

# Prevalence of Maxillary Lateral Incisor and Maxillary-Mandibular Premolar Agenesis In Children Living in The Denizli Region

Denizli İlinde Yaşayan Çocuklarda Üst Çene Yan Kesici ve Üst-Alt Çene Küçük Azı Diş Eksikliği Prevalansı

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## ABSTRACT

**Background:** Tooth agenesis is a phenomenon that occurs commonly as a dental anomaly in humans. The aim of the present study was to evaluate the prevalence of tooth agenesis in a population group in Turkey.

**Methods:** This retrospective study was conducted on -previously taken- panoramic radiographs of 6- and 7- year- old children, who had applied to Pamukkale University Faculty of Dentistry between 2015 and 2022 for dental reasons. Maxillary lateral incisors and maxillary/mandibular premolars that were congenitally missed were noted, while other missing teeth were not evaluated.

**Results:** A total of 1840 panoramic radiographs were examined and the agenesis of maxillary lateral incisors and maxillary/mandibular premolars frequency was found to be 8.15%. The prevalence of missing maxillary lateral incisors was found to be 2.44%, and the prevalence of missing premolar teeth was 5.71%. The teeth most affected by agenesis were the mandibular second premolars. Females were more affected than males (8.88% females; 7.44% males).

**Conclusion:** Since the early diagnosis of missing teeth can provide ideal and conservative treatment and reduce treatment costs, it is important for dentists to have information about early diagnosis and treatments. In this study, it was determined that the prevalence of missing teeth was higher in women than in men. Further genetic studies may elucidate why females are more affected by hypodontia than males. More comprehensive studies should be conducted in the future including the other permanent teeth and more individuals.

**Keywords:** Hypodontia, prevalence, tooth agenesis.

## ÖZ

**Amaç:** Konjenital diş eksikliği, dental anomaliler arasında sıklıkla ortaya çıkan bir olgudur. Bu çalışmanın amacı, Türkiye'de bir populasyon grubunda konjenital diş eksikliği prevalansını değerlendirmektir.

**Gereç ve Yöntemler:** Bu retrospektif çalışma, Pamukkale Üniversitesi Diş Hekimliği Fakültesi'ne 2015-2022 yılları arasında ağız diş sorunları nedeniyle başvuran 6 ve 7 yaşındaki çocukların arşivlenmiş panoramik radyografileri üzerinde gerçekleştirilmiştir. Konjenital olarak eksik olan üst çene yan kesici dişleri ve üst/alt çene küçük azı dişleri not edilmiştir, diğer eksik dişler değerlendirilmemiştir.

**Bulgular:** Toplam 1840 panoramik radyografi incelenmiştir ve üst çene yan kesici ve alt-üst çene küçük azı dişlerinin eksikliği %8,15 olarak bulunmuştur. Üst çene yan kesici diş eksikliği prevalansı %2,44 küçük azı diş eksikliği prevalansı %5,71 olarak bulunmuştur. Eksiklikten en çok etkilenen dişler, alt çene ikinci küçük azıdır. Kızlar erkeklerden daha fazla etkilendirilmiştir (%8,88 kızlar; %7,44 erkekler).

**Sonuç:** Diş eksikliğini erken tanısı ideal ve konservatif tedaviyi sağlayacağından ve tedavi maliyetlerini azaltacağından, diş hekimlerinin erken tanı ve tedaviler hakkında bilgi sahibi olması oldukça önemlidir. Çalışmada, diş eksikliği prevalansının kadınlarda erkeklere göre daha fazla olduğu tespit edilmiştir. İleride yapılacak olan genetik çalışmalar, kadınların neden hipodontiden erkeklere göre daha fazla etkilendiğini açıklayabilir. Daha fazla bireyle ve diğer diş eksikliklerini içeren kapsamlı çalışmalar yapılmalıdır.

**Anahtar Kelimeler:** Agenez, hipodonti, prevalans.

## Introduction

Tooth agenesis is the most frequently seen dental anomaly in humans. Occlusion disorders, malposition, functional and masticatory disorders, decrease in alveolar bone height, speech impairment, and aesthetic problems are the potential the consequences of agenesis.<sup>1,2</sup> It is reported that deep bite and diastema are seen in individuals with hypodontia.<sup>3</sup> Agenesis of teeth can be classified as hypodontia, oligodontia and anodontia. The term hypodontia is used to describe the absence of one to six teeth (excluding third molars), while oligodontia involves the absence of more than six teeth and anodontia represents total absence of teeth.<sup>4</sup>

When the etiology of missing teeth was investigated, evolutionary, local, systemic and genetic factors were involved. Agenesis can be common in diseases such as syphilis and rickets and due to genetic transmission.<sup>5</sup> According to genetic studies, mutation in the MSX1 gene has been detected in the absence of second premolars and third molars. Mutation of the PAX9 gene has been associated with oligodontia, which affects most molars. It has been determined that incisor hypodontia is associated with mutations in transforming growth factor alpha (TGF.).<sup>2</sup>

The prevalence of tooth agenesis has been reported to be between 0.03% to 11.3% in different countries and ethnic groups excluding the third molar. Research conducted in recent decades, shows that the incidence of missing teeth is increasing.<sup>6</sup> Some studies report that the prevalence of hypodontia is higher in women, whereas other studies have not found any significant differences between men and women.<sup>7-9</sup>

Most studies show that the mandibular second premolar is the most common missing tooth (excluding third molars), followed by the maxillary lateral incisor.<sup>1,2,4,10</sup> However, other studies have also reported that the deficiency of maxillary lateral incisors comes first.<sup>8,11,12</sup> Many studies conducted thus far have found different results regarding the prevalence of missing maxillary lateral incisors. These different results in prevalence studies may be due to the racial and ethnic background of people in different populations.<sup>5,13-15</sup> The absence of incisors can result in aesthetic problems by causing the midline to shift or affecting the smile. Studies on aesthetic perception show that the eyes and teeth are the most important factors.<sup>16,17</sup> Children who experience such aesthetic problems during adolescence may lose their self-confidence.<sup>16</sup>

Patients with tooth agenesis often receive complicated treatments for many years. Multidisciplinary treatments are important in these patients. In this team, specialists in pediatric dentistry, orthodontics, oral surgery, prosthodontics, and a consulting psychologist are needed.<sup>4,10</sup> This process can be costly and complex for pediatric patients and their parents. If missing teeth are diagnosed early, treatment costs and psychosocial effects can be reduced. Early diagnosis of premolar agenesis allows for ideal and conservative treatment planning and may include less invasive treatment options for patients diagnosed at an early stage. Restoring the primary tooth with a minimally invasive approach and keeping it in the mouth reduces the need for complex treatments such as endodontic treatments. Extraction may be necessary if permanent tooth agenesis is diagnosed

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late and the primary tooth becomes untreatable. In such cases, a space maintainer should be placed to prevent the gap from closing. For these reasons, dentists' awareness of these treatments needs to be increased.<sup>18</sup>

Panoramic radiographic examination is an easy and inexpensive method for identifying tooth agenesis that cannot be observed during physical examination.<sup>19</sup> Calcification of premolars generally begins between the ages of 2 and 3, and for maxillary lateral incisors it starts around the age of 1. However, mineralization of the second premolars may occur later, and tooth deficiency can not be determined in the permanent dentition before the age of 6 if the third molars are not considered. In addition, premolars erupt between the ages of 10-12 and maxillary lateral incisors between 8-9.<sup>2</sup>

**Material and Methods**

Ethical approval (2022/17) for the study was obtained and all the procedures performed in the study were performed in accordance with the ethical standards given in the Declaration of Helsinki. This retrospective study was conducted on -previously taken- panoramic radiographs of 6- and 7- year-old children (1840 patients), who had applied to Pamukkale University Faculty of Dentistry for dental reasons between 15.05.2015 (the date that the institution started accepting patients) and 15.11.2022. Panoramic radiographs were taken during routine examination; no panoramic radiographs were taken for the study purpose. All patients had panoramic radiographs taken using standardised methods with the same device. Panoramic radiographs with unclear images and poor quality were excluded from the study. A total of 1840 panoramic radiographs were examined by a calibrated pediatric dentist with 15 years of experience (H.Ö.İ.). All analyses were performed under standardised lighting conditions, screen resolution and brightness. Teeth in which mineralization was not seen observed in panoramic radiographs were considered to be affected by agenesis. Maxillary lateral incisors and maxillary/mandibular premolars that were missed were noted. Age and gender information were recorded from patient files.

Statistical data were analyzed in the NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA) package program. In addition to the use of descriptive statistical methods (mean, standard deviation, frequency and percentage distributions) in evaluating the data, Chi-square and Fisher's exact test were used in comparisons of qualitative data. Significance was assessed at a level of p<0.05.

**Results**

A total of 1840 panoramic radiographs (924 males, 916 females) were examined and the frequency of agenesis of the maxillary lateral incisors and maxillary/mandibular premolars frequency was found to be 8.15%. The teeth most affected by agenesis were the mandibular second premolars. (4.19%). Tooth agenesis was mostly seen in females (8.88% of girls and 7.44% of boys). The frequency of agenesis of each maxillary lateral incisors and maxillary/mandibular premolars is shown in Table 1.

**Table 1. Frequency of agenesis of each maxillary lateral incisors and maxillary/mandibular premolars.**

Agenesis of Tooth Number	Total		Girl		Boy		p
	n	%	n	%	n	%	
Agenesis of 12	26	1.41%	16	1.73%	10	1.09%	0.245+
Agenesis of 22	19	1.03%	11	1.19%	8	0.87%	0.501+
Agenesis of 15	13	0.71%	7	0.76%	6	0.66%	0.793+
Agenesis of 25	13	0.71%	7	0.76%	6	0.66%	0.793+
Agenesis of 35	41	2.23%	23	2.49%	18	1.97%	0.446+
Agenesis of 45	36	1.96%	18	1.95%	18	1.97%	0.979+
Agenesis of 14	1	0.05%	0	0.00%	1	0.11%	0.315‡
Agenesis of 24	1	0.05%	0	0.00%	1	0.11%	0.315‡
Agenesis of 34	0	0.00%	0	0.00%	0	0.00%	-
Agenesis of 44	0	0.00%	0	0.00%	0	0.00%	-

+Chi-square Test ‡ Fisher's Exact Test

The percentage of children with maxillary lateral incisor agenesis was found to be 2.44% and it was reported to be more common in women (2.92%) than in men (2.06%). Mandibular premolar deficiency was more common than maxillary premolar deficiency. The percentage of mandibular premolar agenesis was 4.19% and the percentage of maxillary premolar agenesis was 1.52%. Mandibular second premolar agenesis frequency (4.19%) was higher than maxillary second premolar agenesis (1.42%). The unilateral and bilateral agenesis frequency of maxillary lateral incisors and maxillary/mandibular premolars is shown in Table 2.

**Table 2. Agenesis frequency of maxillary lateral and maxillary/mandibular premolars.**

	Total		Girl		Boy		p
	n	%	n	%	n	%	
Agenesis of at least one of the Maxillary Lateral Incisors and Premolars	84	4.57%	47	5.09%	37	4.04%	0.282+
Agenesis of at least one of the Maxillary Lateral Incisors	29	1.58%	16	1.73%	13	1.42%	0.591+
Agenesis of at least one of the Premolars	59	3.21%	33	3.57%	26	2.84%	0.372+
Agenesis of at least one of the Mandibular Premolars	51	2.77%	28	3.03%	23	2.51%	0.497+
Agenesis of at least one of the Maxillary Premolars	20	1.09%	10	1.08%	10	1.09%	0.984+
Bilateral Agenesis of the Maxillary Lateral Incisors	16	0.88%	11	1.20%	5	0.55%	0.138+
Unilateral Agenesis of the Maxillary Lateral Incisors	13	0.71%	5	0.55%	8	0.88%	0.401+
Bilateral Agenesis of Right-Left Premolars	34	1.87%	18	1.98%	16	1.77%	0.736+
Unilateral Agenesis of Right-Left Premolars	25	1.38%	15	1.66%	10	1.11%	0.322+

+Chi-square Test ‡ Fisher's Exact Test

**Discussion**

Calcification of premolars generally begins between the ages of 2 and 3, and around the age of 1 for the maxillary lateral incisors. However, mineralization of the second premolars may occur later, and tooth deficiency can not be determined in the permanent dentition before the age of 6 if the third molars are not considered. In addition, premolars erupt at 10-12 years old and maxillary lateral incisors erupt at 8-9 years old.<sup>2</sup> In the light of this information, in the present study, it was planned to examine the panoramic radiographs of 6- and 7- year-old children to ensure that the maxillary lateral incisor and premolar teeth calcification had definitely started. Another reason for the selection of this age group was not to cause suspicion for the missing tooth that it has been extracted before the study. Therefore, maxillary lateral incisors and maxillary/mandibular premolars that were examined in panoramic radiographs, were not erupted yet.

Panoramic radiographic examination is an easy and inexpensive method for identifying anomalies that cannot be observed during physical examination, such as tooth agenesis or the presence of supernumerary teeth.<sup>19</sup> In the present study, digital panoramic radiographs were used. Digital radiographs enable exposure to lower radiation doses and are associated with less environmental contamination compared to traditional films.<sup>20</sup>

It is a well-known theory that the formation and maturation of teeth is tightly governed by factors such as genetics. Missing teeth have been found to be associated with various genetic and syndromic conditions. MSX1 and PAX9 mutations are associated with tooth agenesis.<sup>2</sup> Some mutational and evolutionary changes in the dentition also cause

disorders in tooth formation. The teeth that most frequently fail to erupt are the upper lateral incisors, second premolars and third molars. Agenesis can also be explained as the lack of innervation in the final stages of development of the teeth furthest from the innervations of the area.<sup>3</sup> The difference in the prevalence of missing teeth in different societies and different geographical locations can be attributed to genetics. However, it is known that environmental factors are also effective.<sup>18</sup>

Demiriz et al. examined 6535 people and found that 4.7% had the absence of at least one tooth (except the third molars).<sup>2</sup> Topkara and Sari reported the frequency of missing teeth (excluding third molars) as 6.77% in the orthodontic patient population in Turkey.<sup>7</sup> Another author investigated missing teeth in Turkish society and found a frequency of 4.6%.<sup>8</sup> In an article investigating missing teeth in the Turkish orthodontic population, the frequency was found to be 7.0%.<sup>21</sup> In the present study, we examined the prevalence of maxillary lateral incisor and maxillary/mandibular premolars and found a prevalence of 8.15%. However, there has been no previous study on the prevalence of missing teeth in Denizli, and therefore this is the first study on this subject in this province.

Many studies have been conducted in different countries to investigate the prevalence of upper lateral incisor absence. While the prevalence of congenital lateral missing teeth is 1.2% in Swedish children<sup>22</sup>, this rate has been reported to be 1.3% in the Portuguese population<sup>23</sup>. In Saudi Arabia, the incidence of congenital upper lateral incisor deficiency is 2.6%.<sup>24</sup> Different studies have also reported that lateral incisor deficiency rates of between 1% and 4%.<sup>25,26</sup> Bassiouny et al. investigated the maxillary lateral agenesis prevalence and found a rate of 4.9%.<sup>27</sup> In the present study, the maxillary lateral agenesis prevalence was found to be 2.44%.

The prevalence of agenesis in the second premolar teeth was previously reported to be 3.4-6.6%.<sup>28</sup> Premolar agenesis varies between countries. A prevalence of 1.9% in Slovenia and 5% in the Turkish population were reported.<sup>8</sup> Koç et al. reported second premolar agenesis prevalence of 6.7%. Gelgor et al.<sup>30</sup> reported mandibular second premolar agenesis with a rate of 3%, while Sümer et al.<sup>31</sup> reported the prevalence as 2.59%.

Demiriz et al. reported that the most common missing teeth were mandibular second premolars (37.8%), and the second most common teeth were maxillary lateral incisors (27.0%).<sup>2</sup> These results are consistent with those of Polder et al.<sup>32</sup> Dzemidzic et al. reported that the most common tooth agenesis seen in orthodontic patients involves the mandibular second premolars.<sup>33</sup> In the present study, the results are compatible with these findings; mandibular second premolar tooth agenesis has the highest percentage of agenesis prevalence.

In this study, it was observed that the rate of missing teeth was more common in the female population. This result was parallel to the results of previous studies, which reported that females were more affected than males in the permanent dentition in the Turkish population (except the third molars).<sup>7,8</sup> While missing teeth were reported to be seen in 4.6% of men and 6.3% of women in Europe, it was seen in 5.5% of men and 7.6% of women in Australia.<sup>32</sup> Another study reported that the rate of missing maxillary lateral incisors in women was strikingly higher than in men. While this rate was approximately 0.9% in men, it was around 2.8% in women.<sup>3</sup> Parallel to these results, in the present study, the percentage of missing upper lateral incisors was found to be higher in women than in men. However, Demiriz et al. reported a higher prevalence of tooth agenesis in males in their study.<sup>2</sup> In a study conducted in orthodontic patients in Korea, no significant difference was found between male and female prevalence.<sup>9</sup>

Many authors have reported that missing teeth are more common in the lower jaw than in the upper jaw<sup>34-37</sup> and these results are compatible with our findings. The percentage of mandibular premolar agenesis was found to be 4.19% and the percentage of maxillary premolar agenesis was 1.52% in the present study. However, studies have also shown that tooth deficiency is predominantly in the maxilla.<sup>38-40</sup> In the present study, bilateral missing teeth were more common than unilateral ones. These results are in line with those of Dzemidzic et al.<sup>33</sup> However, there are also studies showing that unilateral tooth deficiency is more common than bilateral.<sup>36-38</sup>

## Conclusion

The purpose of this study was to determine the prevalence of missing permanent upper lateral incisors and upper/lower premolars in a group of children in the Denizli region. The most common missing teeth were

determined to be the mandibular second premolar teeth. The prevalence of upper lateral incisor absence was found to be 2.44%, and it was reported to be more common in women than in men. While the prevalence of missing upper and lower premolar teeth was found to be 5.71%, agenesis was observed to be more common in women than in men. Bilateral agenesis of upper lateral incisors was observed at a higher rate than unilateral agenesis. In the same way, bilateral agenesis of the premolars was detected at a higher rate than unilateral agenesis. Since the early diagnosis of agenesis enables ideal, conservative treatment and reduces treatment costs, it is important for dentists to be aware of early diagnosis and treatments. Further genetic research may elucidate why females are more affected by hypodontia than males. More comprehensive studies should be conducted including the other permanent teeth and more individuals in the future.

## Değerlendirme / Peer-Review

İki Dış Hakem / Çift Taraflı Körlleme

## Etik Beyan / Ethical statement

It is declared that during the preparation process of this study, scientific and ethical principles were followed and all the studies benefited are stated in the bibliography.

Bu çalışmanın hazırlanması sürecinde bilimsel ve etik ilkelere uyulduğu beyan edilmiş olup, yararlanılan tüm çalışmalar bibliyografyada belirtilmiştir.

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