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Original

Non-syndromic hypodontia in an Iranian orthodontic population

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Abstract: To investigate the prevalence, characteristics (ie, malocclusion, location, type), and sex distribution of hypodontia in an Iranian orthodontic population. A retrospective study was conducted using periapical and panoramic radiographs and study models of 1,751 subjects attending university orthodontic clinics (870 females, 881 males, age 9-27 years). The Chi-square test was used to analyze differences in the distribution of hypodontia, after stratification by sex and malocclusion type. A total of 197 congenitally missing teeth were observed in 160 patients (9.1%; 74 boys and 86 girls); there were no statistically significant differences between sexes (Chi-square = 0.832, *P* = 0.36). Hypodontia was more common in patients with Class III malocclusion (45.2%), and was more prevalent in the maxilla (71%) than in the mandible (29%). Maxillary lateral incisors (35.6%) and maxillary second premolars (13.0%) were the most commonly missing teeth, followed by mandibular lateral incisors (9.6%) and mandibular second premolars (8.2%). The prevalence of missing teeth was higher in the anterior segment (incisors and canines) than in the posterior segment (premolars and molars). The prevalence of oligodontia was 0.34%. The prevalence and characteristics of the most frequently missing teeth accorded with the findings of most studies conducted in other countries. (J Oral Sci 52, 455-461, 2010)

Keywords: hypodontia prevalence; Iranian orthodontic population; malocclusion.

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Introduction

The congenital absence of teeth, or hypodontia, is one of the most common developmental abnormalities in humans. Third molars are the most commonly absent tooth in the dentition: at least 1 is absent in 20% to 30% of the population (1). The prevalence of agenesis of other permanent teeth, ie, excluding third molars, ranges from 1.6% to 9.6%, depending on the population studied. Primary dentition may also be affected, although the prevalence is lower (0.5%-0.9%) (1). The term hypodontia is generally used to describe the absence of 1 to 6 teeth, excluding third molars. The majority (80%) of persons with hypodontia lack only 1 or 2 teeth (2) – predominantly permanent second premolars and upper lateral incisors (3). Severe hypodontia, or oligodontia, refers to the absence of more than 6 teeth, excluding third molars, while anodontia refers to the complete failure of 1 or both dentitions to develop. Approximately 1% (0.08%-1.1%) of the population suffers from oligodontia (4-5).

According to Bolk's theory of terminal reduction (6), reduction of the distal element of a tooth group occurs more

frequently than in mesially placed teeth, due to the phylogenetic evolution of humans. Therefore, the teeth most often missing are the second premolars, the upper second incisors, and the third molars. There are two forms of hypodontia. Syndromic hypodontia refers to tooth agenesis in individuals who have an underlying recognizable clinical syndrome. Examples include Down syndrome, ectodermal dysplasia, Ehlers-Danlos syndrome (Type VII), Rieger syndrome (Type I), and Witkop syndrome. The non-syndromic (or familial) form is the most common reason for congenital tooth absence, and tooth agenesis is the primary condition. It occurs as an isolated trait and affects different numbers of teeth (7), encompassing phenotypes ranging from hypodontia of one tooth (excluding third molars) to oligodontia and anodontia. The pattern of inheritance for the familial form can be autosomal dominant (8-11), autosomal recessive (12,13), or sex-linked (14), with considerable variation in penetrance and expressivity. Indeed, a multifactorial model has been proposed that explains the inheritance of anomalies in both tooth number and size, and posits that the phenotypic effect is related to certain thresholds that are themselves influenced by both genetic and environmental factors (15). Anodontia is the most severe form of non-syndromic hypodontia, but it is extremely rare in the absence of accompanying genetic disease (16).

The prevalence of oligodontia is only approximately 0.25% in European populations (17). The more localized incisor-premolar hypodontia affects only one to four teeth, but is more common, affecting approximately 8% of the population (7). Excluding third molars, the most commonly missing teeth due to hypodontia in Europeans are the mandibular second premolar, maxillary lateral incisor, premolars (prevalence, approximately 2%), and the mandibular central incisor (0.2%). The absence of canine teeth, first molars, and second molars is extremely rare in hypodontia, and is associated with severe forms of syndromic oligodontia (3,18).

Hypodontia can be an indication for orthodontic treatment. A recent study revealed that nearly a third of Iranian schoolchildren needed orthodontic treatment (19). Although the prevalence of hypodontia has been studied in other countries, it has not been well documented in English-language studies of the Iranian population. Therefore, the aim of this study was to investigate the prevalence, characteristics, and sex distribution of tooth agenesis in an Iranian orthodontic population. We also investigated the association between tooth agenesis and type of malocclusion.

Subjects and Methods

In this retrospective study, we reviewed the records of Iranian orthodontic patients treated between September 1999 and December 2009. Ethical approval for the study was given by the deputy of the Research Council, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran. The age of the subjects ranged from 9 to 27 years (average, 12.5 years). All subjects had visited the orthodontic departments of the Schools of Dentistry of Shahid Beheshti University and Tehran University in the city of Tehran, Iran. A total of 1,751 orthodontic patients (870 females, 881 males) were included in the present study. Diagnosis of hypodontia was based on pretreatment and longitudinal radiographs (panoramic and periapical views), study models, and intraoral photographs. Third molars were not evaluated in this study. Patients were excluded if they had developmental anomalies (eg, ectodermal dysplasia, cleft lip or palate, and Down syndrome) or a history of orthodontic treatment.

As shown in Table 1, the sample was equally divided between sexes; however, the distribution of malocclusion type (according to the Angle's classification) differed between sexes (Chi-square = 8.81, $P = 0.01$). Panoramic views have been used to confirm a diagnosis of hypodontia (20-24). In the present study, a tooth was diagnosed as congenitally missing when there was no mineralization of its crown on panoramic views or a full-mouth set of periapical radiographs, and no evidence of its extraction. In a study of hypodontia, Aasheim and Ogaard (24) reported that no tooth, excluding third molars, was found to mineralize in patients after age 12 years. The visibility of tooth germs on radiographs depends on their mineralization stage, and there are major differences in mineralization stage and dental age in individuals of the

Table 1 Distribution of malocclusion type (%) by sex

		Malocclusion			Total
		Class I	Class II	Class III	
Sex	Female	257 (44.6)	553 (52.2)	60 (52.2)	870 (49.7)
	Male	319 (55.4)	507 (47.8)	55 (47.8)	881 (50.3)
Total		576	1060	115	1751

Chi-square = 8.81, $P = 0.01$

same chronological age. Therefore, to prevent classification of late mineralized teeth as congenitally missing, final longitudinal panoramic views were also used to confirm a diagnosis of hypodontia.

Statistical analysis

Data were collected and entered into the SPSS 17 program for statistical analysis (Statistical Package for Social Sciences, SPSS Inc., Chicago, Illinois, USA). The Chi-square test was used to analyze differences in the distribution of hypodontia, after stratification by sex and malocclusion type. Bar charts were used to show the distribution of missing teeth according to their location. The level of significance was set at 5%.

Results

Excluding third molars, a total of 197 congenitally missing teeth were observed in the permanent dentition of 160 patients. Thus, the prevalence of hypodontia was 9.1%. The 160 patients comprised 74 (8.5%) males and 86 (9.8%) females; there were no statistically significant differences between sexes (Chi-square = 0.832, $P = 0.36$; Table 2). The prevalence rate of hypodontia was significantly higher (45.2%) in patients with Class III malocclusion (Chi-square = 193.01, $P < 0.001$; Table 3). The lowest prevalence was seen among patients with Class I malocclusion (6.4%). Table 3 shows the distribution of malocclusion type by sex.

Hypodontia was more prevalent in the maxillary arch (71%) than in the mandibular arch (29%). The distribution of missing teeth by location (maxillary or mandibular arch) is shown in Fig. 1. Overall, in both the maxillary and mandibular arches, the lateral incisors were the most commonly missing teeth (45.2%), followed by the second premolars (17.8%; Fig. 2). The least commonly missing teeth were the second molars (4.1%), followed by the canines (4.8%). With respect to location, the maxillary lateral incisors (35.6%) and maxillary second premolars (13.0%) were the most commonly missing teeth, followed by the mandibular lateral incisors (9.6%) and mandibular second premolars (8.2%; Fig. 1). The prevalence of missing teeth was higher in the anterior segment (incisors and canines) than in the posterior segment (premolars and molars). The percentage of patients with oligodontia was 3.75% (4 males and 2 females), which yields a prevalence rate of 0.34% for oligodontia.

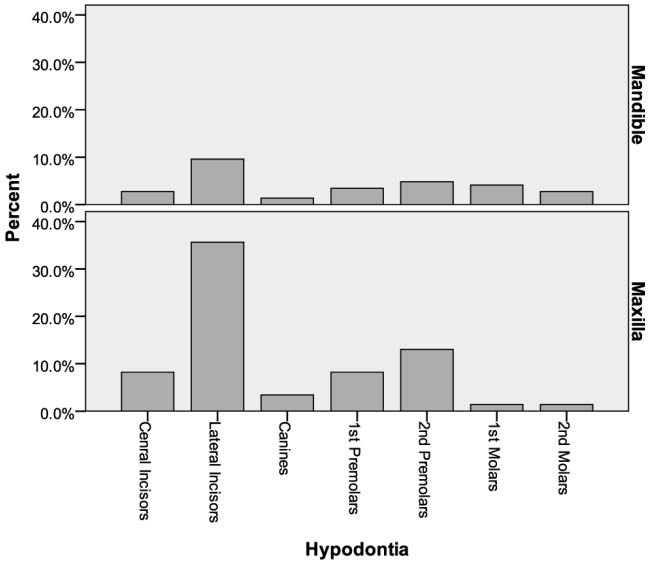

Fig. 1 Location of the missing teeth.

Table 2 Distribution of hypodontia (%) by sex

		Hypodontia		Total
		No	Yes	
Sex	Male	796 (91.5)	74 (8.5)	870
	Female	795 (90.2)	86 (9.8)	881
Total		1591 (90.9)	160 (9.1)	1751

Chi-square = 0.832, $P = 0.36$

Table 3 Distribution of malocclusion type (%) in patients with and without hypodontia

		Malocclusion			Total
		Class I	Class II	Class III	
Hypodontia	No	539 (93.6)	989 (93.3)	63 (54.8)	1591 (90.9)
	Yes	37 (6.4)	71 (6.7)	52 (45.2)	160 (9.1)
Total		576	1060	115	1751

Chi-square = 193.01, $P < 0.001$

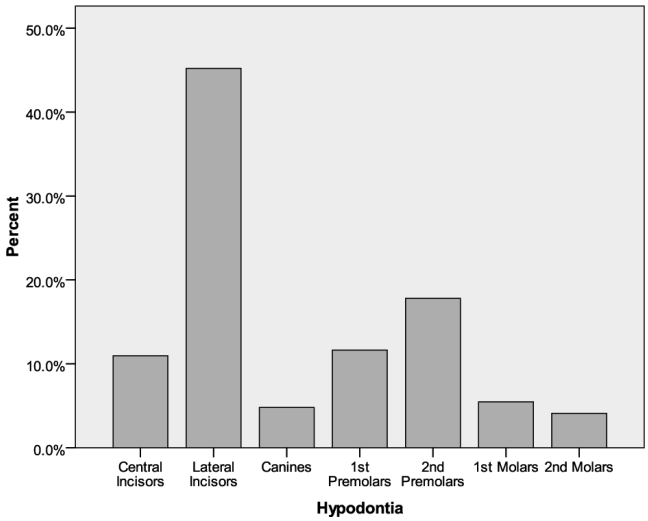

Fig. 2 Distribution of the missing teeth.

Discussion

Although the prevalence of dental anomalies has been reported in many countries, there has been no published study of an Iranian population. The present study provides preliminary information on the prevalence and distribution of hypodontia in 1,751 Iranian orthodontic patients treated between 1999 and 2009 at two university orthodontic clinics. According to Bolk's theory of terminal reduction (6), which was later confirmed by Jorgenson (25) and Schalk van der Weide et al. (17), when only one to four teeth are missing, the absent tooth will be the most distal tooth of a given type (ie, lateral incisors, second premolars, and third molars). This accords with our findings; we observed that the most frequently affected teeth were the maxillary lateral incisors (35.6%) and maxillary second premolars (13.0%), followed by the mandibular lateral incisors (9.6%) and mandibular second premolars (8.2%).

The prevalence of hypodontia (excluding third molars) in the present study was 9.1%, which was higher than that observed in a Mexican population (2.7%) (26), but lower than in Slovenian orthodontic patients (11.3%) (27). This value is within the range of 1.6% to 9.6% reported for a normal population (1). However, this prevalence rate is nevertheless relatively high, which appears to support the findings of Horowitz (28), Ringqvist and Thilander (29), and Silverman and Ackerman (30), which indicated that teeth were more likely to be missing in orthodontic patients than in the general population. There are differences between countries in the organization and provision of orthodontic service; thus, there will be differences in the availability and uptake of orthodontics. Such differences can affect calculations of the occurrence rate of hypodontia. The higher prevalence rate that we observed in the present study might also be due to unique characteristics of the Iranian population and the fact that the evaluation was performed retrospectively with an Iranian orthodontic population, rather than prospectively with a planned random sampling of the general population. However, the current data can be used for sample size calculation in future epidemiological studies.

In the present study, females had a higher prevalence of hypodontia, but there was no significant difference between sexes, which is in agreement with most previous studies (27,31-34). However, some investigators did observe statistically significant sex differences (29,35-37). In the present study, hypodontia was more common in the maxilla than in the mandible. This agrees with previous studies by Symons et al. (3), Silva Meza (26), Fekonja (27), Lavelle and Moore (38), Altug-Atac and Erdem (39), Salama and Abdel-Megid (40), and Peker et al. (41). However, Kirzioğlu et al. (42) reported that missing teeth were more common in the mandible than in the maxilla.

Calcification of the crown starts at age 3 years and is usually complete by age 6 years (24). Tooth buds with late onset of mineralization (eg, mandibular second premolars) might result in a false-positive diagnosis of agenesis on radiographs. On average, mineralization of the mandibular second premolar starts at age 3 to 3.5 years, but it can begin many years later (43,44). A mandibular second premolar, classified as agenetic in a patient aged 7 years, later developed after age 10 years (45,46). In some individuals, development of premolars may be delayed (22); therefore, a diagnosis of hypodontia cannot be certain before approximately age 9 years, particularly in boys (47). Wisth et al. (48) demonstrated that the prevalence of missing teeth was higher in children aged 7 years than in those aged 9 years: at age 7 years, 7.1 percent of the children had missing teeth; 2 years later, hypodontia was diagnosed in only 6.6 percent of the same sample. Therefore, only patients older than 9 years were included in the present study sample.

The prevalence of oligodontia is estimated at 0.14% in whites (49). In our study we observed a prevalence of 0.34%, which is much lower than that observed by Peker et al. (7%) (41) in their study of a Turkish population. However, Sisman et al. (50) reported a prevalence of 0.17% in their sample of Turkish orthodontic patients. The prevalence of oligodontia in our study was higher than that noted by Sisman et al. (50) and Nordgarden et al. (0.0084%) (24). The fact that the present study used orthodontic patients, and not a sample of the general population, partially explains the higher prevalence of

oligodontia. The differences could also be due to differences in ethnicity and sample size. As in the Turkish study by Peker et al. (41), none of the present patients had anodontia, most likely because such patients would not visit orthodontic clinics, and would instead be treated in pedodontic or oral diagnosis clinics.

As was the case in most previous studies, the maxillary lateral incisor was the most frequently missing tooth in the current study (26,27,31). Excluding third molars, a review of the literature reveals some variation in the description of the most frequently missing tooth. Some studies indicate that the mandibular second premolar was the most frequently missing tooth (32,33). As Gomes et al. (31) suggested, these differences may reflect differences in the psychosocial aspects of orthodontic treatment between countries.

Several studies have investigated the prevalence of hypodontia in different populations; however, only a few (51-53) have addressed the issue in relation to orthodontic malocclusion. These studies (51-53) used different methods for classification of malocclusion, which makes it difficult to compare their findings with the present results.

We observed a higher prevalence (45%) of hypodontia in patients with Class III malocclusion, which was also reported by Basdra et al. (51) and Chung et al. (53). However, Oslu et al. (52) found no relationship between malocclusion type and hypodontia prevalence. Our finding may be explained by the higher incidence of tooth agenesis in the maxillary arch (71%) of the present patients and the fact that hypodontia has a tendency towards Class III skeletal pattern (54,55). The higher prevalence of hypodontia in patients with Class III malocclusion can be partially explained by the fact that hypodontia was more prevalent in the maxilla (71%) than in the mandible (29%), and by the higher prevalence of missing teeth in the anterior segment (incisors and canines) than in the posterior segment (premolars and molars). Given the relatively high prevalence of Class III malocclusion in the Iranian population (56) and the positive associations observed in this preliminary study, larger studies of the Iranian general population are needed to further investigate this association. The present findings, however, provide information that should help clinicians to determine where to focus their attention in orthodontic examinations of patients when hypodontia is suspected.

The prevalence of hypodontia in the present study was 9.1%; it was more common in patients with Class III malocclusion and presented mostly in the maxillary arch. In accordance with most studies from other countries, the teeth most likely to be affected were the maxillary lateral incisors, maxillary second premolars, mandibular lateral incisors, and mandibular second premolars.

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