



Dento-Maxillofacial Radiology in Implant Dentistry

Kivanc Kamburoglu

Radiology is essential in the diagnosis and evaluation of pathology in the implant site, implant planning, surgical guidance and postimplant assessment. Pre-surgical implant planning is of paramount importance for the successful outcome of dental implant treatment. In order to enable appropriate placement of implants, planning should include the identification of critical anatomical landmarks (the inferior alveolar nerve, mental foramen, incisive canal, maxillary sinus, ostium and nasal cavity floor), a bone-quality and quantity assessment and prosthetic considerations [1,2]. A relatively common problem is the use of an inappropriate insertion depth or path during the insertion of dental implant fixtures, which may cause sensory disturbances. Generally, it requires a safety zone of at least 1-2 mm in order to avoid critical anatomical structures [3,4].

Currently intraoral and panoramic radiography are the most common preferred modalities for implant dentistry. Intraoral imaging continues to provide the best spatial resolution of any imaging method currently available. The clinical diagnostic capacity of intraoral radiography is influenced by a number of variables, including beam angulation, exposure time, receptor sensitivity, processing, viewing conditions, superimposition of anatomic structures and lesion location [5]. Panoramic radiography, in which images of both jaws are obtained through the synchronous rotation of an x-ray source and image receptor around a stationary patient, can provide broad coverage of both jaws and teeth, but without the anatomical detail available with intraoral radiography. Moreover, there is a magnifying factor associated with image formation, and projection geometry results in image distortion and a marked overlapping of tooth crowns [6]. Distortion is reported to be 14% for periapical and 23% for panoramic radiographs [3]. In contrast to both intraoral and panoramic techniques, which by their nature are incapable of capturing information about the third dimension of teeth and adjacent structures, Cone-Beam Computerized Tomography (CBCT) was developed and introduced specifically for dento-maxillofacial imaging. CBCT which is recently very popular in implant planning offer reduced effective radiation doses, shorter acquisition scan times, easier imaging and lower costs compared to medical CT. CBCT doses, while lower than those from conventional CT, and are still significantly higher than those from conventional dental radiography. Differences in CBCT device, FOV, exposure parameters (kVp, mA) and other technical factors result in substantial differences in radiation doses. Dose is strongly related to (Field of view) FOV, which varies according to indication. Not only have CBCT images been proven successful when used for linear measurement, CBCT has also been shown to provide reliable 3-D information for the assessment of relative bone quality and quantity, 3-D evaluation of ridge topography and

preimplantation identification of vital anatomical structures [1,7]. This information can be used in the treatment planning process to identify suitable implant sites and to determine whether or not there is a need for surgical procedures, such as sinus lifting and bone augmentation [1,2]. CBCT is also recommended in sinus grafting operations as a means of better predicting complications, thereby achieving better surgical outcomes [8]. CBCT images have yielded promising results when used for surgical guidance. Commercially available implant simulation software can be used to process CBCT data to provide preoperative views of anatomical structures in the jaw bone, and the use of a stereolithographic guide can ensure that pre-operatively planned implant positions are accurately transferred to the surgical field [2]. As a new approach, CBCT bone images can also be fused with softtissue images acquired with digital impression techniques in order to enhance planning efficiency and to obtain predictable results [9]. Studies regarding post-implant assessment have examined various parameters including mobility, pain, infection, inflammation and marginal bone (also referred to as crestal bone) levels, with particular emphasis given to the use of standardized, serial intraoral radiographs to monitor changes in the amount of marginal bone surrounding the implant. Vertical bone loss at the surfaces facing implants should not exceed 1-2 mm during the first year of function and 0.2mm thereafter. A decrease in bone level indicates a loss in the implant's bony anchorage [10]. CBCT can also be used to localize implants after placement; to assess bone-implant interfaces; to evaluate demineralized bone and bone transplants and to identify peri-implant defects. However, it should be noted that metal artifacts caused by implants may complicate assessment and measurement; moreover, keeping in mind concerns over dose, CBCT should only be used if two-dimensional techniques have been unsuccessful. Obviously, conducting routine or screening imaging prior to obtaining a history and performing a clinical examination is an unacceptable practice [1,11,12].

References
 1. Benavides E, Rios HF, Ganz SD, An CH, Resnik R, et al. (2012) Use of Cone Beam Computed Tomography in Implant Dentistry: The International Congress of Oral Implantologists Consensus Report. *Implant Dent* 21: 78-86.
 2. Murat S, Kamburoglu K, Ozen T (2011) Accuracy of a Newly Developed CbctAided Surgical Guidance System for Dental Implant Placement: An Ex Vivo Study. *J Oral Implantol*.
 3. Murat S, Kamburoglu K, Kilic C, Ozen T, Gurbuz A (2011) Nerve damage assessment following implant placement in human cadaver jaws - an ex vivo comparative study. *J Oral Implantol*.
 4. Kamburoglu K, Kiliç C, Ozen T, Yüksel SP (2009) Measurements of mandibular canal region obtained by cone-beam computed tomography: a cadaveric study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 107: e34-e42.
 5. Tsesis I, Kamburoglu K, Katz A, Tamse A, Kaffe I, et al. (2008) Comparison of digital with conventional radiography in detection of vertical root fractures in endodontically treated maxillary premolars: an ex vivo study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 106: 124-128.

Author Affiliations

¹The University of Guyana, Georgetown, Guyana. ²Georgetown Public Hospital, Georgetown, Guyana* Corresponding author. Current address: Turkeyen Campus, Georgetown, Guyana. schimzesagon@gmail.com