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Case Series

CBCT: The third eye in orthodontics

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ABSTRACT

Accurate diagnostic imaging is essential to derive the correct diagnosis and treatment plan in orthodontics. In two-dimensional diagnosis, geometric distortion, superimposition of structures, projective displacements, and rotational errors are common. This case series, affirming that the CBCT is vital key in the diagnosis of some specific orthodontic conditions, and presenting five case reports which was difficult to diagnose it with two-dimensional radiograph. Case 1 includes horizontally impacted 21 with crown located labially, and root palatally with close proximity to nasopalatine canal, which was veiled in 2D orthopantomogram. Case 2 is an infrazygomatic implant case, the placement of which was debatable by seeing through the 2D IOPA radiograph. Here, CBCT removed the black curtain and proved its monarchy. Case 3 is a premolar impaction, which in 2D radiograph appeared like an iceberg, but its true anatomy was revealed by the CBCT. After this, the next case 4 is about the central incisor mimicking a canine in 2D radiograph, which was found to be supernumerary tooth on CBCT. Followed by temporomandibular disorder (5) which severity was brought to light by CBCT. The need for this case series is to wave the flag for CBCT in the orthodontic diagnosis which will help in delivering proper treatment plan and emphasis where it is essential to do CBCT.

1. Introduction

Conventional (or medical) computed tomography (CT) was developed in 1972 by the English engineer Hounsfield and the American physicist Comark.[1] It represented great progress, and for this reason, its creators were recognized with the Nobel Prize for Medicine in 1979. Despite the advances, conventional CT has been applied in dentistry with restrictions due to high radiation doses, excessive size of the device, the need for the patient to be in supine position during the shot and its cost.[2] Towards the end of the 90's, technological advances led to a new version that met the needs of dental and maxillofacial regions, and became known as Cone-Beam Computed Tomography (CBCT).[3,4]

As the name suggests, the CBCT produces radiation in the shape of a cone that rotates around the patient to acquire volumetric data. The radiation dose emitted by CBCT depends on the desired field of view, exposure time, kilovoltage and milliamperage, but it has been reported that it corresponds to approximately 20% of a conventional CT and it is equivalent to the complete exposure of periapical radiographs.[5] The differential in the CBCT is also the possibility of shooting in real size in all three planes of space, unlike the two-dimensional X-rays that project the image of the structures in one plane, often distorted and overlapped[3] which can lead to misdiagnosis and will deliver wrong treatment plan and it have short scanning time of 10-70 sec

Accurate diagnostic imaging is essential to derive the correct diagnosis and treatment plan, as well as to

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monitor the treatment progress and final outcome. In Two-dimensional (2D) diagnostic imaging, including traditional radiographs, cephalometric tracings, photographs and video imaging, has been a part of the orthodontic patient record. With the limitations of these imaging modalities, which include magnification, geometric distortion, superimposition of structures, projective displacements, and rotational errors. In contrast to 2D, three-dimensional (3D) imaging allows for the evaluation of an anatomical object in three orthogonal plane.[6]

When used correctly, the data derived from CBCT imaging provides information for treatment planning that is more accurate when compared with other imaging methods, and allows clinicians to provide better results.[6] Despite many suggested indications of CBCT, scientific evidence supports the fact that its utilization improves diagnosis and treatment plans and the resultant outcomes have only recently begun to emerge for some of these applications.[7]

The ability to view structures from all three planes of space without any superimposition and geometric distortions is the key advantage of CBCT over conventional images. Synthetic cephalometric and panoramic images also can be produced. The key disadvantage, of course, is the increased radiation exposure, and the simplest way to balance this risk against the benefits is to follow the rule that CBCT is indicated when it is the only way to get the necessary information for appropriate treatment.[8]

2. Case Series

2.1. Case 1

A 12-year-old patient complains of spacing in the anterior region since 4 years. Bulge can be palpated in the buccal aspect. Patient was referred for orthopantamogram required for essential diagnosis. Orthopantamogram revealed that the fully formed crown with partially formed root and evident increased radioopacity in the cervical third of lateral incisor (22) root. (Figure 1)**.** CBCT revels that Horizontally impacted 21 with crown located labially, root palatally; the tooth 21 is in close proximity to nasopalatine canal; the impacted 21 is located away from the nasal floor. (Figure 2).

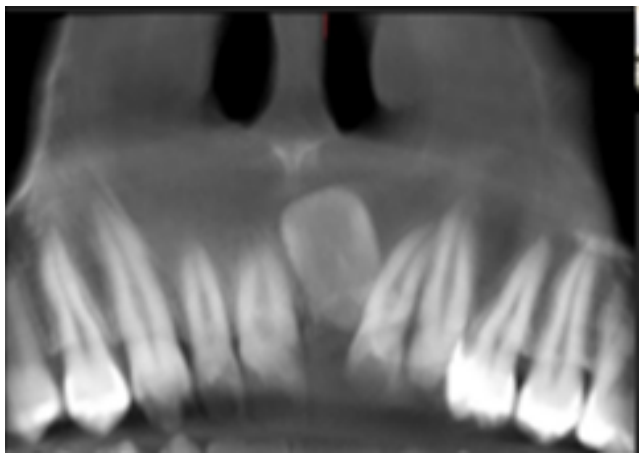

Fig. 1: Orthopantamogram of case

Fig. 2: 3D reconstruction of CBCT

2.2. Case 2

Patient came for the orthodontic treatment for irregularly and forwardly placed tooth. Treatment plan was distalization with infrazygomatic crest screw. After placing the IZC bone screw patient was symptomatic and intra oral periapical radiograph was taken. Infrazygomatic crest miniscrew placement for molar distalization shows doubtful screw positioning in 2D radiograph which was pointing to the root of 27. (Figure 3). CBCT revels the IZC miniscrew was touching the root of the second molar. (Figure 4).

Fig. 3: IOPA of case 2

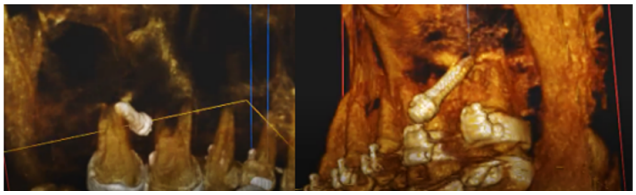

Fig. 4: 3D reconstruction of CBCT

2.3. Case 3

Patient came for orthodontic treatment with impacted premolar. OPG shows the positioning of premolar in between the 14,13. But the proper position and angulation of premolar is doubtful in orthopantamogram. (Figure 5).

Crown of 15; coronal & middle 3rd of root of 15 is located in the middle of arch; the apical 3rd of root of 15 is buccally placed; The root apex of 15 is within right maxillary sinus; the crown of 15 is in close proximity with roots of retained 55 & root of 14; the root of 15 is in close proximity with root of 14 (Figure 6)

Fig. 5: Orthopantamogram of case 3

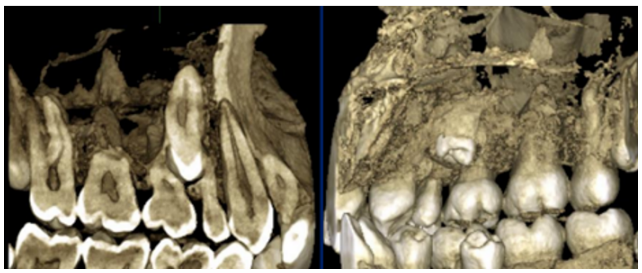

Fig. 6: 3D reconstruction of CBCT

2.4. Case 4

Patient came with complaint of spacing in the upper front tooth region. OPG shows incisor mimicking canine which was cannot diagnosed as transposition because canine was already present in Orthopantamogram. (Figure 7). Diagnosis was doubtful and so referred to CBCT

Position of impacted 11 & a conical supernumerary tooth bud placed posterior to 11. The long axis of the impacted teeth is oblique to the axial plane, with their crown positioned between the roots of 21& 12 and root placed closer to the nasal floor & palatal cortex respectively. (Figure 8)

Fig. 7: Orthopantamogram of Case 4

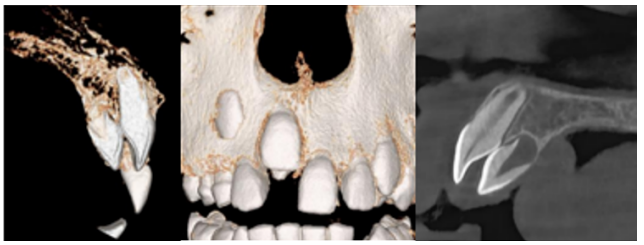

Fig. 8: 3D reconstruction of CBCT

2.5. *Case 5*

Patient complains of pain in front of the ear on the right side. TMJ radiograph was taken in both open and closed and decreased joint space was observed. But bony changes in the articular surface was not confirmed by the 2D radiograph. (Figure 9).

2.6. Right TMJ

TMJ view shows bony changes in the right condyle and flattening & irregular articular surface of condyle and decreased joint space (Figure 10).

3. Discussion

Guidelines from the British Orthodontic Society[9] and the European Academy of Dental and Maxillofacial Radiology[10] recommend that the CBCT should be used cautiously, without repetition or routinely, but as a complementary tool for conventional exams.

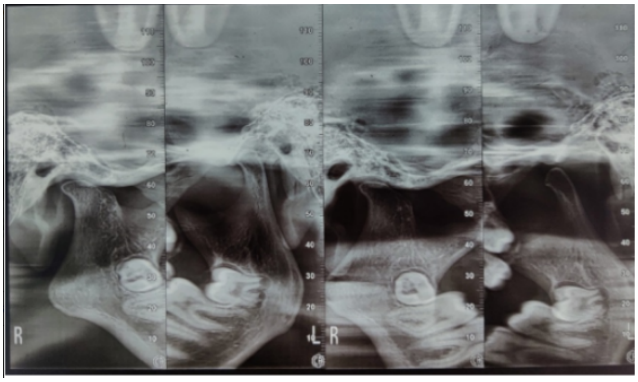

Fig. 9: 2D TMJ radiograph of case 5

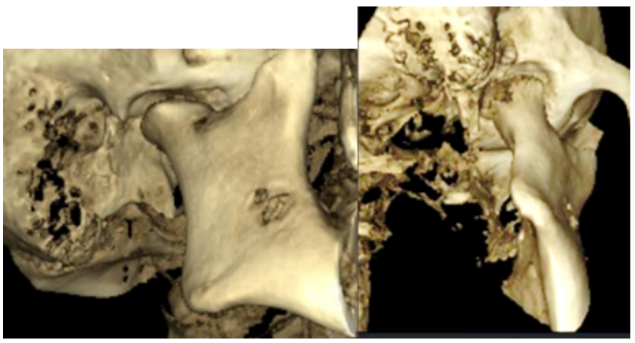

Fig. 10: 3D reconstruction of CBCT

In impacted cases CBCT is essential for estimating the root angulation and position of the tooth and to know whether it is favourable or not and angulation of impacted tooth is important so that proper biomechanics can apply in treatment. Temporomandibular bony changes can be clearly estimated through the CBCT which will be helpful in determining the osteoarthritis.

Changes in the treatment plan can be occurred in some of the cases if an orthodontist is only considering the 2D radiographsWilliam H E. (2005) Clearly quoted 2D radiographs can be misleading because of projecting a 3D object into 2D film. Author mentioned about the concept of "Linear projective transformation".[11] According to Castro et al The orthodontic treatment plan was redirected to a simplified mechanics and control of the lesions during orthodontic treatment and 3D images are able to increase diagnostic accuracy and redirect orthodontic treatment plan.so in important aspects like cases mentioned in these articles it is necessary to open the third eye in orthodontics.[1]

4. Conclusion

The use of CBCT in these and other situations such as root resorption, supernumerary teeth, asymmetries and alveolar boundary conditions should be justified on the basis of the merits relative to risks of imaging. CBCT has also been used to assess 3D craniofacial anatomy in health and disease and of treatment outcomes including that of root morphology and angulation; alveolar boundary conditions; maxillary transverse dimensions and maxillary expansion; airway morphology. Finally, this study utilizes findings of these samples and current voids in knowledge to provide ideas for future research that could be beneficial for further optimizing the use of CBCT in research and the clinical practice of orthodontics.

5. Source of Funding

None.

6. Conflict of Interest

None.

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