VOLUME - 10, ISSUE - 04, APRIL- 2021 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Dental Science

"CBCT-THE THIRD AND THE MOST DIAGNOSTIC DIMENSION": A CASE REPORT

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ABSTRACT Radiology is an essential tool in the dental clinical practice as most structures harbouring disease are not visible to the naked eye. There are various entities that are generally not noticed until periapical pathology occurs. Under such circumstances, the diagnosis is difficult, as they mimic various other conditions. One of such condition is root fracture after an endodontic treatment of tooth. Vertical root fracture (VRF) usually starts from an internal dentinal crack and develops over time, due to masticatory forces and occlusal loads. Here in this paper we will discuss how we stepwise diagnostic radiographic modalities are used to see the actual cause of pain in a 60 year old male patient. Cone Beam Computed Tomography (CBCT) was done to view in 3D which revealed VRF of tooth. Throughout the paper the edge of CBCT over other diagnostic modalities is discussed till we get our diagnosis.

KEYWORDS : Vertical Root Fracture, CBCT

INTRODUCTION

In day to day practice radiographic modalities have been considered an absolute must for accurate diagnosis and treatment planning in oral and maxillofacial complications. With emergence of radiographic imaging techniques we can view inner structures in 2D or 3D format. Various imaging modalities used in dentistry includes radiographs, Cone Beam Computed Tomographic (CBCT) scan, Magnetic Resonance Imaging (MRI) etc. Among the ionising imaging modalities most commonly used in dentistry are radiographs and CBCT scan. With the advent of better technologies there had been a paradigm shift in usage of 3D imaging as compared to 2D, giving more accurate results.

The Cone Beam Computed tomography (CBCT) is a variant of CT scan quite popular in dentistry used to see oral and maxillofacial structures in 3D view. The CBCT machine uses cone-beam imaging technology compared to a fan-shaped X-ray beam as that used in conventional CT machines. The images assimilated as raw data undergo primary reconstruction to mathematically replicate patient's anatomy into a single, 3D volume that consists of volume elements called voxels ranging in size 0.07-0.5mm.[1] Thus CBCT provides us a complete 3D view of the maxilla, mandible, teeth, and supporting structures which has relatively higher spatial resolution as well as lower radiation dose to the patient.[2] The image can be utilized for soft tissue enhancement, and can be shown in color images, videos, designing surgical guides and formulate treatment objectives. CBCT unit rotates at 360° and it scans arc of a single, large area in which the X-ray source and a reciprocating area detector move in tandem around the patient's head, taking only few seconds to minutes for creating an image. [3]

There are many indications for cone-beam imaging in dentistry which includes evaluation of the jaws for placement of dental implants(height and width of residual bone and proximity of vital structures), examination of teeth and facial structures for orthodontic treatment planning, assessment of temporomandibular joints (TMJs) for osseous degenerative changes, estimation of the proximity of the lower wisdom teeth to the mandibular nerve before surgical procedure, evaluation of teeth for root fracture or periapical disease, and assessment of bone for signs of infections, cysts, or tumors.[2],[4],[5]

Thus CBCT imaging is quickly replacing conventional tomography in Dentistry because of its applications and benefits from viewing thin sections through the field of view without superimposition of complex anatomy of maxillofacial region onto the image. Therefore, it ranks exceptionally well when considering the balance between high diagnostic yields, low risk, and low cost compared to CT and other ionizing imaging modalities.[6]

METHODOLOGY

This is a case of 60 year old male who reported to the Department of Prosthodontics , Maulana Azad Institute of Dental Sciences, with a chief complaint of dislodged left lower fixed prosthesis and dull, aching and continuous pain in left lower back tooth region from past 1 month. His medical history revealed no relevant systemic condition but his dental history revealed root canal treatment of left lower second premolar 2years back followed by 3-unit fixed dental prosthesis wrt 35,36, and 37. Personal history indicated no history of trauma, accidental heavy biting on hard object, and night bruxism. On clinical examination, prepared abutments w.r.t 35and 37 teeth were observed. Besides this other relevant findings were chronic generalised gingivitis , missing 36 and dislodged FDP wrt 35,36,and 37. The coronal part of 35 was found to be chipped off/fractured. The patient was advised to get an IOPA radiograph done of 35 tooth region to aid in diagnosis.

IOPA radiograph revealed well obturated 35 tooth with no evidence of periapical pathology. The patient was advised medications to relieve the symptoms but the dull pain still persisted .To rule out any missed finding two more IOPA radiograph were performed using SLOB(Same Lingual Opposite Buccal)/ Cone Shift technique/ Tube shift technique/ Clark's[7] technique/ Buccal object rule[8] from different

angulations . A radiolucent space was observed along the mesial aspect of the gutta percha cone wrt 35, prompting a suspicion towards ill condensed gutta percha or a vertical root fracture as a possible cause of dull toothache. No lesion was visible in radiograph from both the angles. In order to clarify the new diagnostic "space" finding and establish a definite diagnosis towards the patient's symptoms, need of the hour was to view the concerned region in a 3-dimensional view. Hence patient was advised for CBCT of left mandibular section.

The CBCT revealed vertical root fracture of root of the left lower second premolar and extirpation of obturating material and sealer cement from the fracture region. The patient was educated about the hidden finding as the cause of his pain and referred to the Department of oral and maxillofacial surgery for further treatment. The patient seemed satisfied with his diagnosis.

DISCUSSION

Although intraoral radiographs are a useful diagnostic aid and are commonly recommended, but sometimes these images may not provide accurate information for many reasons. Vertical root fracture (VRF) occurs along the tooth axis and usually extends from the apex of root to the coronal part and from the internal wall of root canal to the root surface. VRFs may be complete (involving both sides of the root) or incomplete (involving one side of the root). The incidence of VRF in endodontically treated teeth is between 3.7 and 30.8%. It is more prevalent in premolars and mesial root of mandibular molars[9],[10]. VRF reduces tooth prognosis, can lead to inflammation, followed by bone resorption and granulation tissue formation, and can result in tooth extraction[11]. Identification of VRF is challenging and requires the combination of clinical and radiographic signs and sometimes surgical findings. Sometimes due to overlap of adjacent structures in two-dimensional radiographs (conventional radiography) limits the visualization of fracture line. The type of root canal filling, restoration done and the type of root canal sealer used also make the visualisation of vertical root fracture in 2D questionable[12]. Cone-beam computed tomography (CBCT), on the other hand, can provide a better visualization of fracture line through multiplanar reconstructed images (axial, coronal, and sagittal planes).

The above case also warranted the usage of 3D radiographic diagnostic modality once the 2D findings could not complement the patient's complaint of the persistent dull ache. The patient wanted recementation of his dislodged prosthesis; unaware of the status of his underlying anterior abutment. In adherence with DeVan's dictum "the perpetual preservation of what is remaining is more important than meticulous replacement of what is lost" and considering the strategic importance of 35 with regards to this particular case for fixed prosthesis placement, every effort was directed toward salvaging this particular tooth , thus bringing into involvement the usage of CBCT as a diagnostic aid when conventional 2D radiography proved to be inconclusive. (However, radiopaque materials like gutta-percha create artifacts in CBCT images due to beam hardening and reduce the diagnostic quality). Natural teeth should be saved if they can be made comfortably functional or if they can, in a modified state, contribute to the function of the masticatory system.

Bender[13] described the basic principles involved in the detection of bone loss in local resorptive lesions; and concluded that, because of the low mineral content of medullary bone, large resorptive lesions in this region could go undetected; furthermore, the cortices (particularly in the mandible) have a masking effect on lesions occurring within the cancellous bone. The angle for the 2D radiograph also plays a vital role in determining VRF. Post endodontic restorations and fillings can hinder in detection of fracture. The direction of fracture line i.e. mesio-distal, bucco-lingual, etc. can also go undetected in conventional 2D radiographs. There is no significant difference between intraoral film and CBCT in detecting vertical root fractures. If the diagnosis is still questionable, then CBCT should be prescribed in order to increase the likelihood of detecting the fractures.[14]

CONCLUSION

CBCT imaging has surpassed the obstacles of 2D imaging, offering practitioners with high quality, sub-millimeter resolution images, with short scanning time and low radiation dose. Since this equipment has become accompaniment of the dentist, dependence upon practice-based guess-estimations have been replaced , benefiting both patient and dentist. Huge scope is available for further applications and needs exploration from diagnosis to image guidance of dental procedures.

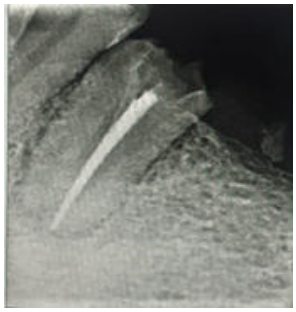

Figure1. conventional IOPA radiograph of tooth from distal aspect

Figure 2. conventional IOPA radiograph from mesial aspect.

Figure 3. CBCT transverse cross-section at the occlusal level reveals vertical root fracture running bucco-lingually in direction.

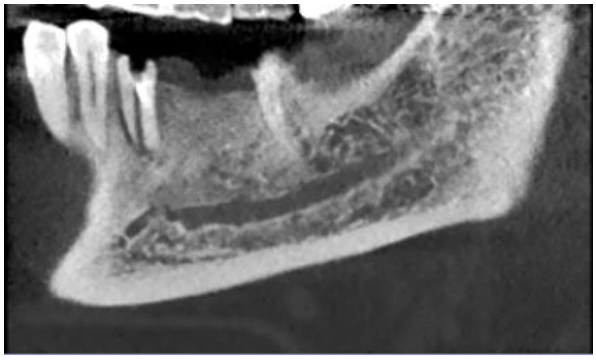

Figure 4. CBCT saggital section of mandible reveals fracture line is evident till apex of root.

Figure 5a saggital view of 3D multiplanar construction of CBCT data to see the propagation of fracture line.

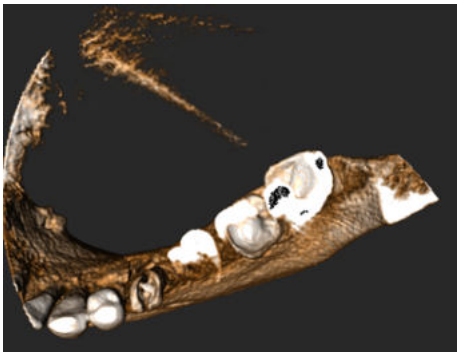

Figure 5b. transverse crossection of 3D multiplanar construction of CBCT data to see the propagation of fracture line.

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