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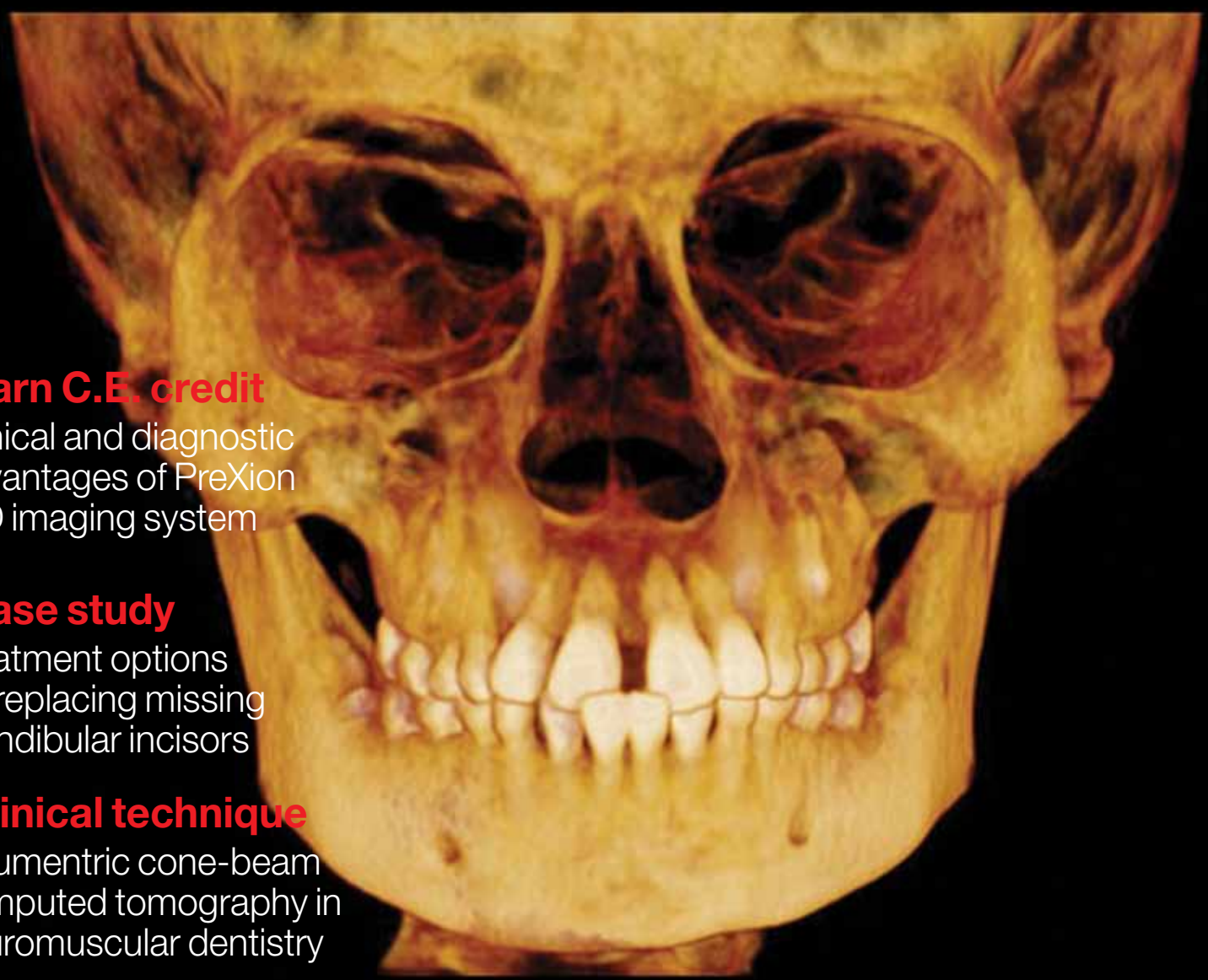

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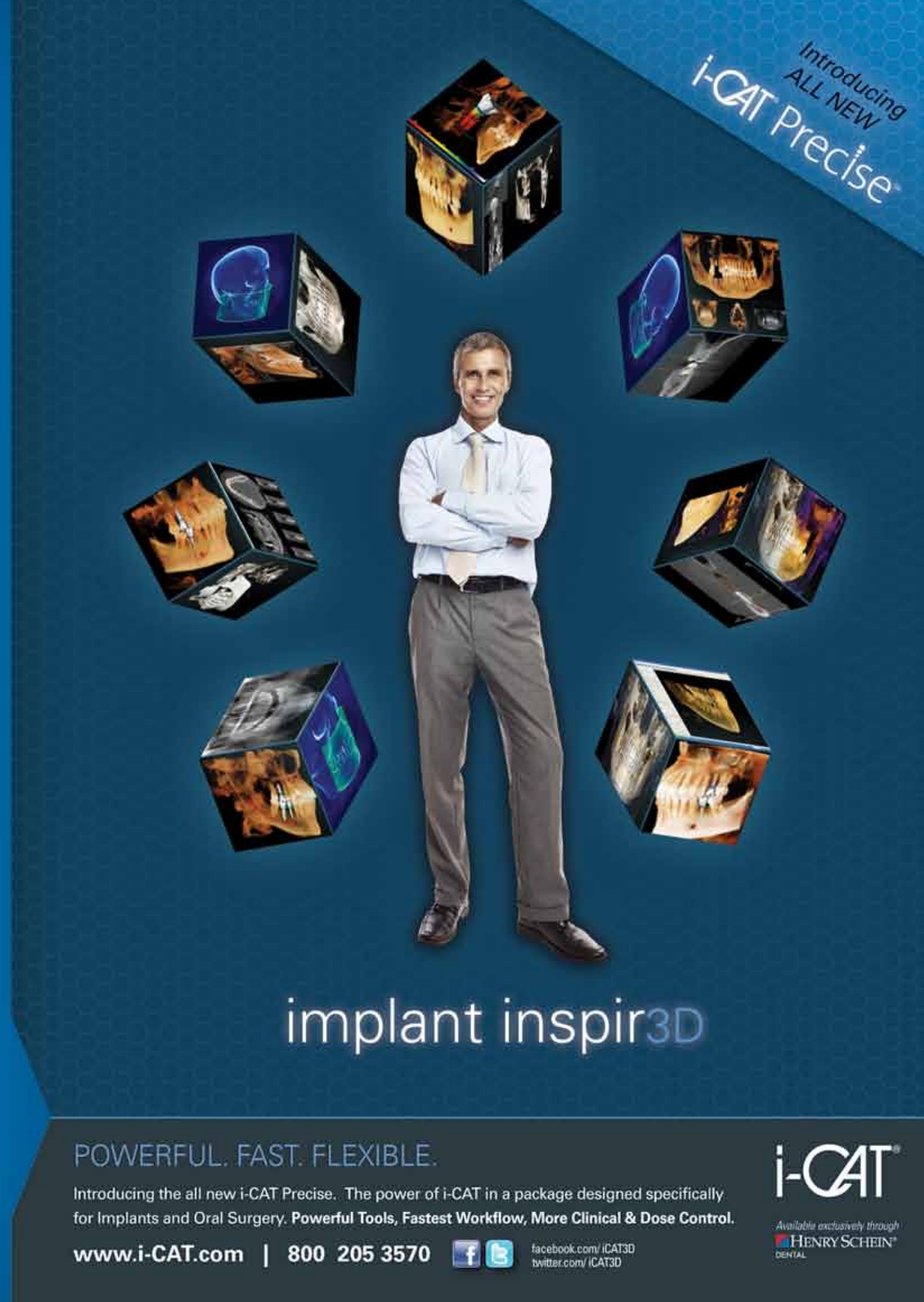
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Cone-beam computed tomography ...
What's not to like?

Dale A. Miles, BA, DDS, MS, FRCD (C), Dip. ABOMR, Dip. ABOM

First approved by the Food and Drug Administration in March 2001, cone-beam computed tomography (CBCT) is unlike other digital X-ray imaging technologies and has experienced rapid adoption in the past decade. This is because it improves the clinical decision-making across a wide variety of dental disciplines. It is dentistry's newest disruptive technology. Dentists do not place an implant every day or even a three-unit fixed prosthetic bridge. Dentists and dental specialists perform different imaging examinations on almost every patient and certainly every day in their practices.

X-ray imaging procedures have the highest profit margin of any procedure in the dental office. Most clinicians are not aware of this because they could not perform the actual tasks of image acquisition. Dentists interpret the image data to help them make a treatment plan and to help decide what procedures are necessary. In this regard, CBCT provides more precise, more useful and more graphically detailed information to help clinicians with their diagnostic tasks. Whether one is imaging a prospective implant site, the condyles, the morphology of the tooth to be treated endodontically, an impacted tooth or orthodontic or airway analysis, CBCT data sets can provide thin slice, highly accurate, 2-D multiplanar grayscale images, or if necessary, full 3-D color reconstructed images to assess both anatomy and pathology. No other technology can provide this type of information at such a low dose to the patient. What's not to like?

However, just as they must with any other newly introduced technology, dentists or dental specialists must navigate their way through myriad claims, sometimes inappropriate, made by manufacturers about the capability of the various machines that they are investigating to purchase. Stated simply, "the technology is always introduced ahead of the education." Thus, the early adopters often make purchases based upon pretty images and manufactures' claims and are sometimes disappointed with the results of the technology. This happened with panoramic imaging many decades ago.

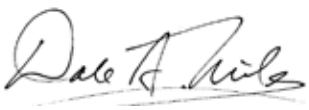
Before the understanding of simple positioning adjustments that could render almost any image useless for diagnosis, many clinicians would use panoramic images that were unacceptable for their clinical decisions. Thus, the modality was panned by many early critics as being inappropriate and too high a dose to use instead of using intraoral images for many of the dental tasks that the dentist wished to perform.

Today, thanks to decades of the training dental students, practicing clinicians and dental auxiliaries have received about panoramic positioning errors, the acceptance and use of panoramic X-ray imaging is universal. Because CBCT has many more applications, and because of the tremendous improvements in imaging and computer technology, this modality has been accepted much more rapidly than previous X-ray techniques. What's not to like?

Therefore, we will continue to see manufacturers make improvements to their machines in their software. We will continue to see widespread adoption of the technology, and we will continue to see better decision-making arising from the use of this technology. Again, what's not to like?

If clinicians, manufacturers and oral and maxillofacial radiologists worked together to provide the missing piece, genuine and robust education, CBCT technology will lead to a true and appropriate imaging revolution. Let's all work together to make this happen. What's not to like?

Sincerely,



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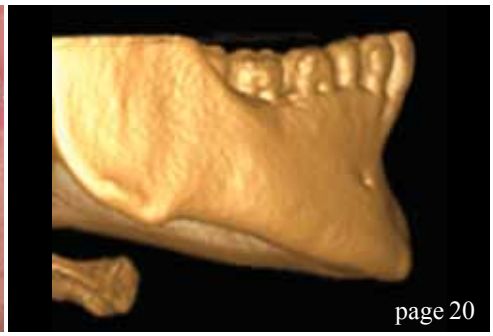
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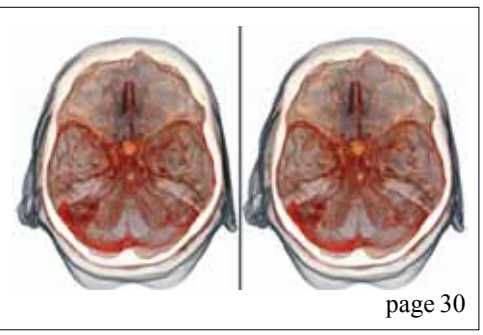
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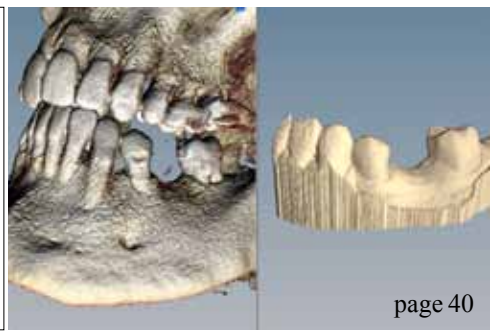
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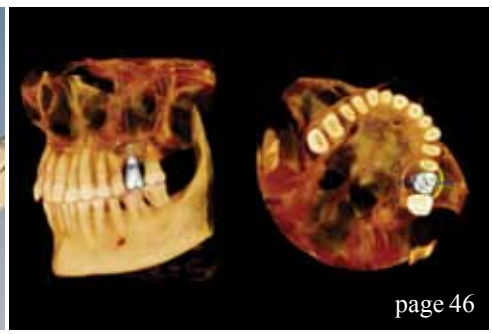
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Clinical and diagnostic advantages of PreXion 3-D imaging system

Author_Dan McEowen, DDS

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This article qualifies for C.E. credit. To take the C.E. quiz, log on to *www.dtstudyclub.com*. The quiz will be available on March 1.

For nearly 100 years, dentists have relied on 2-D radiographic imaging for diagnosis and treatment planning. With the 1999 introduction of cone-beam computed tomography (CBCT), all dentists now have tools available for more accurate diagnosis and treatment.[1]

The ability to look at a tooth in any direction and orientation, as well as in 3-D, eliminates much of the guesswork commonly experienced with 2-D radiographs.

We have been limited in most cases to only a buccal-lingual view provided by periapicals, bitewings and panoramic radiographs with the occasional axial view of an occlusal film. Medical CT scans and images began in the early 1970s and were sometimes used by dentists, offering our first multiplaner views.[2]

The adoption of 3-D cone-beam imaging is appropriate and has important advantages for all modalities of dentistry. From every specialist to the general dentist, the increased amount of radiographic information as well as increased accuracy will aid in the most sound diagnosis possible.

_CBCT description

CBCT is a single or partial rotation of an X-ray source around the head, capturing X-rays on various flat panel arrays and sensors. The information is converted to a series of axial slices by computed tomography and stored as virtual anatomy in the computer.

With the use of sophisticated software, the dentist is able to view information in several different views, including: axial slices (head-to-toe orientation), coronal slices (front-to-back orientation), saggital slices (side-to-side orientation) all known as multiplaner reconstructions (MPR). The thickness of each slice can be varied to include more or less information.

Because the voxels (volumetric pixels 3-D) are isotropic, other MPR images can be generated by

Fig. 1_Saggital CBCT MPR showing bone defect at point of dehiscence of the implant coating.

Fig. 2_Periapical does not show the sinus anatomy or the width of the bone.

Fig. 3_MPR showing post-op of sinus graft and implant placement.


Fig. 1


Fig. 2


Fig. 3

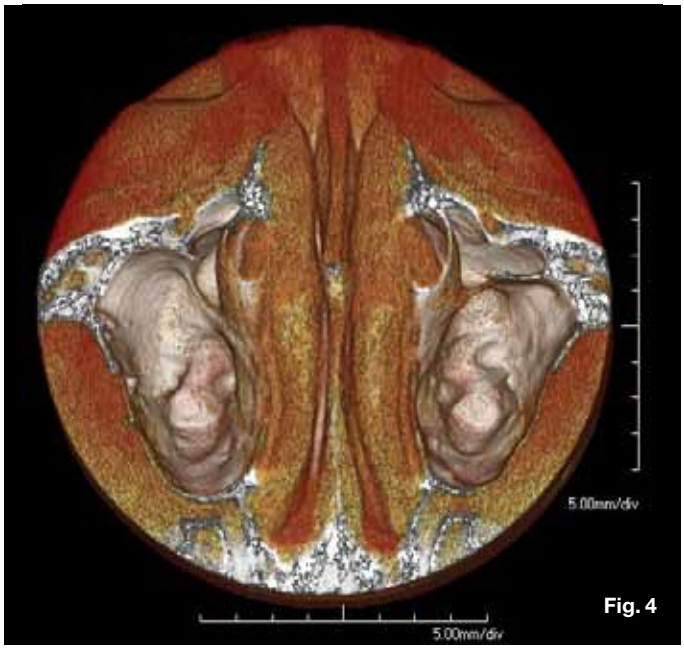

Fig. 4

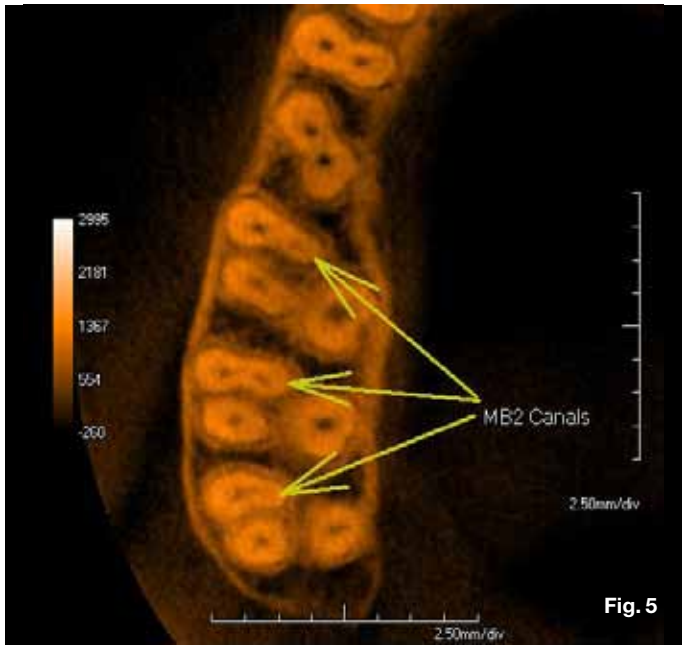

Fig. 5

slices drawn at any angle, curve or thickness through the scan to view areas critical to the final diagnosis.[3,8]

The final view offered by CBCT is a 3-D view that can be rotated and viewed in any direction.

Once again through software manipulation, 3-D images can be viewed as conventional radiographs, maximum intensity projections (MIP), soft-tissue projections and a variety other views.

This nearly endless ability to manipulate the data aids in the diagnosis and identification of disease, nerve canals, sinus morphology, dental caries, bone density, fractures, endodontic pathology, implant placement criteria, periodontal defects, bone pathology, fractured teeth, iatrogenic trauma, TMJ morphology and disease, third-molar position and many more healthy or diseased conditions.

_Early CBCT adoption with implants

The first and primary use of CBCT for early adopters was implant placement. As the scope and the value of the information became better known, dentists of all branches began to see the value of MPRs and 3-D renderings including periodontics, endodontics, oral surgery, treatment of TMJ, orthodontics, implantology and general dentistry.[1,7,8]

Clinical periapical and panoramic radiographs for the placement of implants can be misleading with elongation, foreshortening, superimposition and geometrically incorrect data.[7,8] A look at the implant in the periapical shows no obvious disease to an existing integrated implant. Clinically, a buccal fistula was present with exudate and slight pain. The CBCT scan (Fig. 1) reveals a more accurate view showing a buccal defect on a saggital MPR. A surgical flap revealed a dehiscence of the coating of the implant. Removal of the foreign body resulted in an asymptomatic and healthy patient

The evaluation of the available bone for the initial implant placement can be crucial for the long-term success of the case. If there is inadequate bone available, grafting may be a necessity. CBCT studies render the most accurate information available at a low radiation dose. The periapical shows an obvious lack of bone height, but does not show the buccal-lingual dimensions or an accurate view of the sinus morphology (Fig. 2).

The MPR view of the CBCT shows all necessary measurements to perform the sinus lift and grafting with the immediate placement of the implant fixture (Fig. 3). Three-dimensional views show the floor of the sinus and any soft-tissue pathology (Fig. 4). Having accurate measurements in all dimensions is an advantage of CBCT scanning.

_CBCT and endodontics

Endodontics is a field that is rapidly adopting the use of CBCT and for good reason. The inherent geometric deficiencies of 2-D radiographs make the CBCT scan a valuable adjunct to investigate the root morphology in both 3-D and MPR. The typical periapical will show superimposed canals in the anteriors, bicuspids and molars as well as unwanted bone densities both buccal and lingual to the affected tooth making the image quality poor.

The ability to view MPR slices in cross-section, long axis and oblique directions gives the ability to follow all canals in any direction and show their relationship and measurements from other known

Fig. 4_The 3-D CBCT showing anatomy of the maxillary sinuses.

Fig. 5_Axial MPR showing mesial buccal roots in first, second and third molars.