The Brown

PerioDontaLetter

PDL tm

I. Stephen Brown, D.D.S., *Periodontics & Implant Dentistry*

Summer

From Our Office to Yours...

Accurate diagnosis and treatment planning are essential for predictable results when placing dental implants. Advances in computerized tomography (CT) technology enable clinicians to achieve this accuracy with a precision not previously available with conventional radiography.

Medical CT scanners are the gold standard in medicine regarding clarity and accuracy for bone imaging. A new generation of scanners, Cone Beam CT (CBCT) scanners, has been developed for dentistry. Because of their speed -- they can complete a scan of the maxilla or mandible in seconds -- these scanners substantially reduce radiation exposure to the patient and virtually eliminate motion artifacts.

In this current issue of ***The PerioDontaLetter****, we address the emerging benefits of CT scanning in the diagnosis, treatment planning and prosthetically-driven placement of dental implants. We also discuss its application in orthodontics, diagnosis of endodontic lesions and vertical root fractures, and restorative applications.*

As always, we look forward to working with you in providing this exciting technology to our mutual patients and welcome your comments and suggestions.

The Benefits of Computer-Assisted Tomography in Diagnosis and Treatment Planning

Dentists have a variety of radiographs available for implant diagnosis and treatment planning. These include periapical, panoramic, conventional tomography, and computer-assisted tomography.

The panoramic radiograph is the most frequently used dental x-ray for dental implant treatment and is also the least accurate. Distortion can range from 25 to 30 percent. The average distortion of a periapical radiograph has been estimated at five to ten percent.

Conventional tomography also exhibits considerable dis-

Figure 1. Upon clinical examination, it appears there is sufficient width of bone for placement of an implant in the maxillary anterior. (See Figures 2 and 3 on page 2)

I. Stephen Brown, D.D.S. *220 South 16th Street, Suite 300, Philadelphia, PA 19102 (215)* ***735-3660***

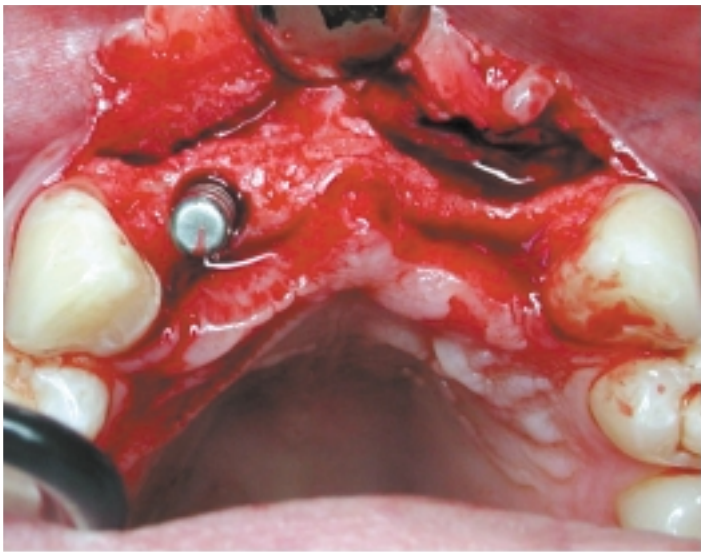


Figure 2. Without the use of CBCT scanning, unpleasant surprises can occur on flap reflection, which in this case revealed insufficient bone for placement of a second implant.

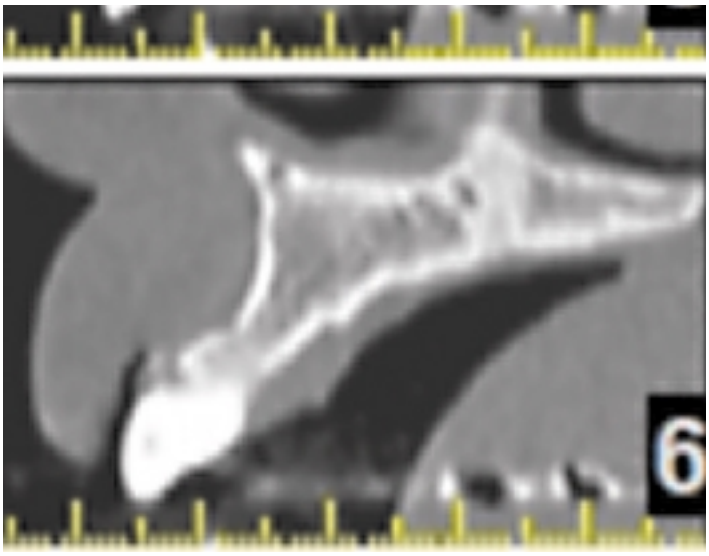


Figure 3. Fortunately, a CBCT scan was done prior to treatment planning which ensured a proper diagnosis and plan for ridge augmentation for future implant placement.

tortion and lacks the uninterrupted continuity of a three-dimensional image.

Cone Beam CT (CBCT) scanning provides the clinician the advantage of a three-dimensional image with the least distortion, an average of 0.2 to 0.5mm. Anatomic structures can be seen in their entirety without superimposition and with superior magnification, sharpness and significantly reduced distortion in relation to other radiographic techniques.

This makes CBCT a more precise diagnostic tool which provides greater clinical confidence in the placement of dental implants than conventional radiography.

Radiation dosage for an intraoral CBCT scan is about equal to that of two panorex films and about **1/50th the radiation of a conventional medical grade CT scan**.

The amount of valuable information available with CBCT scanning is well worth the minimally-elevated level of exposure compared with traditional films.

Films produced by the CBCT scanner can be viewed in three planes of space. Typical formatting of the CT data produces panoramic, axial, and cross-sectional oblique views.

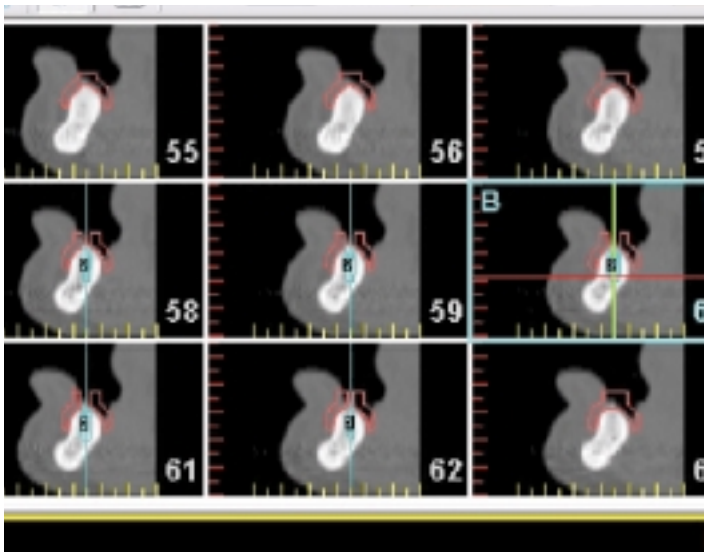
Utilizing one of several available software programs, the clinician can simulate the placement of implants on the computer screen.

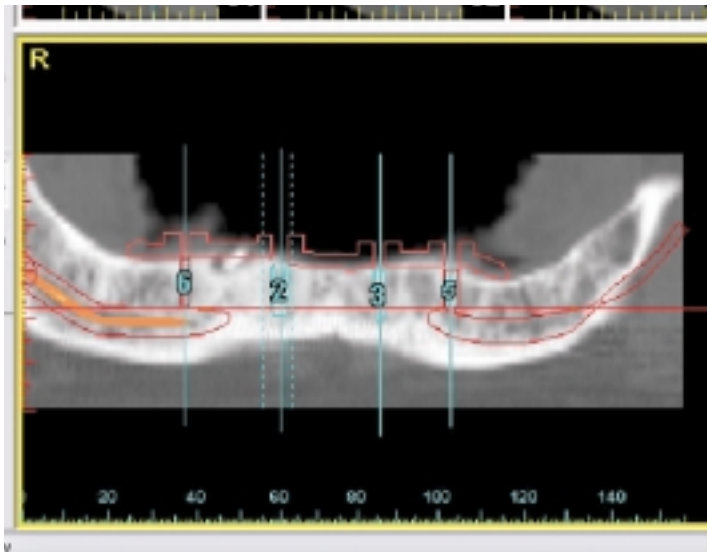
Readily available case planning programs provide the clinician the opportunity to "place" implants in optimal positions, making certain that the sites chosen will provide sufficient surrounding bone for each implant and good positioning of the implants in relation to each other. The locations of the implants can be altered to provide proper functional positioning.

Additionally, the clinician can measure the quality (density) of alveolar bone surrounding each implant fixture.

CBCT planning software permits the clinician to:

- Measure distance, angle and position of implants relative to other anatomic structures, teeth and implants
- Analyze bone density
- Identify the mandibular nerve and the presence of an anterior loop
- Simulate bone grafts
- Predict the final prosthetic outcome
- Place implants for orthodontic anchorage





Figures 4 and 5. This cross-sectional view of the mandibular anterior ridge reveals a very severe lingual undercut due to angulation of the bone. With the information from this CBCT scan, the accurate implant length can be determined to prevent lingual perforation.

With CBCT, clinicians can avoid such complications as perforating the buccal/lingual plates, severe bleeding episodes, violating the neurovascular bundle, perforating a sinus, damaging an adjacent tooth, overlooking anatomy like a bifurcated mandibular canal, an extension of the mandibular nerve, other anatomic variations or pathology which needs to be treated prior to implant placement.

Implant planning software can reformat the CT into a three-dimensional image from which a stereolithographic model can be constructed.

The model is machined with CADCAM technology into an accurate anatomic replica of the jaw.

Once a treatment plan is selected, a customized surgical drill guide can be constructed. Built directly from the selected treatment plan and based on the patient's exact measurements, these guides ensure safe, predictable implant surgery.

Three surgical guides are available: mucosa supported, bone supported and tooth supported.

The opportunity for restorative practitioners to set surgical performance standards for implant placement marks a paradigm shift in implant dentistry.

In an era which places a high value on esthetics, exquisite implant placement is important to ensure that the implant-supported restoration is indistinguishable from the tooth it is replacing.

CT Scanning in Orthodontics

The use of the CBCT scan in orthodontics also portends a new era in diagnosis and treatment. Historically, the examination tools most commonly used in the diagnosis of malocclusion are the panorex in combination with intraoral and cephalometric radiographs.

Caprioglio et al reported this technique is reliable in about 60 percent of cases.

CBCT scanning gives orthodontists revolutionary new information for treatment and care that isn't possible with conventional two-dimensional radiography.

The applications of 3D imaging in orthodontics include:

- 3D treatment planning
- 3D soft and hard tissue prediction (simulation)
- Three-dimensionally fabricated and precisely-machined archwires

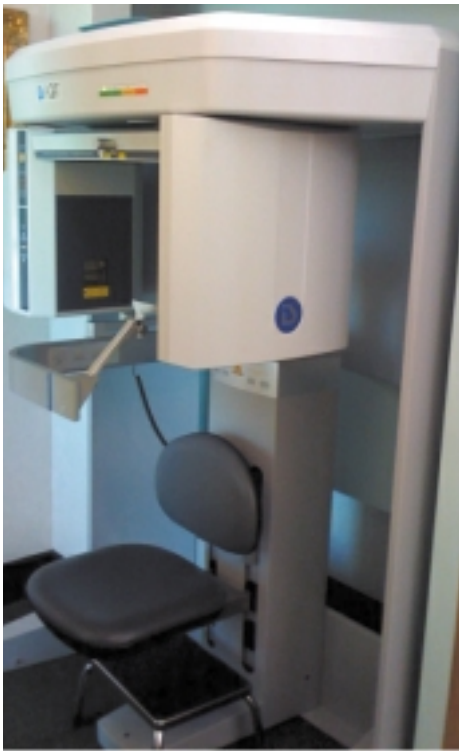


Figure 6. The iCat Cone Beam CT scanning machine.

Diagnosis of Endodontic Lesions and Vertical Root Fractures

Researchers have found CBCT scanning often reveals the presence of endodontic lesions not visible with conventional radiography. Additionally, it is easier to identify the mandibular canal. These scans reveal the amount of cortical and cancellous bone and the bone thickness, as well as the three-dimensional extent of the lesion.

Lastly, 50 percent more root resorptions are detected with CBCT scanning.

"Computer-assisted dentistry will become increasingly valuable for its increased accuracy .... As the cost of computerized tomography declines and the demand for such sophisticated diagnostic methods increases, CT Scans will inevitably become the Standard of Care."

Published studies have shown CBCT scanning is superior to conventional dental radiography in the detection of vertical root fractures. Youssefzadeh reported that conventional radiography only showed fracture lines in about a third of all cases while CBCT scanning revealed fracture lines in 100 percent of cases.

Restorative Applications

Restorative dentists have for many years been using three-dimensional computer imaging combined with a precise, diamond-cut milling machine to produce ceramic inlays, onlays, veneers and crowns in a single office visit.

State-of-the-art computer-imaging software is combined with a high speed diamond bur and disk milling machine that precisely carves the new crown or veneer from a solid block of tooth-colored ceramic without the need of an outside laboratory.

In conclusion, computer-assisted dentistry will become increasingly valuable for its increased accuracy.

Three-dimensional images can provide the patient with visual evidence of the treatment the clinician is proposing, along with the potential limitations of treatment due to variations in their individual anatomy.

Furthermore, it assists patients in making an informed health care decision prior to commencing treatment.

The current costs of this methodology have been a deterrent to some clinicians.

However, once the clinician learns to work with computer-generated models, the savings in intraoperative time and the predictability of treatment more than makes up for the expense.

As the cost of computerized tomography declines and the demand for such sophisticated diagnostic methods increases, CT scans will inevitably become the Standard of Care.

PDL