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Review

Diagnostic Efficiency and Usage of Cbct in Pediatric Dentistry

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ABSTRACT:

X-ray images are mostly needed in order to diagnose the problems of our patients who apply to dentistry clinics with many complaints. In cases where the diagnosis cannot be made with conventional x-ray techniques, it may be necessary to resort to advanced imaging techniques such as cone beam computed tomography (CBCT). Although CBCT applications provide a lower x-ray spread compared to imaging methods with computed tomography, when pediatric dentistry applications are considered, the high x-ray spread compared to conventional x-rays requires careful selection of areas of use in children. Since children are highly sensitive to ionizing radiation, exposure should be kept reasonably low. There are a significant number of published guidelines on the clinical use of CBCT in the literature. However, there is limited literature information on when and how often CBCT is indicated in pediatric dentistry. The purpose of this article is to evaluate the diagnostic efficacy and usage areas of CBCT in pediatric dentistry.

Keywords : Cone beam computered tomography, dental imaging, pediatric dentistry.

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1. INTRODUCTION

Dental imaging is a method used in the diagnostic evaluation of oral pathologies. Cephalometric radiography was discovered in 1895, right after the great progress that started with the discovery of X-rays by Röntgen [1]. With the introduction of orthopantomography in dental radiology in the 1960s, it was possible to visualize maxillofacial structures with only one radiography. However, 3D imaging techniques were needed because two-dimensional (2D) radiographic images of the three-dimensional (3D) anatomical structure of the maxillofacial region, created by extraoral and intraoral methods, have disadvantages such as superposition and magnification. With the developing technology, digital imaging, computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET) and cone-beam computed tomography (CBCT) were discovered, thus making it possible to visualize the maxillofacial region in 3D [2]. CBCT was first produced for angiography in 1982. The first CBCT device produced for dentistry was put into the service of medicine in 1987, and the development of this device continues today [3].

CBCT produces 3D digital imaging with less cost and less radiation to the patient than traditional CT scans, and also provides faster and easier image acquisition [4]. Due to

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these advantages, it is an alternative three-dimensional imaging technology used in dentistry fields such as periodontology, implantology, endodontics, orthodontics, and oral surgery [5]. Considering the pediatric dentistry applications of CBCT, it causes a very high x-ray spread compared to traditional imaging methods, which requires careful selection of application areas in children. Since children are highly sensitive to ionizing radiation, exposure should be kept reasonably low [6]. There are a significant number of published guidelines on the clinical use of CBCT in the literature. However, literature information on when and how often to apply CBCT imaging in pediatric dentistry is limited. Our purpose of this review is to reveal the diagnostic effectiveness and usage areas of CBCT in pediatric dentistry by examining the studies published so far.

Dental Trauma

Dental trauma is a common condition in children and adolescents, and accurate diagnosis and treatment are essential for a good prognosis. Traumatized teeth pose a clinical challenge in terms of diagnosis, treatment plan and prognosis. Unfortunately, the sensitivity of two-dimensional radiographs for the detection of minimal tooth displacements, root and alveolar fractures remain poor [14]. This is due to projection geometry, overlapping of anatomical structures, and processing errors. The use of CBCT in dental traumatology was first described in 2007 [15], [16]. Cases that may appear simple on periapical radiographs may present a different and more complex situation when evaluated in three dimensions. CBCT will contribute to more accurate diagnosis and treatment planning in traumatic dental injuries.

Crown Root Fractures

Crown root fractures are injuries that affect enamel, dentin, and cementum. The pulp may or may not be exposed as a result of injury. In order to accurately detect the crown-root fracture, the periodontium and the tooth should be examined in detail. If the contact of the broken pieces with the periodontal continues, it may be mobile. Accurate determination of the apical extent of the fracture is not always possible when using two-dimensional periapical radiographs, and it is therefore recommended to use CBCT to assess the location and extent of the fracture [16].

Root Fractures

Root fractures are observed in the root part of the tooth affecting the cementum, dentin and pulp by the collateral effects in the periodontium. Root fractures pose a diagnostic challenge due to limitations of two-dimensional images such as projection geometry, overlapping of anatomical structures, and processing errors [15, 17-19]. For this reason, it has been suggested to use the periapical imaging technique with different angles such as 45°, 90°, and 110° [26]. In a retrospective clinical study, it was reported that while 30_40% of root fractures were detected with periapical imaging, this rate increased to 90% with CBCT [21]. Results from systematic reviews of predominantly ex vivo studies have shown that CBCT for root fractures has very high diagnostic accuracy. In addition, these accuracy levels were found to be higher than using periapical radiographs [22–26]. The 47 studies included in the systematic review of the

radiographic diagnosis of root fractures analyzed CBCT images and other image types. Only one study did not achieve better results using CBCT. In this study, the authors concluded that Periapical radiography showed fewer false positive cases (high specificity) [26]. It has been stated that cervical fracture detection is more common, especially in CBCT, which affects the treatment management [27]. Since fractures in the cervical region are considered to have the worst prognosis, failure to identify the cervical fracture line may lead to incorrect treatment and adverse outcomes.

CBCT should be strongly considered when conventional radiography gives poor results or shows a fracture of the middle third of the root. CBCT can more precisely confirm or rule out a root fracture that cannot be visualized by conventional radiography. Accurate diagnosis will provide critical information needed to develop a comprehensive and an appropriate treatment plan [27].

Luxation Injuries

Luxation is defined as injury to periodontal tissues due to damage and clinical and/or radiographic displacement. The luxation can be intrusive, lateral, extrusive, or a combination of these. The amount of luxation can range from mild to severe, depending on the magnitude and angle of the forces absorbed by the dental and surrounding anatomical structures. Luxation injuries cause damage to the periodontium and often occurs in combination with alveolar fractures. This is particularly the case in luxation injuries in which the crown is displaced lingual/palatal and the apical third is buccally displaced. An accurate diagnosis is essential to properly manage these injuries. Because movements and subsequent displacements are mostly in the sagittal plane, intraoral two-dimensional radiographs will not always reveal the severity of the injury. Failure to diagnose alveolar fractures can lead to incorrect treatment planning and further complications, particularly pulp necrosis and infection. Furthermore, improper tooth repositioning can result in poor alveolar healing and chronic pain due to apical fenestration [28].

Intrusion and avulsion of primary teeth are considered serious dental injuries due to most of the developmental disorders seen in permanent teeth as sequelae of trauma [29, 30]. Among developmental disorders, dental morphology and eruption disorder poses a clinical challenge in terms of diagnosis, treatment plan and prognosis. These situations indicate the need for advanced imaging techniques rather than conventional radiographs, and CBCT may be useful. It shows sections at various depths of the region of interest and allows clinicians to accurately assess the exact position of the crown, apex, and the degree of dilaceration [31]. By showing cross-sections at various depths of the region of interest, CBCT allows clinicians to accurately assess the exact position of the crown, the apex and the degree of dilation, and to plan the correct treatment [31].

The International Union of Dental Traumatology (IADT) published a report in 2020, and it was stated that the image quality of CBCT improves in dental traumatic injuries such as root fractures, crown-root fractures and lateral luxations [38]. However, before

using CBCT in such specific injuries, the radiation dose to which the patient will be exposed should be considered [33].

Dental Anomalies

CBCT is used to locate the anomalies observed in the oral region. Some centers have reported an increased incidence of oral anomalies (oral cysts, ectopic/impacted teeth, and supernumerary teeth) with the use of CBCT in their routine dental examinations [5]. In a clinical study to determine the positions of impacted and supernumerary teeth, CBCT was found to be successful with a high rate of 96.7% in determining the correct preoperative localization of the bucco-palatal position of the teeth using CBCT and conventional radiographs [34]. In the diagnosis and treatment management of impacted and supernumerary teeth, 3D imaging can significantly affect the treatment approach, increase confidence and predictability, and reduce invasiveness [35]. Dens invaginatus (DI) is a developmental dental anomaly with complex anatomical features and a wide range of morphological variations that creates diagnostic and therapeutic challenges for dentists. CBCT can provide a more detailed 3D view of complex anatomical variations in DI and help dentists validate DI classification and improve diagnostic accuracy [36]. Studies of the diagnostic value of CBCT have focused on tooth resorption and mostly on the resorption of the unerupted maxillary canine and incisor. In this context, it is seen that the most common pediatric use of CBCT is on this subject.

Developmental Anomalies

When the publications on developmental disorders are examined, it has been seen that CBCT should be used as an alternative to CT in patients with cleft lip and palate and that volumetric data should be obtained before bone grafting [37]. Pediatric dentists have a role as a part of the multidisciplinary approach in the treatment of cleft lip and palate. They can get it. Apart from case studies, there is little evidence of the value of CBCT in certain craniofacial syndromes.

Pathological Conditions

Conventional radiographs show bone pathologies in 2D only. However, 3D imaging is absolutely needed to evaluate the expansion of these pathologies in the antero-posterior direction. CBRT; It allows the evaluation of cortical expansion, bone resorption, adjacent bone sclerosis, internal and external calcifications, and adjacent anatomical structures [38]. CBCT may be needed in the evaluation of the relationship of pathological lesions encountered in the mixed dentition with neighboring teeth and tissues and permanent tooth germs. CBCT provides useful and precise results in distinguishing pathologies with adjacent teeth and tissues, thus facilitating treatment planning and reducing treatment time [39].

2. CONCLUSION AND RECOMMENDATIONS

As pediatric patients are more vulnerable to radiation dose, CBCT should be justified and exposure should be kept reasonably low. The application of CBCT in pediatric patients should only be considered when conventional radiography cannot provide relevant information. In addition, the cooperation of the child patient and the

movement during the long procedure are other issues that should be taken into account, as well as the resulting decrease in image quality. However, we recommend developing guidelines for the use of CBCT in pediatric patients and that more research is needed.

Conflict of Interest

Author has no personal financial or non-financial interests.

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