Diagnostic imaging in clinical practice

Prosthetically driven implant placement planning requires images on which you can rely

Author: Dr Bart Vandenberghe, Belgium

A sequence of scientific papers has demonstrated the crucial role of cone beam computed tomography (CBCT) in the field of implant dentistry. In 2012, the American Academy of Oral and Maxillofacial Radiology recommended the application of this imaging technology as the preferred method of pre-surgical assessment of intraoral implant sites. The ability of CBCT imaging to visualize the smallest bony details means that CBCT is superior to CT for evaluating the morphology of the residual alveolar ridge and bone quantity in most cases, while emitting very low doses of radiation. The data can then be used in dedicated CAD/CAM software. Finally, the relatively low cost of CBCT systems makes them economically viable—more so than conventional CT—for use in everyday clinical practice.

CBCT imaging as preferred method

Until recently, radiographic modalities for diagnosis during implant treatment planning relied upon two-dimensional projections of three-dimensional anatomical structures. With the advent of computed tomography, cross-sectional imaging had evolved from simple, locally produced tomographic sections to more accurate, faster and more versatile 3-D reconstructions computed for maxillofacial diagnostic tasks. However, this came at the cost of relatively high exposure doses.

By the late 1990s, CBCT further advanced the field of dental and maxillofacial radiology by allowing 3-D visualization of anatomical structures and their spatial relationship with a significantly reduced radiation exposure to the patient. In contrast to the fan-shaped beams and multiple detectors used in multi-slice computed tomography (MSCT), CBCT uses a conical X-ray beam to acquire images. The entire volume is imaged in one single rotation using a flat two-dimensional image receptor, thus making it the widely accepted method of choice for the pre-surgical assessment of intraoral implant sites today.

High accuracy and patient satisfaction

The past decade witnessed a paradigm shift from surgically driven to prosthetically driven implant placement planning. No longer just an add-on to the process, CBCT scanning has become the cornerstone of an integrated treatment workflow helping clinicians better execute their treatment plans. With a single scan, practitioners are able to acquire much more—and more accurate—data at lower effective radiation doses that are nearly equivalent to the dose of panoramic exams. The superior radiographic visualization compared with 2-D radiography facilitates better pre-surgical assessment and a better understanding of any oral pathologies. At the same time, the data can be used to optimize virtual treatment planning in 3-D and to prepare for guided surgery, which contributes to optimized treatment tailored for each patient.

Furthermore, less invasive procedures reduce patient discomfort and result in high patient satisfaction, as shown in observational studies on guided flapless
ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of continuing dental education.

ADA CERP does not approve or endorse individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry.

Join the largest educational network in dentistry!

www.DTStudyClub.com

- education everywhere and anytime
- live and interactive webinars
- more than 1,000 archived courses
- a focused discussion forum
- free membership
- no travel costs
- no time away from the practice
- interaction with colleagues and experts across the globe
- a growing database of scientific articles and case reports
- ADA CERP-recognized credit administration

Dental Tribune Study Club
Use of CBCT in dental implantology

**Preoperative planning**

**Initial evaluation**
Panoramic radiograph, followed by intraoral radiographs to obtain supplemental information. Use of cross-sectional imaging discouraged.

**Radiographic exam of implant sites**
Include cross-sectional imaging orthogonal to the site of interest. CBCT considered the imaging modality of choice.

**Bone augmentation**
CBCT if augmentation procedures or site development before placing dental implants are required, and if bone reconstruction and augmentation procedures have been performed prior to implant placement.

**Postoperative implant assessment**

**Immediate post-op evaluation**
Intraoral radiographs are recommended in the absence of clinical signs or symptoms. Cross-sectional imaging—particularly CBCT—should only be used immediately postoperatively if the patient presents with implant mobility or altered sensation.

**Follow-up examination**
CBCT to be considered if implant retrieval is anticipated. Should not be used for periodic review of clinically asymptomatic implants. Instead, intraoral and, in some cases, panoramic images are adequate for postoperative implant monitoring.

**Statement on the use of CBCT for research purposes**
Applicable to all scanning procedures. Adhere to the principle of keeping radiation doses As Low As Reasonably Achievable (ALARA).

---

**Superior visualization of anatomical structures**
Digital imaging can offer clinicians and technicians an extremely accurate diagnostic and treatment-planning tool with the potential to reformat the scan data and create virtual models of the patient’s anatomy. There is also the distinct advantage of accurate measurement in any dimension.

A recent study to assess prospective implant sites using panoramic radiography versus panoramic scans combined with CBCT imaging revealed that CBCT increases the accuracy of treatment planning as it makes it possible to predict the actual implant dimensions required at surgery (Mello et al., Braz Oral Res. 2014). Furthermore, performing a CBCT scan during the planning phase increases accurate prediction of implant length as well. The overall outcome is a more predictable surgical and restorative result.

**Parameters that affect radiation dose**

In practice, higher resolution of bone structures can be obtained with CBCT than with MSCT. Radiation exposure from CBCT is typically considered to be lower than that incurred from common spiral and multi-slice protocols. Depending on the geometrical configuration and the exposure parameters of the system, there is significant variability in the effective radiation dose delivered by CBCT machines. Dose reduction can be achieved by adjusting operating parameters. Crucial parameters include exposure time, tube current, the size of the field of view (FOV) and the angular degree at which the gantry rotates around the patient’s head.

---

**Table 1: Imaging modalities recommended by The American Academy of Oral and Maxillofacial Radiology.**

<table>
<thead>
<tr>
<th>Use of CBCT</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative planning</td>
<td>Panoramic radiograph, followed by intraoral radiographs to obtain supplemental information. Use of cross-sectional imaging discouraged.</td>
</tr>
<tr>
<td>Postoperative implant assessment</td>
<td>Intraoral radiographs are recommended in the absence of clinical signs or symptoms. Cross-sectional imaging—particularly CBCT—should only be used immediately postoperatively if the patient presents with implant mobility or altered sensation.</td>
</tr>
<tr>
<td>Bone augmentation</td>
<td>CBCT if augmentation procedures or site development before placing dental implants are required, and if bone reconstruction and augmentation procedures have been performed prior to implant placement.</td>
</tr>
<tr>
<td>Follow-up examination</td>
<td>CBCT to be considered if implant retrieval is anticipated. Should not be used for periodic review of clinically asymptomatic implants. Instead, intraoral and, in some cases, panoramic images are adequate for postoperative implant monitoring.</td>
</tr>
<tr>
<td>Statement on the use of CBCT for research purposes</td>
<td>Applicable to all scanning procedures. Adhere to the principle of keeping radiation doses As Low As Reasonably Achievable (ALARA).</td>
</tr>
</tbody>
</table>

---

**Editorial note:** A complete list of references is available from the publisher.

This article originally appeared in Nobel Biocare News 2/2016. Find the full journal references at nobelbiocare.com/news