



Premolar Agenesis Prevalence and Patterns in a Sample of Turkish Children

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ABSTRACT

Objective: The aim of this study was to evaluate the characteristics of premolar tooth agenesis patterns in Turkish children and confirm a valid cutoff age.

Methods: Included in this study were panoramic radiographs of 3637 Turkish pediatric patients aged 7–12 years (1819 males and 1818 females), whose panoramic radiographs were taken. The prevalence of premolar hypodontia, sex distribution, distribution of premolar hypodontia in the maxilla and mandible, unilateral/bilateral incidences and cutoff ages were examined in radiographs.

Results: The prevalence rate of agenesis of one or more premolars was 3.1% (n = 111) for both sexes combined, and 1.4% for boys and 1.6% for girls, with no significant difference between the sexes (p = 0.498). No significant difference was observed between younger and older groups at the cutoff ages examined.

Conclusion: An early diagnosis of premolar agenesis enables ideal and conservative treatment planning, which may involve less invasive treatment options for patients diagnosed in the early period. For these reasons, the awareness of dentists regarding these treatments should be enhanced. Therefore, there is a need for more studies regarding the prevalence of this condition, which will provide important clinical value in the timely diagnosis of hypodontia.

Keywords: Hypodontia, premolar, prevalence, children

1. INTRODUCTION

Tooth agenesis is the most common dental anomaly in permanent dentition that occurs due to genetic or environmental factors (1, 2). It is categorized according to the number of missing teeth: hypodontia if < 6 teeth are missing, oligodontia if ≥ 6 teeth are missing, and anodontia is the agenesis of all teeth (3, 4). The prevalence of congenitally missing teeth in the permanent dentition, excluding the third molars, varies from 0.15% to 16.2% (5). In previous studies, the lateral incisors and premolar agenesis were the most common congenitally missing teeth. Over the last few decades, research suggests the prevalence of tooth deficiencies has increased (6).

Previous studies have reported that a deep bite and diastema are seen in individuals with hypodontia. Individuals with premolar or molar tooth agenesis tend to have a deeper bite, but this condition leads to non-working interferences, poor gingival contours, and an over eruption of the opposing teeth. In addition, patients with premolar hypodontia have more difficulty in chewing due to having a smaller occlusal table (6, 7).

Tooth agenesis (except the third molar) involves a multidisciplinary approach (orthodontics, prosthodontics, pediatric dentistry, and surgery), which can be a costly and complex process for health insurance providers, patients and families. If a tooth deficiency is diagnosed early, treatment costs and its psychosocial effects can be reduced (8, 9).

Calcification of premolars starts between the ages of 2 and 2.5 years, and calcification of enamel is usually completed at 6–7 years of age (10). Sometimes calcification of premolars is delayed. For instance, the second premolars can develop long after what would ordinarily be expected. There is no consensus on the age criteria for detecting dental agenesis. Some authors have reported that tooth agenesis cannot be detected before the age of 9 or 10 years (11–13). Nevertheless, other authors have refused this idea, arguing that any time after 7 years of age is sufficient to detect a tooth deficiency (14). The minimum cutoff age in previous epidemiologic studies has varied.

Results of studies conducted over last few decades have reported in increased prevalence of hypodontia (15). The

aim of this study was to evaluate the characteristics of premolar tooth agenesis patterns in Turkish children and confirm a valid cutoff age. The null hypothesis states that there will be no difference between ages for detecting premolar agenesis.

2. METHODS

This retrospective cross-sectional study was conducted with archived panoramic radiographs taken at the Istanbul Gelisim University School of Dental Medicine Affiliated Hospital. Ethical approval was obtained from Istanbul Gelisim University Ethics Committee (22/04/2021:2021-15).

Included in this study were Turkish pediatric patients aged 7–12 years, whose panoramic radiographs were taken between June 2016 and December 2020. Poor image quality radiographs and patients with developmental anomalies, such as ectodermal dysplasia or a cleft lip or palate, were excluded from this study. Tooth extraction was not performed on patients. If the patient had more than one radiographic image, the most recent image was included in the study. Patient names and information were anonymized prior to the analysis.

Teeth with no mineralization as observed on panoramic radiographs were considered agenesis. All radiographs were evaluated by an observer with 11 years of experience (E.E.). To test the reliability of agenesis, 30 randomly selected radiographs were reassessed after 2 weeks, and the Cohen's Kappa was calculated to measure the strength of agreement for intra-observer reliability. The prevalence of premolar hypodontia, sex distribution, distribution of premolar hypodontia in the maxilla and mandible, and unilateral/bilateral incidences was examined in radiographs.

Descriptive statistics for age (mean, standard deviation [SD], minimum, maximum) were calculated for the sample. The rates and percentages of the variables were determined through a frequency analysis. The differences between groups were tested with chi-square tests or Fisher's exact tests. The odds ratio (OR) was calculated at a 95% confidence interval (CI) to measure the strength of associations between the sexes and the groups.

The number of missing teeth was identified for each patient. For each cutoff age (8 to 11 years), patients were grouped as a cutoff age below (younger group) and above (older group). The mean, SD, median, and interquartile range (IQR) were calculated for each group. The distribution of normality was evaluated with Shapiro-Wilk tests. Since the groups did not show a normal distribution, Mann-Whitney U tests were used for comparisons and these were repeated for each cutoff age.

The result was considered statistically significant for a p value <0.05 . All statistical analyses were performed using SPSS version 25.0 (SPSS Inc., Chicago, IL, USA).

3. RESULTS

Intra-examiner reproducibility was 100% in the diagnosis of tooth agenesis.

We examined 3637 radiographs, consisting of 1819 boys and 1818 girls with a mean age of 9.82 years (SD: 1.48, minimum: 7, maximum: 12). The prevalence rate of agenesis of one or more premolars was 3.1% ($n = 111$) for both sexes combined, and 1.4% for boys and 1.6% for girls, with no significant difference between the sexes ($p = 0.498$).

In this study, the most common missing premolar was the mandibular right second premolar (2.3%), followed by the mandibular left second premolar (2.1%) (Table 1). As shown in Table 2, both males and females had significantly increased prevalence rates of unilateral or bilateral second premolar agenesis. There were significantly more missing second mandibular premolars than maxillary premolars. In comparing the prevalence of a bilateral absence of the second premolars with sex, the prevalence was higher for females compared to males in the mandible ($p = 0.028$). In the maxilla, unilateral absence of second premolars, the prevalence was higher for males than females ($p = 0.046$) (Table 2).

Table 1. Numbers of Subjects with Agenesis of Second Premolars Between Sexes

	Females n=1818 (%)	Males n=1819 (%)	Both sexes n=3627 (%)	p value*	Odds ratio	95% Confidence interval
15	5 (0.3)	4 (0.2)	9 (0.2)	0.754 ^a	1.25	0.33-0.66
25	7 (0.4)	1 (0.1)	8 (0.2)	0.039 ^{a*}	6.97	0.85-56.73
35	46 (2.5)	32 (1.8)	78 (2.1)	0.109 ^b	1.45	0.91-2.28
45	47 (2.6)	38 (2.1)	85 (2.3)	0.322 ^b	1.24	0.80-1.00

^aFisher exact test, ^bChi-square test, * $p < 0.05$

As a result of this study, 11 different agenesis patterns were observed (Figure 1). A bilateral second premolar agenesis pattern was observed for the mandibular arch as 42.3%. Mandibular right second premolar agenesis pattern was observed as 26.1%. The tooth agenesis pattern with the highest prevalence was second premolar agenesis (75.6%). Five patients had a premolar agenesis pattern in all four quadrants. No significant difference was observed between younger and older groups at the cutoff ages examined (Table 3).

Table 2. Second Premolar Agenesis in the Maxilla and Mandible

	Number (%) of subjects with unilateral agenesis of second premolars		
	Females	Males	Both sexes
Maxilla	2 (3.4)	4 (7.7)	6 (5.4)
Mandible	24 (40.7)	31 (59.6)	55 (49.5)
p value	<0.001 ^{b*}	<0.001 ^{b*}	<0.001 ^{a*}
Odds ratio	0.051	0.056	0.058
95 % Confidence interval	0.011-0.230	0.018-0.180	0.024-0.144
	Number (%) of subjects with bilateral agenesis of second premolars		
	Females	Males	Both sexes
Maxilla	5 (8.5)	2 (3.8)	7 (6.3)
Mandible	35 (59.3)	20 (38.05)	55 (49.5)
p value	<0.001 ^{a*}	<0.001 ^{b*}	<0.001 ^{a*}
Odds ratio	0.063	0.064	0.069
95 % Confidence interval	0.22-0.182	0.014-0.293	0.029-0.160
	Number (%) of congenitally missing second premolars		
	Females (n=59)	Males (n=52)	Both sexes (n=111)
Maxilla	12 (10.1)	5 (4.8)	17 (7.6)
Mandible	93 (78.8)	70 (67.3)	163 (73.4)
p value	<0.001 ^{a*}	<0.001 ^{a*}	<0.001 ^{a*}
Odds ratio	0.030	0.025	0.030
95 % Confidence interval	0.014-0.064	0.009-0.066	0.017-0.166

^aChi square, ^bFisher exact test, *p<0.05

Table 3. Comparison of Means, SDs, Medians, and IQRs of Numbers of Missing Teeth Per Patient According to Different Cutoff Ages

Cut of age	<Cutoff age (younger group)					≥ Cutoff age (older group)					p* value
	Missing teeth per patient					Missing teeth per patient					
	n	Mean	SD	Median	IQR	n	Mean	SD	Median	IQR	
8	12	1.416	0.514	1	1	99	1.656	0.771	2	1	0.369
9	26	1.615	0.136	2	1	85	1.635	0.834	2	1	0.938
10	51	1.509	0.944	1	1	60	1.733	0.103	2	1	0.114
11	79	1.557	0.780	1	1	32	1.812	0.859	2	1	0.130

*Mann-Whitney U test, IQR:interquartile range

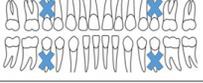
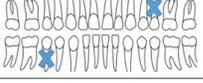
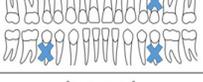
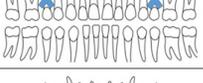
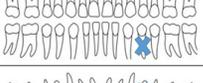
Rank	Pattern	Number of patients	Prevalence of pattern(%)
1		47	42.3
2		29	26.1
3		27	19.8
4		5	4.5
5		2	1.8
6		1	0.9
7		1	0.9
8		1	0.9
9		1	0.9
10		1	0.9
11		1	0.9

Figure 1. Premolar Agenesis Patterns

4. DISCUSSION

Tooth agenesis is the most commonly seen dental anomaly in the permanent dentition.

Tooth agenesis appears most frequently in the second premolars (excluding third molars), with variations in the frequency and sequence of the agenesis, which may be affected by ethnic differences (12, 16). The aim of this study was to establish the prevalence and agenesis patterns of premolars in a group of nonsyndromic Turkish children.

The prevalence of tooth agenesis has varied between 0.15%–16.2% in previous studies (17). Although there are many studies on the prevalence of hypodontia, the number of publications reporting premolar agenesis is limited. The prevalence of agenesis has previously been reported at 3.4%–6.6% for the second premolars (18). The prevalence of premolar agenesis also varies from country to country: 5.8%

in the Italian population (19), 1.9% in Slovenia, and 5% in the Turkish population (20). Our results showed that 3.1% of the patients had one or more instances of premolar agenesis; thus, our results are in agreement with previous studies. On the contrary, Koc et al reported second premolar agenesis of 6.7% (21). Gelgor et al. (22) reported a mandibular second premolar agenesis of 3%, while Sumer et al. (23) reported the prevalence at 2.59%. Dzemic et al. reported the teeth most affected by agenesis were the lower second premolars in orthodontic patients (24). In addition, although there are many studies regarding the prevalence of hypodontia in our country, the prevalence values of premolar agenesis have not been specified in these studies. Therefore, the number of studies in which the prevalence of premolar hypodontia can be compared was insufficient. Considering this, more studies are needed on this condition.

Bilateral premolar agenesis is more prevalent in females, while unilateral agenesis is found more frequently in males; however, these differences are not statistically significant. Previous studies have suggested that bilateral premolar agenesis is more common than unilateral premolar agenesis (25–27). In our study, there were no significant differences between unilateral and bilateral premolar agenesis. The numbers for both unilateral and bilateral premolar agenesis were significantly higher in mandibular premolars than in maxillary premolars.

The effect of a cutoff age was evaluated in patients with premolar agenesis in the present study. There was no significant difference between the groups at the determined cutoff ages. More studies on premolar agenesis are required to validate the results of this study.

This study has some limitations. The sample group consisted of patients who applied to the dental clinic. Socioeconomic differences may have affected the patients' dental visits and their ability to receive treatments. Therefore, the results of this study may not reflect the actual biological variation within the population.

An early diagnosis of premolar agenesis enables ideal and conservative treatment planning, which may involve less invasive treatment options for patients diagnosed in the early period. Restoring the primary tooth with a minimally invasive approach and retaining it in the mouth increases the survival rate of the tooth and decreases the need for complicated treatments, such as endodontic treatments. With a late diagnosis, extraction of the primary tooth may be the only treatment option. In such cases, a space maintainer should be placed to protect the cavity from closure due to mesial/rotational movements of the first molar or overturning of the first molar into the cavity. For these reasons, the awareness of dentists regarding these treatments should be enhanced. Therefore, there is a need for more studies regarding the prevalence of this condition, which will provide important clinical value in the timely diagnosis of hypodontia.

Pediatric dentists are likely to be the first specialist to diagnose congenital tooth agenesis. Therefore, pediatric

dentists are best able to educate the child and family members about dental care and help guide the child to cope with the situation by preventing possible malocclusions. In a multidisciplinary approach, the aim is to preserve the presence of the existing primary tooth, improve aesthetics and speech, provide appropriate chewing, and improve the psychological and emotional health of the child. The role of the pediatric dentist within this dental team is to guide the child's behavior, maintain good oral hygiene, manage malocclusions, and when necessary, provide restoration of the tooth.

5. CONCLUSION

The prevalence of agenesis of one or more premolars was 3.1%. There was no significant difference between the groups with cutoff ages ranging from 7 to 12 years. Therefore, further longitudinal studies of premolar agenesis are required to confirm the results of the present study.

Ethics Committee Approval: Ethical approval was obtained from Ethics Committee of Istanbul Gelisim University, Turkey (22/04/2021:2021-15).

Author contributions: EE designed the study, generated the data for the study, analyzed of the data, wrote the original draft of the paper, and approved the final version of this paper.

Conflict of Interest: Author declared no conflict of interest.

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