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ORIGINAL ARTICLE

DENTAL ANOMALIES IN PANORAMIC RADIOGRAPHS OF PERUVIAN ADOLESCENTS

Anomalías dentarias en radiografías panorámicas de adolescentes peruanos

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ABSTRACT

Aim: Determine the prevalence of dental anomalies in panoramic radiographs of Peruvian adolescents according to their sex and age.

Material and Methods: A retrospective study was carried out using panoramic radiographs of 300 patients (147 men and 153 women) aged between 12 and 18 years who attended a radiological center in the period from May to August 2022. These patients were examined to determine the presence of dental anomalies of shape, size, number, position and structure. The incidence of these anomalies was evaluated according to sex and age.

Results: Among the 300 subjects, a total of 129 individuals (75 men and 54 women) presented at least one of the selected dental anomalies (43%). The anomalies in our study were position 22.3%, number 17%, shape 11.7% and size 1.6%.

Conclusions: Tooth impaction was the most frequent anomaly in Peruvian adolescents, followed by dental hypodontia; and these have a relationship with sex and age.

Keywords: *Panoramic radiograph; Tooth abnormalities; Supernumerary teeth; Adolescence; Epidemiology, descriptive; Prevalence.*

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RESUMEN

Objetivo: Determinar la prevalencia de anomalías dentarias en radiografías panorámicas de adolescentes peruanos según sexo y edad.

Material y Método: Se realizó un estudio retrospectivo mediante radiografías panorámicas de 300 pacientes (147 hombres y 153 mujeres) con edades entre 12 y 18 años que acudieron a un centro radiológico en el período de mayo a agosto de 2022. Estos pacientes fueron examinados para determinar la presencia de anomalías dentales de forma, tamaño, número, posición y estructura. La incidencia de estas anomalías se evaluó según sexo y edad.

Resultados: Entre los 300 sujetos, un total de 129 individuos (75 hombres y 54 mujeres) presentaron al menos una de las anomalías dentales seleccionadas (43%). Las anomalías en nuestro estudio fueron de posición 22,3%, de número 17%, de forma 11,7% y de tamaño 1,6%.

Conclusiones: La impactación dentaria fue la anomalía más frecuente en los adolescentes peruanos, seguida de la hipodoncia dental; y estos tienen relación con el sexo y la edad.

Palabras clave: *Radiografía panorámica, Defectos del desarrollo dental; Anomalías dentarias; Diente supernumerario; Adolescente; Epidemiología descriptiva; Prevalencia.*

INTRODUCTION

Tooth development is an incredibly complex process that is regulated by a series of molecular and cellular interactions. Interruptions and alterations during the initiation, morphogenesis and histodifferentiation phases can cause the appearance of dental anomalies.[1] Dental anomalies are deviations in shape, size, number, position, and structure; these may be congenital, developmental, or acquired.

Congenital anomalies are present from birth (e.g., cleft-associated anomalies), developmental anomalies arise during the morphodifferentiation phase (e.g., hypodontia, taurodontism), and acquired anomalies appear after tooth development due to trauma, infection, or other environmental factors (e.g., enamel hypoplasia).[2] These alterations are influenced by genetic, multifactorial, and environmental factors such as trauma, radiation, infections, and hormonal imbalances.[3–5] They can manifest as isolated defects or as part of systemic syndromes.

For instance, dental anomalies frequently occur in individuals with Down syndrome, including hypodontia, microdontia, and taurodontism.[6] All of these defects can have occlusal, aesthetic, and functional implications, potentially interfering with surgical, restorative, and endodontic treatment.[7]

Consequently, correct early diagnosis made by clinical inspection and with the help of routine radiographic examinations is of utmost importance for evaluation and treatment planning.[8] Very few studies have been carried out in Peru, however there are several epidemiological studies of dental anomalies in other populations, but the results show inconsistencies,[9-13] which demonstrates a geographical and ethnic variation in their prevalence, important information for phylogenetic and genetic studies that can help

understand variations within and between different populations.[2]

The objective of this study is to determine the frequency of dental anomalies detectable in panoramic radiographs, their relationship with sex and age, in a sample of adolescents from a Peruvian population.

MATERIALS AND METHODS

A retrospective study was carried out using panoramic radiographs of 300 patients (147 men and 153 women) in adolescents (12 to 18 years old) extracted from the archives of the Panol 3D Radiographic Center in 2022. The sample selection criteria were inclusion criteria: panoramic radiographs of adolescent patients aged 12 to 18 years, of both sexes, taken between May and August 2022 at the Panoral 3D radiological center; and exclusion criteria: panoramic radiographs that are not legible or clear. Patients with known syndromic conditions (e.g., Down syndrome, cleidocranial dysplasia) were also excluded from the study.

This radiological center receives referrals for various dental evaluations, including a substantial number of patients undergoing orthodontic assessment. As a result, the sample may overrepresent individuals with orthodontic treatment needs rather than reflecting a random sample of the general adolescent population. This potential selection bias must be considered when interpreting prevalence rates.

All radiographic assessments were performed independently by two calibrated examiners: an oral and maxillofacial radiologist with more than 10 years of clinical experience, and a postgraduate dental student trained in identifying dental anomalies.

Prior to data collection, inter-examiner reliability was evaluated using a random subset of 30 radiographs, achieving a kappa value >0.85. A sample size calculation was performed using the standard formula for epidemiological studies:

$$n = (Z^2 * P * Q) / E^2$$

Where:

Z = 1.96 (corresponding to the critical value of Z for a 95% confidence level).

P = 23% = 0.23 (the estimated prevalence of dental anomalies in the population).

Q = 1 - P = 0.77

E = 5% = 0.05 (the desired margin of error).

The calculation resulted in a sample size of approximately 272,139, rounded to 300 panoramic radiographs. This sample size was considered adequate to detect significant differences in the prevalence of dental anomalies in the population of Peruvian adolescents. In the present study, the following dental anomalies were evaluated: size anomalies (macrodontia and microdontia), number anomalies (hypodontia and supernumerary teeth), shape anomalies (dilaceration, taurodontism, fusion, gemination, concrescence, invaginated, evaginated and talon cusp), position anomalies (retained primary teeth and impacted) and structural anomalies (amelogenesis imperfecta, dentinogenesis imperfecta and dysplasia).

Third molars were included in the assessment of dental anomalies. A third molar was classified as “impacted” if it presented closed apices (complete root formation) and no observable eruptive pathway. This operational definition follows the maturity index approach described by Akkaya *et al.*,[14] used to distinguish impacted from unerupted teeth in adolescent populations.

Table 1
Prevalence of dental anomalies

			Dental Anomalies	
			n	%
Size	Microdontia	Yes	4	1.3
		No	296	98.7
	Macrodontics	Yes	1	0.3
		No	299	99.7
Number	Hypodontia	Yes	29	9.7
		No	271	90.3
	Supernumerary	Yes	22	7.3
		No	278	92.7
Shape	Dilaceration	Yes	13	4.3
		No	287	95.7
	Taurodontism	Yes	5	1.7
		No	295	98.3
	Fusion	Yes	0	0
		No	300	100
	Gemination	Yes	0	0
		No	300	100
	Concrescence	Yes	0	0
		No	300	100
	Invaginated	Yes	12	4
		No	288	96
	Evaginated	Yes	0	0
		No	300	100
	Talon cusp	Yes	5	1.7
		No	295	98.3
Position	Retained primary teeth	Yes	1	0.3
		No	299	99.7
	Impacted	Yes	66	22
		No	234	78
Structure	Amelogenesis Imperfecta	Yes	0	0
		No	300	100
	Dentinogenesis Imperfecta	Yes	0	0
		No	300	100
	Dental dysplasia	Yes	0	0
		No	300	100

Table 2
Distribution and relationship of dental anomalies according to sex and age

Demographic Data		Dental Anomalies				*p*-value
		Yes		No		
		N	%	N	%	
Sex	Female	54	41.9	99	57.9	0.006 *
	Male	75	58.1	72	42.1	
Age	12 years	11	8.5	40	23.4	0.000 **
	13 years	16	12.4	28	16.4	
	14 years	19	14.7	31	18.1	
	15 years	23	17.8	25	14.6	
	16 years	15	11.6	19	11.1	
	17 years	32	24.8	17	9.9	
	18 years	13	10.1	11	6.4	
Total		**129**	**100**	**171**	**100**	

*: Chi square. **: Mann Whitney U.

In this study, data on the prevalence of dental anomalies, sex and age of adolescents were collected and analyzed. The Statistical Package for the Social Sciences (SPSS) for Windows, version 26.0 (SPSS Inc., Chicago, IL, USA) was used. To determine the cha-racteristics of the sample, standard des-criptive methods such as mean, standard deviation and frequency were applied. The chi-square and Mann-Whitney U tests were used.

RESULTS

Of the 300 orthopantomograms analyzed, a total of 129 presented at least one of the dental anomalies (43%). Impacted teeth were the most frequent of all dental anomalies in the study, with the most frequent positional anomaly (22%), followed by hypodontia (9.7%); dilaceration (4.3%); and microdontia (1.3%). It is important to note that third molars with closed apices and no visible eruptive pathway were included in the classification of impacted teeth. (Table 1)

Among the 29 cases of hypodontia observed, the most commonly missing teeth were the maxillary lateral incisors and the mandibular second premolars, consistent with previously reported patterns in the literature.[9,15,16] No cases of molar agenesis were recorded.

Regarding sex and age, the male sex (58.1%) and the age of 17 years (24.8%) predominate. Furthermore, it was observed that there is a statistically significant relationship between the prevalence of dental anomalies with sex (p=0.006) and age (p=0.000), (Table 2).

DISCUSSION

Dental anomalies can occur before, during, or after tooth formation, and their clinical consequences vary. Some anomalies, such as dilaceration or invaginated teeth, may remain asymptomatic but complicate endodontic or surgical procedures if unde-tected. Others, like hypodontia or micro-dontia, can affect occlusion and aesthetics. Anomalies such as taurodontism and dens invaginatus are often diagnosed only through

radiographic examination.[9,17,18] The prevalence rate and distribution of such anomalies will help dentists identify and recognize them early, planning the appro-priate comprehensive treatment.[9] Although there are studies related to the prevalence of dental anomalies at the international level, no studies were found at the national level, in Peruvian adolescents. Various studies indicate that the frequencies of dental anomalies vary in different populations.

In the study by Mohammadi *et al.*,[19] with 602 Iranian patients, at least one dental anomaly was found in 60.7% of the patients, while in the study by Mohan *et al.*,[20] in 2385 patients from India, only in 5.83% of them. Between these extremes are the results of Hummel *et al.*,[21] in 1042 adolescent patients from North America with 40.88%. This last result is very similar to ours, where we found at least one dental anomaly in 43% of Peruvian adolescents. The reason for such large differences is not entirely clear; could result from racial differences, variable sampling techniques, sample size, and inconsistent or different diagnostic criteria.[9,13,19,22]

However, all variations can be manipulated by the interaction of genetic, epigenetic and environmental factors. This interaction can have a direct or indirect impact on the development of the dentition.[23] In our study, differences were found between dental anomalies and sex (p =0.006), with a greater predisposition to the male sex. In contrast, to the studies of Dagdiya *et al.*,[24] and Bilge *et al.*,[25] The observed sex differences may reflect sample characteristics or potential genetic influences rather than behavioral factors alone. Similar findings were reported in other studies,[16,24] although results across populations remain inconsistent. However, in other studies no significant differences were found.[15,25,26] Likewise, in our study, sig-nificant differences were fo-und between dental anomalies and age (p=0.0000), at 17 years of age. In the study by Aren *et al.*,[27] where the age varied from 13 to 35 years, significant differences were found between the age groups with respect to the preva-lence of dental anomalies, in the age range of 13 to 18 years. However, in the study Sella Tunis *et al.*,[25] no significant differences were found.

The anomalies in our study were position with 22.3%, number with 17% and shape with 11.7%, these were the most common, while size anomalies with 1.6% and structure with 0% were the least common in both sexes. Saberi *et al.*,[18] reported that the most common type of dental anomalies were those of shape with 71.70%, position with 19.81% and number with 8.49%, similar to the study by Aljuaid *et al.*,[8] form with 46.80%, position with 42.90% and number with 26.9%. It is also important to consider that our sample was obtained from a specialized radiographic center, where many patients are referred for orthodontic evaluation. This context likely contributes to the elevated prevalence of anomalies such as impaction and hypodontia observed in our study. Previous literature has reported higher rates of dental anomalies in orthodontic populations compared to the general population,[3,5] supporting the notion that referral patterns can influence prevalence findings.

Impaction, with a 22% prevalence, was the most common subtype of dental anomaly in our study. Similarly, it was the most frequent anomaly in epidemiological studies by Bilge *et al.*,[22] (45.5%) Sella Tunis *et al.*,[25] (14.9%) and Ku *et al.*,[12] (8.6%). This may be due to dental transmigration, where bone fusion points can act as physical barriers, or due to

non-resorption of the deciduous tooth roots. Additionally, morphogenetic variations of the mandible, such as insufficient remodeling of the ramus, can limit eruptive space.[25] In our study, third molars were included in the classification of impaction, provided they had fully formed roots and no evident eruptive pathway, which may partly explain the high frequency observed. In contrast, some comparative studies excluded third molars from analysis,[18] leading to lower reported prevalence.

On the other hand, Saberi *et al.*,[18] reported a prevalence of only 3.41%. This discrepancy may also be due to differing diagnostic criteria or methodological limitations in identifying impacted teeth. Hypodontia, with 9.2%, was the second most prevalent subtype in our study. The results are consistent with the studies of Aljuaid *et al.*,[9] in a Saudi population where it was found to affect 11.3% of people, and Bilge *et al.*,[15] with 13.8% of the Turkish population. This finding is in accordance with Bolk 's theory of terminal reduction, which explains that hypodontia is due to the embryonic union of the upper jaw with the medial nasal process, in addition to being located in a genetically unstable area at the end of the dental lamina.[3] Furthermore, the absence of tooth buds is usually controlled by genetic factors.

However, in some studies, environmental factors were observed as the only etiological factors.[15] In contrast, Jain *et al.*,[13] reported a prevalence of 4.7% in an Indian population. It is also important to consider which specific tooth types were affected. Although our study did not record this detail, previous literature consistently identifies maxillary lateral incisors and mandibular second premolars as the most commonly missing teeth.[9,15,16] Supernumerary teeth, with 7.3%, were the third most prevalent subtype in our study. Similar to the study by Fidele *et al.*,[28] in Chinese residents (5.2%). It can be explained by various theories, the tooth bud dichotomy and the hyperactivity theory, the local hyperactivity of the dental lamina that is both independent and conditioned to the development of an additional tooth bud.[29] In contrast, many studies conducted in Saudi Arabia reported that the prevalence rate of supernumerary teeth ranges between 1 and 1.8%.[16,23,26,29] However, even lower prevalences were reported in a study from Iran (0.51%).[18] It may be due to the fact that in our study they were counted with other anomalies (impacted teeth), in addition, this difference can also be explained by the fact that the population included were adolescents, who have not received any dental treatment.

Dilaceration with 4.3% frequency in our study. In the studies Goutham *et al.*,[30] Al Humaid *et al.*,[26] and Mohammadi *et al.*,[19] a high prevalence was reported in the population of India at 46.7%, Saudi Arabia at 30.2%, and Iran at 27.7%, respectively. Contrarily, Baron *et al.*,[10] reported a prevalence of 0.18% in a French population. However, this discrepancy is because the possibility of misdiagnosis of dilaceration is greater with panoramic radiographs since it is difficult to identify root angulation in labial and lingual directions.

Additionally, low reporting of childhood trauma and lack of regular dental check-ups. Invaginated teeth with 4% frequency in our study. The study by Haghanifar *et al.*,[31] reported a prevalence of 3.8% similar to our study, in an Iranian population. However, there is a large variation, Kfir *et al.*,[32] reported a high prevalence of 26% in an Israeli population; Chen *et al.*,[33] 8.47% in a Chinese population and Saberi *et al.*,[18] 1.37 in a southeastern population of Iran.

This high variability reported could be due to the method and criteria used to define the presence of dens invaginatus.

Talon cusp with 1.7% frequency in our study. In the study by Yassin[34] he reported a prevalence of 1.4% in a population of children from Saudi Arabia. Fekonja[35] reported a prevalence of 3.4% in a population of children from Slovakia. This variability is due to the influence of sample size, talon cusp definition, and detection methodology. Taurodontism with 1.7% frequency in our study. Percentage consistent with the studies of Aljuad *et al.*,[9] and Yassin *et al.*,[34] where they reported a prevalence of 1.9% and 1.4% in populations of Saudi Arabia, respectively.

However, variability is evident. The study by Baron *et al.*,[10] presented a prevalence of 15.06% in a French population. Bilge *et al.*,[15] 11.2% in a Turkish population. Saberi *et al.*,[18] 5.38% in a southeastern Iranian population. Balija *et al.*,[3] 1.2% in a Croatian population. Aren *et al.*,[27] 1.18% in a Turkish population. Mohammadi Shayan *et al.*,[19] 0.16% in an Iranian population. The main cause of this inconsistency may be differences in the criteria used to define taurodontism. Microdontia with 1.3% prevalence was lower than that observed by Mohan *et al.*,[22] of 5.44% in an Indian population, but comparatively higher than that of Vani *et al.*,[16] with 0.9% in a Saudi population. It is because in this last study the third molars were not taken into account. In addition, the criteria when selecting the study groups. None of the patients showed fusion, gemination, concrescence, evaginated tooth, amelogenesis imperfecta, dentinogenesis imperfecta and dental dysplasia.

This study had limitations, limited sample size, a cross-sectional design, and the potential for bias caused by the geographic setting of the study; additional long-term studies are recommended. One limitation of this study is the nature of the sample, which was obtained from a radiographic center rather than a random population-based survey. This may result in a selection bias, as individuals referred for orthodontic evaluation often present a higher frequency of dental anomalies.

Future epidemiological studies should aim to compare prevalence rates in community-based *versus* orthodontically referred populations. Additionally, the study did not classify hypodontia by tooth type, which limits the ability to compare site-specific prevalence with other populations.

CONCLUSIONS

The results of the study on dental anomalies in Peruvian adolescents determine that there is a prevalence of 43% and there is a statistically significant relationship with sex and age. Tooth impaction was the most frequent anomaly, followed by dental hypodontia. The findings must be interpreted considering the potential overrepresentation of orthodontic cases in the sample.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest in relation to the published results.

ETHICS APPROVAL

There's no need.

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AUTHORS' CONTRIBUTIONS

Angie Bernardo-Cuba: Concept; Design; Funding; Materials; Literature search; Writing; Data collection and/or processing

David Bernardo-Cuba: Concept; Design; Funding; Materials; Literature search; Writing; Data collection and/or processing

Heber Arbildo -Vega: Supervision; Analysis and/or interpretation; Critical review

Fredy Cruzado-Oliva: Drafted the manuscript and revised the final manuscript.

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