ABSTRACT
Radiographic imaging is important in diagnosis and treatment planning in oral and maxillofacial surgery. Conventional radiographs produce a two-dimensional image of a three-dimensional anatomical structure with superimposition, distortion, magnification of the anatomic structures. The radiation dose, cost, access, poor resolution have resulted in limited use of conventional CT in oral and maxillofacial surgery. These problems may be overcome using CBCT. The purpose of this article is to review the practical applications of CBCT in oral and maxillofacial surgery.

Keywords: Radiographs, Computed tomography, CBCT, Impaction, Trauma.


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INTRODUCTION
Cone beam technology has been given several names, i.e. beam volumetric tomography, cone-beam volumetric imaging. Most frequently preferred term is cone-beam computed tomography (CBCT). This technique is based on cone-shaped X-ray beam centered on a two-dimensional (2D) detector. The source-detector performs one rotation around the object producing series of 2D images. The images are reconstructed in a three-dimensional (3D) data set using modification of the original cone-beam algorithm developed by FELDKAMP et al in 1984. Hence data can be reformatted in volume rather than a slice, thereby giving 3D information. CBCT also allows multiplanar reformation, i.e. 2D images in axial, coronal, sagittal and oblique/curved image planes.

APPLICATIONS OF CBCT IN ORAL AND MAXILLOFACIAL SURGERY
Implantology
Radiograph is an important tool for accurate treatment planning in dental implants. The ability of CBCT to produce cross-sectional images makes it valuable in implantology. Information, such as morphology and volume of alveolar bone, location, size of maxillary sinuses, incisive canal, mandibular canal, mental foramina, can be easily assessed on CBCT which contributes to precise treatment planning and reducing risk for surgical complications. In a study published by Georgescu et al in 2010, CBCT was evaluated as a method of quantitative and qualitative analysis of the alveolar crest in the anterior mandible. This improves the surgical plan and increases the success rate of the implant placement as well as reduces the possibility of surgical mishaps.

TOOTH IMPACTON
Removal of impacted teeth demands precise knowledge of the tooth location and its relation to other teeth, surrounding anatomical structures. In the mandible, the relationship of the roots of impacted third molars to the mandibular dental canal must be accurately assessed since the canal is frequently very closely associated with an impacted molar and postoperative complications due to nerve impingement are reported. Inferior alveolar canal may follow a tortuous path, and may not be reliably interpreted on conventional radiograph. Multiplanar views from CBCT are useful not only in tracing the canal, but also in assessing bifurcated/trifurcated canal. In the maxilla, localization of impacted canines relative to the lateral and central incisors is essential. Information regarding the orientation of impacted canine and its proximity to the root of the lateral incisor is essential. CBCT orthographic tomographic slices and panoramic reconstructions are superior to conventional panoramic radiographs in determining the location, orientation of impacted tooth and its relationship to adjacent vital structures in the maxilla and the mandible.

BONY PATHOSIS
CBCT is recommended when there is a need for diagnosis of cysts, malignancies, tumors or infections in maxillofacial region due to its multiplanar views. Such views provide important information on exact location, size, extent, cortical expansion and proximity to vital structures. CBCT is helpful in post-surgical follow-up of lesions with high recurrence rate. CBCT is reliable as conventional CT in predicting bone invasion by malignant lesions. CT images can provide information in the early stages of malignant lesions.

DENTOMAXILLOFACIAL TRAUMA
The diagnosis of simple dental/jaw fracture can be achieved with conventional radiographs. Initial assessment of...
complex jaw fracture may also be performed with plain films. However, multiple jaw fractures with bone displacement may be better assessed with CBCT. For complex jaw fractures, CBCT may be alternative to conventional CT, considering radiation dose and image quality. Non-displaced fractures of mandibular condyle can be very difficult to diagnose with conventional radiographs. Multiplanar views of CBCT scans allow much better assessment of intra-articular fractures of condylar head. In orbital floor fractures, although CBCT can demonstrate orbital content herniation, it lacks the contrast resolution to differentiate tissue composition of the herniated materials.

Most CBCT units require patient to be in an upright sitting or standing position during image acquisition. Therefore, CBCT unit may not be appropriate when there is trauma to cervical vertebra and when neck is stabilized. The role of CBCT in fracture diagnosis, therefore, appears to be limited to fracture of teeth and jaws, without other parts of the body.

CRANIOFACIAL DISORDERS
Patients with developmental disturbances like cleft palate, malocclusion or deformity require surgical treatment. CBCT is valuable in patient education, treatment planning, follow-up to evaluate growth, development and function. For a cleft palate patient, use of panoramic radiograph is limited to identifying an alveolar cleft only. Cross-sectional imaging, such as with CBCT, assists in the assessment of width of the cleft, tooth proximity to the cleft, deviation of the nasal septum and its degree of fusion to the palate, as well as visualization of the entire osseous defect. Thorough evaluation of the maxillofacial structures with cleft or other developmental defects and syndromes can be achieved with cross-sectional imaging and 3D reconstruction.

TMJ DISORDERS
Conventional radiographic TMJ projections may be adequate in number of clinical situations in Temperomandibular disorders. Bony alterations like erosions, osteophytes, pneumatization of articular eminence occur in these disorders; these are difficult to be detected in conventional radiographs due to overlapping of anatomic structures. This warrants the use of CBCT. CBCT parasagittal and coronal slices show clear images of the condylar head and glenoid fossa. Additionally, provides images from different orientations and reconstruction views. CBCT is more accurate than panoramic radiography and conventional tomography for detecting TMDs.

ORTHOGNATHIC SURGERY
CBCT 3D surface reconstructions of the jawbones are used for preoperative surgical planning and simulation in patients with skeletal malformations. Coupled with dedicated software tools, simulations of virtual repositioning of the jaws, osteotomies, distraction osteogenesis and other interventions can now be successfully implemented. Pre and postoperative 3D CBCT skull models can also be registered (i.e. superimposed on each other) to assess the amount and position of alterations in the mandibular rami and condylar head following orthognathic surgery of the maxilla and the mandible. Follow-up CBCT imaging is useful in evaluating the success of orthognathic surgery as well as to measure movement of the surgical segments in all three orientations.

DETECTING FOREIGN BODIES IN THE MAXILLOFACIAL REGION
Limitations of conventional CT scans in the maxillofacial area, is artefacts arising from metal restorations. Extensive bridgework, metal restorations can make MDCT scan virtually nondiagnostic. Such artefacts from metal objects are lower on CBCT. Therefore, CBCT is a better imaging modality to assess metal objects in the face, such as fragments embedded from a gunshot following automobile or industrial accidents and for localizing retained broken dental needles or surgical wires.

SOFT TISSUE CALCIFICATIONS
Although CBCT images have low contrast resolution, they can be better than conventional CT in depicting soft tissue calcifications, such as carotid atherosclerosis, tonsilloliths, sialoliths. Ossification of the stylohyoid ligament or the carotid artery can easily be diagnosed on an OPG but the relationship of the ligament to other structures is better evaluated by CBCT.

AIRWAY ANALYSIS
CBCT can be used as an improved method for evaluating airways. A comparison of lateral cephalograms to CBCT shows a moderate variation in the measurement of the upper airway area and volume. CBCT has demonstrated significant differences in measurements of airway volume and the anterioposterior dimension of the oropharyngeal airway between obstructive sleep apnea patients and gender-matched control. Three-dimensional airway analysis is useful when sedation is planned for dental reconstruction.

CONCLUSION
The clinical applications of CBCT in Oral and Maxillofacial Surgery are constantly increasing. CBCT allows complete visualization of oral and maxillofacial complex in multiplanar view. It aids in diagnosis of bony pathosis,
Thus CBCT is a better investigating tool in OMFS.

CBCT has increased accuracy, higher resolution, reduced scan time, radiation dose and reduced cost for patient when compared to conventional CT. It also eliminates superimposition of surrounding anatomical structures when compared to conventional radiographs. Thus CBCT overcome limitations of both conventional CT, conventional radiographs and provides accurate information. Thus CBCT is a better investigating tool in OMFS.

REFERENCES

Application of Cone-Beam Computed Tomography in Oral and Maxillofacial Surgery


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