ABSTRACT:
Dental implant placement has become an integral part of comprehensive treatment plans for dental rehabilitation for edentulous patients. A thorough patient assessment is a pre-requisite for adequate treatment planning and placement of dental implants. Dental imaging is an important tool to accomplish this task. Traditional radiographs provide a two-dimensional (2D) representation of three-dimensional (3D) structures. Their limited film size, image distortion, magnification, and 2-D view restrict their use in some cases. To overcome this, cone-beam computed tomography (CBCT) systems have become available for 3D visualization of the craniofacial complex. CBCT produces views and volumetric reconstructions of craniofacial structures similar to multi-slice conventional computed tomography (CT); however, it does so with reduced acquisition times, lower effective radiation doses, and a decreased financial burden compared with CT. The present paper reviews the role of CBCT in dental implant imaging.

INTRODUCTION
Dental implants are gaining immense popularity and wide acceptance because they are the conservative method of replacing lost teeth and restore function with proprioception, esthetics and thereby revamp the self-esteem of the patients. Successful implant treatment depends on efficient planning. This should include information on height, width, morphology and density of the bone, and evaluation of critical structures in imaging techniques. The type of imaging technique selected should be able to provide the
required information with adequate precision and dimensional accuracy. In whatsoever technique used, the patients X-ray beam and imaging receptor should be positioned to minimize distortion. The imaging information should balance with the radiation dose and financial cost to the patient. 

Earlier conventional radiographic techniques like IOPA, panoramic were accepted as standard methods. However improvements in sectional images led to use of tomographic methods to investigate potential implant sites. The American Academy of Oral & Maxillofacial radiology (AAOMR) recently recommended CBCT as best option for implant imaging. To improve the overall success of implant therapy with possible reduction in surgical and postoperative implant complications, implantologists should have three-dimensional (3D) information of bone volume and topography prior to implant placement.

PRINCIPLES OF IMAGING FOR DENTAL IMPLANT ASSESSMENT

The basic principles of radiology apply to imaging for implant evaluations. Images should have appropriate diagnostic quality and not contain artifacts that compromise anatomical structure assessments. Images should extend beyond the immediate area of interest to include areas that could be affected by implant placements. The goal of radiographic selection criteria is to identify appropriate imaging modalities that complement the goals at each stage of implant therapy. Cone beam computed tomography (CBCT) is the preferred option for implant dentistry, providing greater accuracy in measuring compared to 2D imaging, while utilizing lower doses of radiation.

Use of a CBCT, because of its ability to reconstruct a fully three dimensional model of the maxilla and mandible, will help identify critical anatomic structures accurately for precise placement of dental implants with minimal complications.

RIDGED MORAPOLOGY

Bucco-lingual ridge pattern cannot be viewed on 2D radiographs, but CBCT provides with advantage of appreciating the type of alveolar ridge pattern present. Cross-sectional images provide the implantologist the appearance of ridge patterns like irregular ridge, narrow crestal ridge and knife-shaped ridge. Also loss of cortical plates, undulating concavities can also be appreciated on cross-sectional images, which cannot be seen on panoramic image. McGinvney et al and Schwartz et al concluded that three-dimensional images more accurately reflected the true osseous topography and considered it as a valuable diagnostic aid.

QUANTITY OF AVAILABLE BONE AT IMPLANT SITE

Available bone is the amount of bone in the edentulous area considered for osseo-integration of the implant. As a general guideline a distance of 1.5 mm is maintained for surgical error between the implant and any adjacent landmark. Cortical bone is best suited to provide support for implants. CBCT allows accurate estimates of the alveolar bone height and width, which is mandatory for selecting the appropriate implant size and determining the degree of angulation of the edentulous alveolar ridge. (Fig: 1) The original height of available bone in the mandible is twice that of maxilla. CBCT helps us to determine the amount of bone required to be removed during the osteotomy procedure for adequate acquisition of buccolingual width. This function can be performed by utilizing the linear scale tool present on the software. An interesting clinically relevant classification can be used for determining the available bone as suggested by Chanavaz and
Donazzan. This classification is termed as Chanavaz and Donazzan French Volumetric Classification (1986)

*(Table: 1)*

**QUALITY OF BONE AT IMPLANT SITES**

The term bone quality is commonly used in implant treatment and in reports on implant success and failure. Lindh et al emphasized that bone density, bone mineral density (BMD) and bone quality are not synonymous. Bone quality encompasses factors other than bone density such as skeletal size, the architecture and 3D orientation of the trabecular and matrix properties. Bone quality is not only a matter of mineral content but also of structure. With CBCT software methods, it is possible to improve the accuracy of CBCT -HU values for determining bone densities at implant sites.

**CBCT-GUIDED IMPLANT SURGERY**

Type and size of the planned implants, its position within the bone, its relationship to the planned restoration and adjacent teeth and/or implants, and its proximity to vital structures can be determined before performing surgery. This is possible with integration of CBCT scans with CAD/CAM technology (e.g. CEREC, Sirona Germany). (Fig: 2) Computer-generated surgical guides can be fabricated from the virtual treatment plan. (Fig: 3) These surgical guides are used by the implantologist to place the planned implants in the patient's mouth in the same position as in the virtual treatment plan, allowing more accurate and predictable implant placement and reduced patient morbidity.

**Figures**

![Figure 1: Measurement of available bone at proposed implant site.](image-url)
Figure 2: Virtual implant placement from Galileo (Sirona) implant library. A. Reconstructed orthopantomograph (OPG); B. Implant library; C. Tangential view; D. Cross-sectional view; E. Axial view.

Figure 3: Three-dimensional reconstruction using virtual implant placement.
CONCLUSION:
CBCT provides a subjective assessment of bone quality and not objective assessment. CBCT allows the imaging in three dimensional views, thereby improves the ability to predict the actual implant length, thus reducing inaccuracy in surgical planning of dental implants. But, professional judgment varies depending on skill, competence, knowledge and experience of the clinician.

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