Interpretations of Cone Beam Computed Tomography

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Abstract

Dental volumetric tomography is the concept in which tissues of maxillofacial region are depicted using a cone beam shaped x-radiation to provide rapid accurate details. The salient advantages of cone beam computed tomography (CBCT) are shorter exposure time, reduced image distortion due to patient movements, decreased patient dose and multiplanar screening. CBCT aids the clinicians to localize the anatomic structures as a whole which can be visualized in three planes as in axial, coronal and sagittal sections. As a prerequisite for interpretation of every imaging mode, it is essential for the clinician to know the normal from the abnormal. This review highlights the essence to comprehend CBCT and interpret it in the accurate manner with minimal complications.

Keywords: CBCT; Maxillofacial region; Interpretation.

Introduction

Cone beam computed tomography (CBCT) had been established since 3 decades by now. The ease of handling or the reach of this imaging modality to the clinicians even now is not proportional to this long period though. The lack of availability, cost factor forms the major hindrance for this. Another missing link here is the lack of familiarity in the anatomical landmarks in the head and neck imaging in CBCT which is a prerequisite in identifying the pathology associated with it. The present article aims to plug this gap and make this imaging modality familiar and accessible to the clinical practitioners.

Common anatomical structures in head and neck region and its presentation and significance in CBCT is enlisted and described.

Mandibular Canal:

Mandibular canal is a clinically significant structure on accounts of impactions, Implants, benign and malignant lesions, osteotomies, fractures or any operative procedures in mandible. Distortion of image accuracy in 2D imaging leads to miscalculation of the location of mandibular canal.[1,2] It is a tube like structure that transverses whole length of mandible from mandibular foramen in the ramus till the mental foramen in premolar region. On a CBCT image, it appears as a radiolucent circle surrounded by thin radioopaque ring which represents the wall of the canal. The canal is best visible in coronal and cross-sectional images; and is less appreciated in axial sections. On sagittal views, canal might take a variable tube like appearance depending on actual location and orientation of slice selected.[3]

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Mental Foramen

Mental foramen is an opening on the external surface of mandible which is located on the premolar region and it signifies the anterior end of mandibular canal. It possess the mental nerve and vascular supply to the lower lip region. On a CBCT image, it appears as a crescent incomplete circle which is readily visible on all sections. Implantations in this region is a common clinical scenario which demands the precise dimension and viscinity of mental foramen.

It can vary with regard to size, shape, location and direction of opening. Popular method for identification of mental foramen in horizontal plane was proposed by Green.[4] In this method, position of mental foramen is recorded as either in the line with longitudinal axis of a tooth or as lying between the two teeth. The location of mental foramen is also related to the race of an individual.[5,6]

When planning dental important in mandibular premolar region, clinician should be able to identify vertical mental foramen position, as post extraction phase can lead to alveolar bone resorption and the movement of mental foramen closer to alveolar crest. In extreme degrees of resorption, mental nerve and vessels could be found directly under the oral mucosa.

Katakami et al. detected 17 accessory mental foramina in 16 patients using CBCT imaging. Naltoh et al. had detected accessory mental foramen in 7 % of patients with CBCT images. Accessory mental foramen is found in the apical area of the first molar and posterior or inferior to the mental foramen. Mandibular canal may extend beyond the mental foramen as an intraosseous anterior loop. The description by Bavitzet[7] and Misch[8] is: “where the mental neurovascular bundle crosses anterior to the mental foramen than doubles back to exit the mental foramen”.

The location of the foramen and the possibility that an anterior loop of mental nerve may be present medical to

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the mental foramen need to be detected by CBCT imaging to avoid the possible injury to mental nerve and vessels.

Mandibular condyle and coronoid process:

CBCT imaging had been effective in demonstrating the bone changes in coronoid process and mandibular condyle that affects the temporomandibular joint(TMJ).[9,10] The head of the condyle is an elliptical shaped bony process. The articulation surface of condyle is hemicylindrical antero-posteriorly. The hemicylindrical appearance of condylar head is prominent in sagittal and coronal sections; whereas condylar head appears elliptical on axial sections. On coronal view in open mouth situation, it leads to clearer view of condyle, as it translates over the tubercle and gives an unobstructed view of condylar head.

Coronoid process is a bony prominence located in anterior superior portion of ramus of mandible which is flattened lateromedially. It serves as an attachment site for muscles of mastication and on its medial surface is the attachment of temporalis muscle. On CBCT, it appears as a prolonged elongation that is continuous with that of mandibular ramus on sagittal and coronal views; while it demonstrates a triangular shape on corresponding axial slice.[10]

Mandibular incisive canal and lingual foramen:

Mandibular incisive canal is a tube like structure and a prolongation of mandibular canal anterior to mental foramen, continuing towards the incisor region in a slightly downward direction, narrowing crossing the midline at times. Lingual foramen is usually situated in the internal region of mandibular symphysis and begins superior to the mental spines and contain an artery that develops from the anastomosis of the two sublingual arteries and ends at the buccal lingual cortex.[11] It is clinically significant as the surgical procedures in this area can have post operative complications if not imaged and interpreted properly.[12] Mandibular incisive canal and lingual foramen are best viewed in cross-sectional views.[13]

Frontal sinus:

It is an air filled cavity located in forehead region superior to paired nasal bones. On CBCT image, it appears as a radiolucent cavity surrounded by thick cortical layer of frontal bone. The anterior wall of thickness is inversely correlated with the dimension of frontal sinus. It is visible in all three orthographic views.[14]

Orbit:

The orbital cavity is readily visible as a large round or oval radiolucent cavity and is best visualized on coronal slices of CBCT.[15]

Nasal cavity:

It is a pear shaped cavity bounded by maxillary sinus laterally and ethmoidal sinus superiorly. It is separated into three distinct chambers (meati or turbinates) on either side of three osseous processes and nasal conchae. It appears as a pear shaped cavity in coronal slice in CBCT; cavity should be traced along the path of nasal concha and middle nasal septum.[16]

Nasal septum:

It is a mid sagittal septa that divides the nose into two compartments, composed of a hard tissue (vomer) and a soft tissue (nasal cartilage). On CBCT, it is visible on coronal sections as a longitudinal line segmenting the nasal cavity and on the mid-sagittal plane, the anterior soft tissue cartilage and the posterior hard tissue bone can be visualized.[17] On trans-axial slices, it runs along the nasal cavity antero-posteriorly while surrounded by the nasal concha anteriorly and the ethmoidal sinuses in the posterior region.

Sphenoid sinus:

Sphenoid sinus is located on the midline and it separates anterior and middle cranial fossa from each other.[18,19] It is filled with air and is separated by a bony septum and is adjacent to vital structures such as internal carotid artery.[20] On CBCT, it appears as dark and is located posterior to ethmoid sinus below the base of sphenoid bone.[16]

Ethmoid sinus:

Ethmoid sinus is present at birth and enlargement of the sinus terminated by the age of 12.[21] It is made up of multiple small air cells separated by the vomer bone in the middle.

Maxillary sinus:

On CBCT, maxillary sinus can be visualized in all orthographic views as a large triangular radiolucent compartment surrounded by cortical bone. It is lined by a mucosal layer that appear as a thin lining to the cavity; which is thickened and increased in size following the infection.[22]

Infraorbital foramen:

Infraorbital foramen is formed laterally by zygomatic bone and medially by maxilla. At 1 cm below the infraorbital margin, there is infraorbital foramen for the passage of infraorbital nerve and vessels. On CBCT, it appears as a round radiolucent opening situated in the superior border of the maxillary sinus lateral to the nasal cavity.[23]

Zygomatic bone:

Zygomatic bone is a pyramidal bone which forms the lateral wall of the orbit and with the zygomatic process of the temporal bone. It is a strong buttress of lateral portion of middle third of facial skeleton and is responsible for midface contour and protection of orbital contents. Zygoma plays a major role in facial contour and any damage of zygomatic bone carries a risk of functional and aesthetic deficiency.[24,25] On CBCT, bone might appear constricted in middle on coronal slices due to presence of zygomaticofacial canal.

Anterior nasal spine:

It represents the anterior most part of nasal cavity and is formed by the union of paired maxillary bones. On CBCT, it exhibits a triangular shaped spine on cross-sectional views.

Conclusion

CBCT has immense potentials which is not explored fully till date. The increase in awareness, availability and use of this imaging modality is the sole method to use its potential to the benefit of diagnosis and treatment of pathologies involving head and neck region.

Conflict of Interest

Nil

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