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Review

Pediatric Dentist-Pediatrician Cooperation in Early Diagnosis of Congenital Tooth Agenesis

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ABSTRACT

Early diagnosis of congenital tooth agenesis increases the quality of treatment options and the final success of the treatment. However, in some clinical conditions, overlooking this diagnosis causes late diagnosis of these anomalies. Late diagnosis reduces the number of appropriate treatments, increases the cost of treatment and may lead to possible complications. In the diagnosis of congenital tooth agenesis, findings during the routine medical examination of the pediatric patient are beneficial. At this point, as well as pediatric dentists, pediatricians also play a great role in early diagnosis of these anomalies. The aim of this study is to draw attention to pediatric dentist-pediatrician cooperation in the early diagnosis of congenital tooth agenesis.

Keywords: Pediatric dentist, pediatrician, early diagnosis, congenital tooth agenesis

Introduction

The term "congenital tooth agenesis" expresses the inherent absence of one or more teeth in primary or permanent dentition (1,2). This situation is more specifically defined by the terms hypodontia, oligodontia and anodontia. Excluding third molars, congenital agenesis of 1-6 teeth is defined by hypodontia, 6 or more by oligodontia and anodontia is used in defining agenesis of all teeth (1,3). Early diagnosis of congenital tooth agenesis ensures optional treatments and affects the quality and success of treatment positively (4-7). However, in situations where the associated cases are not under regular dental control, or where there is no clinical complaint related to the persistent molar tooth in the region with congenital agenesis, this diagnosis may be overlooked (8). In addition, the fact that congenital tooth agenesis is associated with some syndromes, gene mutations and familial predisposition makes it more likely that this deficiency can be diagnosed by medical doctors. Identification of conditions that can point to congenital tooth agenesis in routine check-up by pediatricians of child patients and directing them to the pediatric dentistry clinic makes it possible to carry out the diagnosis in the early period so that the resultant success and quality of the treatment can be increased. This review aims to summarize the familial, syndromic and non-syndromic conditions associated with congenital tooth agenesis and to highlight the early diagnosis, treatment options and the success of treatment obtained by pediatric dentist-pediatrician collaboration.

Prevalence

General Hypodontia Prevalence Among the Population

Congenital agenesis of permanent teeth is the most common dental anomaly (2,9,10). The incidence of this

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anomaly in permanent teeth varies among countries and societies. The incidence of hypodontia being 0.3% in the Israeli population (11) and 26.1% in Thailand's population (12) clearly indicates the difference. In the Turkish population, the prevalence of hypodontia ranges from 2.63% to 8.5% (13-18). However, the incidence of hypodontia in the primary teeth is very low, with a prevalence ranging from 0.1% to 2.38% (10,19-22). In the Turkish population, this rate was reported as 0.2% (23).

Dental Differences in Hypodontia Rates

In the literature, it is reported that, when third molars are excluded, agenesis of mandibular second premolars are the most common among permanent teeth (5,7,24-26), this is followed by maxillary lateral incisors, maxillary second premolars and mandibular incisors (24). Race is considered to be significant in the type of tooth which is affected by agenesis. Endo et al. (27) have stated that, in hypodontia cases; agenesis of mandibular lateral incisors may be more frequent among the Japanese population and Asian studies when compared to other races (9,27). Additionally, evaluations performed on records of orthodontic patients have brought to light that agenesis of maxillary lateral incisors are more frequent (15,16,28,29). This is attributed to the higher rate of referral due to aesthetic concerns caused by the lack of anterior teeth and does not reflect the general population (16). Due to the same aesthetic reasons, studies on orthodontic patients seem to have a higher rate of hypodontia in females, whereas in the general population, the difference among genders is not statistically different (15,16,28-31).

Prevalence of Mandibular Second Premolar and Maxillary Lateral Incisor

The prevalence of agenesis of mandibular second premolars, which is the most common, varies between 1.65-4% (28,32-35), and the absence of these teeth comprises 13-44.9% of all hypodontia (28,34,35). Similarly, congenital agenesis of the mandibular second premolar teeth was found to be the most common in the Turkish population (13,14,17,36-39). It was found that prevalence rates vary between 1.59-3.85% and it comprises 17.7-61.3% of all hypodontia (13,17,37,39). Congenital agenesis of maxillary lateral incisors, which is the second most frequent agenesis following mandibular second premolars, have a 0.8-2.5% prevalence ratio (24,33,40-48).

Etiology of Congenital Tooth Agenesis

Congenital tooth agenesis is linked to defects related to evolutionary, environmental or genetic factors (4,9,49). Tooth agenesis are in fact related to a long-term adaptation and evolutionary process and due to this, it presents with a variety of numeric absences (50).

Congenital tooth agenesis is also related with environmental factors; early radiation exposure of the tooth bud, hormonal and metabolic defects, infections such as rubella, maxilla-facial traumas, osteomyelitis, drugs like dioxin or thalidomide may have an effect (9,51-53).

Etiologic factors of tooth agenesis are also evaluated in terms of syndromic and non-syndromic situations and their genetic bases. Shimizu and Maeda (3) have categorized hypodontia as non-syndromic, syndromic and familial according in its etiology and have stated that congenital tooth agenesis is mostly related to non-syndromic conditions. Additionally, researchers have evaluated the syndromic and non-syndromic cases, which are responsible for tooth agenesis, together with the genes.

Congenital tooth agenesis related with non-syndromic situations are likely to arise due to mutations on the genes responsible for tooth formation Shimizu and Maeda (3). (Muscle Segment Homeobox-1) is one of these genes, which is known for its important role during the tooth formation period (54), and [(Paired Box-9 (PAX-9)] is the gene involved during initialization, bud, cap and bell phases of the tooth formation period and a mutation in this gene results in agenesis especially of permanent molars and second premolars (55). (Axin Inhibition Protein-2) is another gene in which its polymorphic variants are related with hypodontia and oligodontia (56). Moreover, the *PAX* gene family is assumed to be responsible for cellular signalization of cancer cell formation and increasing expression in tumor formation level (57).

Diagnosis of Congenital Tooth Agenesis

Early diagnosis is crucial in establishing optimal treatment options for congenital tooth agenesis, ensuring treatment with the highest success that can be achieved, applying the most minimally invasive treatment options for the patient and eliminating the increased treatment costs of late diagnosis (4-8). The most critical point in this regard is the missed diagnosis and both the pediatric dentist and the pediatrician should perform a detailed clinical and radiological examination of the child patient to prevent this. In the mixed dentition period when both primary and permanent teeth simultaneously can be seen in the dental arch, the absence of clinical signs such as decay, pain, swelling, edema and abscesses in the area of the congenitally absent permanent teeth may lead to congenital agenesis being missed if the patient does not consult a clinic due to the absence complaint (8). Additionally, even in regular dental check-up visits, if the persistent primary teeth in the area do not show any clinical symptoms and no complaint is inferred, the pediatric dentist may skip radiographic screening, thus congenital tooth agenesis may not be detected (8). However, if these patients have a syndrome and are under regular pediatric control,

the pediatrician may facilitate the early diagnosis of tooth agenesis, which is linked with the syndrome, to be made by directing the patient to the pediatric dentist. At this point, after a detailed medical history, followed by clinical and radiological examinations, a pediatric dentist can diagnose congenital tooth agenesis and can take advantage of this early diagnosis.

If the patients do not have a syndromic condition, due to the presence of a clinical complaint in persistent primary teeth in the related area, the pediatric dentist will provide an accurate diagnosis via clinical and radiological examination (8). In this case, the pediatric dentist should direct the patient to a pediatrician for the diagnosis of a possible relation of the agenesis to a syndromic or non-syndromic condition. Thus, both the pediatrician and the pediatric dentist should assist each other in the early diagnosis of both syndromic and non-syndromic conditions, and congenital tooth agenesis associated with these conditions, in a continuous collaboration. If the shedding time of primary teeth has come, the existence of a primary tooth in the dental arch, during transition to permanent dentition and the permanent dentition period, is a clinical sign for congenital agenesis of the permanent tooth in that region (8,58). In a primary tooth retention case like this, a pediatric dentist can diagnose the congenital tooth agenesis by clinical and radiographic examination. This, however, is accompanied by the disadvantage of limited treatment options due to late diagnosis of congenital tooth agenesis (58). One of the most important precautions that can be taken in this case is to make a pedodontic and pediatric evaluation of the younger children in the family of the patient based on the fact that congenital tooth agenesis may be a familial transition, thus, an early diagnosis may be advantageous in these other individuals. Considering the regions where congenital tooth agenesis is most frequently observed, patients applying to dental clinics due to aesthetic concerns are more likely to be diagnosed with permanent lateral tooth agenesis in a persistent maxillary primary lateral incisor case when compared to persistent mandibular primary second molar (8). Thus, both pediatric dentists and pediatricians should carry out a more attentive examination as diagnosis of permanent mandibular second premolar may be overlooked. Considering the regions where congenital tooth agenesis are mostly seen, due to root resorption over time, the root of the persistent primary tooth in both mandibular second premolar and maxillary lateral incisor region becomes fused with the bone as the structure of the periodontal ligament is lost, thus, resulting in ankylosis (4,8,59). In the case of ankylosis detected in a radiographic examination when a certain rate is exceeded, these teeth may stay below the occlusion plane and develop an "infraocclusion" as they cannot physiologically act on the jawbone (4,8,59,60). At the end of mixed dentition and more in the permanent dentition period, these findings in persistent primary teeth, detected both clinically and radiographically, should raise concerns about congenital tooth agenesis (8). The pediatric dentist should confirm the diagnosis of tooth agenesis based on clinical and radiological evidence with careful synthesis of all signs related to congenital tooth agenesis, making absolutely necessary analysis in the presence of such a condition. Subsequently, the pediatrician should be contacted to identify the patient's syndromic or non-syndromic conditions or familial transmission characteristics, similar to previous cases.

Treatment Options in Congenital Tooth Agenesis

In cases of congenital tooth agenesis, early diagnosis of the situation regardless of tooth type, allows the treatment process to be carried out most comfortably by increasing the number of treatment options and quality of treatment outcomes, by ensuring that the treatment process is as non-invasive as possible for the patient, and avoiding costly treatments in cases of late diagnosis allows for optional treatments and increases the success of the treatment, ensures the treatment period is as non-invasive as possible for the patient, avoids high-cost treatments in cases of late diagnosis and thus, allows the most comfortable treatment course for the patient. For this reason, findings that indicate congenital tooth agenesis in patients should be carefully evaluated for early diagnosis and interdisciplinary communication should be conducted if necessary (4-8).

Treatment options for congenital agenesis of the permanent maxillary lateral incisor teeth are generally in the form of conservation of the space resulting from congenital agenesis of the lateral tooth or orthodontic closure of this space (61). The preservation and restoration of the space in the region where the permanent maxillary lateral incisor tooth is missing allows for the maintenance of the natural position of the canine in the dental arch, the ideal class 1 molar occlusion and the continuity of the canine protected occlusion (62). This preserved space is later on restored with fixed/removable prosthodontics or implants when the growth of the patient is complete (61,62). Another approach to congenital agenesis of the permanent maxillary lateral incisor is the orthodontic closure of the mentioned tooth space. This approach is more preferable in cases with class 2 malocclusion, class 1 malocclusion with severe crowding in the maxillary dental arch in which extraction is indicated and in cases of proclined upper incisors (61,62). In this principle, the structure of the alveolar bone is preserved. Later on, the morphology of the canine brought to the lateral incisor region is transformed into the lateral incisor tooth form by applying composite build-up or porcelain veneers (61,62).

Diagnosis of mandibular second premolar agenesis, the most common congenital agenesis in the population, in the early stages of the mixed dentition period also provides optional treatments (7). Fines et al. (5) have stated that there are more treatment options for younger patients, however, these options reduce after 9 years of age. In the early stages, patients with congenital mandibular second premolar agenesis have less-invasive treatment options. The first of them is closure of the space by mesial drifting of the permanent first molar via controlled grinding from the mesial and distal sides of the primary second molars or hemisection followed by extraction (4,63,64). In a right orthodontic profile such as hyperdivergent face type, lack of space in the anterior region/contrary arch and a protrusive face profile, extraction can be done without making the existing profile worse (7,65), thus, in the early stages, achieving the best results from the treatment becomes possible. In the hemisection technique, the permanent first molar is directed towards the space obtained after the extraction of first the distal half and then the mesial half of the primary second molar, by total mesial drift. The parallel movement of the permanent first molar is possible only if the root apices are open, thus the ideal time for hemisection is when the patient is 8-9 years old (8,64). By the time the permanent first molar moves into the space left from the extraction of distal half of the primary molar, approximately within 3-4 months, the mesial half is also extracted, and later on this space is fully closed by the permanent first molar, finally making contact with the adjacent first premolar tooth (8). Additionally, hemisection can be applied combined with the controlled stripping of the distal and mesial surface of the tooth to 1 mm. With regards to root resorption, ankylosis and infraocclusion which may occur in persistent primary teeth, in order to both eliminate these pathologies and to obtain a more natural occlusion, applying hemisection may provide a less invasive treatment period for the patient (8). Hence, in cases of progressive root resorption and ankylosis, the possibility of losing the tooth in advance, and in cases of infraocclusion, the necessity of restoration of the occlusion using composites, compomer, overlay, stainless steel crown and ceramic crown will adversely affect the survival of these teeth (8). Additionally, implants and prosthetic applications after the extraction of primary teeth due to these mentioned pathologies will bring about some disadvantages seen in all artificially applied treatments such as application difficulties, possible complications and high-cost, thus, treatment options in the early stages are more advantageous in terms of obtaining long-lasting success when compared to treatments applied at a later stage. This points out the importance of treatment being applied with an early diagnosis on the success of the treatment (8).

In some cases, even at an early stage, the primary tooth needs to be extracted due to poor prognosis. The extracted tooth's space may either be closed with orthodontic treatment or kept for a future prosthetic, dental implant or autotransplantation application (4,5,7,59,66-70). However, if the space is chosen to be kept orthodontically, due to the fact that implants and prosthetic applications are not initiated until the child patient has reached the end of their growth period, this space should be preserved by space-maintainers for future applications (8). However, this space-maintainer application does not provide for the preservation of the 3D structure of the alveolar bone and causes resorption in all surfaces. This situation brings about both high-cost bone-augmentation procedures in future implant and prosthetic applications and complication risks (8). Therefore, late diagnosis of patients results in a more exhausting and complicated treatment period meaning that the prognosis becomes uncertain. In cases where the primary second molars have a good crown-root structure, are functional and have acceptable esthetic properties, they may be kept in use for a long period (6,71,72), in fact, these teeth can be preserved until 20-30 years of age (59,73).

However, because the mesio-distal width of the primary second molars are greater when compared to second premolars, in order not to adversely affect the occlusion and harmony of the posterior teeth, they should be reduced to the size of premolars. Additionally, in the future, this will make the premolar-formed implant applications possible (65,74). In spite of this, in the preserved primary second molars, because of the risk of progressive root resorption, ankylosis and infraocclusion development, in many cases where these pathologies are progressive and aggressive, these teeth may need to be extracted, which shows that pediatric dentist-pediatrician cooperation in early diagnosis and treatment offers more optimal results and lower-cost treatments.

Conclusion

Dentists or pediatric dentists are the first to diagnose congenital tooth agenesis. Determining tooth agenesis in dentition early increases the potential for functional, aesthetic and stable outcomes. However, considering that hypodontia is often associated with a familial, syndromic or non-syndromic condition, the medical conditions related with the situation can also be diagnosed during the routine examinations of pediatricians. At this point, in cases where congenital tooth agenesis is considered, pediatricians should work in cooperation with dentists or pediatric dentists. Moreover, in addition to hundreds of syndromic conditions related with hypodontia, non-syndromic cases should also be investigated in terms of familial history and dental anamnesis should be obtained, and if needed, contact with a pediatric dentist might be helpful in early diagnosis.

Ethics

Peer-review: Externally peer-reviewed.

Authorship Contributions

Design: Ş.S., Data Collection or Processing: A.D., Ş.S., Analysis or Interpretation: A.D., Ş.S., Literature Search: A.D., Writing: A.D., Ş.S.

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