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

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***Objective**: To determine the prevalence and distribution of premature eruption and agenesis of premolars in a sample of Turkish children. **Study design**: A sample of 1715 patients aged 5 to 11 years was selected. Panoramic radiographs were used to assess premature eruption and agenesis of premolars. Developmental stage of erupted premolars was assessed using Demirjian's method and selecting prematurely erupted premolars on the basis of clinical eruption with a root length less than half of their final expected root lengths. Statistical analysis was performed using chi-square test ($p < .05$). **Results**: One hundred fifteen (6.7%) of 1715 patients presented at least one premolar agenesis with no significant sex difference (56 boys, 59 girls). Mandibular second premolars were the most absent teeth. Multiple agenesis of premolars (3.4%) was more common than single agenesis (3.3%). A total of 85 (5.0%) patients (51 boys, 34 girls; no significant sex difference) had at least one prematurely erupted premolar, and maxillary first premolars were most commonly affected. Early erupted premolars were in stage D or E based on Demirjian's dental formation scale. **Conclusions**: The prevalence of premature eruption and agenesis of premolars in Turkish children were 5.0% and 6.7%, respectively. Both conditions are not uncommon and may highlight the need for early diagnosis to prevent subsequent clinical problems.*

***Keywords**: Dental Anomalies; Tooth Eruption; Panoramic Radiography; Tooth Agenesis; Premolars.*

INTRODUCTION

Anomalies of teeth are caused by genetic factors and their interactions with environmental influences involved in different stages of tooth development. Their effects may manifest as various deviations in tooth size, morphology, structure, and number; and such anomalies may occur together as an isolated entity or as part of a syndrome[1].

Among dental anomalies, tooth agenesis is the most common developmental dental anomaly. It is estimated that prevalence of congenitally missing teeth in permanent dentition (except for the third molar) varies from 2.6% to 11.3%, depending on the population studied. The most common missing teeth are mandibular second premolars and maxillary lateral incisors[2]. Agenesis of permanent teeth may occur simultaneously with several clinical situations, such as abnormalities in tooth size or shape, delayed development, or ectopic eruption of permanent teeth[3].

Tooth eruption is often defined as a physiologic process that consists of movements of a tooth during odontogenesis in its crypt through the alveolar process till its functional position in the oral cavity[4]. Although numerous theories have been postulated to explain the eruption of teeth, the underlying mechanism(s) still remains unclear. Because the eruptive movement begins with the initiation of root formation, root growth and elongation have been considered in the eruptive mechanism[5]. However, teeth can also

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erupt after completion of root formation or when their root is removed surgically[6].

Eruption of teeth with little or no root development may rarely occur as a result of radiotherapy[7] and congenital kidney disease[8]. Tooth eruption with partial or complete arrest of root formation due to traumatic injury to overlying primary tooth has also been reported[9,10]. Even a rootless mandibular second premolar has been reported to erupt under a primary molar with no signs of decay or infection[11].

Premature loss of deciduous teeth due to periapical infection or decay may cause its permanent successor to erupt prematurely in the very early stage of root development[12]. Abscess formation of the overlying primary tooth causing bone destruction may also result in very early emergence of premolars.

To date, there have been only a few reports to describe early eruption of premolars with inadequate root formation[9,10]. The aim of this study was, therefore, to determine the prevalence and distribution of two distinct entities in the premolar region: premature eruption and agenesis in a sample of Turkish pediatric patients.

MATERIALS AND METHOD

This retrospective study assessed 1715 digital panoramic radiographs from 1794 patient records taken at the Dental School of Hacettepe University, in Ankara, Turkey, between 2018 and 2019. All radiographs were obtained for routine dental examination of children aged 5 to 11 years using the same device (Veraview IC5 device, Morita Corporation, Japan) and parameters (67 kV, 5.0 mA, 13.9 s). The panoramic images were viewed simultaneously by an experienced radiologist and an experienced pediatric dentist. In case of disagreement between their assessments of any image, a senior reviewer made the final decision. The study protocol involving the use of panoramic radiographs was approved by the Local Ethics Committee.

Patients with disorders such as syndromes or clefts and those with previous jaw fractures were excluded. Agenesis and premature eruption of premolars were assessed on digital panoramic images. Only erupted premolars in full occlusion were selected and included. Based on the description of Gron[13], a premolar was defined as prematurely erupted when the root length of the tooth at clinical eruption was less than half of its final expected root length. The developmental stage of premolars was recorded according to Demirjian's dental maturity stages[14], as defined below:

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.

Stage G: Root development is completed, but apical foramen is open.

Stage H: Root apex is completely closed.

In cases involving more than one agenesis or premature eruption of premolar (PEP), the finding was recorded as multiple.

Statistical analysis

Statistical analysis was performed by using SPSS for Windows 21.0 (IBM Corp. Released 2012. Armonk, NY). The number, percentage, mean, standard deviation, median, 1st and 3rd quartiles, minimum and maximum values were estimated for descriptive statistics. Chi-square were used to assess the significance of the differences between categorical variables.

The level of significance was set at p-value < 0.05.

RESULTS

The study sample consisted of 926 boys and 789 girls with a mean age of 8.8±1.68 years and 8.9±1.56 years, respectively. One hundred fifteen patients (6.7%) had at least one premolar agenesis. The distribution of missing premolars is presented in Table 1. Mandibular left and right second premolars were the most absent teeth. Multiple agenesis of premolars (n=59, 3.4%) was more common than single agenesis (n=56, 3.3%). The prevalence of premolar agenesis was 7.5% (n=59) in girls and 6.0% (n=56) in boys, and the difference between them was not significant (Table 2, p> 0.05).

The frequency and distributions of PEP is presented in Table 3. Eighty-five (5.0%) patients had at least one PEP. The most common PEPs were maxillary left and right first premolars, respectively (Table 3). The prevalence of PEP was higher in boys (51, 5.5%) than in girls (34, 4.3%), in the absence of statistical significance (Table 4, p> 0.05). With regard to their development; stage D (Fig.1) and stage E (Fig. 2) were observed in 51 and 47 of the premolars respectively. In nine cases, PEP was accompanied by premolar agenesis (Fig. 3 and 4).

Table 1. Prevalence and characteristics of premolar agenesis

Total (1715)	n	%
Single	56	3.3
Multiple	59	3.4
Total	115	6.7
Tooth number		
35	75	4.3
45	69	4.0
25	30	1.7
15	24	1.3

Table 2. Prevalence of premolar agenesis according to sex

	Male		Female		Total		
	n	%	n	%	n	%	p*
Absent	870	94.0	730	92.5	1492	93.3	0.246
Present	56	6.0	59	7.5	115	6.3	
Total	926	100.0	789	100.0	1715	100.0	

*Chi Square Test, p>0.05

Table 3. Prevalence and characteristics of prematurely erupted premolars

Total (1715)	n	%
Single	62	3.6
Multiple	23	1.3
Total	85	5.0
Tooth number		
24	29	1.7
14	28	1.6
44	24	1.4
15	13	0.8

Table 4. Prevalence of premature eruption of premolars according to sex

	Male		Female		Total		
	n	%	n	%	n	%	p*
Absent	875	94.5	755	95.7	1630	95.0	0.266
Present	51	5.5	34	4.3	85	5.0	
Total	926	100.0	789	100.0	1715	100.0	

*Chi Square Test, p>0.05

Figure 1. Panoramic radiograph showing a prematurely erupted maxillary right first premolar (stage D) in a 6-year-old boy. The tooth is in occlusion with almost initial root development.

Figure 2. Radiographic view of a 7-year-old girl with prematurely erupted maxillary right first premolar (stage E). The tooth is in occlusion with the root length less than that of the crown.

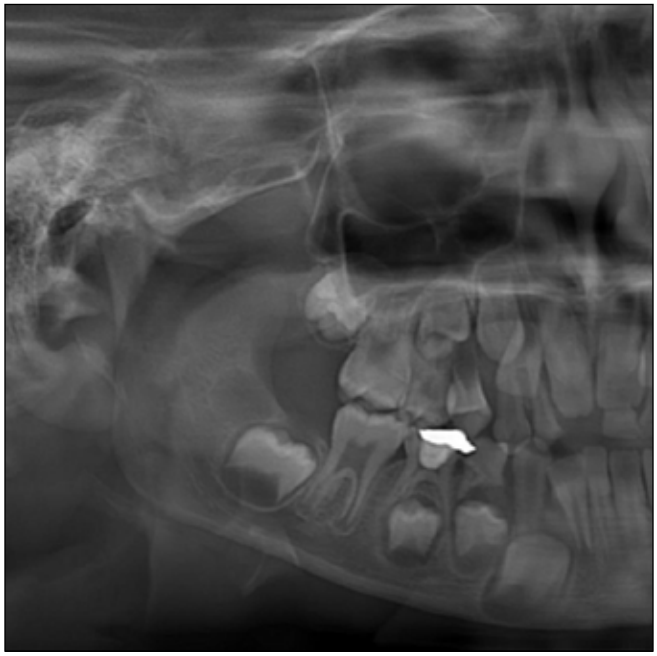

Figure 3. Radiographic view of a 10-year-old girl with prematurely erupted mandibular first premolar (stage E) and agenesis of mandibular second premolar.

Figure 4. Panoramic radiograph showing a prematurely erupted maxillary right second premolar (stage D) and congenital absence of the maxillary right first premolar in an 8-year-old boy.

DISCUSSION

The present study was designed to investigate the prevalence and characteristics of premature eruption and agenesis of premolars. This study supports evidence from previous observations that rootless teeth or teeth with little root formation can erupt into full occlusion, indicating that root formation is not required for tooth eruption[7,8,10,11]. Although root development does not seem to provide eruptive force or to be responsible for the active eruption of a tooth, it has correlations with eruption. According to Gron[13], the gingival emergence of a premolar usually occurs when one-half to three-fourth of its final root length is formed. Based on the diagnostic criteria suggested by Becker[15], if an erupted tooth has less root development than its expected root length at eruption, is defined as prematurely erupted. Gron's[11] method estimates the root length with reference to the adjacent roots and alveolar outlines of adjacent teeth, and the criteria of Demirjian's method[12] rely on the proportion of root length to crown height rather than its absolute tooth length. Thus, the well-known distortions of developing teeth in panoramic images were considered to have a minimal impact on measurement accuracy.

In the present study, the developmental stages of PEP were D and E according to Demirjian's classification[14]. This finding indicates that once the tooth prematurely erupts, it reaches the occlusal level in a very early stage of root development. This is also consistent with the findings of Brin and Koyoumdijsky-Kaye[16], who demonstrated that permanent successors of prematurely extracted primary molars have a reduced root length than their usual root length at the time of normal eruption.

The mean ages of patients with prematurely erupted maxillary and mandibular first premolars were 8.78 ± 1.11 years and 9.06 ± 1.20 years, respectively; and the mean ages of the patients with prematurely erupted second premolars were 9.66 ± 1.15 years. In a previous study[17], the mean eruption times were 10.25 ± 1.44 years and 10.22 ± 1.39 years for maxillary and mandibular first premolars; and 11.00 ± 1.10 years and 11.06 ± 1.08 years, for maxillary and mandibular second premolars, respectively. From a chronologic perspective, the present findings confirm the premature eruption times of premolars[15].

The premature extraction of primary teeth may impact the eruption time of their permanent successors by either delaying or accelerating their eruption. According to Posen[18], eruption is delayed if the extraction is done at ages four and five, while early eruption occurs if the primary tooth is lost at ages five to eight. Fanning[12] reported that eruption of a premolar is accelerated in the presence of an infected deciduous tooth and extraction of a deciduous molar before the premolar crown has formed. The premature loss of primary tooth resulting in accelerated vertical movement of the permanent tooth bud may cause bud to face occlusal stresses early, which negatively affects the root formation[16,19]. Maxillary deciduous molars, particularly the first molars, are one of the most frequently early extracted teeth due to extensive decay and periapical infection[20,21]. This may explain the higher prevalence of maxillary first premolars among the prematurely erupted teeth in our study. Further, the number of prematurely erupted premolars were higher in boys than in girls in the present study, probably because boys had more extracted deciduous molars compared to girls.

The prevalence and distribution of developmental dental anomalies have been widely studied among various populations, ethnic groups and races[22-24]. The premolar teeth, especially second premolars may present a wide variety of developmental anomalies, with tooth agenesis, supernumerary teeth, dens evaginatus, rotation, and root dilacerations being the most common[24,25]. The concurrent occurrence of these anomalies is not uncommon which may suggest a possible role of shared genetic mechanisms.

The reported prevalence rates for premolar agenesis vary from 0.1% to 11.3% in different populations [2,26]. In this study, the

overall prevalence of premolar agenesis (6.7%) was higher than those reported by Altug-Atac and Erdem[22] (0.46%), Uslu *et al* [25] (3.5%), and Kazanci *et al* [27] (1.58%). In line with previous reports[20-22], mandibular second premolars were the most frequent missing premolar teeth in our study. Here, a minor, insignificant difference was observed between males and females as well as between single and bilateral agenesis. Agenesis of premolars is often associated with other dental anomalies such as distoangulation, delayed development of mandibular second premolars, and infraocclusion of primary molars[3,28-30]. However, the present study did not aim to investigate such concurrent conditions.

The premature loss of primary molars may cause succedaneous premolars to erupt early with a reduced root development than their expected root length at normal eruption time. The fate of PEP is unstudied, but it can be speculated that undeveloped root status makes them unstable to occlusal forces. Another complication of early loss of primary molars is the loss in arch length and subsequent malocclusion, which coincides with the effects of tooth agenesis on the permanent dentition. Long-term follow-up observations are necessary to manage complications in a timely fashion.

CONCLUSIONS

The prevalence of premature eruption and agenesis of premolars in Turkish children were 5.0% and 6.7%, respectively, indicating that those conditions are not uncommon among Turkish children. Mandibular second premolars were the most frequently missing teeth, and the maxillary first premolars were most commonly affected by premature eruption. Neither the frequency of premature eruption nor that of the agenesis of premolars were significantly affected by sex. Both conditions may highlight the need for early diagnosis to prevent subsequent clinical problems.

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Conflict of interest

The authors declare that they have no conflict of interest.

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