**THE ROLE OF CONE BEAM COMPUTED TOMOGRAPHY IN ORTHODONTICS**

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**ABSTRACT**

Cone beam computed tomography (CBCT) has probably been one of the most thoroughgoing innovations in the field of Dentistry.(1) CBCT was introduced into the field of dentistry due to its very compact size, reduced cost, low ionizing radiation exposure when compared to other medical computed tomography techniques. It is the technology used to take three dimensional (3-D) scans of your teeth, nerve pathway, maxillary sinus and bones in the maxillofacial region with single scan. Three-dimensional imaging (3D) developed to meet the demands of advanced technologies in provide the treatment and at the same time responsible for the evolution of new treatment strategies in Dentistry.

**Clinical significance:** CBCT played a salient role alongside clinical evaluation with the treatment planning and follow-up of dental implants. It not only provides an excellent tool for accurate diagnosis, but also more predictable treatment planning. It also provides more efficient patient management, education, improved treatment outcome and patient satisfaction.

**Keywords:**Cone beam computed tomography, maxillofacial imaging and 3-D imaging

 **I.INTRODUCTION**

Conventional film-based tomography, also known as body-section radiography, which is a technique used designed image more clearly lying within a plane of interest such as teeth or jaw bones. Today the technology is so grown up that we can visualize the entire head in 3D. Today cone beam computed tomography has made a exceptional entry into field of Orthodontic and orthopedic dentistry in the last few years. (3) CBCT is a radiographic imaging technique consisting of computed tomography where the X-rays are divergent, that forms a cone beam. With rapid 180° or more, a CBCT provides essentially immediate and accurate two-dimensional and three-dimensional radiographic scans of an anatomical structure. This article mainly describes the application of Cone beam computed tomography in the field of orthodontics through its different and unique image display of maxillofacial region. (3)

 **II.CONE BEAM COMPUTED TOMOGRAPHY (CBCT)**

**A. Cone beam?**

Cone beam imaging is quick, easy and entirely painless 3D x-ray in which patients just sit in a chair for asingle10-15second scan and that scan can quickly see computer generated views of the bones of the face, the teeth, and other anatomical details from any angle, in three-dimensional view and in colorful images. Cone-beam CT is used to investigate the exact location of jaw pathologies such as tumors, inflammatory lesions, and exact location of impacted teeth before oral or maxillofacial surgery. It is also used in endodontics, implant dentistry, orthodontics, peridontics, temporomandibular joint imaging, and forensic dentistry. (7)

**B. CBCT vs CT?**

Computer tomography imaging is also known as computerized axial tomography (CAT) imaging. CT was invented at the end of the 1960’s by Godfrey Hounsfield in England and by Allan Cormack. They developed image reconstruction mathematics that can provide cross sectional view of head. The term tomography comes from the Greek words Tomos, which means to divide, and graph in, which basically means to write. So, by definition CT is an imaging of an object (teeth, jaw bones, maxillary sinus etc) by analyzing its slices. Cone-beam is basically a cone shape of the X-ray beam. Unlike a conventional computer tomography, which uses a fan-shaped beam to create many thin slices or scan of an image (1).CBCT in dentistry is the digital imaging which forms high resolution and low distortion images of the hard tissues of the head. In CBCT images are measured in voxel instead of pixels and also forms sharper image than CT.

**C. HOW DOES IT WORK?**

CBCT uses a divergent “Cone shaped” beam of ionizing radiation like X-rays. A 2D area detector rotate around the area of interest to acquire multiplanar sequential images in a single scan and the scanning software in computer system collects this projection data and reconstructs images, and that produces volumetric data.

**D.CBCT IMAGE RECONSTRUCTION**

While capturing a CBCT scan, from predefines angles multiple single 2D snapshot images are captured as the machine moves through isocentric rotation the x-ray source. These raw images are then compiled by computer system into a 3D dataset with the use of specialized reconstruction algorithms. The volume is known as the “3-Dimentional image”

 **III. SEVERAL APPLICTION OF CBCT IN ORTHODONTICS**

* Impacted and ectopic teeth
* Root abnormalities
* Supernumerary Teeth
* Pathologies of Jaw
* Teeth Development and eruption sequence
* Cleft lip & cleft palate
* Thickness of Alveolar Bone
* Dental Anomalies

Impacted and Ectopic teeth:

An impacted or ectopic tooth is the disturbance in the pattern of eruption because of some physical barrier in their path of eruption or local factors such as (lack of space, cysts or tumors, persistent primary teeth). The diagnosis of impacted or ectopic positioned maxillary canines is usually made by cone beam computed tomography and radiographic examination. Impacted maxillary canine has a close association with other tooth and eruption disturbances (9). CBCT is widely used in cases of ectopic or impacted canines, also in delayed in eruption of permanent teeth.

Root Abnormalities:

Root resorption of buccal or lingual/palatal root which is not easily visualized by 2-D radiographs could differentiate pre- or in-treatment planning by CBCT scans. CBCT scans have the clear images of root resorption due to its high resolution and low distortion scan.(1)

Supernumerary teeth:

Supernumerary teeth may be briefly described as any teeth or tooth substance in excess of the usual configuration of 20 deciduous and 32 permanent teeth. Supernumerary teeth are the extra number tooth present in the dentition other than usual dentition it can vary from a simple odontoma, through a conical or tuberculate tooth, which closely resembles a normal tooth. (5) It may cause the delayed eruption of succedaneous teeth, displacement or rotation of permanent teeth(malocclusion), crowding, abnormal diastema (such as midline diastema or mesiodens), or premature space closure. CBCT imaging in supernumerary teeth provides an excellent tool for accurate diagnosis and more predictable treatment planning.

Pathologies of Jaw:

Jaw tumors and cysts are growths that develop in the bone of maxilla or mandible, the soft tissues in the orofacial region. These growths or lesions are usually noncancerous (benign) and painless, but later they can be aggressive and expand, surrounding bone and tissue. Also, growth can displace teeth of surrounding region. Such lesions or growths can be viewed easily using cone beam computed tomography scans. These growths appear to have no causative factors but can prevent tooth movement and causes tooth displacement or malformed teeth eruption. (6)

Cleft lip and Cleft Palate:

Cleft lip and Cleft palate are most common congenital anomalies of orofacial region. CBCT can provide the cleft’s exact and accurate anatomic relationships. It also provides bone thickness around the existing teeth that is in proximity to the cleft or clefts. This can help in grafting procedure planning and treatments of existing dentition. (1)

Teeth Development and eruption sequence:

In child’s Dental health estimation of eruption schedule is important tool in treatment planning that includes diagnosis, prevention and treatment planning. It also plays an essential role in diagnosing several growth disorders. A CBCT is used to determine the anatomic structures and location of retained teeth. Many dental anomalies are associated with dental eruption disorders such as delayed eruption of permanent teeth or over retained deciduous teeth increase the likelihood of a correct diagnosis. (10)

Thickness of Alveolar Bone:

CBCT is also used to view apical bone thickness in buccal and lingual aspect of maxillary and mandibular teeth. A high-resolution CBCT provides alveolar bone thickness which helps in orthodontic implants. (4)

Dental Anomalies:

Dental anomalies usually caused due to complex interactions between genetic and various environment factors during the process of tooth development. This is multidimensional and complex process. The co-relation between dental anomalies have been a focus to number of clinical orthodontics. Early diagnosis of dental anomalies helps the clinician for accurate treatment planning and it can reduce complications due to delayed eruption. The earlier is the diagnosis, lesser the complexity in treatment planning. A CBCT scan helps the dentist to assess changes in pattern of eruption of tooth which frequently affect dental arches and later forms malocclusion. (8)

 **IV. Conclusion:**

CBCT is boon in the field of Dentistry. Cone beam computed tomography is a technique which broadly used in the field of dentistry for diagnosis and treatment possibilities. The most common indication of CBCT was dentomaxillofacial anomalies and malocclusion of teeth in either primary or permanent dentition. CBCT also provides thorough knowledge in the management of impacted or ectopic teeth (most common maxillary canine).In mixed dentition stage CBCT is indicated in orthodontic or orthognathic surgery. However, cone beam computed tomography should be used when and where needed and shouldn’t be used where 2D scans are sufficient. (3)

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