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Prevalence and Distribution of Non-Syndromic Dental Agenesis in Turkish Population: A Retrospective Study

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Abstract

Objective: This retrospective study aimed to determine the prevalence and distribution of hypodontia, except third molars, according to localization in dental arches and sex.

Methods: This retrospective, observational, epidemiological study was conducted with patients who applied to a university hospital (Istanbul, Turkey) between 2020 and 2022. Patients with any syndrome, jaw fracture, tooth extraction, or history of orthodontic treatment were excluded from the study. The age range of the patients included in the study was between 18 and 26 years. In addition to descriptive statistics, data were analyzed using Fisher's exact test. The level of significance was evaluated at $P \leq .05$.

Results: In the total sample of 754 patients, hypodontia was found in 54 patients, including 31 females and 23 males. The prevalence of hypodontia was 7.2%. The most common agenesis was mandibular second premolar agenesis (22.5%), followed by maxillary second premolar (16.6%) and maxillary lateral incisor (11.6%).

Conclusion: The prevalence of hypodontia was determined as 7.2% according to the findings of this retrospective study. Mandibular second premolar agenesis was the most common agenesis, followed by maxillary lateral incisor and maxillary second premolar. There were no significant differences in the distribution of hypodontia by sex or arch.

Keywords: Dental agenesis, hypodontia, prevalence, retrospective study

INTRODUCTION

Tooth agenesis is described as the absence of tooth germs and is considered a public health concern because it is the most common dental anomaly among developmental anomalies in the population.[1] It is frequently associated with certain syndromes such as Down syndrome, ectodermal dysplasia, and cleft lip and palate.[2,3] Although it is defined with different terms in the literature, agenesis of 1 to 6 teeth (excluding third molars) is commonly referred to as hypodontia, while agenesis of more than 6 teeth is referred to as oligodontia, and a very rare condition, agenesis of all teeth in the dentition is called anodontia.[4]

It has been reported that genetic and environmental factors are effective, although the etiology of tooth agenesis is not precisely known.[5,6] Researchers have put forward a few theories about tooth agenesis. According to a common belief, tooth agenesis is usually observed in the most distal teeth of a tooth group[7]: lateral incisor agenesis in the incisor group, second premolar agenesis in the premolar group, and third molar agenesis in the molar group. During the development of the tooth germ, larger tooth germs are thought to adversely affect the formation of other germs.[8,9] Previous studies suggested that agenesis is carried by an autosomal recessive gene.[10] Although it has been reported that MSX1 gene mutations are mainly associated with premolar agenesis and PAX9 gene mutations are associated with molar agenesis, the relationship between

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gene mutations and specific dental agenesis patterns has not yet been fully elucidated.[11-13]

The prevalence of hypodontia has been reported in the literature between 0.15% and 16.2% when third molars were excluded.[14] It is thought that the age range in the inclusion criteria and the differences in the examination method may cause varying prevalence values.[15] Of most studies, it is seen studies indicate that regional and racial differences significantly affect the prevalence results and distribution of hypodontia.[15] Retrospective studies indicate that third molar agenesis is the most common in all regions; however, in hypodontia studies that exclude third molars, regional variations are observed. In some populations, agenesis of the maxillary second premolar is more common, while in some populations, the maxillary lateral incisor is more common.[15]

Tooth agenesis can cause functional and aesthetic problems, as well as low self-esteem in patients.[16] Furthermore, early diagnosis of such developmental dental anomalies is crucial to prevent future complications or reduce their severity. There are many studies investigating the prevalence of hypodontia, but conflicting results are observed among these studies with varying populations. Therefore, population-specific prevalence studies are required to provide clinicians with accurate information that can impact oral health and quality of life. Prevalence studies on the Turkish population are insufficient and some of them have been performed with a population of patients with the syndrome and/or a limited population such as orthodontic patients. Therefore, this study aimed to evaluate the prevalence of hypodontia in the Turkish population and to determine its distribution according to sex and arch by evaluating the non-syndromic patients referred for routine examination.

METHODS

This study was conducted in accordance with the Helsinki Declaration of Human Rights and ethical approval was granted by Research Ethics Committee of Altınbaş University with Decision No. 2022/9.

This retrospective, observational, epidemiological study was carried out with patients applied to the Oral and Dental Research and Application Center of Altınbaş University (Istanbul, Turkey) between September 2020 and June 2022.

Main Points

- The prevalence of hypodontia was determined as 7.2% according to the findings of this retrospective study. This finding revealed that hypodontia was not a rare anomaly in the Turkish population.
- Mandibular second premolar agenesis was the most common agenesis, followed by maxillary second premolar and maxillary lateral incisor.

Patients had a panoramic radiograph during their routine dental examination and a dental follow-up file was included. Patients with any syndrome, cleft lip and palate, jaw fracture, tooth extraction, orthodontic treatment history, and whose radiography quality was deemed insufficient for optimal evaluation were excluded from the study. The age range of the patients included in the study was between 18 and 26 years.

Clinical examinations of the patients were performed under standard dental illumination with a dental mirror and probe. All panoramic radiographs were acquired with a single device (NewTom Vgi evo; CeflaGroup, Verona, Italy). The diagnosis of hypodontia was made by an experienced researcher in dental anomalies. Radiographs were re-evaluated 15 days later for reproducibility and reliability of the diagnosis.

The absence of a tooth or germ was recorded as agenesis. Tooth agenesis was evaluated for each patient and recorded on the forms. Patients with no history of tooth extraction, no syndrome, and less than 6 germ agenesis (excluding third molars) were considered hypodontia.

Statistical Analysis

Statistical analysis was performed using GraphPad Prism (GraphPad Software, Inc., San Diego, Calif, USA). In addition to the descriptive statistics, Fisher's exact test was performed to determine the significant differences in the prevalence rate of hypodontia between sex and distribution in the dental arches. The level of significance was assessed at $P \leq .05$.

RESULTS

Of a total of 754 patients (420 female and 334 male) included in the study, 121 agenesis were diagnosed in 54 patients (31 females and 23 males). The prevalence of hypodontia was found to be 7.2% in this study. It was found that the prevalence rates were 7.4% in females and 6.9% in males, but there was no statistical difference according to sex ($P > .05$) (Table 1). The highest prevalence of agenesis was observed for mandibular second premolar, maxillary second molar,

Table 1. Descriptive Statistics of the Whole Sample and Prevalence Rates of Agenesis

	Hypodontia	Non-Hypodontia	Total
Total	54 (7.2)	700 (92.8)	754 (100)
Sex			
Female	31 (7.4)	389 (92.6)	420 (55.7)
Male	23 (6.9)	311 (93.1)	334 (44.3)
P	>.05		

Values are presented as number (%). Fisher's exact test was performed.

and maxillary lateral incisor (Figure 1). This ranking applies to both sexes (Table 2).

Of the 121 congenitally missing teeth, 71 were found in females and 50 in males. Agenesis was often observed as 1 or 2 teeth per patient. Of all the examined patients, 20 had 1 missing tooth (37%), 20 (37%) had 2 missing teeth, 4 (7.4%) had 3 missing teeth, 5 (9.3%) had 4 missing teeth, and 5 (9.3%) had 5 missing teeth or more. The difference between males and females was not statistically different (Table 3).

A higher number of agenesis was observed in the mandible (53.5% in females and 55.4% in males) than in the maxilla (46.5% in females and 44.6% in males), and this difference was not statistically significant ($P > .05$). The number of missing teeth in the right and left parts of the arches was examined. It was seen that the missing teeth on the left side (50.7% in females and 50% in males) and on the right side (49.3% in females and 50% in males) were quite similar. Additionally, the prevalence of agenesis in the anterior and posterior regions was examined, and it was detected that the agenesis in the posterior region (70.8% in females and 63.2% in males) was significantly higher than in the anterior region (29.2% in females and 36.8% in males) ($P > .05$) (Table 4).

DISCUSSION

Genetic and environmental factors play an important role in the formation of dental anomalies, and hereditary genetic disorders are the dominant factor. Among dental anomalies, hypodontia is the most common.[17] Although there are many studies published in the literature to determine the prevalence of hypodontia, it is seen that the number of studies conducted in the Turkish population is scarce.[18,19] In addition, some of the studies focusing on the Turkish population were conducted with limited populations such as patients with cleft lip and palate and orthodontic patients.[19] This study includes a large population consisting of non-syndromic patients referred to a university hospital. In our study, the prevalence of hypodontia and its distribution in the dental arches were examined, and the prevalence of hypodontia was found to be 7.2%.

The overall prevalence of dental anomalies was 20.9%.[17] It is noteworthy that the findings of prevalence studies of hypodontia are so broad. The study design, methodology, and inclusion criteria for sampling are believed to be highly effective in this variability. Factors such as the inclusion of third molars, the sample size, whether the sample was randomized or selected from a specific group (e.g., orthodontic patients), and the age range of the sample affect the results of the study.[15]

The prevalence of third molar agenesis is higher than in other teeth, and therefore, the prevalence of total hypodontia is higher in studies evaluating third molars (up to 34.8%).[20] The prevalence of hypodontia has been reported between 0.15% and 16.2% when third molars are not included.[14] On the other hand, patients with dental anomalies frequently require orthodontic treatment, so in studies conducted with the sample group visiting the clinic for orthodontic treatment, naturally, hypodontia is more likely to be observed.[15,21] Since the data in this study were gathered from randomly selected patients referring to the university hospital, it may provide more reliable results in terms of reflecting the general population.

The age range of patients included in the study is important in terms of both the prevalence and distribution of hypodontia.[15,21] It is stated that permanent tooth germ calcifications start at approximately 3 years of age and continue until 6 years of age.[22] Previous studies have indicated that calcification of the mandibular second premolar may be delayed, and it may be incorrect to record this tooth as missing in children under 10 years of age.[23,24] In a population of children aged 5 to 7 years, a reduction in the incidence of hypodontia was

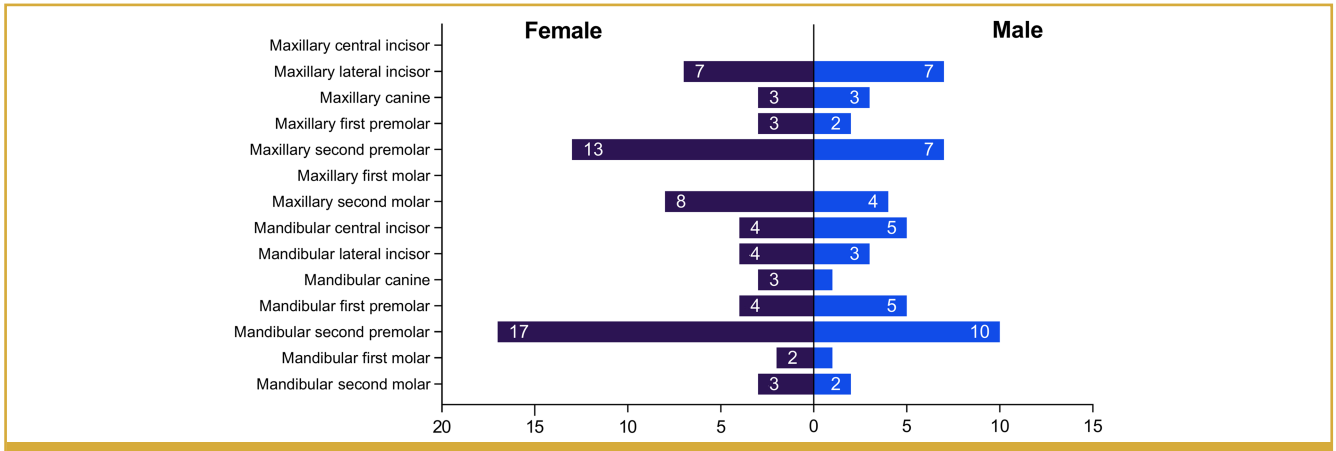

Figure 1. Agenesis numbers according to teeth.

Table 2. Distribution of Agenesis According to Sex

	Female	Male	Total
Maxillary central incisor	0 (0)	0 (0)	0 (0)
Maxillary lateral incisor	7 (9.5)	7 (13.6)	14 (11.6)
Maxillary canine	3 (3.8)	3 (5.1)	5 (4.4)
Maxillary first premolar	3 (3.7)	2 (4.2)	5 (3.9)
Maxillary second premolar	13 (18.7)	7 (14.4)	20 (16.6)
Maxillary first molar	0 (0)	0 (0)	0 (0)
Maxillary second molar	8 (10.8)	4 (7.3)	11 (9)
Mandibular central incisor	4 (5.8)	5 (9.3)	9 (7.5)
Mandibular lateral incisor	4 (5.6)	3 (6.2)	7 (5.9)
Mandibular canine	3 (4.5)	1 (2.6)	4 (3.5)
Mandibular first premolar	4 (6.3)	5 (10.5)	10 (8.4)
Mandibular second premolar	17 (24.2)	10 (20.7)	28 (22.5)
Mandibular first molar	2 (2.7)	1 (2)	3 (2.4)
Mandibular second molar	3 (4.5)	2 (4.1)	5 (4.3)

Values are presented as number (%).

observed when the sample was re-evaluated 2 years later, and this was particularly associated with late mineralization of the second premolars.[24] Therefore, adult patients over the age of 18 were included in the present study. On the other hand, significant differences may occur in dentition with the effect of traumatic events, dental diseases, and related treatments due to increasing age. Thus, it is predicted that data collection may not be performed accurately causing a decrease in reliability. Therefore, 26 years was set as the upper limit for inclusion criteria in line with previous research.[25]

There is no consensus on which tooth has the highest prevalence of agenesis following the third molars.[15] In many studies, agenesis of the mandibular second premolar has been reported as the most common, followed by maxillary laterals and maxillary second premolars.[16,18,26-28] Some researchers reported that the most frequently missing teeth were the maxillary lateral incisors[19,29] or the maxillary second premolars,[30] followed by the mandibular second premolars and mandibular central incisors. According to a meta-analysis study, in the European population, the teeth that were most

Table 3. Number of Agenesis per Patient

	Female	Male	Total
One tooth	11 (35.5)	9 (39.1)	20 (37)
Two teeth	12 (38.7)	8 (34.8)	20 (37)
Three teeth	2 (6.4)	2 (8.7)	4 (7.4)
Four teeth	3 (9.7)	2 (8.7)	5 (9.3)
Five teeth or more	3 (9.7)	2 (8.7)	5 (9.3)

Values are presented as number (%).

Table 4. Distribution of Agenesis According to Location

	Female	Male	*P*
Arches			
Maxilla	33 (46.5)	22 (44.6)	.05
Mandibula	38 (53.5)	28 (55.4)	
Side			
Left	36 (50.7)	25 (50)	.05
Right	35 (49.3)	25 (50)	
Region			
Anterior	21 (29.2)	18 (36.8)	.05
Posterior	50 (70.8)	32 (63.2)	

Values are presented as number (%). Fisher's exact test was performed.

frequently affected by hypodontia are the following: mandibular second premolar, maxillary lateral incisor, and maxillary second premolar.[25] In the present study, the most frequently missing tooth was the mandibular second premolar (22.5%; 24% in females and 20.7% in males), followed by the maxillary second premolar (16.6%; 19% in females and 14.4% in males) and maxillary lateral incisors (11.6%; 10% in females and 13.6% in males). It is widely accepted that missing teeth are usually observed in the most distal teeth of a tooth group.[7] Supporting, lateral incisor agenesis in the incisor group, second premolar agenesis in the premolar group, and third molar agenesis in the molar group are observed predominantly.[15] However, the exact reason why agenesis is seen with a high prevalence in the distal of the tooth groups remains unclear. The agenesis of maxillary central incisors, mandibular and maxillary canines, and first molars is rare and is usually seen in cases of oligodontia.[31] In this study, agenesis of the maxillary central incisor and the maxillary first molar was not observed. Although it is observed with low frequency, agenesis of the maxillary canine (4.4%) was found to be higher than agenesis of the mandibular canine (3.5%). Mandibular first molar agenesis was detected at the lowest prevalence (2.5%).

The prevalence of agenesis was observed to be higher in females (7.4%) than in males (6.9%). However, the difference in prevalence between the sex was not statistically significant ($P > .05$). This finding is consistent with many studies.[15,16,18] It is not known exactly whether sex affects agenesis. There are some opinions suggesting that the higher prevalence of agenesis in females is observed because smaller jaw bones negatively affect the formation of tooth germs.[14,32] Furthermore, the agenesis and the accompanying reduction in the size of the jaws are thought to be part of human evolution and will continue to become more frequent in the future.[29] The agenesis can be caused by several defective genes, acting alone or in combination with other genes, resulting in a distinct phenotypic pattern.[33] Although it has been suggested that MSX1 gene mutations are mainly associated with premolar agenesis and PAX9 gene mutations are associated with molar agenesis,[11-13] the relationship between gene mutations and specific dental agenesis patterns has not been fully elucidated.

It is thought that determining the distribution of the agenesis between the arches may also contribute to the etiology. It has been investigated and different results were observed for the prevalence of agenesis in the mandibular or maxillary arch. According to some researchers, dental agenesis is more common in the maxillary arch, while according to some studies, the opposite may be the case. However, in general studies, there is no statistically significant difference in the distribution of dental agenesis between the arches.[16,18] In this regard, it may be beneficial to refer to meta-analysis studies that make it possible to reach higher population numbers. In a previous meta-analysis study, it was stated that a similar prevalence of hypodontia was observed in both arches, and it was concluded that the difference may vary according to the type of tooth.[25] In the present study, the prevalence of hypodontia was higher in the mandible, but it was not statistically significant.

Region-specific studies of dental anomalies will contribute to dentists' knowledge of the prevalence of the most common types of anomalies in that region and will allow patients to be informed about dental anomalies as well as to plan their treatment correctly. Alternative treatments can be planned with a multidisciplinary approach in order to minimize the complications of agenesis with early diagnosis and to improve the dental aesthetics and functionality of the patients.

Despite the limitations, the prevalence of hypodontia was found to be 7.2% according to the results of this retrospective study. This finding indicated that hypodontia was not a rare anomaly in the Turkish population. Mandibular second premolar agenesis was the most common agenesis, followed by maxillary lateral incisor and maxillary second premolar. There were no significant differences in the distribution of agenesis by sex or arch.

Ethics Committee Approval: Ethics committee approval was received for this study from the Research Ethics Committee of Altınbaş University with Decision No. 2022/9.

Informed Consent: Written informed consent was obtained from the participants of the study.

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