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Research Paper

CBCT Imaging Modality Used to Diagnose Dental Anomalies: Case Reports

Medical Science

KEYWORDS : CBCT, 3 – D imaging, palatogingival groove, dens invaginatus

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ABSTRACT

The advent of CBCT has made it possible to visualize the dentition, the maxillofacial skeleton, and the relationship of anatomic structures in three-dimensions. adiographic imaging is essential in diagnosis, treatment planning and follow-up in endodontics. The interpretation of an image can be confounded by a number of factors including the regional anatomy as well as superimposition of both the teeth and surrounding dentoalveolar structures. As a result of superimposition, periapical radiographs reveal only limited aspects, a two-dimensional view, of the true three-dimensional anatomy. Additionally, there is often geometric distortion of the anatomical structures being imaged with conventional radiographic methods. These problems can be overcome by

utilizing small- or limited-volume cone beam-computed tomography imaging techniques, which produce accurate 3-D images of the teeth and surrounding dentoalveolar structures.

Introduction:

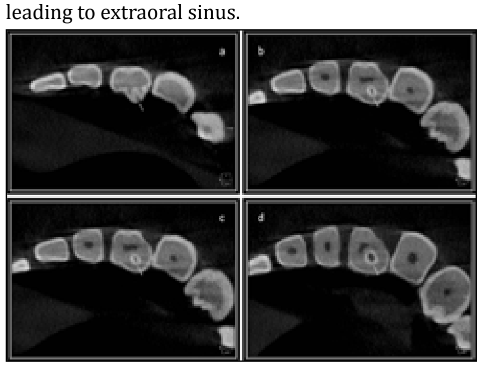
Two-dimensional imaging modalities have been used in dentistry since the first intra-oral radiograph was taken in 1896.[1] Significant progress in dental imaging techniques has since been made, including panoramic imaging and tomography, which enable reduced radiation and faster processing times. However, the imaging geometry has not changed with these commonly used intra-oral and panoramic technologies.

Cone-beam computed tomography (CBCT) is a new medical imaging technique that generates 3-D images at a lower cost and absorbed dose compared with conventional computed tomography (CT).[1] This imaging technique is based on a cone-shaped X-ray beam centred on a 2-D detector that performs one rotation around the object, producing a series of 2-D images. These images are re-constructed in 3-D using a modification of the original cone-beam algorithm developed by Feldkamp et al. in 1984.[2] Images of the craniofacial region are often collected with a higher resolution than those collected with a conventional CT. In addition, the new systems are more practical, as they come in smaller sizes.

Today, much attention is focused on the clinical applications—diagnosis, treatment and follow-up—of CBCT in the various dental disciplines. The goal of this article is to document the use of this three dimensional radiographic technique in diagnosing and treating various dental anomalies.

Case Report 1:

An 18-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with the chief complaint of purulent discharge from the chin area. History revealed that he had visited some general physician a few months back for pain and purulent discharge from the chin area. He was prescribed an antibiotic and analgesic for five days. Local applications of corticosteroid, antifungal and antibacterial agents were also tried by the same. At presentation, the patient was in good health and had no history of any systemic disorder. Intraoral examination revealed a projection from the cingulum of mandibular left lateral incisor which was diagnosed as type III talon cusp. The tooth was mobile, tender to vertical percussion and showed the negative response to vitality testing (cold test and electric pulp test). The response of adjacent teeth was within normal limit. No history of trauma, caries or restoration was recorded. The IOPA radiograph revealed periapical radiolucency associated with mandibular left lateral incisor. The radiographic examination also revealed dens invaginatus located apical to the talon cusp. Orthopantogram did not reveal dens in contralateral mandibular lateral incisor or any other tooth. Since a 2-dimensional imaging could not provide a proper understanding of the root canal morphology, CBCT scan of the mandible was taken with CS 9300 scanner at voxel resolution (0.09mm x 0.09mm x 0.09mm) and a three dimensional reconstruction of the involved tooth was done to evaluate the type of invagination and the root canal morphology. Cross-sectional images of mandibular left lateral incisor revealed a distinct enamel-lined groove (or invagination) incisal (above) to the cingulum on the lingual aspect of crown, due to infolding of the enamel and dentin (figure 1). The invagination extends into the pulp chamber without any obvious communication with the compressed pulp (figure 1, figure 2). Contiguous extension was seen till the middle third of the root with a distinct enamel lining (figure 1, figure 2). Further apically, the invagination was devoid of enamel lining and near-total obliteration of the radicular pulp is also seen at the apical third level (figure 3). The invagination extends till the radiological apex, with communication to the periodontal ligament through the apical foramen (figure 3). This type of presentation is largely consistent with Oehlers' type IIIB dens invaginatus. Reasonably well-defined radiolucent lesion (measuring approx. 0.5cm x 0.9cm x 1.2 cm in greatest antero-posterior, transverse and supero-inferior dimensions) is also noted in apical peri-radicular and periapical region of #32 with thinning, permeative erosion of adjoining cortices (fig. 2). Focal erosion of labial cortex and apical root resorption are also seen. The final diagnosis was periapical abcess in mandibular left lateral incisor having type III talons cusp and type IIIB dens invaginatus leading to extraoral sinus.



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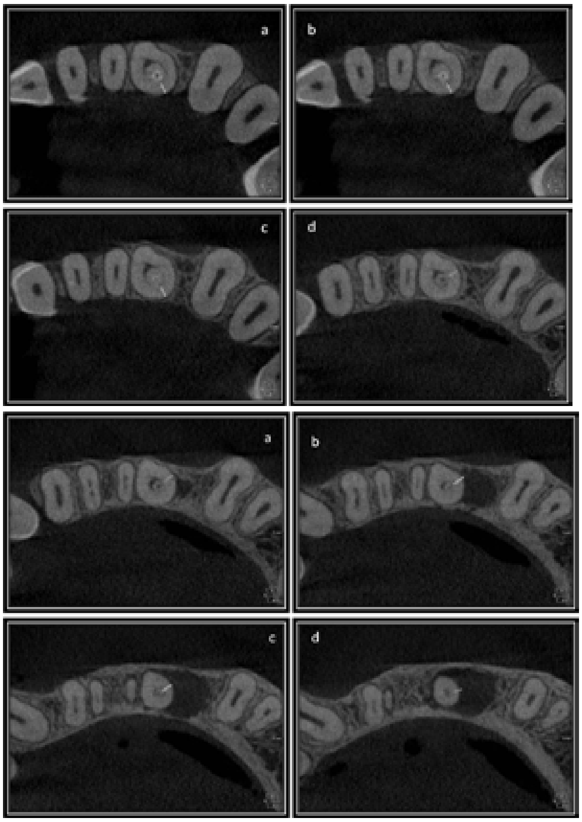


Fig. 1, 2 and 3

Case II:
A 20-year-old patient reported with the chief complaint of pain, discoloration, and mobility in relation to tooth 12 for the last 3-4 months. Periodontal examination revealed an around 10-mm pocket associated with a deep palatoradicular groove in relation to the maxillary right lateral incisor on its lingual surface. The tooth was discolored gray-black and revealed a negative response to an electronic pulp tester (Parkell Electronics Division, New York, USA), confirming the diagnosis of a nonvital pulp. There was neither caries nor any history of trauma in relation to the concerned tooth. Thus, it appeared likely that pulp necrosis had occurred secondary to the deep periodontal defect occurring as a result of the palatoradicular groove. An intraoral periapical radiograph revealed a periapical lesion with a bony defect. Since bilateral occurrence of the palatoradicular groove is possible, tooth 22 was also examined, but no evidence of a palatoradicular groove was found after sulcular probing and radiography.

Gutta-percha tracing into the periodontal pocket revealed direct communication of the periodontal pocket with the periapical area, thus confirming that the problem was primarily periodontal and secondarily endodontic in nature. Extension of the groove along the root was not clear either clinically or on radiography; on angulated x-ray views it simulated a two-rooted lateral incisor. To clarify these doubts and to establish a definitive diagnosis, we decided to refer the patient for a three-dimensional CBCT of tooth 12. CBCT demonstrated the complex anatomy of tooth 12 and showed that the groove extended till the root apex, in this manner bifurcating the root into two halves, with each having a different apex in the axial planes (figure 4). The pulp chamber was found to be in intimate association with the groove. CBCT revealed the presence of a ‘C’ shaped sheet of pulp tissue surrounding the bifurcation coronally, extending from mesial to distal along the palatal aspect of the tooth.

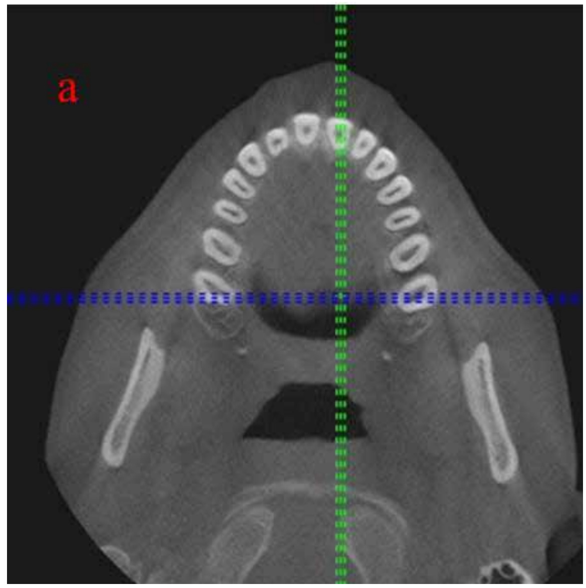


Fig-4.

Discussion:
CBCT scanners represent a great advance in dento-maxillofacial (DMF) imaging. This technology, introduced into dental use in the late 1990s, has advanced dentistry significantly. The number of CBCT-related papers published each year has increased tremendously in the last years.

Cone-beam computed tomography in dentistry is synonymous with other terminologies encountered in the literature, such as cone-beam volumetric scanning, volumetric computed tomography, dental CT, dental 3-D CT and cone-beam volumetric imaging.[3]

The clinical applications for CBCT imaging in dentistry are increasing. The most common clinical applications are in the field of oral and maxillofacial surgery, implant dentistry, and endodontics. CBCT has limited use in operative dentistry owing to the high radiation dose required in relation to its diagnostic value.

The literature on CBCT is promising and needs further research, especially with regard to its use in forensic dentistry, in order to explore more potentially beneficial indications in that area. No literature concerning direct CBCT indications in prosthodontics was found. However, several overlapping indications were found in other dental specialties attributing to the final standard of care in prosthodontic treatment. These indications include but are not limited to bone grafting, soft-tissue grafting, prosthetically driven implant placement, maxillofacial prosthodontics and temporomandibular joint disorder. CBCT images can also be of great value in special cases in which multiple teeth have to be assessed for restorability.

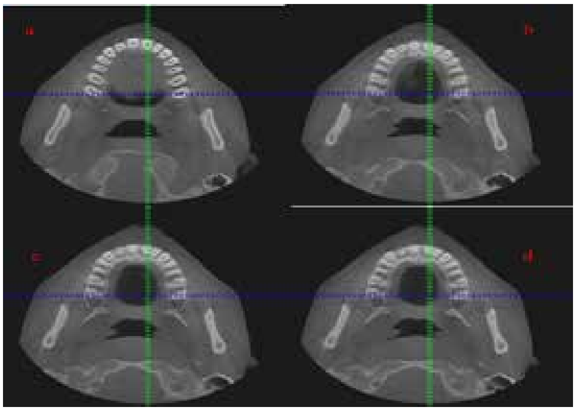
The latest CBCT units have a higher resolution, lower exposure, are less expensive and designed for use in dentistry.[4] Additionally, the flat-panel detectors appear to be less prone to beam-hardening artefacts. There are, however, several important disadvantages as well, such as susceptibility to movement artefacts, low contrast resolution, limited capability to visualise internal soft tissues and, owing to distortion of Hounsfield Units, CBCT cannot be used for the estimation of bone density.[5]

It is crucial that the ALARA principle (As Low As Reasonably Achievable) is respected during treatment, as far as the radiation dose of CBCT imaging is concerned. CBCT imaging will improve patient care, but users have to be trained to be able to interpret the scanned data thoroughly. Dentists should ask themselves whether these imaging modalities actually add to their diagnostic knowledge and raise the standard of dental care or whether they only place the patient at a higher risk. Continuous training, education and thorough research are thus absolutely essential.

One of the most clinically useful aspects of CBCT imaging is the highly sophisticated software that allows the huge volume of data collected to be broken down, processed or reconstructed.[5] This makes data interpretation much more user friendly, if the appropriate technical and educational knowledge is available.

The increasing popularity of CBCT resulted in numerous CBCT-unit manufacturers, frequent presentations at conferences and an increase in published papers. This resulted in an uncontrolled and non-evidence based exchange of radiation dose values and attributed to the limited technical knowledge about medical imaging devices for new-user groups.[6]

The complex anatomy of palatogingival groove calls for detailed knowledge of the dental root's internal morphology for successful planning of endodontic therapy. Periapical radiographs provide 2-D images of anatomic structures, and the superimposition of adjacent tissues may obscure the true nature of these anomalies and the extent of periodontal damage. CBCT is an x-ray imaging approach that provides high-resolution 3-D images. It is especially useful in endodontics for identification of anatomic features and variations of the root canal system.[7] In these particular cases, the use of CBCT proved to be of great advantage as it demonstrated the dimensions of groove and extent of invagination, its communicating nature, the site of bifurcation, the volume of bone loss and, thus, the approximate amount of graft required for filling the defect.



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