Original Article

Evaluation of Developmental Dental Anomalies in an Adult Dentate Iraqi Sub-Population of Sulaimani City by Using Panoramic Radiographs

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Abstract

Objective: The present study attempts to evaluate the prevalence of developmental dental anomalies in patients aged 18 years and over by using panoramic radiographs among the Kurdish subpopulation in Sulaimani city.

Methods: Seven hundred and ninety-four OPGs between 2010 and 2022 were evaluated retrospectively in this study. Using panoramic radiography to evaluate the frequency of dental anomalies in shape, structure, number, and size.

Results: The prevalence of dental anomalies diagnosed by panoramic radiographs was 26.6% among the sample. Anomalies of shape were the most common abnormalities, followed by number, size, and structure. The most common anomaly seen in this study was dilaceration (18.52%), followed by hypodontia and microdontia (both 16.67%), taurodontism, and macrodontia (16.05.%). Less frequent sub-types were amelogenesis imperfecta, peg-shaped lateral incisors and ghost teeth, accounting for 0.62%.

Conclusions: Tooth shape anomalies were the most prevalent forms of developmental dental defects among the Kurdish sub-population in Sulaimani city. Dilaceration, hypodontia, microdontia and taurodontism were the most prevalent categories of abnormalities. The study confirmed that racial variables play a role in the incidence of dental anomalies. In addition, digital panoramic radiography is a beneficial method for the detection of dental abnormalities. Importantly, patient management and the treatment design are dependent on an early diagnosis.

Keywords: *Developmental Anomalies, OPG, Kurdish population, Sulaimani City.*

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Introduction

Developmental anomalies happen throughout tooth development, while acquired anomalies happen after tooth maturation[1]. Some of them emerge during pregnancy and are often present at delivery and last the rest of one's life; others can take years to show themselves. Most of these defects are congenital, and many of them have genetic roots[2]. Although they may also indicate a serious problem or a specific syndrome, abnormalities of the oral and dental structures can be isolated[3]. Teeth abnormalities, including changes in eruption time, position, size, number, shape, and other characteristics, might be signs of various systemic diseases[4]. These anomalies can cause aesthetic issues, malocclusion, and complications with dental procedures, including tooth extraction and root canal therapy[5,6]. Their occurrence and degree of expression in distinct population groups can provide crucial information for phylogenic and genetic studies and aid in the study of variations within and between the different populations[7].

Clinical examinations, medical and dental histories, and radiographic examinations are used to diagnose dental anomalies[8]. Radiographic examination is crucial for identifying anomalies and determining their severity. It might also reveal accidental findings unrelated to the patient's primary complaint[9]. In many populations, dental abnormalities are common. Most dental malformations appear in children, and because dentists lack the expertise to recognize them, they are either misdiagnosed or not treated[10]. The present study used digital panoramic radiographs to evaluate the prevalence of dental anomalies in the adult dentate Kurdish sub-population in the Sulaimani Governorate.

Methods

This retrospective cross-sectional study was conducted using panoramic radiographic data on patients seeking dental treatments for different dental problems and carried out in different private radiographic clinics between 2010 and 2022 in Sulaimani Governorate. This study was registered and approved by the College of Dentistry at Sulaimani University (registration no.145/23 on February 14, 2023). The G power statistical program was used for the determination of sample size; the study involved the analysis of standard orthopantomography (OPGs) of 794 subjects aged 18 years and above. The exclusion criteria included patients with syndromes that could cause dental developmental anomalies, cleft palate, low-quality radiographs, patients undergoing orthodontic treatment, or with traumatic injuries or fractures. To assess the inter-observer variations, using Kappa statistics, 50% of the selected radiographs were reviewed by two experienced radiologists and an oral pathologist. The agreement level between observers was tested. The dental anomalies were recorded depending on the following criteria[11]:

1. Number: hyperdontia and hypodontia.
2. Size: macrodontia and microdontia.
3. Structure: Dentinogenesis imperfecta and amelogenesis imperfecta, ghost teeth, dentinal dysplasia
4. Shape: dilaceration, fusion, gemination, peg-shape lateral incisors, taurodontism, dens evaginates, dens invaginates, supernumerary roots, fused roots, and enamel pearls.

All patients' data were obtained from their medical records. Using a digital machine (Kodak 9000 extra-oral imaging system), exposure time (12.5s), voltage (73 kV), and current (12 mA), all OPGs were captured, and images were stored in a digital database.

Statistical analysis

Statistical software package SPSS 26 (SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk (W) goodness-of-fit test was used to check the data's normality; as the data were not normally distributed, the Chi-Square test was used to show differences between the age and sex groups. Cross-tabulation was used to show the distribution of data in relation to age groups and sex.

Results

This radiographic survey showed that among the 794 OPGs examined (365 males and 429 females), anomalies were found in 211 OPGs (26.6%). The distribution of the sample among the age groups and the sexes is summarized in Table l.

Since the Shapiro-Wilk (W) goodness-of-fit test result was significant (p-value= 0.000), non-parametric tests were used.

In this study, among the 2l1 radiographs with anomalies, 324 anomalies were detected (26.6%); interestingly, some radiographs revealed more than one anomaly. Table 2 shows the distribution of the anomalies; the most frequently repeated anomaly was dilaceration (60 cases), which constituted 18.52% of the total cases, and the least frequent anomalies were amelogenesis imperfecta, ghost teeth, and peg-shaped lateral incisors, with 2 cases (0.62%) for each.

Regarding differences in the frequency of anomalies based on sex, the Chi-Square test result revealed a

significant difference between males and females (p value= 0.023), as shown in Table 3. Regarding differences between males and females in relation to frequencies of anomalies in each patient (i.e., some patients experienced only one anomaly, while others showed more than one 2, 3, or 4), these differences in relation to sex are shown in Table 3.

Meanwhile, no significant difference was detected between age groups, as the p-value was 0.102 (Table 4).

Analysis of the data showed that among the 324 anomalies, the teeth most affected with abnormalities were the maxillary left central incisor and maxillary right lateral incisor (39 reported abnormalities, 12.04%), and the least affected was the maxillary right canine, with only one anomaly reported (0.5% of total anomalies) (Table 5).

Figure 1 shows the distribution of the shape, number, size, and structure categories of anomalies, with shape anomalies being the most frequent.

Table 1: Distribution of anomalies according to age and sex.

Categories	Sub-categories	Anomalies		Total
		No anomalies	Have anomalies	
Age Groups	18-29 Years	169 (21.3%)	68 (8.6%)	237 (29.8%)
	30-40 Years	212 (26.7%)	61 (7.7%)	273 (34.4%)
	Over 40 Years	202 (25.4%)	82 (10.3%)	284 (35.8%)
Total		583 (73.4%)	211 (26.6%)	794 (100%)
Sex Groups	Male	264 (33.2%)	101 (12.7%)	365 (46%)
	Female	319 (40.2%)	110 (13.9%)	429 (54%)
Total		583 (73.4%)	211 (26.6%)	794 (100%)

Table 2: Distribution of anomalies according to the frequency of single or multiple repeats.

Anomalies	One anomaly	Two anomalies	Three anomalies	Four anomalies	Total (among anomalies)
Supernumerary tooth	2 (0.97%)	1 (1.16%)			3 (0.94%)
Congenital Missing	33 (15.94%)	14 (16.28%)	5 (22.73%)	2 (22.2%)	54 (16.67%)
Microdontia	28 (13.53%)	18 (20.93%)	6 (27.27%)	2 (22.2%)	54 (16.67%)
Macrodontia	32 (15.46%)	16 (18.60%)	3 (13.64%)	1 (11.1%)	52 (16.05%)
Amelogenesis Imperfecta	2 (0.97%)	0 (0.00%)			2 (0.62%)
Dentinal Dysplasia	4 (1.93%)	0 (0.00%)			4 (1.23%)
Dilaceration	48 (23.19%)	9 (10.47%)	2 (9.09%)	1 (11.1%)	60 (18.52%)
Fusion	3 (1.45%)	1 (1.16%)			4 (1.23%)
Taurodontism	30 (14.49%)	15 (17.44%)	5 (22.73%)	2 (22.2%)	52 (16.05%)
Dens invaginatus	8 (3.86%)	1 (1.16%)			9 (2.78%)
Dens evaginatus	2 (0.97%)	2 (2.33%)			4 (1.23%)
Supernumerary root	2 (0.97%)	1 (1.16%)	1(4.55%)		4 (1.23%)
Fused roots	3 (1.45%)	0 (0.00%)		1 (4.5%)	4 (1.23%)
Enamel pearl	8 (3.86%)	6 (6.98%)			14 (4.32%)
Ghost teeth	1 (0.48%)	1 (1.16%)			2 (0.62%)

Table 3: Chi-square test showing the difference between the sex groups in relation to the frequency of anomaly repeats.

	Sex Groups	One anomaly	Two anomalies	Three anomalies	Four anomalies
Chi-Square	5.159	224.220	76.571	5.273	1.000
Df	1	13	11	5	5
Asymp. Sig.	0.023	0.000	0.000	0.384	0.963

Table 4: Chi-square test showing the difference between the age groups in relation to the frequency of anomaly repeats.

	Age Groups	One anomaly	Two anomalies	Three anomalies	Four anomalies
Chi-Square	4.567	224.220	76.571	5.273	1.000
df	2	13	11	5	5
Asymp. Sig. (p-value)	0.102	0.000	0.000	0.384	0.963

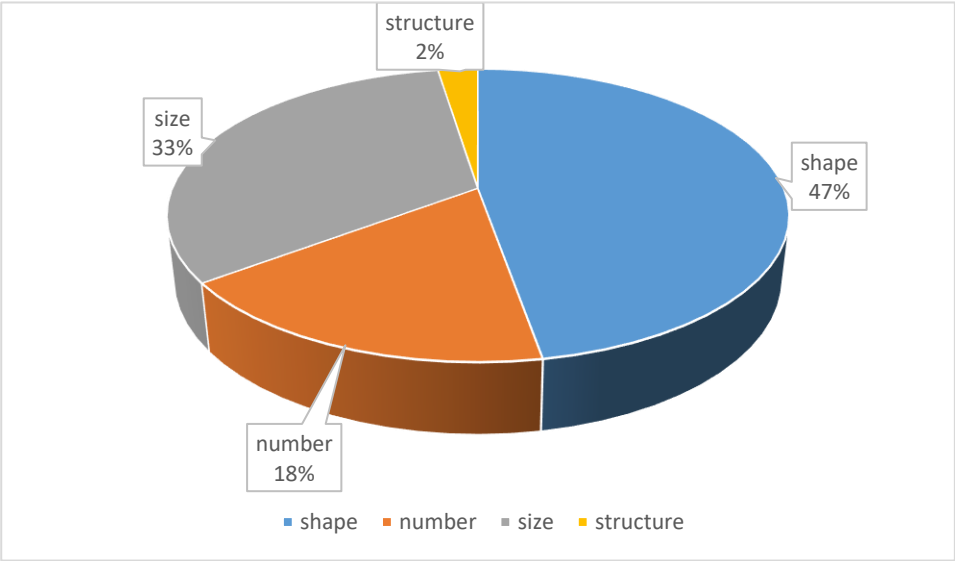

Figure 1: A pie chart showing the distribution of the different categories of anomalies.

Table 5: Crosstabulation of anomalies affecting teeth in the different quadrants.

Teeth	One tooth anomaly	Two teeth anomalies	Three teeth anomalies	Four teeth anomalies	Total
Upper right central incisor	26 (12.3%)	5 (5.68%)	3 (13.6%)		34 (10.49%)
Upper right lateral incisor	28 (13.3%)	8 (9.09%)	3 (13.6%)		39 (12.04%)
Upper right canine	1 (0.5%)				1 (0.31%)
Upper right 1st premolar	5 (2.4%)				5 (1.54%)
Upper right 2nd premolar	3 (1.4%)	1 (1.14%)			4 (1.23%)
Upper right 1st molar	4 (1.9%)	5 (5.68%)			9 (2.78%)
Upper right 2nd molar	1 (0.5%)	5 (5.68%)			6 (1.85%)
Upper left central incisor	17 (8.1%)	19 (21.59%)	2 (9.1%)	1 (11.1%)	39 (12.04%)
Upper left lateral incisor	7 (3.3%)	7 (7.95%)	3 (13.6%)	2 (22.2%)	19 (5.86%)
Upper left canine	1 (0.5%)	1 (1.14%)			2 (0.62%)
Upper left 1st premolar	4 (1.9%)				4 (1.23%)
Upper left 2nd premolar	1 (0.5%)	2 (2.27%)		1 (11.1%)	4 (1.23%)
Upper left 1st molar	7 (3.3%)	2 (2.27%)	2 (9.1%)		11 (3.40%)
Upper left 2nd molar	4 (1.9%)	3 (3.41%)	1 (4.5%)	1 (11.1%)	9 (2.78%)
Lower left central incisor	7 (3.3%)		2 (9.1%)		9 (2.78%)
Lower left lateral incisor	2 (0.9%)	1 (1.14%)	1 (4.5%)		4 (1.23%)
Lower left canine	3 (1.4%)				3 (0.93%)
Lower left 1st premolar	9 (4.3%)		1 (4.5%)		10 (3.09%)
Lower left 2nd premolar	12 (5.7%)	1 (1.14%)	1 (4.5%)		14 (4.32%)
Lower left 1st molar	8 (3.8%)	3 (3.41%)	1 (4.5%)	1 (11.1%)	13 (4.01%)
Lower left 2nd molar	21 (10%)	3 (3.41%)			24 (7.41%)
Lower right central incisor	3 (1.4%)	8 (9.09%)		1 (11.1%)	12 (3.70%)
Lower right lateral incisor	2 (0.9%)	1 (1.14%)		1 (11.1%)	4 (1.23%)
Lower right canine	2 (0.9%)	2 (2.27%)			4 (1.23%)
Lower right 1st premolar	8 (3.8%)	1 (1.14%)	1 (4.5%)		10 (3.09%)
Lowr right 2nd premolar	8 (3.8%)	4 (4.55%)	1 (4.5%)		13 (4.01%)
Lower right 1st molar	2 (0.9%)				2 (0.62%)
Lower right 2nd molar	9 (4.3%)	6 (6.82%)		1 (11.1%)	16 (4.94%)
Total	205 (100%)	88(100%)	22 (100%)	9 (100%)	324 (100%)

Discussion

Dental developmental abnormalities are a common finding in both radiographic and clinical examinations[12]. The prevalence of these developmental defects cannot be determined by clinical examination alone without radiographic imaging[13]. The preferred technique for most dental procedures, including orthodontics, prosthesis, and surgery, is digital panoramic radiography, using low-dose radiation to display more information at a lower cost and over a larger area of the jaws and teeth. These radiographs can be used to examine normal and pathological discoveries, such as dental malformations that occasionally need to be checked on and followed up on in case extra treatment is necessary[5].

In the current investigation, we used OPGs to assess the prevalence of developmental dental abnormalities in patients from Sulaimani City, whose ages ranged upwards from 18 years. Our study's main finding was the presence of dental anomalies in 26.6% of patients.

The prevalence of developmental dental anomalies has been recorded in a wide spectrum of literature, and different frequencies have been reported. Various age ranges, racial and genetic factors, and diagnostic criteria for dental malformations could contribute to this variance.

According to the findings of this study, the prevalence of dental anomalies diagnosed by panoramic radiographs was approximately 26.6%. This percentage was comparable to that found by Haghanifar et al.[1] in 2019 (28.06%), Mahmood et al.[14] (28.22%) in Kurdistan -Halabja City and Shokri et al.[15](29%), but lower than those found in Iraqi studies by Missan and Najaf, and Gupta et al., who detected higher levels of anomalies (33.9 %, 32.8%, 34.28%, respectively)[2,4,16]. Research done by Ardakani et al.[17] in 2007 also recorded a higher prevalence of 40.8% (sample size 900 OPGs). In contrast, Kumar et al.[13] (2020) reported that only 16.7% of the 1100 OPGs in their study had dental anomalies.

This discrepancy in results may be attributable to the diagnostic criteria used to identify and classify dental anomalies and genetic and racial factors. In addition, the types of anomalies evaluated by those studies may be an additional cause of this inconsistency, given that previous studies only investigated a subset of anomalies[13,15.18].

The present study's results revealed a statistically significant difference between genders in the occurrence of dental anomalies. This finding is different from those reported by Kumar et al.[13], Alamiri[10], and Baron et al.[19] but agrees with those of Khaleel et al.[4] and Bilge et al.[20], Guttal et al.[21], Afify and Zawawi[22], and Nemati et al.[23]. This lack of consistency in the results could be attributed to the sample size and racial diversity among the population's various racial groups.

Regarding the different types of abnormalities, our study revealed that the prevalences of shape, size, number, and structure anomalies were 47.22%, 32.72%, 17.59%, and 2.47%, respectively. Among the anomaly sub-types, dilaceration was the most common shape anomaly (prevalence: 18.52%), while hypodontia was the most numerous anomaly (prevalence: 16.67%), amelogenesis imperfecta and ghost teeth were the most common among the structure anomalies (prevalence: 0.62%), and microdontia was the most common among size anomalies (prevalence: 16.67%). Comparing our findings to those of Saberi and Ebrahimipour[5], they found that shape (71.70%), malposition (19.81%), and number (8.49%) were the three most prevalent dental abnormalities. In addition, Khaleel et al.[4] and Bilge et al.[20] reported that malposition anomalies accounted for a high percentage of the study cases, followed by anomalies in shape. These findings might be due to limited sample size, racial disparities, and the fact that the studies looked at both clinical and radiographic data.

In the current study, the dilacerated root was the most prevalent dental anomaly, with 18.52%, followed by hypodontia and microdontia at 16.67%, taurodontism, and macrodontia at 16.05%. Amelogenesis imperfecta and peg-shaped lateral and ghost teeth were the least prevalent anomalies, at 0.62%. These results support the findings of Diab[24], who reported 20% dilacerated roots, followed by hypodontia (15.4%), and taurodontism (5.7%). In reporting similar results, Ardakani et al.[17] and Ghabanchi et al.[25] both recorded the same prevalence (15%, 5.6%,1.4%, respectively). While Khaleel et al.[4] reported that hypodontia (14.4%) was the most prevalent anomaly, followed by taurodontism (11.27%) and then dilaceration 3%.

The prevalence of hypodontia in our sample was 16.67%, which is comparable to the results of Shokri et al.[15] and Diab[24] (15.88% and 15.4%, respectively). The maxillary lateral incisor was the tooth most affected with hypodontia, representing 52% of cases. This agrees with results found by Najim et al.[26], Mohammed[27] in Sulaimani City, and Mahmood et al.[14] in Halabja City, but disagrees with the finding by Sarkis,[28] in Al-Radwaniya village, that lower second premolar was the tooth most affected with hypodontia. Our study also recorded a higher percentage of taurodontism (16.05%) than in the studies by Shokri et al.[15] and Diab[24] (3.34%, 7.5%, respectively).

According to literature reports[29], the prevalence of hyperdontia ranges from 0.1% to 3.8%. In the current investigation, the finding of 0.94% is in accordance with Fardi et al.[18], Gupta et al.[16], and Sarkis[28], who reported hyperdontia in 1.8%, 0,89, and 0.93% of cases, respectively. Lower prevalence has been reported by Guttal et al.[21] (0.43%), Al-Nori[30] (0.4%), and Najim and Yunis[2] (0.36%). This may be because the study did not consider different age groups (individuals aged less than 18 years were excluded). In other radiographic studies, Shokri et al.[15] from Iran (2.43%) and Diab[24] from Saudi Arabia (5.4%) reported a higher prevalence of hypodontia.

Mesiodens was not found in our study, which may be because our study only included participants who were 18 years of age and older. Hence, mesiodens may have been extracted for cosmetic purposes.

In comparison to the findings by Najim et al.[26], Al-Nori[30], Sarkis[28], and Mahmood et al.[14], of 4.8%, 1.1%, 1.86%, and 1.75% cases of microdontia, respectively, our study recorded a very high percentage (16.67%), and the lateral incisors were the most affected teeth.

In our study, the prevalence of macrodontia was 16.05%, which contrasts with results reported by Patil et al.[7] and Bilge et al.[20] (0.2% and 0.16%, respectively). Dens evaginatus appeared in about 1.23% of the sample, which is very similar to Mahmood et al.[14](0.87%) and Mohammed[27] (0.74) and higher than Najim and Yunis[2] (0.23%), but less than was recorded by Gupta et al.[16] (2.40%). These variations highlight the need for further research in different populations.

Supernumerary root (most affected was the lower second premolar), fused root (associated with the lower first molar), fusion, and dentinal dysplasia were recorded in only 4 cases, representing 1.25% of the sample.In the present study, upper incisors were associated with supernumerary teeth, dens invaginatus, congenitally missing teeth, and dens evaginatus.

The frequency of dens invaginatus was 9 cases, constituting about 2.78% of the sample. This was more than the frequencies found by Patil et al.[7] (0.4%), Najim and Yunis[2](0.03%), and Sabri[5], who recorded 1.4%, but less than Khaleel et al.[4] who reported 5.16%. Several studies based on radiographic examinations did not record dens invaginatus, such as Afify and Zawawi[22], Patil et al.[7], and Alamiri[10].

In our analysis, no instances of gemination were discovered, while Najim et al.[26] found just one case in their study.

Only two cases of amelogenesis imperfecta were found, which might be due to difficulty interpreting enamel defects from OPGs, and further clinical examinations are needed.

The prevalence of peg-shaped lateral incisors in our study was only 2 cases (0.62 %), whereas Najim et al. 26 recorded a high prevalence of 16%. According to a systematic review by Hua et al.[31], the overall prevalence of peg-shaped maxillary permanent lateral incisors was 1.8%.

In comparison to Khaleel et al.[4], Najim et al.[26], Najim and Yuins[2], Afify and Zawawy[22], Mahmood[14], and Patil et al.[7], enamel pearl accounted for a higher prevalence of about 4.32% in the current study.

One of this study's limitations is that some anomalies are better diagnosed clinically and radiographically (e.g., Dentinogenesis imperfecta and different types of dens invaginatus). Nevertheless, in terms of its strengths, this study examined many developmental anomalies (about 16 sub-types) that panoramic radiographs might detect, had an acceptable sample size representing a large community, and used a single radiographic machine.

Numerous epidemiological studies have recently been conducted in various parts of the world to ascertain the prevalence of dental abnormalities[1,4,9,13]. The results of these studies have shown that variations in the prevalence of dental anomalies could be due to regional and racial differences[7]. This is the first study to assess the prevalence of developmental anomalies among the Kurdish population in Northern Iraq.

Conclusion

The prevalence of dental anomalies in our study was 26.6%; the most common type of developmental dental anomaly among a sub-Iraqi subpopulation in Sulaimani City related to the shape of the teeth. The three most common types of anomalies were dilaceration, hypodontia, and taurodontism. The study has shown that racial factors influence the prevalence of dental abnormalities. Moreover, diagnosing dental irregularities can be done extremely well with the help of digital panoramic radiography.

Although these anomalies may not always be symptomatic, they can still lead to various clinical problems. Early diagnosis is crucial, since many therapeutic and preventative measures are most successful when employed in the earliest possible stages.

Multicentric studies with a broader sample size are encouraged to represent larger regions of the country.

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