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USE OF CBCT – CONE BEAM COMPUTED TOMOGRAPHY IN DIAGNOSIS OF HYPERDONTIA – A CASE REPORT

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Abstract

Awareness of hyperdontia pattern/prevalence can be useful in early diagnosis and prevention by general practitioners, pediatric dentists, and orthodontists. Since the previous results regarding the pattern of hyperdontia (supernumerary teeth) are controversial, this study aimed to assess this issue in an 8-year-old boy.

Cone Beam Computed Tomography (CBMT) is a relatively new three-dimensional imaging technology, which has been specifically developed for imaging of the teeth and jaws. The main aim of this paper is to acquaint the dental team with various forms of this technology and its potential applications. An understanding of the underlying principles will allow the users of this technology to tailor the imaging protocol to the patient's individual needs to achieve appropriate imaging at the lowest radiation dose. The second (narrow) aim of the paper is an overview of the fundamental principles of operation of maxillofacial CBCT technology; and discussing the role of CBCT in the precise positioning of supernumerary teeth and choosing the most appropriate method for their removal.

CBCT is a result of dramatic advances in computer and electronic technology and (along with similar advances in scanning and manufacturing) is one of the key components in the rapidly evolving field of digital dentistry. It is becoming widely available and has applications in implant dentistry, endodontics and oral surgery.

Keywords: hyperdontia, supernumerary teeth, orthodontic patients, prevalence

Introduction

Hyperdontia is a condition of having excess number of teeth or supernumerary teeth in the dental arches or jaw bones. It is relatively infrequent taking into account that hypodontia is more commonly seen in clinical practice. Accordingly, different authors reported various incidence, but in general it is around 1%. It occurs more commonly in the permanent dentition, but can be seen in primary dentition as well. The male/female ratio has been shown to be around 2.6 *vs*. 1.

The causes of presence of supernumerary teeth are not fully understood, although it is certain that a modification during the embryonic development is directly responsible for the occurrence of an excess of tooth bud. Furthermore, the most accepted theory is that this happens due to a local hyperactivity of the dental lamina, which in addition to the extension is responsible for development of the eumorphic tooth, leaves some epithelial remnants which usually continue to grow and form a tooth or tooth-like structure [1].

Majority cases of hyperdontia show only one additional tooth in a normal series. Supernumerary teeth may occur in isolation or as part of a syndrome or developmental abnormalities, such as cleidocranial dysplasia, Gardner's syndrome or cleft lip and palate. The presence of one or two supernumerary teeth is quite common when compared to hyperdontia involving multiple teeth. The discovery of impacted supernumerary teeth is commonly an incidental finding on a routine panoramic radiograph [2].

In various populations, the reported prevalence of hyperdontia is (0.1-3.8%) with a particular male predilection, and the coincidence of multiple hyperdontia in the absence of associated syndromes or systemic conditions is rare [3].

Supernumerary teeth are more frequent in patients with cleidocranial dysplasia and Gardner syndrome, and those are called syndromic cases. However, non-syndromic hyperdontia is also possible, in which case the mandibular region is somewhat more susceptible compared to the maxillar region. Most

commonly there is only one tooth present in excess, but two or more supernumerary teeth have been also reported. Early detection of these teeth is essential for proper diagnosis and treatment plan. The complications of persisting of supernumerary teeth are usually benign in nature, but when they are present in the frontal area, it may cause aesthetic disturbances. Moreover, consequences of not taking any treatment may lead to failure for eruption of the adjacent teeth, a free space between the erupted teeth in case of mesiodens, root resorption of the adjacent teeth and orthodontic problems, such as tooth displacement, which eventually may lead to problems with occlusion, temporomandibular joint and difficulties to maintain proper oral hygiene. Radiographic examination of a dental clinic patient revealed the presence of 32 erupted teeth and 8 unerupted supernumerary teeth, or a total of 40 teeth. There was no evidence of systemic disease [4].

Within the process of hyperdontia, it is not surprising that eruption anomalies may affect more than one type of tooth. Because the eruption process is common to all teeth, it is unlikely that the mechanisms of eruption of different teeth are due to the action of different genes. Therefore, a defect in the eruption process may reasonably be expected to affect all teeth to some degree. Variations in temporal and spatial gene expression of the mutant genes as well as regional differences in regulation may account for the range of eruption anomalies seen [5].

Supernumerary teeth may be impacted in the jaw bone and may prevent eruption of the regular teeth, which is sometimes the sole symptom for referral of the patient to the dental office. Supernumerary teeth may occur in isolation or as part of a syndrome or developmental abnormality [6].

Furthermore, diagnosis of supernumerary teeth is set by clinical examination and x-ray imaging. Panoramic x-ray has been used for a long time to detect any changes in the number of teeth, but sometimes occlusal and retroalveolar x-ray images may be helpful, especially in detection of the correct position. However, in cases with multiple and impacted supernumerary teeth, it is crucial to set the exact localization, especially when the teeth are in close proximity to some important anatomic structures, like the nose cavity, maxillar sinus or inferior alverolar channel. Accordingly, here we present a case of an impacted supernumerary central incisor, which was evaluated with cone beam computed tomography, and based on that evaluation surgical and orthodontic treatment plan was set.

Clinically, supernumerary teeth can induce various alterations which require surgical or orthodontic intervention. Furthermore, early recognition of hyperdontia provides a diagnostic indicator of some multiple congenital anomaly syndromes, such as cleidocranial dysplasia, trichorhinophalangeal syndrome, familial adenomatous polyposis, and craniosynostosis [7].

Knowledge about the supernumerary teeth is important for dental clinicians as they are relatively common but are detected as an incidental finding in a radiograph. A routine screening panoramic radiograph is mandatory for every patient to prevent the possible complications associated with it [8].

Case Report

An 8-year-old boy was referred to the Department of Oral Surgery, complaining on absence of eruption of permanent central incisors in the upper jaw. The clinical examination revealed persistence of both maxillary central incisors, with no signs of eruption of the permanent central incisors. The first permanent molars and lateral incisors were erupted. The latter were in slightly rotated position. A thorough familial, medical and dental history was made and it was concluded that no acute or chronic diseases existed, neither a syndrome was present. Moreover, mental development was without any disturbances.

Image 1: Situation in the mouth
Source: Image made by the Author

Preliminary retroalveolar x-ray image showed retention of the permanent central incisors and another two impacted teeth. A consultation with an orthodontist was made and it was decided that additional imaging for evaluation of the 3-dimensional relationship of the supernumerary teeth with adjacent anatomic structures and adjacent teeth is necessary in order to plan the prospective treatment correctly. The 3D CBCT imaging showed palatal placement of the supernumerary central incisors, with their apexes in close proximity to the nasal floor, but not interfering with its structure.

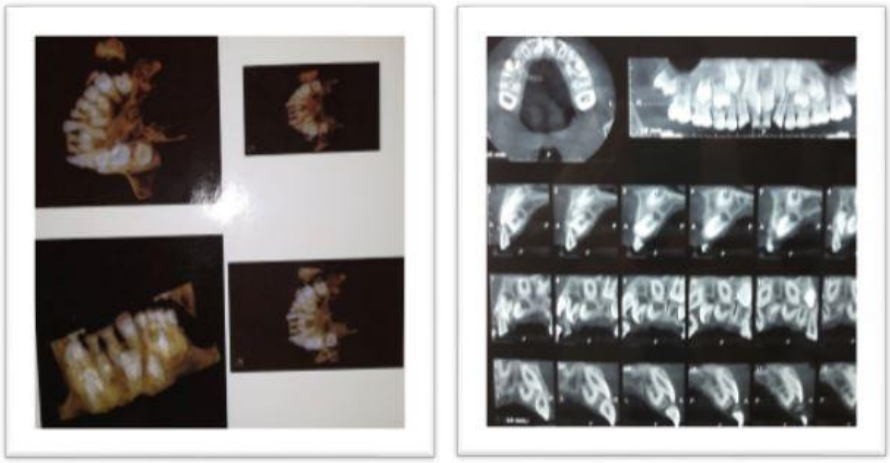

Image 2:Patient's CBCT
Source: Image made by the Author

A decision for a surgical treatment was made after a thorough examination of the condition in three planes. The teeth were removed with palatal approach, after administering a local anesthesia using Mepivacaine Hydrochloride 2% with Levonordefrin 1:20.000. The teeth were extracted after a careful osteotomy with a small steel bur, taking special precaution and consideration for the proximity of the roots and crowns of the regular permanent central and lateral incisors, as well as the floor of the nose. After the extraction, a primary closure with non-resorbable silk sutures was performed.

Furthermore, the postoperative follow-up showed a relatively quick eruption of the central incisors (in six months) and their placement in the dental arch. Finally, the patient underwent an orthodontic treatment after the surgery in order to obtain sufficient space for proper placement of the teeth.

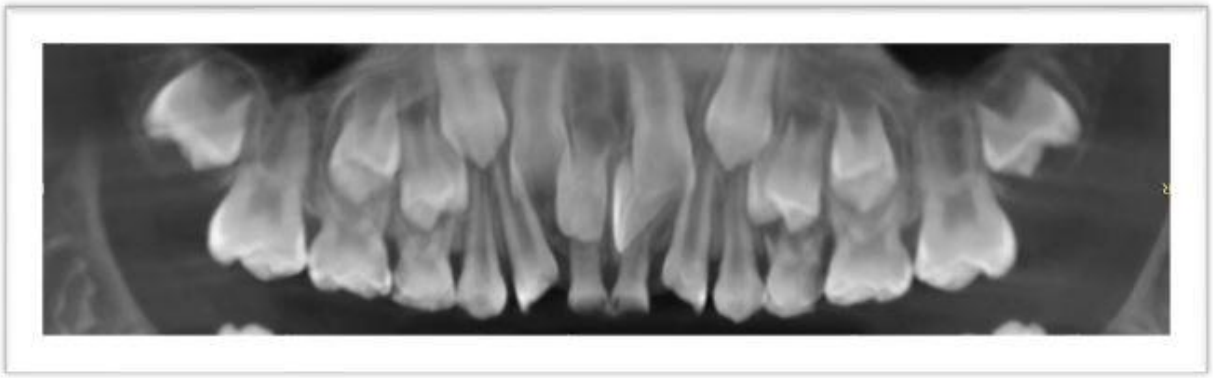

Image 3:Patient's OPG
Source: Image made by the Author

Discussion and Conclusion

This paper provides (1) an overview of the fundamental principles of operation of maxillofacial CBCT technology; and discusses (2) the role of CBCT in the precise positioning of supernumerary teeth and choosing the most appropriate method for their removal.

Within the framework of the present study, it has been concluded that supernumerary teeth do not have to be more commonly associated with local disturbances, which can be detected during routine radiographic examinations. CBCT provides relevant data on a model of multiple teeth in three planes, and on adjacent structures, with a significantly lower radiation dose than traditional spiral CT.

The ability to display three-dimensional structures is of importance for many defects in the maxillofacial area. A disadvantage, however, is that the dose of a CBCT-study is higher than the dose of more conventional imaging techniques. This should be taken into account when prescribing a CBCT examination. Because a CBCT image usually displays a larger area than that of conventional radiography, there is a possibility abnormalities to be shown outside the direct field of experience of the dentist. For all these reasons, the user of a CBCT-device needs to have additional knowledge [9].

In addition to the above insights, it is important to note the low availability of this technique, which greatly limits its use. Namely, according to the clinical picture of patients they undergo orthodonic treatment; panoramic and cephalometric treatments are considered as the first and basic step in order to further successfully plan the subsequent treatments.

In fact, the main directions are seen in the fact that the panoramic film determines the mesiodistal and vertical dimensions of the numerous teeth, relatively easy, efficient and precise.

Additionally, the buccolingual dimensions can be expected to be discerned in lateral cephalometric views. Therefore, it is important to have a full understanding of the technical principles of dental CBCT imaging in order to reap the full benefit of this technique while minimizing radiation-related patient risk [10].

Further applications and increasing availability of this technology will extend maxillofacial CBCT imaging from diagnosis to image guidance of operative and surgical procedures. CBCT will

undoubtedly affect the expected standards of care, and this has implications for increased practitioner responsibility both in the performance, optimal visualization and interpretation of volumetric datasets [11].

Within the framework of the research, based on the application of CBCT, a new system for classifying the complex arrangement (spatial location) of numerous teeth in the maxillary forearm is promoted. Accordingly, types I and III were the most common, followed by type II, type IV, type VI, and type V. Type I, type II, and type VI were located palatal to the neighboring incisors in a craniocaudal variant position. Type III and type IV lay within the dental arch, oriented normally, inverted, or in cross section. Type V, which represents supernumeraries located labially and superior to the incisor root, was the rarest type.

It is of particular importance to note that the above classification system in fact based on its sophistication can give an accurate picture of the 3-dimensional relation of the numerous teeth, which in practice plays a particularly important role, especially in surgical and orthodontic evaluation.

However, in order to plan dental treatment on a long-term basis, it is important to have an accurate insight into their type and position as well as their effect on adjacent teeth. Moreover, within interpreting a therapeutic intervention, there are two alternatives - the initial approach to the surgical extraction method of the supernumerary teeth and the possibility of recovery and repositioning of the dental arch.

The dilemma between the scientific communities as to which life stage is most appropriate to undertake the surgical removal of an unused supernumerary tooth has not yet been resolved, especially in the premaxillary region. Consequently, most researchers believe that the age range of 8 to 10 years is the most ideal, as in this early period of personality development the root development of the incisors is in the final stages.

Although it can be expected that the basic principles behind this imaging modality will not change, several future developments may lead to important alterations regarding its application. On one hand, various image quality aspects may improve, which could broaden the application range of CBCT. On the other hand, patient radiation dose for existing applications may gradually reduce over time [12].

On the basis of the above, the classification system presented in this paper finds that it is likely to be particularly useful when making crucial decisions to implement appropriate treatment. Regarding the case analyzed and interpreted in this paper, types I and III are located near the crown region of the incisors and can be removed with relative ease.

In addition, if they are related to local disorders, such as diastema, delayed eruption, or displacement, or interfering with active orthodontic treatment, or if there is associated pathology, then they should be extracted whenever detected. Other types of supernumeraries are located high at the root apex of the neighboring incisors, and are sometimes closely associated with the nasal floor and the nasopalatine duct.

As they are less frequently associated with local malocclusions, the best suggestion is to leave them in a certain area but still properly monitored. In this respect, if steps are taken for early surgery, it may, without intent, cause further injury to adjacent teeth and bone structures.

According to Dawood *et al.* [13]:

- CBCT is a relatively new technology to dentistry, used for 3D imaging of the teeth and jaws.
- Radiation dose to the patient is much less than for conventional CT scanners, but still higher than for conventional 2D dental imaging.
- Training is crucial for all members of the dental team involved in CBCT radiography and radiology.

When selecting the best CBCT examination for an individual, it is important to minimise X-ray dose while striving for an image that enables appropriate

diagnosis and management. This requires an understanding of the concepts behind CBCT and related technologies, making appropriate training essential for every member of the dental team [14].

It is necessary to note the following issues that describe the position of the numerous teeth:

- In Type I, the supernumerary teeth were located palatal to the longitudinal axis of the normal incisor neighbour and inferior to its root apex.
- In Type II, the supernumerary teeth were located superior and palatal to the neighbouring incisors.
- In Type III, the supernumerary teeth were located within the neck region of the normal arch (normally oriented or transverse).
- In Type IV, the supernumerary teeth were located superior to the apex of the adjacent incisors (inverted or normally oriented), or obliquely across the apex of the incisors.
- In Type V, the supernumerary teeth were placed beyond the labial aspect of the adjacent incisor root.
- In Type VI, the supernumerary teeth were placed palatal to the incisors, with the vertical position between that of Type I or Type II.

In order to be able to choose the appropriate surgical approach to remove supernumerary teeth, it is important to have CBCT photographs. This will help in extracting the tooth very precisely, without creating conditions for additional trauma to the adjacent hard and soft tissues.

References

1. Rajab LD, Hamdan MAM. Supernumerary teeth: review of the literature and a survey of 152 cases. Int J Paediatr Dent 2002;12:244-54.
2. Shah AK, Joshi MU. Nonsyndromic multiple supernumerary premolars: Report of three cases. Health Agenda. 2013, 1:85–89.
3. Mallineni SK. Supernumerary Teeth: Review of the Literature with Recent Updates. Conference Papers in Science 2014:1-6
4. James, D., Smith, JADA – The Journal of the American Dental Association, Hyperdontia: report of case,1969, 5:1191-1192.
5. Camilleri, Simon, Double Transmigration and Hyperdontia. The Angle Orthodontist: July 2007, Vol. 77, No. 4, pp. 742-744.
6. Roopashri Rajesh Kashyap, Rajesh Shanker Kashyap,1 Raghavendra Kini, and Vathsala Naik, Prevalence of hyperdontia in nonsyndromic South Indian population: An institutional analysis, Indian J Dent. 2015 Jul-Sep; 6(3): 135–138.
7. Nakamura T, Fukumoto S. Genetics of supernumerary tooth formation. Journal of Oral Biosciences 2013, 55(4): 180-183.
8. Roopashri Rajesh Kashyap, Rajesh Shanker Kashyap,1 Raghavendra Kini, and Vathsala Naik, Prevalence of hyperdontia in nonsyndromic South Indian population: An institutional analysis, Indian J Dent. 2015 Jul-Sep; 6(3): 135–138.
9. Tijdschr Tandheelkd, Ned. Cone beam computed tomography: is more also better?, 2016, 123(4): 189-98.
10. Pauwels, R.,Araki K, Siewerdsen, J.H., Thongvigitmanee, S. Technical aspects of dental CBCT: state of the art, Dentomaxillofac Radiol. 2015 Jan; 44(1).
11. Scarfe, WC, Aboelmaaty, Z Li W, Farman AG, Scott SA, Maxillofacial cone beam computed tomography: essence, elements and steps to interpretation, Australian Dental Journal, 2012,1:46-60.
12. P auwels, R., Araki K, Siewerdsen, J. H., Thongvigitmanee, S., Technical aspects of dental

CBCT: state of the art, Dentomaxillofac Radiol. 2015 Jan; 44(1).
13. Dawood, A., Patel, S., Brown, J, Cone beam CT in dental practice, British Dental Journal volume 207, 2009: 23-28.
14. Patel S, Dawood A, Whaites E, Pitt Ford T . New dimensions in endodontic imaging: part 1. Conventional and alternative radiographic systems. Int Endod J 2009, 42: 447–462.