10.5368/aedj.2015.7.1.4.5

NEEDS AND DEEDS OF CBCT-AN ADVANCED IMAGING IN DENTISTRY

[1] Jagathesh P [1] Reader
[2] Christeffi Mabel R [2] Reader

[1]Department of Oral Medicine and Radiology, Narayana Dental College, Nellore, Andhra Pradesh, India.
[2]Department of Oral Medicine and Radiology, Chettinad Dental College and Research Institute, Chennai, Tamilnadu, India.

ABSTRACT: CBCT is an advanced imaging technique that has proved to be a significant adjuvant in the diagnosis of oral and maxillofacial diseases and disorders and also in treatment planning. Since it's commercial availability from the year 1999(the NEWTON DUT 9000 QR snl, verena, Italy) has been a boon in the field of dentistry for the dental practitioners. Ever since the advent of intraoral periapical radiograph in 1896,dental practitioners had relied on 2-D images for diagnosis and treatment planning. Panoromic radiographs in large has provided detailed information but with the disadvantage of magnification and distortion. CBCT imaging is an advancement in dental imaging providing a 3-D image which gives the external replica of the structures imaged without any magnification or distortion.

KEYWORDS: Cone Beam Computed Tomography (CBCT), Dental CT, 3-D image

INTRODUCTION

Cone beam computed tomography(CBCT) is a medical imaging system which provides three dimensional images at a comparatively lower cost and time than conventional computed tomography. CBCT is different from CT as the latter uses a fan shaped beam and helical/spiral consequetive imaging is done to acquire the data to reconstruct the 3D image, where as CBCT uses a cone shaped/volumetric beam with which one /single rotation around the object produces multiples/series of 2 D imaging which can be used to reconstruct a 3 D image . The advandage being low cost, low exposure time(10 TO 70 secs) and low radiation when compared to conventional CT. Although CT has been available, its use by the dental practitioners was limited because of cost, access and most importantly the dose consideration unless and otherwise the need was demanding for confirming the diagnosis or for efficient treatment planning. With the introduction of CBCT there had been a paradoxical shift in dental imaging from 2D to 3D images with adjunct of a third party application software. Many CBCT devices are new multimodal(providing panoramic of cephalometric images), have low footprint suitable for dental office placement, technically easy to operate , collimation of the beam to the region of interest thereby reducing the radiation exposure without compromising the resolution of the images[1].

Cone Beam Computed Tomography machine is available either in sitting, standing or supine position which varies according to the manufactures of which sitting and supine position reduces the motion artifact much further than the standing position. The X ray source of the detectors are fixed opposite to each other. A cone shaped source of ionizing radiation is detected through the area of interest with one rotation (180 degree) around the patient. Multiple sequential planar projection images (150to 600) are produced which are then mathematically reconstructed into a volumetric dataset. The Field of View (FOV) varies according to the type of system and the manufacturer's decision. Smaller the FOV better the image resolution and lesser the radiation exposure to the patient.

- Localized region – approx 5 cm or less (eg.dentoalveolar,TMJ)
- Single arch- 5 cm to 7 cm(maxilla and mandible)
- Interarch – 7cm to 10 cm(mandible and superiorly to include the inferior canalicula
- Maxillofacial – 10 cm to 15 cm(e.g. : mandible and extending to nasion)
- Cranio facial – greater than 15 cm(e.g.: from the inferior border of mandible to the vertex of head)

Applications of CBCT in Dentistry

1. Oral Surgery /Oral Meddicine and Oral Pathology

Conventional panoramic image invariably has a minimum of 25% magnification and distortion as well as the resolution is compromised attributing to degree of area of coverage. This is overcome with the advent of CBCT where the images are an actual replication of the object without exaggeration thereby attributing to precise measurements and accurate diagnosis. Applications of CBCT in oral surgery, oral medicine, oral pathology lies around the following conditions:

i) TMJ disorders- To assess the skeletal discrepancies and morphological alterations. To assess the

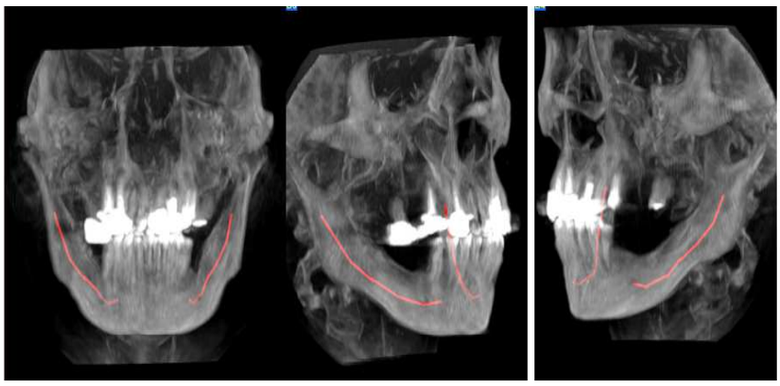

Fig.1:Inferior alveolar nerve tracing in Maximum Intensity Projection Image

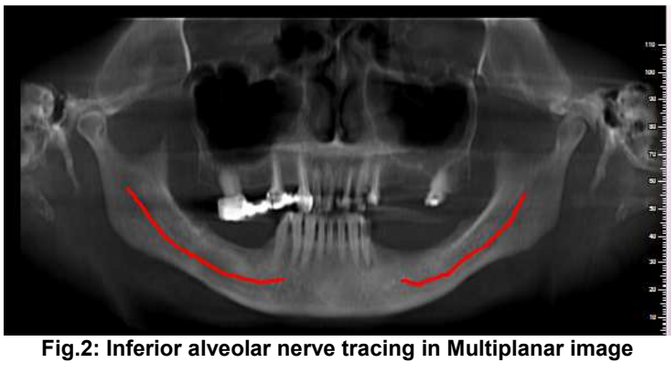

Fig.2: Inferior alveolar nerve tracing in Multiplanar image

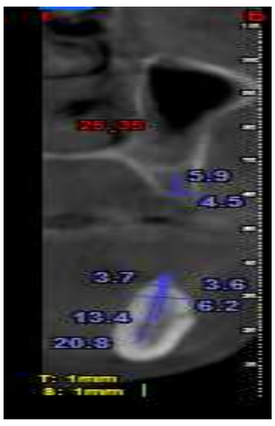

Fig. 3: Implant Measurement

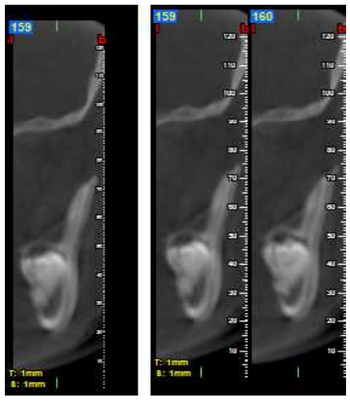

Fig.4: Impacted 38

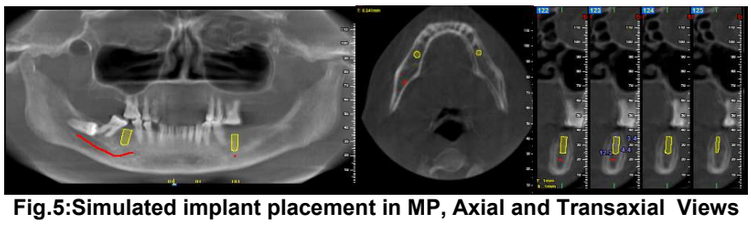

Fig.5:Simulated implant placement in MP, Axial and Transaxial Views

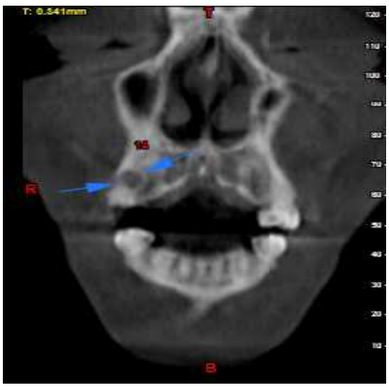

Fig 6: Periapical Cyst

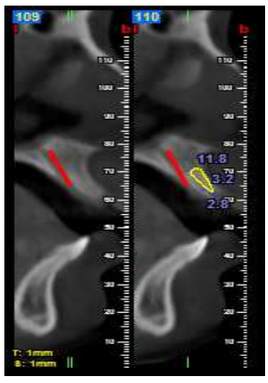

Fig 7: Nasopalatine Canal (Marked in red)

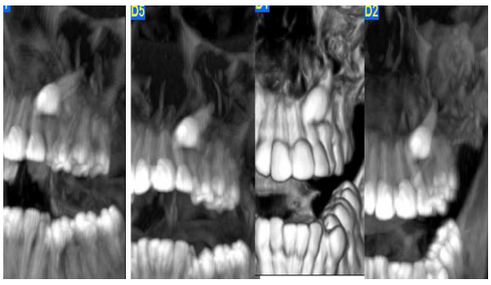

Fig 8: 3D-Image of Impacted 23

Fig.9: Ameloblastoma of left ramus of mandible

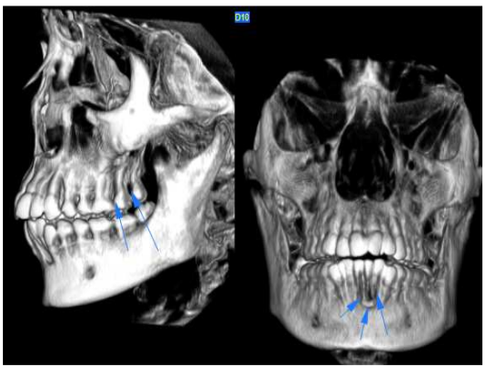

Fig .10: 3-D Images showing alveolar bone loss

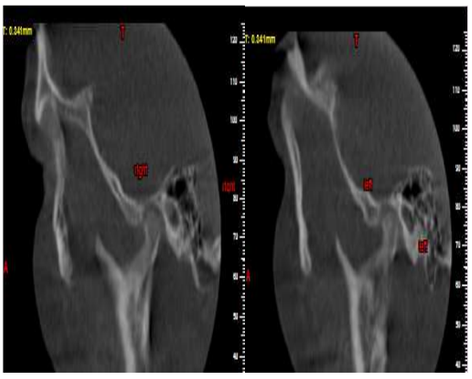

Fig.11: Sagital view showing TMJ

Fig.12: 3-D Image showing impacted 21

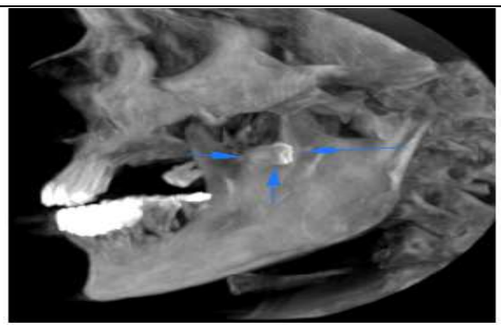

Fig.13: Impacted tooth in left coronoid notch

ii) pathological alteration on the condyle or the glenoid fossa.
iii) Cleft palate- To assess the extent of the cleft and also to evaluate the in the region of cleft lip.
iv) In evaluating and diagnosing – Oral and maxillofacial pathologies like cyst and tumour.
v) To assess the developmental structural deformities of the craniofacial or dentofacial region.
vi) For surgical planning of impacted tooth- To locate the vital structures adjacent to the surgical site.
vii) Maxillary sinus pathology can be distinguished to enable the efficiency of the surgeon doing maxillary sinus lift procedure.

2. Implantology

CBCT has reduced implant failures by providing information about bone density, shape of the alveolus, height and width of the prepared implant site for each patient.[2,3]

a) Assessment of Residual alveolar ridge - The height and width of the residual alveolar ridge can be accurately measured using CBCT.
b) Quality of Bone – can be assessed with CBCT based on the appearance of trabaculae and bone marrow spaces unlike the exact bone density measurement using hounsefield (HU) in CT.
c) Relationship with vital structures- CBCT displays the accurate relationship of the anatomical structures with the region of interest. The following structures are to be analysed while placing for implants.

Anterior maxilla	– Nasopalatine / incisive canal, Labial cortical bone depression, Floor of nasal cavity
Posterior maxilla	– Floor of maxillary sinus, Maxillary tuberosity, Posterior superior alveolar canal
Anterior Mandible	– Mandibular incisive canal, Anterior loop of mental foramen.
Posterior mandible	: Premolar region – Mental foramen :Molar region – submandibular fossa and mandibular canal

Endodontics

Endodontics is an everyday practice in dentistry which might be complicated by negligence of accessory roots or canals. CBCT is an imaging modality with increased radiation dose than intra oral periapical radiograph or orthopantamographs and so its use in endodontics should be limited to the assessment of the following:

i) In cases with post treatment complications such as over extended restorative material, separated instruments, perforations, calcified canals
ii) In situations to evaluate the root morphology and anomalies
iii) To assess the clinical situation in patients with prolonged pain following endodontic restoration
iv) To assess internal and external resorption.
v) To assess fractured root/ tooth following trauma

Low et al compared the radiographic findings of periapical radiograph with CBCT in RC Treated maxillary posterior teeth which were being assessed for periapical surgery. In these studies 34% of periapical lesions detected by CBCT were not detected with periapical radiograph. This might be attributed to the approximation of maxillary teeth root with maxillary sinus in IOPA where in the radiolucency of the sinus is merged with roots of the teeth and hence ignored[4].

3. Orthodontics

CBCT plays a vital role in orthodontic management as it can provide information necessary in a single scan with reduced radiation exposure and scan time. CBCT helps in accessing i)Impacted tooth- especially the canines ii)Amount of bone (bone thickness) around the impacted toot iii)Unerupted teeth iv)Root resorption in roots adjacent impacted tooth vi) Severe

skeletal discrepancies vii)To areas the pathology if any preventing the eruption of teeth(odontomes).Diagnostic use of CBCT includes evaluation of Dental structural anomalies, positional anomalies, buccal / lingual alveolar width, periodontal status, facial asymmetry,TMJ,cranio-facial / dentofacial anomalies, mini implant and maxillary expanders.

CONCLUSION:

CBCT, as described in this article has elaborate applications in the field of dentistry. But considering the radiation dose and the cost of this recent advancement it is very mandatory to limit its usage only in the circumstances where the diagnosis and treatment is relied on the CBCT.

References

1. Tyndall et al .Position statement of American association of oral and maxillofacial radiology selection criteria for the use of radiology in dental, Oral and Maxillofacial radiology, Implantology with explanation on CBCT .vol.113.no.6. June 2012. Pg 817-26
2. Dial c, Mayorge. C. CBCT for pre surgical assessment of implant sites. J.CALIF dental vassociation 2003,31(11):825-833
3. Hua y,Nackaerts Q ,Duyet J .Bone Quality assessment based on CBCT imaging. Clein Oral Implants 2009,20 (8) : 767-71
4. Lew MTI, Dula KD, Burgin W (2008) comparison of periapical radiography and limited CBCT in the posterior maxillary teeth referred for apical surgery , Journal of Endodontics 34, pg 557 to 62

Corresponding Author

Dr.R.Christeffi Mabel M.D.S.,

Af-3, Al-syed builders, 2nd Main road, Dhandeeswaram Nagar,

Chennai-600042

Tamilnadu, India

Email: christeffimabelr@yahoo.co.in