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CBCT: CONE BEAM COMPUTED TOMOGRAPHY- APPLICATIONS IN CLINICAL DENTISTRY

Radiology

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ABSTRACT

Before the advent of OPG and CBCT; Intraoral periapical radiography was mainstay of dental imaging since years. CBCT was first adapted for potential clinical use in 1982 at the Mayo Clinic Biodynamics Research Laboratory. This technique is a recent development and is found to be more efficient and economical than conventional tomography or CT in oral diagnosis. CBCT allows better 3D visualisation of manifested disease/ deformation/ malocclusion, better diagnostic accuracy, better understanding and treatment planning. With reduced patient exposure, reduced processing time and better visualisation, CBCT is an imaging modality that is gaining more and more popularity. The aim of this article is to highlight the application of this modality.

KEYWORDS:

Children with speech & hearing disability, Inclusive Education, RPD Act

Introduction

Radiographic imaging is one of the important diagnostic tool for the assessment of the dental health of the patient1. First intraoral radiographic image was taken in 1896 after which two dimensional imaging technique began to be used in dentistry. Since then, several advancements like panoramic imaging and tomography came into use thereby reducing radiation exposure with improved processing time[2].

In the 1960s panoramic radiography was introduced and by the end of 1980s it was adopted worlwide, providing clinicians with a single comprehensive image of jaws and maxillofacial structures[1].

The use of advanced imaging posed limitation for dental practitioners due to high cost, availability and radiation dose considerations. The introduction of cone-beam computed tomography (CBCT) provides opportunities to request multiplanar imaging[3].

Cone beam imaging technology is most commonly referred to as cone beam computed tomography (CBCT). The terminology "cone beam" refers to the conical shape of the beam that scans the patient in a circular path around the vertical axis of the head, in contrast to the fan-shaped beam and more complex scanning movement of multidetector-row computed tomography (MDCT) commonly used in medical imaging[4].

Discussion

Application of CBCT in clinical dentistry

CBCT was initially developed for angiography5, but more recent medical applications have included radiotherapy guidance[6] and mammography[7]. The idea of using cone-beam geometry was so as to replace conventional CT which uses either fan-beam or spiral-scan geometries, to allow more rapid acquisition of a data set of the entire FOV and use of a comparatively less expensive radiation detector. The advantages are that it allows a shorter examination time, include the reduction of image unsharpness, reduced image distortion due to internal patient movements, and increased x-ray tube efficiency. Its main disadvantage, especially with larger FOVs, is a limitation in image quality related to noise and contrast resolution because of the detection of large amounts of scattered radiation[1].

Nowadays, it is mainly being used for the purpose of diagnosis, treatment planning and follow-up in the various dental disciplines[2].

All CBCT units initially provide correlated axial, coronal and sagittal perpendicular MPR images.Tools include zoom or magnification and visual adjustments to narrow the range of displayed grey-scales. (window) and contrast level within this window, the capability to add annotation and cursor-driven measurement[3]. The value of CBCT imaging in implant planning[8-10], surgical assessment of pathology, TMJ assessment[11-13] and pre and postoperative assessment of craniofacial fractures has been reported[14-16].In orthodontics, CBCT imaging is useful in the assessment of growth and development[14,17-19].

1.Oral and Maxillofacial Surgery

CBCT allows visualisaton of jaw pathology[20-28], the assessment of impacted teeth , supernumerary teeth and their approximation to surrounding structures[29-38], any changes in the bony pattern due to bisphosphonate-associated osteonecrosis of the jaw[39-40] and the assessment of bone grafts[41]. It also helps in visualization of paranasal sinuses42 and in cases of obstructive sleep apnea[43] . Since the images are reconstructed from 2-D slices, it helps in overcoming superimpos itions[43-44]. This advantage helps in better visualisation in mid-face fracture cases, orbital fracture assessment and management and for inter-operative visualisation of the facial bones after fracture[45-46].

2. Endodontics

Imaging is necessary for accurate diagnosis of odontogenic and nonodontogenic pathoses, treatment of the pulp chamber and canals of the root of a compromised tooth via intracoronal access, biomecha nical instrumentation, obturation, and evaluation of healing.

It has been seen that CBCT allows practitioners to make a differential diagnosis by measuring the density from the contrasted images of these lesions, thereby allowing differentiation of an apical granuloma from an apical cyst[47-50]. Cotton et al. used CBCT as a tool to assess whether the lesion was of endodontic or non-endodontic origin.

Cases of external root resorption, external cervical and internal resorption, the extent of resorption can also be determined[38,49,51-52].

It is a reliable modality for pre-surgical assessment of the tooth to surrounding structures, size and extent of lesions, as well as the anatomy and morphology of roots with very accurate measurements [38,49-50,53-57].

3.Implantology

With increasing demand for dental implants, the assessment of vital structures and accurate relation with implant is required. With CBCT giving more ac curate measurements at lower dosages, it is the preferred option in implant dentistry today[22,28,35,55].

CBCT allows the assessment of bone quality and bone quantity. This

leads to reduced implant failure.

4. Orthodontics

CBCT has become the preferred tool for the assessment of facial growth, age, airway function and disturbances in tooth eruption[58-61].

As the images are self-corrected from the magnification to produce orthogonal images with 1:1 ratio, higher accuracy is ensured[62].

5. Temporomandibular Joint Disorder

CBCT allows visualization of the true position of the condyle in the fossa revealing any dislocation of the disk and the extent of translation of the condyle in the fossa[35,49]. It also allows measurement of the glenoid fossa accurately[63,64].

6. Periodontics

With the help of CBCT, morphology of the bone can be studied in detail49. Its accuracy has been proven to be close to that of periodontal probe49. Furthermore, it aids in assessing furcation involvem ents[49,64].

7. General dentistry

Based on the available literature, CBCT is not justified for use in detecting occlusal caries, since the dose is much higher than conventional radiographs with no additional information gained. However, it proved to be useful in assessing proximal caries and its depth.

8. Forensic dentistry

Many dental age estimation methods, which are a key element in forensic science, are described in the literature. CBCT was established as a non-invasive method to estimate the age of a person based on the pulp–tooth ratio

Conclusion

Conventional imaging techniques are more accessible, cost effective, however , high-resolution imaging modality continues to be of value as it provides more diagnostic information with less radiation exposure. There are, however, specific situations, both pre- and postoperatively, where the understanding of spatial relationships afforded by CBCT facilitates diagnosis and influences treatment. The usefulness of CBCT imaging can no longer be disputed—CBCT is a useful task specific imaging modality and an important technology in comprehensive evaluation, diagnosis, treatment planning and follow up.

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