





Prevalence of permanent numeric dental anomalies in panoramic radiography in an Iranian population

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Aim: Dental number anomalies are a group of congenital developmental disorders divided into two groups supernumerary and missing teeth. This study was conducted to investigate the prevalence of numeric dental anomalies using panoramic images in patients referred to the Hamadan Dental Faculty. **Methods:** In this cross-sectional study, 2,197 panoramic radiographs of patients aged 6-49 years were evaluated. These anomalies are divided into two groups: 1) Supernumerary teeth, including Mesiodens, Distodens, and Peridens, and 2) Missing teeth, including Hypodontia, Oligodontia, and Anodontia. A Chi-square test was performed to assess the relationship between the anomalies. Data analysis was performed using SPSS 16, in which P-value < 0.05 was considered the statistical significance level.

Results: Of 736 males (32.2%) and 1548 females (67.8%) in this study, 32 (4.3%) and 55 cases (3.8%) had supernumerary teeth, respectively. The prevalence of supernumerary teeth was 0.3%, 0.5%, and 0.6% in males and 0.2%, 1% and 1.2% in females for mesiodens, distodens, and peridens, respectively. Also, 243 males (10.6%) and 655 females (28.6%) had missing teeth anomalies. Hypodontia in the maxilla was the most common anomaly in both genders, while mesiodens was the least common. **Conclusion:** Hypodontia was the most common anomaly, followed by peridens; the least common anomaly was mesiodens. The prevalence of supernumerary teeth was greater in males, though the difference was not statistically significant. In comparison, females had a greater prevalence of missing teeth.

Keywords: Tooth Abnormalities. Anodontia. Radiography.

Introduction

Numeric dental anomalies are a group of congenital developmental disorders that are divided into two groups of supernumerary and missing teeth. These groups, in turn, are classified into bilateral and unilateral types. Supernumerary teeth include hyperdontia, mesiodens, distodens, peridens, and supplementary teeth, whereas the missing teeth include hypodontia, oligodontia, and anodontia¹.

Factors affecting the development of anomalies are either genetic or environmental². The etiology of dental anomalies is not well known. Although various researchers have attributed dental developmental disorders to genetics, some genetic-environmental factors also are effective in this regard³⁻⁵. These abnormalities can cause many problems in patients, such as misalignment of the teeth (malocclusion) and changes in the maxillary arch length. These disorders, especially in the anterior region, are important in terms of aesthetics and orthodontic treatment plan⁶.

Supernumerary teeth can potentially impact the development, position, and number of teeth in the natural dental system. In the case of an eruption, these teeth can cause misalignment of the normal dentition. Supernumerary teeth that remain in the jaws may cause root resorption of adjacent teeth and the development of dentigerous cysts in their follicles and interfere with the normal eruption sequence of the adjacent teeth¹. Missing teeth can have a potential effect on the aesthetics and function of the mouth. Absent teeth may signify different syndromes and diseases such as orofaci-digital, Crouzon, Down, Ectodermal dysplasia, Gorlin, Ankyloglossia Superior, and Robinson⁷. Therefore, early diagnosis and timely referral are essential to deal with this health issue⁸.

One way to study numeric dental anomalies is the use of panoramic images. Panoramic radiography is used as a first choice radiographic method to detect latent teeth because it provides an overview of the maxilla and mandible, alveolar appendages, dentition, and nasal cavity. Such a tool can be used for a complete evaluation of the dental system, study the congenitally missing teeth, and identify supernumerary teeth and tooth impaction⁹. Clearly, dental number anomalies are essential in different fields of dentistry, especially in treatment planning.

Considering the lack of investigations into the prevalence of these anomalies in the city of Hamadan (Iran), the present study investigates the prevalence of numeric anomalies using panoramic radiography in this population.

Material and Methods

This retrospective cross-sectional study was approved by the Medical Ethics Committee at Hamadan University of Medical Sciences in Hamadan, Iran (IR.UMSHA.REC.1397.422). The need to obtain informed consent was waived by the IRBs because all patient data were anonymized before usage and involved no potential risk to patients. It is worthy to note that the data was extracted from the faculty's archive on panoramic radiographs. Therefore, consent had been obtained from each patient or the patients' parent/guardian (if the patient was under 18 years old)

before the performance of panoramic radiography to complement the clinical examination, and the possibility of research use of data was considered in the consent form given to patients.

The minimum sample size was determined as follows:

$$n = \frac{z^2_{1-\alpha/2} \times \hat{p} \times (1 - \hat{p})}{r^2} = \frac{1.96^2 \times 0.18 \times (1 - 0.18)}{(0.1 \times 0.18)^2} \approx 1800$$

In the above formula the estimated $\hat{p} = 0.18$ was obtained from the previous studies¹⁰ and the relative margin error was considered as 10 percent.

So, we assessed panoramic radiographs and dental records of all 5,000 patients who have been referred to the School of Dentistry of Hamadan University of Medical Sciences to take panoramic images during 2010-2019.

Radiographs of patients over 49 and under 6 years of age and those with a history of tooth extraction, orthodontic treatment, syndromes such as Down's, Gorlin, Crouzon, Ectodermal dysplasia, cleft lip and palate, and extensive tooth loss were excluded. Eventually, 2,284 panoramic radiographs belonging to the age group of 6-49 years were enrolled. In this study, all 2,284 panoramic radiographs were enrolled to increase the precision of estimation. So the final sample size of the present study was $n=2,284$. Each patient has an identification number from which the number of radiographs obtained from them is detectable. Therefore, it can be ensured that only one radiograph of each patient was enrolled in the study. Afterward, the prevalence of dental number anomalies and their relationship to the patient's sex was determined. These anomalies were divided into two groups:

1. Supernumerary teeth, including subgroups of mesiodens (a cone-shaped primary tooth with short roots that forms between the maxillary central incisors and may appear singular or in pairs and also erupted or impacted)¹¹, peridens (supernumerary teeth seen in the premolar area), and distodens (supernumerary teeth that form in the molar area)¹.
2. Missing teeth, including subgroups of hypodontia (missing one or more teeth), oligodontia (a subset of hypodontia that includes missing 6 or more teeth), and anodontia (complete absence of teeth)¹².

The radiographs were examined separately by two dentists, and the reliability between the two observers was measured using the Kappa statistics, which was estimated to be 81.62%. The collected data were recorded in a checklist designed by the researchers and then were statistically analyzed using SPSS version 16. A Chi-square test was performed to analyze the data. Qualitative variables were described using frequency and percentage. The significance level for all tests was set at 0.05.

Results

In the present study, we evaluated the panoramic radiographs of 2284 patients referred to the Hamadan School of Dentistry. Of these patients, 736 (32.2%) were

male, and 1548 (67.8%) were female. The age range of the patients was 6-49 years, and their mean age was 19.12 (\pm 8.74).

Distribution of the numeric anomalies by gender:

Of the 736 studied men and 1548 women, 32 (4.3%) and 55 (3.8%) showed a supernumerary dental anomaly, respectively.

In general, the prevalence of supernumerary teeth was higher in men than of those in women, though it was not statistically significant. The prevalence of mesiodens and distodens (Fig. 1) in men was higher than in women. In contrast, women showed a greater prevalence of peridens (Fig. 2) (Table 1).

Table 1. Frequency distribution of supernumerary anomaly by gender

		Sex		Total
		Male	Female	
Normal	N	704	1493	2197
	% within supernumerary	32.0%	68.0%	100.0%
	% within sex	95.7%	96.4%	96.2%
	% of Total	30.8%	65.4%	96.2%
Mesiodens	Count	6	5	11
	% within supernumerary	54.5%	45.5%	100.0%
	% within sex	0.8%	0.3%	0.5%
	% of Total	0.3%	0.2%	0.5%
Distodens	Count	12	23	35
	% within supernumerary	34.3%	65.7%	100.0%
	% within sex	1.6%	1.5%	1.5%
	% of Total	0.5%	1.0%	1.5%
Peridens	Count	14	27	41
	% within Supernumerary	34.1%	65.9%	100.0%
	% within sex	1.9%	1.7%	1.8%
	% of Total	0.6%	1.2%	1.8%

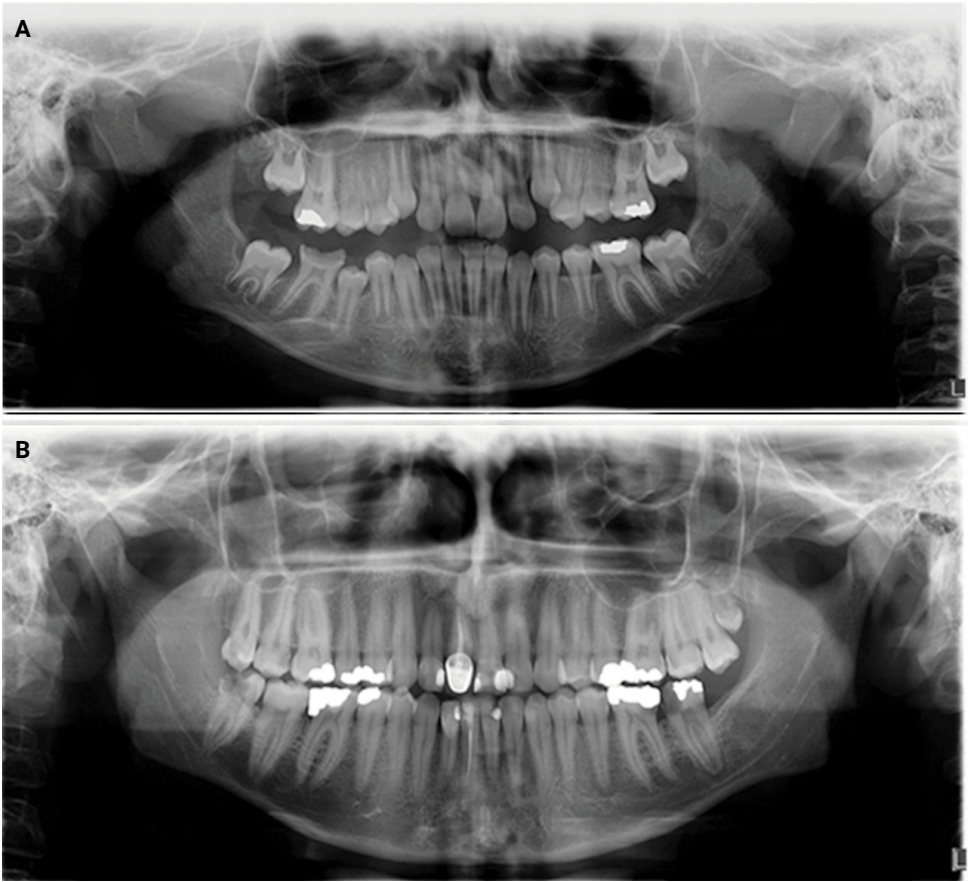


Figure 1. Supernumerary tooth in A) between upper central incisors (Mesiodens) and in B) the upper left molar region (Distodens)



Figure 2. Multiple supernumerary teeth in premolar regions (Peridens)

Among the entire studied population, 243 males (33%) and 655 females (42.3%) had missing teeth. The women had a significantly greater prevalence of missing teeth ($p < 0.001$). All men showed hypodontia (100%) (Fig. 3). In contrast, of 655 women with missing dental anomalies, 590 (90.07%) had hypodontia, and 65 (9.93%) had oligodontia (Table 2 and Fig. 4).

Hypodontia was the most common anomaly, followed by peridens; meanwhile, the least common anomaly was mesiodens.

Table 2. Frequency distribution of absence anomaly by gender

		Sex		Total	
		Male	Female		
Absence	Normal	N	493	893	1386
		% within Absence	35.6%	64.4%	100.0%
		% within sex	67.0%	57.7%	60.7%
		% of Total	21.6%	39.1%	60.7%
	Hypodontia	Count	243	590	833
		% within absence	29.2%	70.8%	100.0%
		% within sex	33.0%	38.1%	36.5%
		% of Total	10.6%	25.8%	36.5%
	Oligodontia	Count	0	65	65
% within absence		0.0%	100.0%	100.0%	
% within sex		0.0%	4.2%	2.8%	
	% of Total	0.0%	2.8%	2.8%	



Figure 3. Bilateral absence of upper lateral incisors and right third molars (Hypodontia)



Figure 4. Absence of four premolars and two right third molars (Oligodontia)

Distribution of number anomalies by jaw:

The highest prevalence of anomalies in the studied population is related to the upper jaw as in the form of hypodontia, and the lowest prevalence is related to distodens in the mandible. The frequency of anomalies in each jaw quadrant is presented in Tables 3 and 4.

Table 3. Distribution of peridens & distodens among study population by jaw quadrant

Jaw quadrant	Peridens		Distodens	
	Frequency	Percent (%)	Frequency	Percent (%)
lower left	6	0.3	1	0.0
lower left & right	1	0.0	0	0.0
lower right	3	0.1	4	0.2
lower right& upper left	1	0.0	4	0.2
upper left	8	0.3	8	0.3
upper right	12	0.5	9	0.4

Table 4. Prevalence of teeth with hypodontia among study population by jaw quadrant

	Upper right	Upper left	Lower right	Lower left
First incisor %	0.1	0.0	0.8	0.8
Second incisor %	4.7	3.6	1.2	1.3
Canine %	1.5	1.3	0.2	0.2
Premolar %	12.3	10.3	8.4	8.7
First molar %	0.7	0.5	0.1	0.1
Second molar %	0.6	0.4	0.1	0.1
Third molar %	12.7	12.1	8	8.9

Tooth-wise distribution of hypodontia:

The highest prevalence of hypodontia is observed in the upper right third molar (105), upper right premolar (101), and the upper left third molar (100), in the order of their appearance.

Besides, the lowest prevalence of hypodontia is related to the upper right incisor, the lower left first molar, and the lower second molars with the prevalence of one tooth.

Supernumerary and Absence anomaly Cross-relationship:

Among people with supernumerary anomalies, 1.9% had both anomalies of the mesiodens and hypodontia. In comparison, among people with missing teeth anomalies, only 0.1% had these two anomalies simultaneously.

Among people with supernumerary anomalies, 45.7% had both distodens and hypodontia anomalies at the same time, while among those with missing tooth anomalies, only 1.9% had both of these two anomalies.

Among people with supernumerary anomalies, 26.8% had both peridens and hypodontia anomalies, while among those with missing teeth anomalies, only 1.3% had these two anomalies simultaneously. Moreover, none of the cases in the study showed simultaneous anomalies of oligodontia and supernumerary teeth.

Discussion

The present study investigates permanent numeric dental anomalies among patients referred to Hamadan School of Dentistry in Hamadan city. For this purpose, 2,284 patients between the ages of 6 and 49 years, including 736 males (32.2%) and 1548 females (67.8%), were studied. The overall prevalence of number anomalies in this study was 43.1%.

In the study conducted by Bilge et al.¹³, the highest prevalence of dental anomalies was related to positional abnormalities, and the prevalence of dental number anomalies was reported to be 17%. In Saberi and Ebrahimipour's study¹², the highest and lowest prevalence of dental anomalies was related to morphological and numeric anomalies (8.92%). Also, in the study of Montasser and Taha¹⁴, the highest anomaly was related to impaction, and the lowest prevalence of anomalies was related to numeric anomalies (5.2%). In Yassin's study², however, the numeric anomalies were the most prevalent ones (13.4%). The prevalence of numeric dental anomalies in the present study was 43.1%. The explanation for the differences in results is that the absence of the third molar was also considered a numeric dental anomaly in this study, while in some studies, the third molar was eliminated from the study cases. Differences in sample size could also contribute to differences in results.

Prevalence of supernumerary anomalies in the population:

Yassin examined the prevalence and distribution of dental anomalies among Saudi children and reported a hyperdontia prevalence of 3.5%². Kumar et al.¹⁵, studying the prevalence of impaction and numeric anomalies, reported that the lowest prevalence

among anomalies was related to hyperdontia (1.1%). Furthermore, Gupta et al.¹⁶, Osuji and Hardie¹⁷, and Trakinien et al.¹⁰ reported the prevalence of supernumerary teeth to be 2.4%, 1.1%, and 0.85%, respectively. In comparison, in the present study, the prevalence of hyperdontia was reported to be 3.8%.

Prevalence of missing teeth in the population:

In the studies conducted by Kumar et al.¹⁵ and Yassin², hypodontia was the most common developmental anomaly (11.6% and 9.7%, respectively). In the study of Bilge et al.¹³, among the observed cases of numeric dental anomalies, hypodontia was the most common subgroup (13.8%). Similarly, Trakinien et al.¹⁰ reported hyperdontia as the highest prevalence (17.11%) among the numeric dental anomalies. In contrast, Montasser and Taha¹⁴ reported impaction as the most common anomaly (12.8%), while the prevalence of hypodontia was 2.4%.

The result of this study showed that hypodontia, with a prevalence of 36.5%, was the most common anomaly among dental number anomalies. These results are in accord with the findings of Yassin² and Kumar et al.¹⁵ and in contrast with those of Montasser and Taha¹⁴.

Prevalence of supernumerary teeth by sex:

Kumar et al.¹⁵ found no statistically significant difference in the distribution of hyperdontia between men and women. Likewise, Saberi et al.¹² reported similar findings. Yassin² and Montasser and Taha¹⁴ reported the prevalence of hyperdontia with similar distributions in both sexes. Moreover, in the study by Trakinien et al.¹⁰ in a Lithuanian population, no significant difference was found among both genders in the distribution of hyperdontia.

In another study, Acikgoz et al.¹⁸ observed that among the 9,550 studied population, 251 people (all being men) had hyperdontia. In a meta-analysis, Anthonappa et al.¹⁹ reported a higher prevalence of hyperdontia in men compared with women. However, according to some studies, this ratio was 2 to 1^{1,2,9} and elsewhere 1.7: 1^{3,14,18}.

The results of the present study showed a nonsignificant difference between the prevalence of hyperdontia in both sexes. This result agrees with the results of Trakinien et al.¹⁰, Yassin², Saberi and Ebrahimipour¹², Montasser and Taha¹⁴, and Kumar et al.¹⁵ and is inconsistent with those of Acikgoz et al.¹⁸ and Anthonappa et al.¹⁹.

Prevalence of missing teeth by sex:

In the present study, the difference between the prevalence of missing teeth was statistically significant in both men and women but higher in women. A similar finding was also reported by Aktan et al.²⁰, Haqhanifar et al.²¹, and Kumar et al.¹⁵. However, in other studies²²⁻²⁵, there was no significant relationship between gender and hypodontia.

Prevalence of supernumerary teeth in terms of area and type of tooth:

In the present study, the prevalence of supernumerary teeth in the maxilla was reported to be more than mandible, which is in agreement with some studies^{14,18}. In contrast,

Yusof²⁶, evaluating 87 supernumerary teeth, reported a higher prevalence of hyperdontia in the mandible (9.60%) versus the maxilla (1.39%). In the mentioned study, the highest prevalence was observed in the premolar region (62.1%), and the mandibular premolar region was considered a specific region for hyperdontia.

Acikgoz et al.¹⁸ evaluated the prevalence of non-syndrome multiple supernumerary teeth. According to their results, the sequence of location frequency for hyperdontia was the premolar region followed by the anterior region with no distodens observed. However, Trakiniene et al.¹⁰ and Yassin² found mesiodens to be the most common supernumerary teeth.

In the present study, the most common number anomaly after hypodontia was related to peridens, similar to the studies of Acikgoz et al.¹⁸ and Yusof²⁶. Meanwhile, inconsistent with the results of Yassin² and Trakiniene et al.¹⁰, mesiodens showed the lowest prevalence among numeric anomalies.

Acikgoz et al.¹⁸ reported the occurrence of supernumerary teeth in premolars and mandible regions to be 8.83% and 5.64%, respectively.

In the current study, most cases of peridens occurred in the right maxillary region (0.5%), and the lowest occurrence of peridens was in the right mandibular area (0.1%). This result is inconsistent with those of Acikgoz et al., both in terms of the most common location of supernumerary teeth and the most common location of peridens.

According to our findings, the highest number of distodens occurred in the right maxillary region (0.4%), while the lowest number was related to the left mandibular area. Also, in 0.2% of cases, distodens were seen jointly in the right and left regions of the maxilla. This finding is consistent with Acikgoz et al.¹⁸ and contrary to Yusof²⁶.

Prevalence of missing teeth by area and tooth type:

In the present study, the highest number of absent teeth anomalies was observed in the upper jaw, in line with the results of Kiliñç et al.²⁴, Sheikhi et al.²⁷, and Aktan et al.²⁰. In contrast, Trakiniene et al.¹⁰ and Soni et al.²⁵ considered the mandible the most common area for the absence of permanent teeth.

The highest prevalence of hypodontia in the current study is related to the third molar and maxillary premolars, respectively. In this regard, Kiliñç et al.²⁴, Sheikhi et al.²⁷, and Trakiniene et al.¹⁰ reported similar results.

Kiliñç et al.²⁴ showed that 23.29% of the population had at least one 3rd molar hypodontia. Also, they reported a statistically significant difference between the absences of the third molar in the maxilla (14.3%) and the mandible (9.6%). Trakiniene et al.¹⁰ considered the highest occurrence of hypodontia for the third molar and reported that the unilateral prevalence of number anomalies was 1.5 times its bilateral prevalence.

Moreover, Sheikhi et al.²⁷ reported that the absence of the second maxillary premolar with a frequency of 22.02%, as in the present study, is the second most common dental anomaly among teeth involved in hypodontia. In contrast, Soni et al.²⁵ observed the highest prevalence of hypodontia in the maxillary lateral incisors. In contrast, Montasser and Taha¹⁴ reported the highest prevalence of hypodontia in the mandibular

second premolar. The explanation for this finding is that the third molars were not considered by their study.

In a study by Behr et al.²³, maxillary incisors had the lowest frequency (0.1%). Also, Ayala Sola et al.²⁸ reported no absence in the first and second molars. In the present study, the lowest number of anomalies in the type of missing teeth was related to the maxillary right first incisor, first mandibular left molar, and second mandibular molars with a frequency of one per each.

According to the results of this study, 65 cases (9.93%) of the population with missing anomalies (2.8% of the total study population) had oligodontia. This value was 15.8% in the study of Behr et al.²³, who investigated all people with absence anomalies. In studies by Gracco et al.²⁹ and Gupta et al.¹⁶, it reached 0.36% and 0.4% of the total population, respectively.

The differences between the results of this study and other studies in this field can be attributed to various factors. One factor could be the study method; in this study, only permanent teeth were examined, while deciduous teeth were also involved in the results in some other studies. Also, in the present study, the loss of the third molar was considered hypodontia, while it was not considered in some studies. Another factor influencing the difference in results was the effect of genetics and environmental factors on the numeric dental anomalies. The difference in sample size can also affect the outcome of the study. As the limitation of this study, it should be noted that it was not possible to differentiate between the absence of first and second premolars due to the similarity in their morphology. Therefore, the absence of premolars was expressed together.

In conclusion, hypodontia was the most common anomaly, followed by peridens; meanwhile, the least common anomaly was mesiodens. The results showed that the prevalence of supernumerary teeth in the studied population was higher in men, though the difference was not statistically significant. In comparison, women had a significantly greater prevalence of missing teeth. The teeth most frequently involved with hypodontia are the right maxillary third molar, the right maxillary premolar, and the left maxillary third molar, in the order of their appearance. The current study has only investigated numeric dental anomalies in one specific population. Therefore, the necessity of further studies in broader diameters and more diverse populations is felt.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author Contribution

AS, PS and AB contributed to conception and design of the study. LT contributed to the data analysis. PS, AB and AS involved in the data interpretation. PS and AS drafted the manuscript. AB and LT commented on the manuscript. All authors read and approved the final manuscript.

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