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Case Report

Cone-beam computed tomography as a surgical guide to impacted anterior teeth

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ABSTRACT

Surgical procedure for removal of impacted teeth is a challenge for clinicians as it involves accuracy in the diagnosis and localization of the dental elements. The cone-beam computed tomography (CBCT), compared to the conventional radiography, has a greater potential to provide complementary information because of its three-dimensional (3D) images, reducing the possibility of failures in surgical procedures. Two 10-year-old boys presented with aesthetic issues associated with the juxtaposition of ectopic teeth with the permanent ones. Both two-dimensional and 3D preoperative radiographic diagnostic sets were produced. The occlusal and panoramic radiographs were not enough for proper localization of impacted incisors. Thus, the CBCT was used as a surgical guide. After 2 years of longitudinal following, no lesion was recorded, and the orthodontic treatment has proven successful. In all cases, CBCT contributed to both diagnosis and correct localization of supernumerary teeth, aiding the professional in the treatment planning, and consequently in the clinical success. The surgeries were completely safe, avoiding damage in noble structures, and providing a better recovering of the patients.

Key Words: Cone-beam computed tomography, diagnosis, impacted tooth

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INTRODUCTION

Diagnosis and localization of impacted teeth is one of the great challenges in surgical practice. For surgically removing these impacted teeth, either supernumerary or not, it is necessary to make an adequate diagnosis based on image evaluation. Several radiographic techniques have been recommended, including periapical X-ray with central beam deviation (Clark's technique), occlusal, and panoramic radiographs or even an association of them.[1,2] However, the use of two-dimensional images may display the presence of unerupted teeth but makes any analysis difficult because of the distortions, artifact effects and image superposition; not allowing distinguishing the details as exact location of these teeth, the impact on adjacent teeth/structures, and the anatomy of roots.[3]

With the technological advance in medicine and accompanying the evolution of computed tomography, three-dimensional (3D) measurements using cone-beam computed tomography (CBCT) allow 3D-images to be obtained, thus providing information not available with conventional radiographs. The

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applicability of such technique to dentistry is broad and has been increasingly employed as a complementary method for diagnosis of buccomaxillofacial pathologies and temporomandibular disorders as well as for localization of impact teeth, placement of implants, orthognathic/craniofacial surgeries, and orthodontic planning.[4]

Particularly in the case of impacted or supernumerary teeth removal, surgeons often operate adjacent to significant anatomical structures such as vessels, nerves, adjacent teeth roots, and paranasal sinuses.[5] The diagnosis and treatment planning is facilitated with CBCT because images are accurate in determining the angulation and buccal palatal location[6] beside eliminates image superimposition and allows tridimensional reconstruction and in different planes.[7] Furthermore, CBCT images are also useful for determining the proximity of impacted tooth to the roots of adjacent teeth, as well as the degree of resorption,[6] avoiding damages to the essential anatomical structures during surgical approach.[5]

Taking into consideration the importance of correct diagnosis through images for a safer therapeutic approach, this article illustrate two clinical cases to characterize the main features of impacted upper teeth and their removal guided by CBCT imaging.

CASE REPORTS

CBCT exams were performed with a classic device (i-CAT, Imaging Sciences International Hatfield, PA, USA), being the patient in seated position exposed to X-ray source with 120 kV and 37 mA. The parameter used for data acquisition and 3D reconstruction involved axial sections of 0.25 mm thickness at an interval of 0.25 mm. The field of view was 6 cm height. The voxel size (determines the image resolution) was adjusted to 0.25 mm during 40 s of scanning.

Patients sought esthetic treatment at Pediatric Dentistry Clinic of the Araraquara Dental School-UNESP and through conventional radiography there were suggestive images of supernumerary teeth. Both patients presented with asymptomatic impacted tooth and no infections related. Every single conventional and CBCT image was analyzed pre- and intra-operatively by experienced surgeons. All cases were documented after the parents signed a free informed consent form. A postoperative recall was recorded. Patients received orthodontic treatment, including traction impacted teeth (followed longitudinally for 2 years), corroborating to self-esteem.

Case 1

A 10-year-old male patient and his caregiver were looking for orthodontic treatment. Clinically, dental elements 53, 12, 51, 21, 22, and 63, including two supernumerary teeth erupted into the palate [Figure 1a], were observed in the region. A slight tilting in the palatal raphe associated with changes in the number of teeth and dental eruption chronology determined the complementary exams to be performed. The panoramic radiograph allowed identification of mesiodens in close contact with the tooth 21, tooth 51 in the oral cavity, and supernumerary teeth adjacent to the impacted permanent incisor (tooth 11). The occlusal radiograph, however, showed no well-defined position of the incisor and therefore it was not possible to define how many supernumerary teeth were present, nor the position of them in relation to the nasal fossae floor. There was no images compatible with expansive lesion [Figure 1b and c].

CBCT images identified of the impacted tooth (11), which was horizontally positioned, in addition to other four supernumerary teeth presenting developmental anomaly [Figure 1d and e]. One of the supernumerary teeth was centrally positioned on the alveolar ridge, between teeth 11 and 12, whereas the other was buccally positioned. The third supernumerary tooth was positioned in the palatal face of tooth 21, and the fourth one had the developmental anomaly and was transversally retained on the maxilla middle line, with its crown being posteriorly oriented. No evidence of cystic lesions and root resorption as dental follicle proliferation result.

Case 2

A 10-year-old male patient and his caregiver were looking for an evaluation of the delayed dental eruption in the anterior region of the maxilla. Clinically, only teeth 53 and 63 were present in the region, in addition to a residual root of tooth 52 [Figure 2a]. Impacted teeth (12, 11, 21, and 22) with suggestive images of supernumerary teeth in the maxilla anterior region were identified in both panoramic and occlusal radiographs, but these complementary exams provided no detail necessary for planning a surgical removal [Figure 2b and c].

CBCT images showed that teeth 12, 11, 21, 22, and 23 were impacted and had an unfavorable eruption axis [Figure 2d and e]. A hyperdense image, compatible

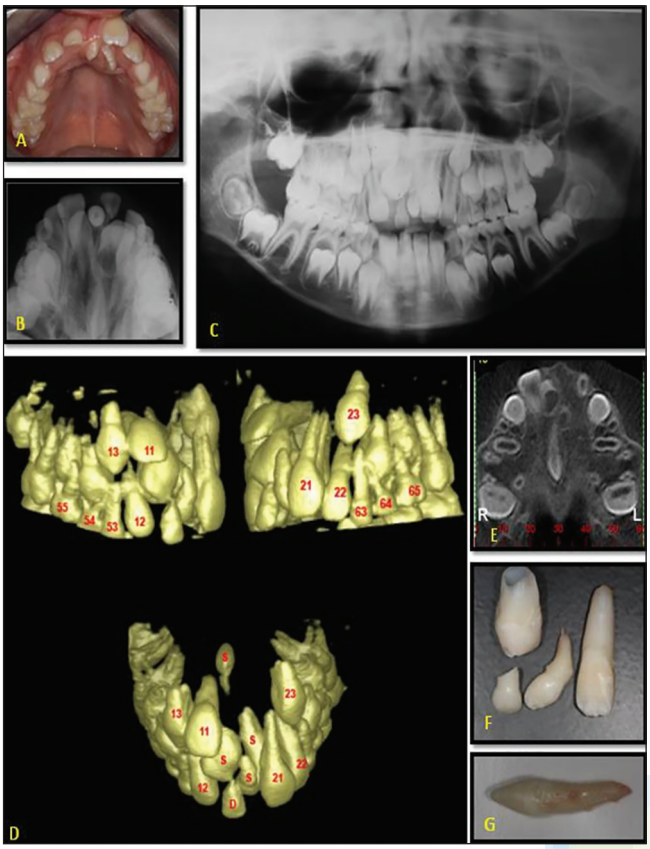

Figure 1: (a) Occlusal view showing abnormal supernumerary teeth in the anterior superior region and tilting of the palatal raphe; (b) Occlusal radiograph of the maxilla; (c) Panoramic radiograph demonstrating the presence of supernumerary teeth in the anterior superior region and palatal raphe; (d) The three-dimensional reconstruction showing the presence of abnormal and supernumerary teeth (in maxilla and palate); (e) Axial section; (f and g) Abnormal supernumerary teeth (n = 4) and deciduous tooth removed.

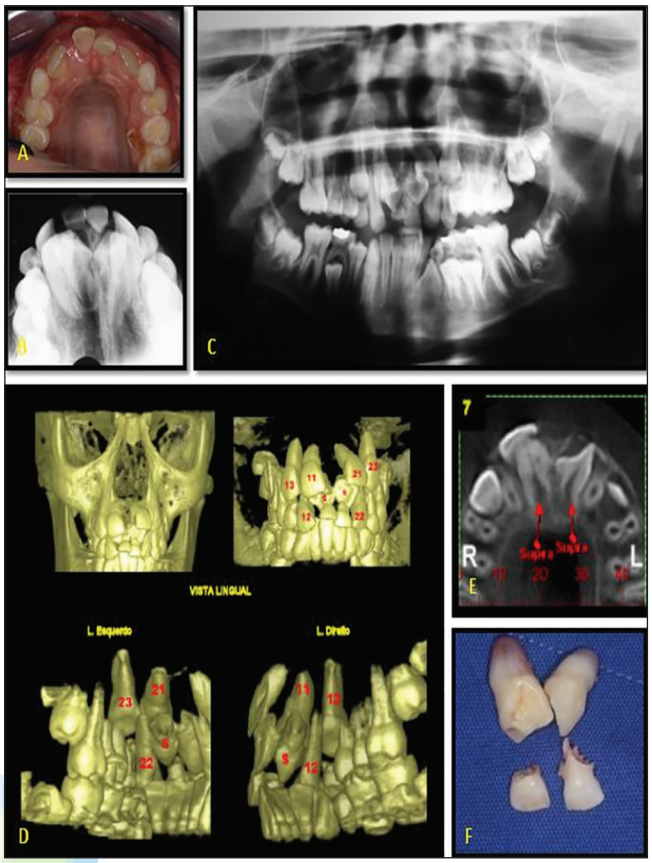

Figure 2: (a) Occlusal view showing teeth 53 and 63 as well as residual root of tooth 52 in the anterior superior region; (b) Occlusal radiograph of the maxilla; (c) Panoramic radiograph demonstrating the presence of supernumerary teeth in the anterior superior region and palatal raphe; (d) The three-dimensional reconstruction for evaluation of impacted teeth 12, 11, 21, 22, and 23; hyperdense image compatible with amorphous dental structure positioned in the region of the alveolar ridge of the right anterior maxilla; (e) Sagittal section; (f) Abnormal supernumerary teeth (n = 3) removed.

with an amorphous structure of the teeth suggestive of complex odontoma, was identified in the region of the alveolar ridge of the right anterior maxilla, between teeth 11 and 21. Three abnormal supernumerary teeth were removed during the surgical procedure, 2 for lingual, and 1 for buccal. Absence of root resorption and cystic lesions in permanent teeth in the region [Figure 2f].

DISCUSSION

The supernumerary teeth found in the anterior superior region are those as being of more concern among the professionals, caregivers, and the patient, since they can cause a delay in dental eruption, thus compromising the normal occlusion development besides provoking a series of esthetic, speech, and psychological complications.[2,8]

The risk/benefit analysis of pretreatment radiological evaluation should always be an important selection criterion.[9] Diagnostic information is essential for making a clinical decision, whereas surgical planning depends on both shapes of supernumerary impacted tooth and on its correct localization.[8] Panoramic radiographs in association with telerradiographs have been used as a preoperatory exam for impacted teeth, but they are not enough for determining the exact localization of the retained tooth due to image superposition.[10] The cross-sectional occlusal may present difficulties in positioning the X-ray tube precisely, may not show structures less radiopaque than teeth and does not show details of the unerupted object and roots of surrounding teeth. Thus, it is not recommended in localization supernumerary teeth

because is one of the radiographs frequently used in the right angle technique of localization.[11]

These limitations of conventional radiographic imaging can be attributed to 3D structures compression that difficult an accurate evaluation of the relationship of a tooth's roots with the surrounding anatomy as well as associated resorption and periapical lesions. Therefore, a geometric distortion (minimum magnification of 5%) of the radiographed object can be expected due to anatomical interferences which can also difficult interpretation.[12,13] These limitations suggest that the parallax technique is the method of choice to localize the unerupted teeth.[11] The same lingual opposite buccal technique, proposed by Clark in 1909, is useful to state the exact anteroposterior position. Two parallax radiographic images performed with changes in the horizontal angulation of the X-ray beam (related to the area of interest) improve appreciation of spatial relationship in dental imaging. According this rule, the object is lingual if the object movement on the second radiograph is on the "same" direction as the source of the X-ray beam. To obtain paralleled images, the image receptor needs to be parallel to the tooth, and the X-ray beam should be perpendicular to both. However, the accurate is seldom achieved due to oral anatomical confines, even with the use of digital radiography.[14]

CBCT allows the impacted tooth to be correctly localized, which makes the surgical procedure less invasive, more efficient, and quicker.[15] Problems with amplitude and superposition of dental structures, which makes radiographic interpretation a particular challenge, are potentially eliminated by using this technique.[16] The CBCT provides true and precise anatomical information and appears superior to conventional radiography (intraoral and panoramic), especially in the anterior region of the maxilla, usually with multiple narrow adjacent anatomical structures. This traditional method produces evaluable diagnostic results, but not with the absolute information and accuracy as CBCT X-ray. It enables more time efficient surgery and reduces costs and surgical complications, especially in cases with mixed dentition.[9]

Other clinical CBCT benefits possessed by the iCAT include for example volumetric data acquisition with relatively fast scan time, digital data saving, navigation opportunities and high image definition, and resolution for all views. On the other hand, conventional radiological devices for intraoral and panoramic X-rays are most common, easy to handle, and lower in cost.[9] Moreover, the different reconstructed images of CBCT (panoramic, multiplanar reconstruction, serial cross-sectional, and 3D images) are useful in evaluation of impacted or supernumerary teeth because the information can be added to define the exact localization and morphologic relation among the critical structures. In the clinical cases presented in this article, CBCT allowed the professional to obtain the exact position of supernumerary teeth and/or odontoma. Such images provided 3D information on amount of alveolar bone adjacent to supernumerary teeth, proximity, and root resorption of adjacent teeth, anatomical changes and tooth developmental stage, enabling surgery to be carefully planned, and orthodontic rehabilitation achieved. In the Case 1, volumetric images allowed for a careful anatomical analysis of the impacted canine in relation to the nasal fossae floor, as can be seen in Figure 2e. In this way, both surgical procedure and tooth removal were safely performed, with all retained teeth being extracted in two steps in order to avoid a prolonged chair time and patient discomfort as the teeth were retained in the palate region and buccal face. The second clinical case illustrates the benefit from CBCT in allowing the surgeon to locate the exact position of an odontoma before removal as well as its proximity to anatomical structures. With this technique, the structures adjacent to the region of interest can be three-dimensionally viewed, thus reducing the risk of surgical complications.[4]

In the two clinical cases presented above, once the presence of supernumerary teeth was confirmed, surgical removal was indicated to allow other dental elements to erupt normally and the space left to be recovered, in addition to preventing more severe occlusal problems from occurring. In removing the tooth causing impaction, it is important to determine the best surgical technique to prevent fewer injuries as possible to roots and main structures of the adjacent teeth. When conventional radiographs are used for decision-making, it is difficult to determine the exact buccallingual relationship between teeth and adjacent dental structures. In many cases, if the anatomy of the region is not so narrow and crowded dental follicles, the technique can aid in the vestibulolingual location of the tooth to be extracted.

The benefits of 3D images for diagnosis and treatment planning have been fundamental to solve the cases presented above. In fact, CBCT provided valued

information that helped determine the correct 3D position of the impacted teeth, thus facilitating the surgical procedure.[8] This fact contributed not only to osseous tissue removal but also reduced the manipulation of soft tissue on the correct side of surgical access had been already defined. In addition, surgery time was reduced, and as a result, the patient experienced less stressful situation. Also importantly, patients related no discomfort/pain and the postoperatory time was rapid and satisfactory in all cases (no inflammation).

The advantages of CBCT have been widely reported in the literature. However, the clinical success depends potentially on the practitioner's ability. In this way, it is necessary that the professional, either specialist or generalist, be trained to assess judiciously all images obtained with this technique.

CONCLUSION

The CBCT contributed to both diagnosis and correct localization of supernumerary teeth, aiding the professional in the treatment planning, and consequently in the clinical success. The surgeries guided by CBCT were completely safe, avoiding damage in noble structures, and providing a better recovering of the patients.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

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