CONE BEAM COMPUTERIZED TOMOGRAPHY 3-D IMAGING - A DIAGNOSTIC APPLICATIONS

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Abstract
The introduction of cone beam CT (CBCT) represents a radical change for dental and Maxillofacial radiology. The three-dimensional (3D) information appears to offer the potential of improved diagnosis for a wide range of clinical application, and usually at lower doses than with Medical multislice CT. Usually CBCT gives increased radiation dose to patients compared with conventional dental radiographic techniques.

Key words: Cone beam computerized tomography, Dental implant imaging, 3 dimensional imaging

Introduction
In 1896 when first intraoral radiograph have been introduced, mark the beginning of use of 2D imaging in dentistry. It got advanced with the introduction of panoramic imaging and tomography. It became possible to visualize maxillofacial structure in one image with the use of Panoramic imaging while tomography enables to isolate an area of interest for better diagnosis.

The goal for recent imaging technique is lower radiation dose and faster processing time with good diagnostic value. The drawbacks in 2D images include magnification, distortion and superimposition which affect the diagnostic quality. 3D cone beam computed tomography (CBCT) introduced in 1998 provides a better diagnosis by producing 3D images. CBCT imaging is principled on cone- shaped beam of x-rays which are centred on 2D detector without use of parallel shift of detector system unlike used in conventional CT providing higher acquisition at lower dose of radiation. The cone beam x-rays rotates around patient’s head and produce several 2D images which can be visualize on 3D data set after reconstruction using variation of algorithm by Feldkamp et al in 1994. This is different from slice by slice imaging of conventional CT. Moreover at lower cost we can get 3D representation of hard tissues.

Limitation for conventional CT over CBCT is higher levels of ionizing radiation, longer scanning time and larger size. We can reduce the levels of radiation in CBCT by directing cone beam x-rays to area of interest only. This can be done by choosing different field of view (FOV). Optimum FOV can be selected for region of interest, providing dose saving by limiting the irradiation to fit the FOV.

CBCT systems can be categorized according to the available FOV:
- Localized region: approximately 5 cm or less (e.g., dentoalveolar, temporomandibular joint)
- Single arch: 5 cm to 7 cm (e.g., maxilla or mandible)
- Interarch: 7 cm to 10 cm (e.g., mandible and superiorly to include the inferior concha)
- Maxillofacial: 10 cm to 15 cm (e.g., mandible and extending to the vertex of the head)
- Greater than 15 cm (e.g., from the lower border of the mandible to the vertex of the head)

CBCT can show cystic lesions, tumors, malignancy, fibro-osseous lesion, relation of lesion with inferior alveolar canal, tempopromandibular joint, styloid process, implant site assessment. Evaluation of cystic lesion: (Fig 1a,1b) showing axial and Sagittal section of mandible with cystic lesion on right side. It causes expansion and thinning of buccal cortical plate while perforation can be seen on Sagittal view. (Fig 1c) showing reformatted OPG relation of lesion with mandibular canal.

Fig 1a-Axial view at level of apical 3rd of root showing the hypodense cystic lesion.

Fig 1b-Sagittal view showing well defined hypodense cystic lesion with perforation.
Impant site assessment- CBCT can be used to assess the implant site assessment by using various tools inbuilt into it. We can also measure the amount alveolar bone thickness needed for implant placement and its relation with various anatomical structures.(Fig 2a,2b )showing dimensions of alveolar bone before implant placement. (Fig 2c) showing 3D reconstructed image of implant site and its relation with inferior alveolar canal.

Disadvantages
Image Noise and Poor Soft Tissue Contrast are limitations in the use of CBCT.

Conclusion
Cone Beam Computed Tomography has heralded a shift from 2D to volumetric approach in maxillofacial imaging. Further application and increasing availability of CBCT are expected to extend maxillofacial CBCT imaging from diagnosis to image guidance of operative and surgical procedure. It will affect the expected standard of care and this has implications for increased practitioner responsibility in the performance, optimal vitalisation and interpretation of volumetric data set.

References