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Prevalence of Premature Eruption and Agenesis of Premolars in Children in Erzurum: A Retrospective Study

Erzurum'daki Çocuklarda Premolar Dişlerin Prematür Sürme ve Agenezi Prevelansı: Retrospektif Çalışma

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ABSTRACT Objective: The management of the functional and aesthetic challenges associated with premature tooth eruption and dental agenesis depends on early and accurate diagnosis. The aim of this study is to determine the prevalence and distribution of agenesis and premature eruption in the premolar teeth of children in Eastern Türkiye. **Material and Methods:** The congenital agenesis and premature eruption of premolar teeth were retrospectively evaluated in the panoramic radiographs' of 1,867 children (965 girls, 902 boys) aged 5 to 11 years. Prematurely erupted premolars (PEP) with less than half of the expected root length, according to the Demirjian method, were included in our study. The data were statistically analyzed using the chi-square test ($p<0.05$). **Results:** In 34 (13 boys, 21 girls) out of 1,867 patients, at least 1 premolar agenesis was observed without a significant gender difference. The mandibular 2nd premolars were identified as the most commonly missing teeth. Multiple (0.9%) and single (1%) tooth agenesis were found to be similar. A total of 542 patients (29%; 262 boys, 280 girls; no significant gender difference) had at least 1 PEP, with the maxillary and mandibular 1st premolars being the most frequently affected. According to Demirjian's Tooth Development Scale, PEPs were predominantly observed in stage F. **Conclusion:** The prevalence of agenesis and premature eruption in the premolar teeth of children in Eastern Türkiye was 1.8% and 29%, respectively, indicating that these conditions are not rare. Timely diagnosis is crucial for effective treatment planning and improving patient outcomes.

Keywords: Bicuspid; panoramic radiography; tooth agenesis; tooth eruption

ÖZET Amaç: Prematüre diş sürmesi ve dental agenezinin yol açtığı fonksiyonel ve estetik problemlerin yönetimi, erken ve doğru tanıya bağlıdır. Bu çalışmanın amacı, Türkiye'nin doğusundaki çocukların premolar dişlerinde agenezis ve prematüre sürmenin prevalansını ve dağılımını belirlemektir. **Gereç ve Yöntemler:** Retrospektif olarak 5-11 yaş arası 1.867 çocuğun (965 kız, 902 erkek) panoramik radyografilerinden premolar dişlerin konjenital agenezisi ve prematüre sürmesi değerlendirildi. Demirjian yöntemine göre kök uzunluğunun beklenenin yarısından daha az olduğu prematüre sürmüş premolarlar [prematurely erupted premolars (PEP)] çalışmaya dâhil edildi. Veriler, ki-kare testi kullanılarak analiz edildi ($p<0,05$). **Bulgular:** 1.867 hastanın 34'ünde (13 erkek, 21 kız) en az 1 premolar diş agenezisi gözlenmiş olup, cinsiyetler arasında anlamlı bir fark bulunmamıştır. En sık eksik olan dişler alt çene 2. premolarlar olarak belirlenmiştir. Çoklu (%0,9) ve tekli (%1) diş eksikliklerinin oranları benzer bulunmuştur. En az 1 PEP dişe sahip toplam 542 hasta (%29; 262 erkek, 280 kız; cinsiyet farkı anlamlı değildir) tespit edilmiştir. Prematüre sürme durumunun en sık görüldüğü dişler üst ve alt çene 1. premolarlar olmuştur. Demirjian'ın Diş Gelişim Ölçeğine göre, PEP çoğunlukla F evresinde gözlemlenmiştir. **Sonuç:** Türkiye'nin doğusundaki çocuklarda premolar diş agenezisi ve prematüre sürme prevalansı sırasıyla %1,8 ve %29 olarak bulunmuş, bu durumların nadir olmadığını göstermektedir. Erken teşhis ve doğru tedavi planlaması dişlerin prognozu için büyük önem taşımaktadır.

Anahtar Kelimeler: Biküspit; panoramik radyografi; diş eksikliği; diş erüpsiyonu

Dental anomalies are characterized by disruptions in the number, shape, size, color, and structure of teeth, resulting from the impact of genetic and environmental factors at various stages of dental development. Among these dental anomalies, 2 conditions stand out due to their clinical significance and devel-

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opmental impact: congenital tooth agenesis and premature eruption. Congenital tooth agenesis is recognized as the most prevalent, often influencing occlusion, arch integrity, and overall oral function.[1] Congenital tooth agenesis is often associated with other dental anomalies, such as ectopic eruption and variations in tooth size and shape.[2] Additionally, deviations in the timing of tooth eruption, such as premature eruption, can further complicate dental development, potentially leading to malocclusion and other clinical challenges.[3] Given the clinical implications of both congenital tooth agenesis and premature eruption, it is essential to investigate their prevalence and patterns to enhance early diagnosis and intervention strategies.

Congenital tooth agenesis is the most common developmental dental anomaly, with its prevalence varying significantly across geographical regions, ethnicities, and population characteristics. Reported prevalence rates range from 1.9% to 33.3%, largely due to methodological differences among studies.[4,5] For example, Endo et al. assessed hypodontia solely through orthodontic records, Berniczei-Royko et al. used cleft defect records, while Peker et al. combined clinical and radiographic findings in non-syndromic patients, potentially increasing diagnostic sensitivity.[6-8] Variations in prevalence data across studies and regions can be attributed to differences in age ranges, sample sizes, diagnostic criteria (e.g., inclusion or exclusion of 3rd molars), sampling methods, inclusion criteria, ethnic backgrounds, and genetic diversity. Some studies rely exclusively on radiographic examinations, while others incorporate clinical evaluations, further contributing to discrepancies.[4,9] Despite numerous studies exploring the distribution and prevalence of congenital tooth agenesis-and its implications for periodontal health, aesthetics, function, and psychological well-being-data specific to Turkish children remain limited.[10,11]

Tooth eruption is a complex physiological process influenced by various genetic, environmental, and systemic factors.[12] Although various theories have been proposed to explain the mechanisms of tooth eruption, the detailed processes remain unknown.[13] Premature eruption of permanent teeth may be associated with congenital anomalies, ethnicity, gender, and local factors such as periapical infection or early extraction of primary teeth due to caries, which can lead to abscess formation and accelerate eruption.[1,14]

Studies in the literature examine both congenital tooth agenesis and premature eruption.[15,16] However, research addressing the early eruption of premolars with incomplete root development remains limited.[17,18] Understanding the prevalence and distribution of these anomalies is particularly important in Erzurum (Eastern Türkiye), a region characterized by unique genetic and environmental factors such as higher rates of consanguinity, rural lifestyle patterns, and dietary differences. These regional characteristics may influence dental development, highlighting the need for localized epidemiological studies. Despite the increasing global attention on dental anomalies, data specific to Turkish children, particularly in this region, are scarce. To our knowledge, this study is the 1st to evaluate both the prevalence and the developmental stages of Prematurely erupted premolars (PEPs) in a large pediatric population from Eastern Türkiye. The correlation of eruption timing with root development stages provides a novel clinical insight that may guide pediatric dentists in risk assessment and treatment planning. The hypothesis of this study is to determine the prevalence of premature eruption and premolar agenesis in children in Erzurum and whether there is a relationship between early eruption of premolar teeth and their root development stages. By addressing this underexplored aspect, our research contributes valuable insights that may enhance early diagnosis and management strategies in pediatric dentistry.

MATERIAL AND METHODS

This retrospective study was conducted at the Department of Pediatric Dentistry, Faculty of Dentistry, Ataturk University, and was approved by the Ethics Committee of the Faculty of Dentistry, Ataturk University (date: February 22, 2024, no: #11). The study was conducted in accordance with the Declaration of Helsinki.

In this study, 1,867 digital panoramic radiographs (OPG) taken at Ataturk University, Faculty of

Dentistry in Erzurum between 2022 and 2023 were evaluated. All panoramic radiographs were taken during the clinical examination of children aged 5 to 11 years using the same device (ProMax® Planmeca Oy Asentajenkatu 600880 Helsinki, Finland) and parameters (65 kVp, 5 mA, and 16.2 seconds). Patients; chronological ages were determined by subtracting the official birth dates from the OPG dates using Excel (Microsoft, USA) software. Additionally, the gender of the patients was recorded.

Patients with systemic diseases, syndromic conditions, or a history of jaw trauma were excluded from the study. Premolar tooth agenesis and PEP were assessed using digital panoramic radiographs. PEPs were defined as those that had clinically emerged through the gingiva and exhibited less than 50% of the expected root length on radiographs, as determined by Demirjian's developmental stages.[19] Only cases showing radiographic evidence of both premolar tooth agenesis and premature eruption were included. The developmental stages of the premolars were documented according to Demirjian's Tooth Development Scales as follows:[20]

Stage D: Crown formation is completed up to the cementoenamel junction.

Stage E: Root length is less than the crown height.

Stage F: Root length is greater than or equal to the crown height.

In cases involving more than one agenesis or PEP, the finding was recorded as multiple.

In order to assess the inter-observer variability related to the premature eruption of premolar teeth and their agenesis, radiographic evaluations were performed again on a sample of 50 patients following a period of 3 weeks.

STATISTICAL ANALYSIS

Statistical assessments were carried out at a 5% significance threshold with IBM SPSS version 25. The chi-square test was utilized to assess the significance of variances among categorical variables. The assessment of inter-observer reliability was conducted employing the intraclass correlation coefficient (ICC) alongside the kappa coefficient.

RESULTS

The study evaluated a sample of 902 boys and 965 girls, with mean ages of 8.8±0.8 years and 8.9±0.9 years, respectively. 34 children (1.80%) were identified as having at least 1 case of premolar agenesis (Table 1). The mandibular 2nd premolars were identified as the most frequently agenesis teeth, with a prevalence rate of 1.98%. Both single (18 cases, 0.9%) and multiple (16 cases, 1%) occurrences of premolar agenesis were recorded at comparable rates (Table 1). The incidence of premolar agenesis was 2.2% (n=21) among girls and 1.4% (n=13) among boys, showing no significant difference across genders (Table 2, p=0.235).

TABLE 1: Prevalence and characteristics of premolar agenesis

Total (1,867 patient)	n	%
Single	18	1
Multiple	16	0.9
Total	34	1.80
Tooth		
14-24	6	0.32
15-25	17	0.91
34-44	2	0.11
35-45	37	1.98

TABLE 2: Prevalence of premolar agenesis according to sex

	Male		Female		Total		
	n	%	n	%	n	%	p value
Absent	889	98.6	944	97.8	1,833	98.2	0.235
Present	13	1.4	21	2.2	34	1.8	
	902	100	965	100	1,867	100	

TABLE 3: Prevalence and characteristics of PEPs

Total (1,867 patient)	n	%
Single	149	8
Multiple	393	21
Total	542	29
Tooth		
14-24	483	25.91
15-25	273	14.69
34-44	503	26.95
35-45	352	19.04

PEP: Prematurely erupted premolar

TABLE 4: Prevalence of premature eruption of premolars according to sex

	Male		Female		Total		
	n	%	n	%	n	%	p value
Absent	262	29	280	29	542	29	0.988
Present	640	71	685	71	1325	71	
	902	100	965	100	1867	100	

The ICC indicated an excellent reliability for PEP and premolar tooth agenesis on radiographic evaluations (kappa coefficients were 0.93 and 0.96, respectively). Table 3 presents a comprehensive overview of the prevalence and distribution of PEP. At least one PEP was observed in 542 patients, accounting for 29% of the total sample. The mandibular (25.91%) and maxillary 1st premolars (26.95%) were the most frequently observed prematurely erupted teeth. The prevalence of PEP was consistent across genders, with a 71% occurrence in both boys and girls (Table 4, p=0.988).

The distribution of premolar agenesis and dental maturity stages is presented in Table 5. Further analysis of the developmental stages of PEPs revealed that most of these teeth were at Stage F (Figure 1), accounting for 15.3% (1,141 teeth) of the cases. Stage D (Figure 2) was observed in 85 teeth (1.1%), and Stage E (Figure 2) was seen in 385 teeth (5.1%). Notably, in 21 cases, premature eruption was accompanied by premolar agenesis.

DISCUSSION

Dental anomalies are frequently observed during routine dental examinations, and their prevalence and severity vary across different populations. Delayed detection of these anomalies can complicate dental treatments, potentially necessitating more costly and multidisciplinary approaches.[21] This study focused on the premature eruption and agenesis of premolar teeth, which are among the most common dental anomalies, and investigated the prevalence of these conditions in the pediatric population of eastern Türkiye. In our study, the prevalence of premolar tooth agenesis was found to be 1.8%, while PEP was detected in 29% of cases. Our results indicate that premolar agenesis and PEP are relatively common. To the best of our knowledge, this investigation marks the first comprehensive examination of the occurrence of PEP and premolar agenesis in a group of patients aged 5-11 years from this city.

Dental anomalies are congenital, developmental, or acquired alterations in teeth that arise due to genetic, epigenetic, and environmental factors during tooth development. These anomalies encompass a wide range of variations affecting the number, position, size, shape, and structure of teeth.[21] In a study conducted by Bayraktar Nahir et al. on children aged 6-15 years in Tokat, number anomalies were reported as the most common dental anomaly.[22] Similarly, Bodrumlu et al. identified congenital missing teeth as the most frequently observed anomaly in their study in Zonguldak, with the mandibular second premolar being the most commonly agenesis tooth.[23] Another study evaluating dental anomalies in children aged 6-15 years in the Trakya region also reported hypodontia as the most prevalent anomaly, with the mandibular 2nd premolar being the most frequently missing tooth.[24] Bezgin et al. determined the prevalence of mandibular 2nd premolar agenesis as 0.99%

TABLE 5: Distribution of premolar agenesis and PEPs according to dental maturity stage [n (%)]

	#15	#14	#25	#24	#35	#34	#45	#44	Total
Agenesis	10 (0.5)	4 (0.2)	7 (0.4)	2 (0.1)	20 (1.1)	1 (0.1)	17 (0.9)	1 (0.1)	62 (0.8)
Stage D	13 (0.7)	27 (1.4)	8 (0.4)	25 (1.3)	2 (0.1)	5 (0.3)	0 (0)	5 (0.3)	85 (1.1)
Stage E	36 (1.9)	68 (3.6)	37 (2)	76 (4.1)	30 (1.6)	43 (2.3)	33 (1.8)	62 (3.3)	385 (5.2)
Stage F	89 (4.8)	150 (8)	90 (4.8)	137 (7.3)	155 (8.3)	206 (11)	132 (7.1)	182 (9.7)	1,141 (15.3)
Total	138 (7.4)	245 (13.1)	135 (7.2)	238 (12.7)	187 (10)	254 (13.6)	165 (8.8)	249 (13.3)	1,611 (21.6)

PEP: Prematurely erupted premolar

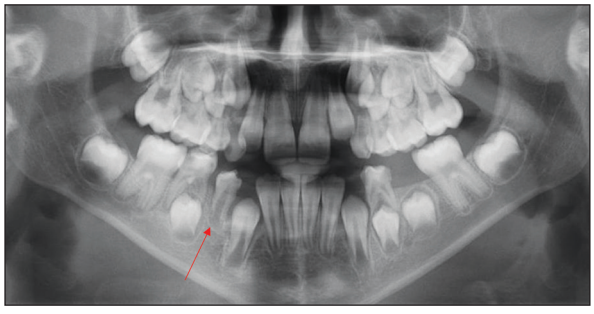

FIGURE 1: Panoramic radiograph showing a prematurely erupted mandibular right 1st premolar (stage F) in a 8-year-old boy.

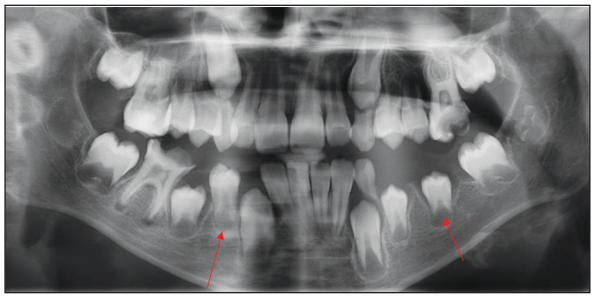

FIGURE 2: Radiographic view of a 7-year-old girl with prematurely erupted mandibular right and left 2nd premolars (stage D) and mandibular left 1st premolar (stage E).

in children aged 7-15 years in Ankara.[25] Consistent with these findings, this study determined the prevalence of congenital tooth agenesis in Erzurum as 1.8%, with the 2nd premolar (26.95%) being the most commonly missing tooth, aligning with previous literature.

Tooth agenesis, characterized by the developmental absence of 1 or more teeth, is among the most prevalent dental anomalies.[26] Research has consistently identified the mandibular 2nd premolar and maxillary lateral incisor as the teeth most frequently absent.[27,28] Our findings align with the literature, as the mandibular 2nd premolar was observed as the tooth most frequently missing. Kim et al. stated that patients with agenesis of mandibular 2nd premolars were more likely to have tooth agenesis or delayed eruption of other teeth.[29] The prevalence of tooth agenesis can be influenced by various factors, including infection, chemotherapy, radiotherapy, genetic predisposition, gender, environmental factors, geographical region, and population. In the literature, the prevalence ranges from 0.1% to 11.3%.[26] In studies conducted in Türkiye, agenesis prevalence varies between 2.63% and 7.95%.[30,31] Specifically, a study focused on premolar agenesis reported a prevalence of 3.3%.[10] In contrast, our study found a lower prevalence of premolar agenesis at 1.8%. This variation could be explained by differences in the inclusion or exclusion of 3rd molars, the populations studied, sampling techniques, diagnostic standards, age ranges, and sample sizes.

The effect of gender on congenital tooth agenesis remains unclear. Some studies suggest that it is more frequently observed in females due to smaller jaw structures, while others report no significant difference based on gender.[32,33] A comprehensive analysis of tooth agenesis across 6 Turkish regions revealed a higher prevalence among females compared to males in 5 of those regions.[34] In this study, while tooth agenesis was more prevalent in females (2.2%) than in males (1.4%), the difference between the genders was not statistically significant ($p>0.05$). This finding is in agreement with several prior studies reported in the literature.[35,36]

The eruption of teeth is affected by multiple factors, such as gender, ethnicity, dietary habits, exposure to fluoride, caries prevalence, early loss of primary teeth, socioeconomic conditions, and congenital anomalies.[1] Premature eruption, where a tooth emerges before its expected time, can lead to a range of complications and treatment challenges. These include malocclusions, gingival issues, functional and aesthetic problems, and an increased risk of dental caries due to incomplete tooth maturation, which may result in pain and sensitivity.[37] In our study, the prevalence of premature eruption was found to be 29%, underscoring the seriousness of this condition. Additionally, a study conducted in this region on caries prevalence, which is a contributing factor, reported that early childhood caries were present at a rate of 73.3%.[38] The high prevalence of caries can lead to early tooth loss, further contributing to premature eruption. Additionally, it is thought that genetic, environmental, and clinical factors may also play a role in this high prevalence of premature eruption. Preventing early tooth loss is crucial, and regular dental check-ups, a healthy diet, consistent brushing habits, and parental education play a vital role in this. The complex treatments required for pre-

mature eruption due to early tooth loss can impose a significant financial burden on both individuals and society.

The premature extraction of primary teeth can influence the eruption timing of permanent teeth. Extraction at the age of 4 or 5 may result in a delayed eruption, whereas extraction between the ages of 5 and 8 can accelerate the process, potentially causing premature eruption of the permanent tooth.[39] Additionally, the presence of an infected primary tooth can lead to the early eruption of the premolar tooth after the primary tooth is extracted, due to bone loss in the bifurcation area. The root development of the PEP is also negatively affected due to its exposure to early occlusal forces.[14] Primary 1st molars are frequently extracted due to extensive caries and periapical infections.[40] This potentially explains the higher prevalence of premature eruption observed in the upper and lower 1st premolars in our study.

The Demirjian method, a widely recognized approach for determining dental age based on root development stages, was utilized in our study to assess prematurely erupted teeth.[41] Consistent with prior research employing the Demirjian method to evaluate prematurely erupted teeth by analyzing root development stages, we adopted the same methodology.[10] Our findings reveal that PEPs predominantly correspond to stages D, E, and especially F of Demirjian's classification.[20] These stages indicate that PEPs emerge at a significantly early phase of root development. This study, in agreement with prior research, confirms that teeth with incomplete root growth can emerge into full occlusion, demonstrating that full root development is not mandatory for tooth eruption.[17,18] Such observations align with the established finding that the root lengths of permanent teeth, which erupt following the premature extraction of primary molars, tend to be shorter than typical root lengths.[40] It is therefore suggested that the early eruption of PEPs may be related to the premature extraction of primary teeth.

This study has certain limitations. Firstly, as this retrospective study was conducted in eastern Türkiye, this may limit the generalizability of the findings to broader populations or different geographic regions. Furthermore, the lack of detailed examination of other factors associated with PEP, such as nutrition, environmental factors, and genetic predisposition, may limit the interpretation of the findings.

CONCLUSION

Premature eruption and premolar agenesis were observed in 29% and 1.8% of children from Eastern Türkiye, respectively, highlighting their common occurrence in this region. The mandibular 2nd premolar was the most commonly missing tooth, while the mandibular and maxillary 1st premolars were the most frequently affected by premature eruption. The prevalence of premature eruption and premolar agenesis was not significantly affected by gender. Future studies should explore the etiology of these anomalies in greater depth and investigate potential prevention strategies. Furthermore, longitudinal studies are recommended to understand the effects of premature eruption on long-term dental health.

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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: *Periş Çelikel, Hazar Baha Karadeniz, Merve Pala;* ***Design:*** *Fatih Şengül, Hazar Baha Karadeniz;* ***Control/Supervision:*** *Periş Çelikel, Sera Derelioğlu Şimşek;* ***Data Collection and/or Processing:*** *Merve Pala, Sera Derelioğlu Şimşek;* ***Analysis and/or Interpretation:*** *Fatih Şengül, Hazar Baha Karadeniz, Fatma Saraç;* ***Literature Review:*** *Merve Pala, Fatma Saraç;* ***Writing the Article:*** *Periş Çelikel, Fatih Şengül, Fatma Saraç;* ***Critical Review:*** *Periş Çelikel, Fatih Şengül;* ***References and Fundings:*** *Sera Derelioğlu Şimşek;* ***Materials:*** *Sera Derelioğlu Şimşek.*

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