CASE REPORT

DOI: 10.5336/caserep.2020-73304

Dental Anomalies in Vitamin D Intoxication

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This case was presented at 8th International Congress of Mediterranean Societies of Pediatric Dentistry and 21st Congress of Turkish Society of Pediatric Dentistry, November 13-15, 2014, İstanbul, Turkey.

ABSTRACT Active vitamin D plays an important role in the matrix formation and calcification phases of tooth development. Vitamin D toxicity occurs as a result of taking inappropriately high doses of vitamin D, which is a potential cause for systemic disorders and dental changes. This case report presents a rare situation of dental anomalies in an 8-year old girl with vitamin D intoxication as a result of excessive vitamin D at the age of 23 months. Hypoplastic and hypomineralized crown defects were diagnosed on permanent incisors and first molars. Major crown defects were observed on permanent canines and the root formations showed dilacerations. No abnormalities were detected in the permanent second molars and premolars. Vitamin D intoxication during infancy can cause dental anomalies. For early diagnosis and treatment, it is important that both dentists and pediatricians should be aware.

Keywords: Dental hypomineralization; enamel hypoplasia; vitamin D intoxication

Vitamin D is synthesized in the skin with the effect of sunlight or is taken into the body from the diet or supplements. Vitamin D is firstly metabolized to 25 hydroxyvitamin D_3 [25(OH)D_3] in the liver, and then to 1.25 dihydroxyvitamin D_3 [1,25$(OH)_2D_3$], which is the active metabolite in the kidney.[1] The main biological mission of 1.25$(OH)_2D_3$ is to maintain the calcium/phosphorus balance and regulate hard tissue mineralization with parathormone (PTH) by faciliating intestinal calcium and phosphorus uptake.[2] Serum 25(OH)D_3 concentration is accepted as the basic parameter used to determine the vitamin D status of the body.[1-3] Normal serum vitamin D level is 20-32 ng/mL in adults, and minimum 20 ng/mL in children which balances the PTH by enabling the optimal absorbtion of the calcium in diet and preventing rickets and osteomalasia.[3]

Approximately 90-95% of vitamin D that is essential for the body is produced via photosynthesis in the skin and the rest is derived from exogenous sources like fortified foods or oral/intramuscular vitamin D therapies.[4] Vitamin D intoxication in children is caused by errors of fortification and formulation of foods or drinks like fortified milk, or by inappropriate high doses of exogenous administration of vitamin D by healthcare personnel or family members.[3-5] Serum levels of 25(OH)D_3 above 100 ng/mL is considered as hypervitaminosis D and above 150 ng/mL is considered as vitamin D intoxication by American Academy of Pediatrics (AAP).[6]

This case report presents a rare situation of dental changes that could be caused by vitamin D intoxication as a consequence of taking high dose vitamin D medication at an early age.

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Peer review under responsibility of Turkiye Klinikleri Journal of Case Reports.

Received: 02 Jan 2020 ***Received in revised form:*** 17 Feb .2020 ***Accepted:*** 18 Feb 2020 ***Available online:*** 25 Feb 2020

CASE REPORT

An 8-year-old girl was referred to the clinic for dental treatment. She was systematically healthy with no chronically used drugs or drug allergy. Her physical examination was normal except the oral cavity.

MEDICAL HISTORY

Detailed medical history revealed that she was hospitalized and treated for vitamin D intoxication when she was 23 months old.

According to the discharge report obtained from her pediatrician; patient was admitted to the clinic with fever, shivers and constipation. It was found that, the patient was treated with 2 vials of intramusculer vitamin D with an interval of 10 days (a total of 600.000 IU) for the complaint of delay in walking. Medical and familial history of the patient did not have any feature. Physical examination revealed that she had tremors with a heart rate of 140/min and with normal respiration. Laboratory blood results were as follows: Calcium level was 24 mg/dL (normal range for infant= 8-13 mg/dL), a low PTH - 7 pg/mL (normal range: 15-65 pg/ml) and a very high $25(OH)D_3$ - 440 ng/mL (normal range 20-120 ng/mL in summer - 10-50 ng/mL in winter), Urea: 36 mg/dl, Creatinine: 0.5 mg/d, Sodium: 137.1 mmol/L, Potassium: 4.06 mmol/L, Magnesium: 2.1 mg/dl, Phosphorus: 3.2 mg/dl, Alkaline phosphatase: 137 U/L. She was diagnosed with vitamin D intoxication via differential diagnosis by not having the characteristic face and skin findings of other diseases, low parathormone levels and showing the characteristic laboratory findings of vitamin D intoxication.

INTRAORAL FINDINGS

The intraoral examination revealed normal oral mucosa and normal mixed dentition appropriate for her age. The patient had poor oral hygiene and the teeth surfaces were covered with extensive dental plaque. Multiple severe dental caries were detected. Major defects were diagnosed on the crowns of permanent incisors (Figure 1). The maxillary central incisors had white hypomineralized lines and hypoplastic areas with brownish discoloration in the middle thirds of the crowns. The general morphology of the teeth appeared normal. As a result of mineral deficiency, the crown morphology of the maxillary incisors were affected by post-eruptive enamel breakdown and yellowish brown discoloration was observed in the incisal margin (Figure 2). The mandibular incisors revealed hypoplastic lines at the junction of the middle and cervical thirds of the crowns and whitish hypomineralized lines in the middle third of the crowns. The first maxillary and mandibular molars showed yellow-brown discolorations with hypoplastic defects. The crown morphology was damaged by severe caries involving the tubercules. The partly erupted right permanent mandibular canine revealed yellowish hypomineralized area in the tubercule. No anomalies were observed in the crown morphology of the deciduous teeth, although there were severe caries involving the tubercules in the second molars.

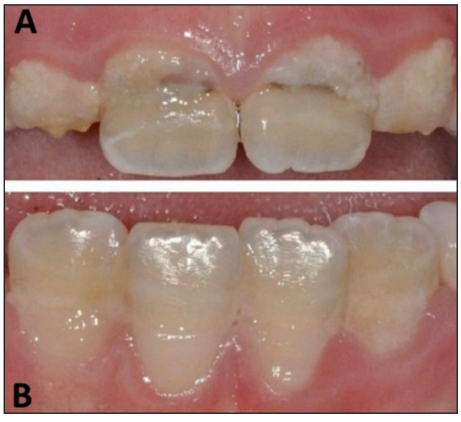

FIGURE 1: The intraoral photographs of the anterior teeth of the patient. **A)** Maxillary incisors, **B)** Mandibular incisors show white linear hypomineralized areas and hypoplastic defects. Morphological defects are seen at maxillary incisors.

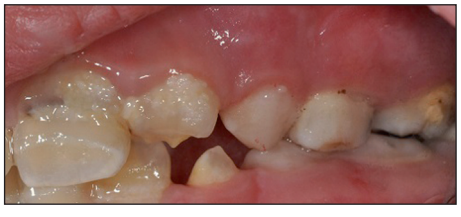

FIGURE 2: The intraoral photograph shot laterally shows the yellow-brown defects at maxillary central and lateral incisor. Also, the canine which is erupting shows yellow-brown discoloration.

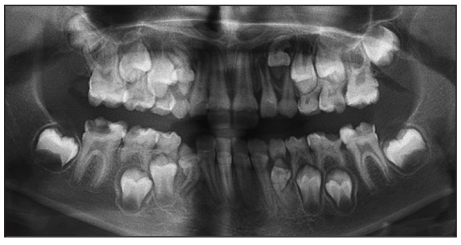

FIGURE 3: The panoramic radiograph shows normal mixed dentition at age 8 years. Defects matching the clinical findings are seen at molars and incisors. Defected crown and root morphology stands out at the non-erupted canines.

RADIOLOGICAL FINDINGS

On the panoramic radiograph (Figure 3), no teeth agenesis was observed in primary and permanent dentition. Radiolucent area was detected in the middle third of the permanent maxillary and mandibular incisors' crowns supporting the clinical findings. Enamel loss was also radiographically detected at the incisal margins of the maxillary lateral incisors. The root development of the maxillary and mandibular incisors was appropriate for the patient's age and the root canals were viewed as normal. The root canals of the maxillary and mandibular first permanent molars were apeared morphologically normal. Radiolucent defects were observed at the junction of the middle and cervical thirds of the crowns. This defect caused the teeth a nodal appearance especially, the mandibular molars. Corrupted morphology was observed on the maxillary and mandibular permanent canines, which had not yet erupted. The root formations of these teeth showed dilacerations and radiolucent hypoplastic defects in the middle third of the crowns. The mandibular second deciduous molars had short and blunted roots in addition to deep caries involving the distal tubercules. No abnormalities were detected in the permanent second molars and premolars which were still germs, and crown formation was almost complete.

Informed consent was obtained from the parents of the patient for publication of the case report.

DISCUSSION

Vitamin D plays an important role in the matrix formation and calcification phases of tooth development by regulating serum calcium and phosphate levels and through gene expression.[1,7] In some studies, it has been suggested that $1.25(OH)_2D_3$ shows its effect only by controlling calcium and phosphate levels.[8] Nevertheless, $1.25(OH)_2D_3$ is thought to have a role in enamel and dentin formation by taking part in gene expressions which affect matrix secretion due to the appearance of vitamin D-dependant proteins such as calbindin-D in ameloblasts and osteocalcin in odontoblasts.[9]

Experimental studies on rats have shown that pathway defects of vitamin D result in morphogenic anomalies, matrix irregularities and hypomineralization.[9,10] To the best of our knowledge, there have been very few reports about the effect of hypervitaminosis D on tooth development. In a study, where the rats were exposed to toxic doses of vitamin D, histopathological evaluation of the incisors revealed early aging in fibroblasts and odontoblasts which form the pulp-dentin complex, and disruption of the dentinal matrix and formation of osteodentin.[10] Becks, et al. found pathological pulp calcifications, hypermineralization in the alveolar bone, defects and striation in enamel and root deformations with the onset of hypercalcemia after a single toxic vitamin D shot in dogs.[11]

The only case to have reported the effects of vitamin D intoxication on tooth development with both intraoral images and radiographs was by Guinta et al.[12] In that case, a 7-year old girl was treated at the age of 15 months because of vitamin D intoxication due to consumption of fortified milk. In the intraoral images of the patient, hypoplastic defects and white striated band-like hypomineralization areas were seen in the permanent maxillary and mandibulary incisors, Hypoplastic defects were also determined in the permanent molars and canines. No pathology was determined in the deciduous teeth and premolars.[12]

This case report presents the dental changes observed in an 8-year old girl with vitamin D intoxication as a result of excessive vitamin D at the age of 23 months. Each stage of tooth formation is under the influence of genetic and environmental factors. Enamel defects may result from insults during any stage of amelogenesis.[13] Although the etiology of the enamel defects is still uncertain, chromosomal and metabolic abnormalities, toxic chemicals, infections and dietery deficiencies as well as local effects have been reported to cause enamel defects.[13-21]

The severity, duration and time of the insults affect the shape and severity of the defects.[13] When the time of the intoxication is taken into account, that defects were observed in both the crowns and the roots of canines and in the crowns of incisors and molars intensifies the possibility that this situation is directly related with vitamin D intoxication. This theory is reinforced by the fact that the premolar germs, which develop between 30 and 36 months, and deciduous incisors, molars and canines, which mostly mature prenatally, were not affected in this case.

Since the enamel does not have the ability to remodel, any defect that occurs during tooth development is observed as permanent damage in the teeth. Both pediatricians and dentists should be aware of the fact that vitamin D intoxication during infancy can lead to defects in teeth.

Acknowledgements

The authors would like to thank Dr. Fatih Aydın (Medical Park Hospital, Department of Pediatrics, İstanbul/Turkey) for his valuable supports by providing the patient's medical records.

Informed Consent

Due to the fact that our study was a case report, ethics committee approval was not required. Singed informed consent form from the patient's parents was obtained.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Şerife Özdemir;* ***Control/Supervision:*** *Şerife Özdemir;* ***Data Collection and/or Processing:*** *Müge Tokuç;* ***Analysis and/or Interpretation:*** *Müge Tokuç, Şerife Özdemir;* ***Literature Review:*** *Müge Tokuç, Şerife Özdemir;* ***Writing the Article:*** *Müge Tokuç;* ***Critical Review:*** *Şerife Özdemir.*

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