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CASE REPORT

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Oral rehabilitation of a pediatric patient with osteogenesis imperfecta type VII: A case report

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Abstract

Osteogenesis imperfecta (OI), also known as glass bone disease, is associated with mutations in COL1A1 and COL1A2, which encode collagen type I chains, and is inherited in an autosomal dominant manner. However, as the molecular structure of the disease progresses, new autosomal recessive types have been identified. Type VII has recently been defined as a type of OI caused by the mutation of a fatal recessively inherited cartilage-associated protein (CRTAP) that causes moderate to severe bone deformities. Type VII OI is characterized by fractures at birth, blue sclera, early deformity of the lower extremities, coxa vara, and osteopenia. There is no known cure for this disease. There are few definitions of craniofacial and oral manifestations of type VII OI available in the literature. The aim of this study was to improve the quality of life of a 6-year-old pediatric patient with primary dentition diagnosed with OI type VII by providing oral rehabilitation, and to offer qualified treatment alternatives to such patients.

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Introduction

Osteogenesis imperfecta (OI) is a rare inherited connective tissue disease characterized by bone fragility resulting from impaired type I collagen synthesis (1, 2). OI has a variable phenotype with mild, moderate, severe, and perinatal lethal forms. Low bone mass in individuals with OI lead to bone fractures and deformities. In addition, short stature, blue-gray sclera, joint hypermobility, hearing loss, cardiovascular complications, respiratory problems, dental abnormalities, and dentinogenesis imperfecta (DI) have been reported in these individuals (3, 4). Approximately 85% of OI cases are associated with mutations in COL1A1 and COL1A2, which encode collagen type I chains, and show autosomal dominant inheritance (5). However, with the discovery of other rare genes, it has been identified that OI is not a disease "related" only to type I collagen (6).

Type VII OI is a specific form of OI caused by autosomal recessive mutations in cartilage-associated protein (CRTAP). In type VII OI, which is usually fatal or very severe due to bone hypomineralization, multiple rib fractures, deformities in long bones, lack of diaphyseal modeling, stenosis of proximal extremity segments, coxa vara, and progressive physiological deformities are observed (7, 8).

A recent study in mice reported that CRTAP deficiency resulted in a brachycephalic skull, fusion of facial bones, mid-face retrusion, class III dental malocclusion, short enlarged periodontal space, and defects in dentin matrix and mineralization; however, the craniofacial and dental phenotype in humans has not been reported in detail (8).

The aim of this case report was to present the oral findings and treatment options of a 6-year-old child who was diagnosed with fatal and incurable type VII OI. No other case in this age group has been reported to date.

Case description

A 6-year-old male patient was admitted to Diyarbakir Dicle University Faculty of Dentistry, Department of Pediatric Dentistry in 2023 because of esthetic and pain problems caused by carious teeth. From the medical history, it was diagnosed that the patient had Type VII OI with autosomal recessive inheritance. No history of OS in mother, father, or siblings was noted. However, some of the child's paternal relatives had the disease, and these individuals died at an early age. A consent form was obtained from the parents of the patient.

Medical anamnesis

The patient was born via normal vaginal birth at the 40th week of pregnancy in 2017 and weighed 2.5 kg at birth. The family history revealed that there was no consanguineous relationship between her parents. The patient has four sisters and a brother and his siblings did not have OI. However, the paternal relatives of the child had the disease and that these individuals died at an early age. When the medical history of her mother was investigated, it was noted that factors such as X-ray exposure, drug use, and smoking were not effective during her pregnancy. On clinical examination, the patient's body posture was impaired because of bone fragility and scoliosis was present. In addition, it was observed that he had a weak and thin build, an asymmetrical and triangular form on his face, short stature, deformities in his feet, and could not walk. Curved ears located lower than normal, wide forehead, flattened and wide nasal root, thin lips, and hypertelorism in the position of the eyes were observed (**Figure 1**). In addition, the lacrimal duct epicanthus fold was present in the eyes, and a blue eye was not found. There were deformities in the legs and feet due to fractures and a diffuse skeletal anomaly due to fractures (**Figure 2**). It was determined that he showed developmental delay in height (by 100 cm) and weight (by 15 kg) compared to his peers. The patient had frequent bone fractures and was receiving bisphosphonate (pamidronate) treatment intravenously.

Dental anamnesis

Extraoral examination of the patient revealed no protrusion in the frontal region or mandible (**Figure 1**). As a result of intraoral examination, caries was observed in teeth 53, 55, 62, 63, 65, 74, 84, and 85 and teeth root was observed in 51, 52, and 54 due to excessive loss of material caused by caries. However, enamel hypoplasia was observed in newly erupted teeth 21, 31, and 41 (**Figure 3**). In the panoramic radiographic evaluation, it was determined that the patient had no permanent tooth germ in tooth number 45 or deficiency in other tooth germs. When the patient's bite was examined, the presence of class III malocclusion and anterior-posterior crossbite was detected. After medical consultation obtained from the pediatric endocrinologist before the dental procedures were performed, it was observed that the patient was cooperative. Hence, dental treatment was initiated. Milk tooth amputation was performed on teeth 55 and 74, compomer filling was performed on teeth 53, 63, 65, and 85, and milk canal treatment was performed on tooth 74. Roots of teeth 54, 52, and 51 were extracted with minimal trauma in the oral, dental, and maxillofacial surgery outpatient clinic.

Polishing procedures and topical fluoride application were performed to ensure plaque control in our patient (**Figure 4 and 5**). After consultation with the orthodontic department, a follow-up decision was made for the follow-up of tooth eruption.

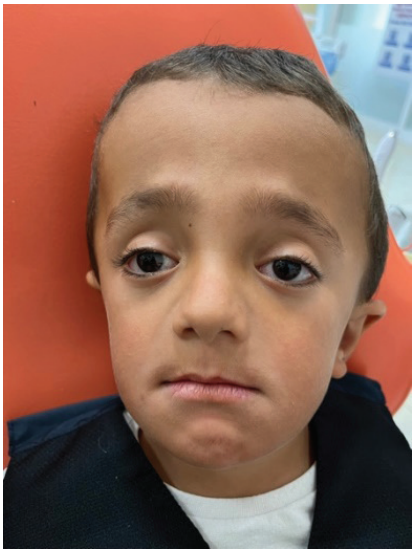

Figure 1: Extraoral view of the patient

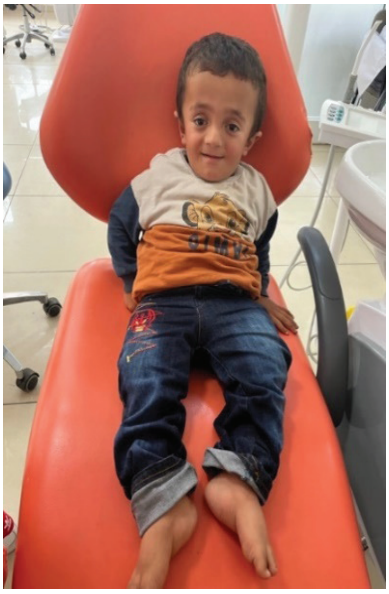

Figure 2: General appearance of the patient

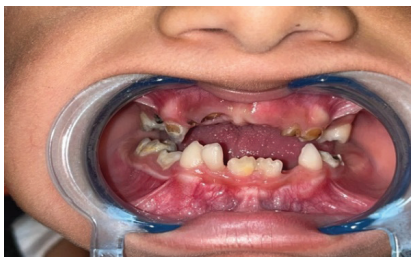

Figure 3: Intraoral view of the patient before treatment

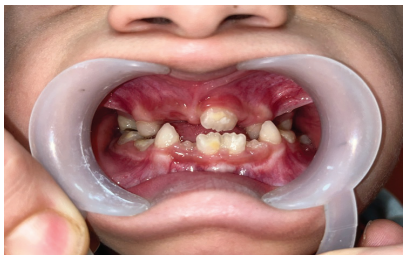

Figure 4: Intraoral view of the patient after treatment

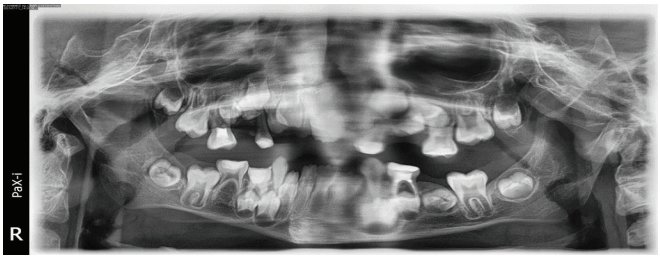

Figure 5: Panoramic radiography image of the patient after treatment

Discussion

Here, we describe the treatment of primary dentition in a 6-year-old boy diagnosed with autosomal recessive OI type VII due to CRTAP mutations. To date, there has been no case report of dental treatment of OI type VII, especially in mixed dentition, in which treatment of deciduous teeth was safely performed in the patient.

Recently, a study of two 11-year-old girls with OI type 7 reported class III malocclusion with anteroposterior crossbite and lateral open bite. However, they did not have other abnormalities that are often associated with OI, such as tooth agenesis, impacted teeth, and DI (9). Similarly, in our case with OI type VII, class III malocclusion, anteroposterior crossbite, and DI anomalies were not present, but a single tooth agenesis was observed in the right lower permanent second molar.

Although the mechanism between collagen type I mutations and DI has not yet been explained in detail, it has been determined that patients sharing the same mutation have a higher incidence. This suggests that DI is mostly determined by the type of collagen mutation and less by other genetic or environmental factors (10). The absence of DI in individuals with CRTAP mutations, as in our case, may be explained by the fact that CRTAP is not critical for dentin development

in humans.

In a study, it was found that every patient with OI with pathogenic alleles in COL1A1 or COL1A2, had an average of 2.4 missing teeth and 0.8 unerupted teeth. However, the incidence of missing or unerupted teeth was found to be higher in patients with severe disorders (OI type III and IV), and this predominantly affected missing premolars and unerupted upper molars (11). In another study, tooth deficiency was diagnosed at a rate of 17% in 128 people with mutations in the COL1A1 and COL1A2 genes (12). In 14 cases with OI type V due to mutation in IFITM5, DI was not present, but tooth deficiency was common, especially in premolars (12). Although it has been suggested that CRTAP may not be necessary for tooth bud formation, dentin matrix secretion, and/or mineralization in two 11-year-old type 7 cases (9), this patient had single tooth agenesis.

Bisphosphonates (BP) are effective in increasing bone mineral density and reducing the risk of fracture in pediatric patients with OI (13). According to a previous study, children with OI who received bisphosphonate treatment, which acts by inhibiting osteoclast function, had significantly delayed tooth eruption, especially in boys, compared to healthy controls. BP administration before the age of 2 years may be a contributing factor to this condition (14). Altered bone growth often leads to maxillary hypoplasia, predisposing the jaw structure to the development of class III malocclusion and anterior crossbite in patients with OI. Tooth development and eruption is accompanied by remodeling of adjacent bone, accumulation of osteoblasts, and reabsorption of osteoclasts. In addition, during tooth structure development, serum calcium and phosphorus are withdrawn, forming hydroxyapatite. Therefore, bisphosphonates may affect tooth eruption, formation of impacted teeth, microdontia, and tooth agenesis (15). In our patient who received BP treatment, no evidence of eruption delay was observed, but it was thought that BP treatment had an effect on class III malocclusion, anterior crossbite, and enamel hypoplasia in permanent teeth.

Conclusions

In a 6-year-old patient with OI type VII, class III malocclusion, anteroposterior crossbite, and loss of vertical dimension were observed. There was no DI. Increased caries in deciduous teeth, agenesis in permanent tooth 45, and enamel hypoplasia in newly erupted teeth were observed. Tooth extractions and intraoral treatments were performed in collaboration with the patient. Identifying dental problems at an early age in individuals with OI can reduce the need for complex procedures and the cost of treatment.

Conflict of interest

The authors report no conflict of interest.

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Ethical Approval

No need for case reports

Informed consent

Written informed consent was obtained from all individual participants and/or their gaurdians.

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Peer-review

Externally. Evaluated by independent reviewers working in at least two different institutions appointed by the field editor.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Contributions

Research concept and design: **EA**
Data analysis and interpretation: **BT, RD**
Collection and/or assembly of data: **BT, RD**
Writing the article: **EA**
Critical revision of the article: **EA**
Final approval of the article: **EA, BT, RD**

All authors read and approved the final version of the manuscript.

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