does the doctor protect himself from a liability situation?**

  **Howerton:** If there is a train wreck, it is going to happen. For example, there is an obvious enlargement in the base of the skull. You are busy in the practice and your concerned only with the teeth and it is missed. Three years later, the tumor grows to be inoperable and there is an unfortunate fatality. The parent remembers there was a scan done three years ago. They look at the scan and it is there. Then the dentist that acquired the data will most likely turn into litigation. Whatever comes out of that litigation and others like that is going to determine the true liability that people face using this technology. Right now with all the scans that are being taken, there is no rule that says you have to have this read for the patient’s best interest.

- **Do you have any final comments for our readers?**

  **Hatcher:** I think 3D technology is absolutely phenomenal. In my career, it’s the single best thing related to imaging that’s occurred. I’m very impressed with how fast it’s been adopted and how it’s going. This technology will benefit orthodontics more than all the other disciplines. I’m very eager to say that this should not just replace the traditional pan and cep, you’re giving an extra dose of radiation that’s not benefiting the patient, and that’s not acceptable. If we can come along and generate information that’s going to benefit the patient, and offset the dose so that the risk/benefit ratio is balanced appropriately, then it’s a good thing.

  **Howerton:** I look at this as providing care in the patient’s best interest, as if it was a loved one. That is how I will always treat this technology. I don’t think anyone should be ashamed to send their data off to be reviewed for $75, it is too easily done.

  **Miles:** Cone beam will never replace the other modalities. We will do cone beam, panoramic and intraoral; we’ll never get away from that. Dental schools are going to have to start oral maxillofacial radiology graduate programs and resurrect some that have actually died in order to produce the number of clinicians it is going to take to keep up with the amount of cone beam data out there. I have about 30 clients currently and eight or 10 of them send multiple cases a week. I get 60 cases a month from one lab service alone. I think there are only about 120 of us in the whole country that are actually diplomats who are capable of reading. That number is not going to last very long with the interest in the cone beam market. You will use this technology or the data from it. It will improve your practice, make your treatment decisions much easier, be better for the patient by reducing morbidity associated with some dental procedures, and will change your view of appropriate dental imaging. Do not wait. Get trained, get ready and get started!
**Cone Beam Comparison**

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<tr>
<th>Manufacturer</th>
<th>Machine name</th>
<th>Gray scale</th>
<th>Footprint (in inches unless noted otherwise)</th>
<th>Image detector</th>
<th>Patient Positioning</th>
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<tr>
<td>1. AFP Imaging/NewTom</td>
<td>NewTom 3G</td>
<td>12 Bit</td>
<td>65 x 75 x 99</td>
<td>Image Intensifier CCD Camera</td>
<td>Supine</td>
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<td>2. AFP Imaging/NewTom</td>
<td>NewTom VGi</td>
<td>14 Bit</td>
<td>Contact company</td>
<td>Amorphous Silicon Flat Panel</td>
<td>Standing/sitting/ wheelchair</td>
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<td>3. E-Woo</td>
<td>Picasso Trio</td>
<td>Contact company</td>
<td>45.4 x 79.4 x 90.1</td>
<td>CsI Coated CMOS Flat Panel</td>
<td>Standing</td>
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<td>4. E-Woo</td>
<td>Picasso Master</td>
<td>14 Bit</td>
<td>51.2 x 57.5 x 75.7</td>
<td>Flat Panel Detector</td>
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<td>5. Gendex</td>
<td>Gendex GXCB 500</td>
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<td>70.8 x 48 x 46</td>
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<td>6. Imaging Sciences International</td>
<td>Next generation i-CAT</td>
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<td>1.2m x 1.16m</td>
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<td>7. J. Morita</td>
<td>3D Accuitomo 80</td>
<td>13 Bit</td>
<td>63 3/4 x 47 3/4 x 81 3/4</td>
<td>CMOS Flat Panel</td>
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<td>9. Kodak Dental Systems</td>
<td>Kodak 9500 Large FOV/Med FOV</td>
<td>14 Bit</td>
<td>67.9 x 64.4</td>
<td>Amorphous Silicon Flat Panel</td>
<td>Standing</td>
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<td>10. Imtec, a 3M Company</td>
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<td>11. MyRay</td>
<td>SkyView</td>
<td>4096 (12 bit)</td>
<td>58 W x 104 L</td>
<td>Image Intensifier</td>
<td>Supine</td>
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<td>12. Planmeca</td>
<td>Promax CBVT 3D</td>
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<td>Panoramic: 96 x 61 x 64</td>
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<td>76 x 62 x 46</td>
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<td>14. Sirona</td>
<td>Galileos</td>
<td>Contact company</td>
<td>79 x 63 x 63</td>
<td>Contact company</td>
<td>Standing/sitting</td>
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<td>15. Suni Medical Imaging</td>
<td>Suni 3D Cone Beam</td>
<td>16 Bit</td>
<td>91.4 x 44.5 x 75.6</td>
<td>Contact company</td>
<td>Standing/sitting/ wheelchair</td>
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Information on CBCT scanners from the following companies was not available at press time. Please contact company for availability in your country. Asahi Roentgen Soredex (www.soredex.com) and Xoran Technologies (www.xorantech.com).
<table>
<thead>
<tr>
<th>Scan time</th>
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<th>Scan diameter</th>
<th>Cephalometrics</th>
<th>Pre-installed software</th>
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<td>36 seconds or less</td>
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<td>10, 15, 20 cm</td>
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<td>12, 15 cm</td>
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<td>8, 14 cm</td>
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<td>i-CATvision</td>
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<td>16 cm</td>
<td>17 cm height/23 cm diameter</td>
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<td>18 seconds/360 degrees, 9 seconds/180 degrees</td>
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<td>40, 60 or 80 mm</td>
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<td><a href="http://www.jmoritausa.com">www.jmoritausa.com</a></td>
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<td>9.4 seconds</td>
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<td>40, 80 mm</td>
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<td>i-Dixel. Also compatible with major 3D software</td>
<td><a href="http://www.jmoritausa.com">www.jmoritausa.com</a></td>
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<td>24 seconds</td>
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<td>8.3 seconds</td>
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<td>Yes</td>
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<td><a href="http://www.suni.com">www.suni.com</a></td>
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What kind of improvements have you seen in 3D imaging over the last few years?

**Boyd**: The images are getting better. The resolution is going up considerably but the amount of radiation is going down significantly. With the latest cone beam imagers we can actually get under what a full-mouth series of X-rays would have. The other good thing is the cost went down. The original New Tom was $330,000. It was very big and very heavy. You typically had to reinforce the floor where you put it. You can now buy a cone beam imaging system for just under $100,000. There is one called E-WOO from Korea. The way they are bringing the cost down is they can make the sensor smaller if it goes around more than once. They are picking up the lower half of the face on the first pass, then get the upper-half of the face on the next. What that has done is to make the size of the equipment smaller, more compact, and bring the cost down. There were only three companies making these machines in 2004 and now there are 35 and counting.

What applications for 3D imaging are being used in orthodontic practices or even in orthodontic education today?

**Boyd**: The biggest thing is you have a source of data because you don’t always know what you are going to get into in an ortho case. The cone beam imager has the ability to go back and look at things you didn’t see before, like TMJ. That is a classic one. Sometimes a patient develops TMJ problems during treatment. Well, if you have a cone beam image in the beginning, you can go back and look and see how it was at the start. Now we can superimpose these images. So you can go back and then check things against what you started with or on the other hand you might see something that, anatomically, is a little bit off. Like one condyle very flat but no symptoms and then as you go into treatment you can monitor that a little more closely because you saw a significant anatomical variation. Also, in the beginning of treatment, we take a full volume i-CAT and then during treatment, instead of taking a panorex to check root position or root resorption, we will take a small volume i-CAT.

Do you see orthodontists buying these machines or at least sending them out for an imaging service?

**Boyd**: The question you have to ask is how much are you going to use it? We ask people how many new cases they see a month and how many of those new cases might they use this machine on? If you do 20 a month then the equipment pretty much pays for itself as far as lease or purchase. Even in a larger practice, to get to 15-20 a month you have to do it on more than just impacted canines, impacted third molars or orthognathic surgery. Another thing some of the orthodontists are doing is they let the periodontist and the oral surgeons that they are working with know that they have this machine and then they charge them a modest fee. You can easily get to 20 even if you can’t get there on your own. I have known orthodontists who have one and it has helped them market their practice because they are then perceived as being on the cutting edge. It really solidifies your professional relationships because you are offering other specialists something that will really help them do a better job. That is especially true in cities of less than 100,000 where it might be 200 or 300 miles to the nearest cone beam machine.

What are the options for interpreting or understanding the scan? What is the orthodontist supposed to do in terms of their skill at understanding this stuff?

**Boyd**: When you buy one, the company will come in and have someone stay the whole day and train you and your staff how to use it. The actual physical manipulation of the machine the companies are very good at. What really helps is Dave Hatcher, an orthodontist in Sacramento, California, has a number of labs in the bay area all with cone beam imaging capability. What he has is a two-day course for the technician and then he has a five-day course for orthodontists or dental radiologists who want to kick up the level of understanding of this new tech-

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Dr. Robert Boyd is currently the Frederick T. West Endowed Chair of the Department of Orthodontics at the Arthur A. Dugoni School of Dentistry at UOP. Boyd is a renowned educator and researcher whose primary research interest involves quantifying potential damage to periodontal tissues during orthodontic treatment. Boyd is a diplomate of the American Board of Orthodontics, a fellow of both the American and International Colleges of Dentists and is a member of the Pierre Fauchard Academy. Boyd has received numerous awards, including the John Vallentine Mershon Award from the American Association of Orthodontists. Prior to his work at Pacific, Boyd worked at University of California, San Francisco, for 15 years, where he last served as a professor and chair of the division of orthodontics in the department of growth and development. He earned his doctor of dental surgery degree from Temple University, postgraduate certificates in periodontics and orthodontics from University of Pennsylvania and a master’s degree in education from University of Florida.
technology. Hatcher has a service where you send the cone beam image to a Web-based storage site and then he picks it off, looks at it and then posts his report with an electronic signature and generally gets it back within 48 hours. We use that service for full-volume scans, because once you get above the beginning of the sinus we start to get out of our areas of expertise as far as a graphic interpretation. So we use a radiologist report for a full-volume i-CAT, but we don’t get a radiologist report for a small volume where we are just looking at the teeth and jaws because we do have the expertise to interpret pathology, etc. in that area. With Hatcher’s course, what I see happening is that more and more orthodontists are simply going to train themselves. We believe at some point orthodontists can educate themselves enough to actually interpret the whole full-volume. As of right now, I think medically-legally speaking, I don’t know of any orthodontist that has that sort of confidence. However, I see people moving in that direction.

So you see training on interpreting 3D images for orthodontists as something that is coming or that needs to be the standard of practice for orthodontics if you are using 3D.

Boyd: I think if you are taking a full-volume scan, it is very nice to have a radiologist to comment. What we are finding is – in about four or five percent of our images – the radiologist finds some pathology. A lot of times that is just something you are going to monitor but we have had a few cysts and other things where treatment was actually recommended. In other words a conventional X-ray wouldn’t have shown this. You send it to a radiologist and the idea is then you haven’t missed anything in the X-ray.

So looking way down the road, conventional orthodontic records would be constructed from a cone beam scan.

Boyd: Yes. In fact now we are using this service from Anatomage, where we send in the intraoral photographs and they have a way of taking that photograph and applying it over the soft-tissue outline, which is just black and white. So what you get back is a model called an Anatomodel. You can look at the soft tissue and then there are tools on that where you can reposition the jaw to see changes. You can show the three-quarter view or different views to the patient and we are finding that is very effective. We can also do set-ups on the teeth by just putting a gyro on it. Our residents will do a set-up on the i-CAT and then, based on that and where the teeth go, it will predict what the soft-tissue changes are.

Do you have any final comments on how 3D imaging is going to impact the practice of orthodontics going forward?

Boyd: The fact is that new technology comes along and frequently it requires a significant expenditure. It took about 10-11 years for ophthalmologists to accept Lasik because you had to take courses to understand how to do it and the equipment was expensive, even though people could see the benefit. We are now at a point where we are starting to increase maybe five to 10 percent more orthodontists each year who are getting involved in CBCT. A colleague told me that three-quarters of the members of the Schulman group, who all have large practices, have CBCTs. My prediction is probably 25 percent of the orthodontists will be using them somewhat routinely in the next two or three years.

Give me some background on your experience in orthodontics and computers and specifically to 3D imaging.

Redmond: In 1978 I bought a TRS 80 from Radio Shack. It had no memory, but it had a modem and a floppy disk drive for storage. I used the modem to search an online encyclopedia and later a subscription database maintained by Stanford. I was hooked. By 1985 I had computerized my orthodontic offices and added an electronic treatment card by 1990. By 1998 the digital pan/ceph was on my radar. CBCT caught my attention in 2001-02. In 2003 I announced to my two sons (practicing with me at the time) my intention to buy a NewTom 9000. They wondered what we were going to do with it and ultimately we decided to give it to the University of Southern California orthodontic department and, “let them figure out what to do with it.” From this came the Redmond Imaging Center. As it turned out, not only the ortho department used it but also endo, TMJ and implant dentistry used it. Since then I have donated an i-Cat and 3dMD to UOP in 2006.
Tell me a little more about the Redmond Imaging Center.

Redmond: There’s really two of them. The one at USC was to help the residents not only be prepared for practice in the future but also to help them with their research and master’s theses. I thought it would push the department into the future and it did. It had the NewTom 9000, which is a recumbent machine and was perfect for sleep studies as well. The second is at University of the Pacific (UOP) in the Redmond Family Clinic and it is doing extremely well. Through this imaging center, Dr. Heon Jae Cho published a 3D Cephalometric Analysis in the April issue of the Journal of Clinical Orthodontics.

What applications do you see 3D imaging being used for in orthodontics?

Redmond: Dr. Robert Boyd at UOP has incorporated the CBCT system into the orthodontic program maximally in supplementing orthodontic records. Along with the support of Dr. Jack Choi, president of Anatomage, they are doing 3D assessments of tooth size, arch form, impactions, volume superimpositions to determine treatment effects and growth, soft tissue simulations related to treatment and airway analysis facilitated by CBCT in the treatment of sleep apnea. One concern with CBCT is radiation. If you take a scan at the beginning of treatment you get your diagnostic information – TMJ, frontal head film, lateral head film, panoramic, airway analysis, 3D analysis, you name it. But progress scans and final scans were of concern about the radiation. But there are different fields of view with shorter lengths of time for exposure that you can take for progress and final records. We believe this keeps the radiation levels acceptable.

Can you be more specific about airway analysis and sleep apnea treatment?

Redmond: There was a study being done at USC on airway analysis. It was very interesting because they had the opportunity to have patients in the prone position so they could see the effects of tongue posture and head posture. What they discovered was that tongue posture has a lot to do with airway. But there were other things. There were restrictions that took place anatomically. One of them is in the cervical vertebrae. Some of the projections that come off the ventral side would project forward and cause the airway to be compromised. When they saw this for the first time they had never considered this could be a factor. The vertebral column itself actually impinges on the airway on the dorsal side. Your body just can’t function at the same metabolic level that you can when you have a sufficient amount of air. I’m beginning to suspect that there are a lot of physiological processes that don’t develop at their optimum level because of airway restriction. I can tell you that airway will become one of the biggest things orthodontists will be involved with in the next 20 years.

Are orthodontists going to buy these machines or are they going to use imaging centers/services?

Redmond: My guess is that it’s an economy of scale. If you have a large practice it is better to own the scanner yourself. In my early practice days I took X-rays and had the chemicals and I developed the films. I hated those chemicals because they were smelly and you had to change them and it was a pain. In 1973 a young man came into South Orange County and opened a maxillofacial imaging center. From that day I no longer took X-rays. The quality he produced was routinely better than anything I could do in my practice. In 1998 digital radiography and pan-ceph machines came out and records came back into my office. Now CBCT scanners have arrived and I think there will be a split in the way this is going to happen. The fellas that can’t afford to pay for a CBCT scanner will send their patients to a lab for CBCT scans. But here’s the rub. Obsolescence is gonna rear its ugly head in about five years. Exponential growth of CBCT scanners with better resolution will appear about the time your old CBCT scanner is completely paid off. So is it better to use a laboratory where that guy has to buy a new scanner or is it better to have it in your office?

What’s your take on the liability the doctor assumes when he takes a scan or requests a scan from a lab?

Redmond: At one of the universities I’m associated with, a girl came in, had a scan done and they determined her orthodontic needs and did their diagnosis and treatment planning. About a year and a half later, she started developing some sinus symptoms so she went to her doctor and he referred her to an ENT doc and he looked and said, “OK, there’s something going on there, but to be definitive we’re going to need to get a CT scan.” The mom said, “You mean you’re going to scan her sinuses? I think we had something done like that about a year and a half ago for her ortho treatment.” The doctor requested the scan to compare with the new scan. Sure enough there was a tumor in the sinus, which showed up in the original scan – but nobody noticed. It turns out the girl needed to go through chemo and radiation to shrink it down and surgically remove it. From the doctors office it went to the attorneys at the university. There is a problem. There are attorneys who are lecturing who are saying, “You don’t have to worry about it because it’s not in your field of education for you to recognize any of these medically related issues.” On the other hand, attorneys can sue you continued on page 32
for almost anything these days. I think you need to have someone take a look. I send all my patients’ CBCT scans out for a radiologist’s review. Almost all of the universities are taking that step. They’re having someone qualified to review these scans. Another part of the problem, as I understand it, is that we have a limited number of maxillofacial radiologists who can read one of these for us as orthodontists.

It has been suggested that if a parent/patient decides they don’t want to pay for a CBCT scan, then you can have them sign an “informed refusal” document as a part of their records. What do you think about that?

Redmond: I think that is like walking through a supermarket and seeing a sign that reads, “Be careful, floors are wet.” If you walk down the aisle and you slip and fall and break your arm, that store still gets sued. It might be a good technique like informed consent. It gives you a line of defense. Does it stop a lawsuit? No. You still get sued, but you might slow the attorney down a little bit. It’s a good idea though.

Do you have any final comments for our readers?

Redmond: One of the things we need to talk about is the ability of a CBCT scan to be used to produce orthodontic appliances like Invisalign, SureSmile and Insignia. Dr. Dave Paquette has been doing some research with his i-CAT in producing models that could be used by Invisalign for production of the aligners, rather than taking impressions. I think they’re making some progress on it. Dr. Ed Lin has two i-CAT machines and he is about 85 percent impression-free for his SureSmile cases. Dr. Lin tells me he is able to use CBCT scans in almost all cases. The limitation right now is metal in the mouth that causes radiation scatter, but he tells me i-CAT is working on correcting those issues.

Everything’s moving forward. As I said to an orthodontic resident recently, “I envy you. I’m at the end of my orthodontic career and what you’re going to experience in your next 40 years is totally different. You’re going to be dealing with genetics and 3D analyses and ways of treating patients and obtaining growth information we’ve never even thought of.” The new generation is going to have fun.