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Dental Anomalies in a Sample of Lebanese Children: a Retrospective Study

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ABSTRACT

Background: Dental anomalies (DAs) represent a significant chapter in pediatric dentistry with a lot of practical relevance. Both primary and permanent dentitions may be affected. **Objective**: The main objective of our study was to evaluate, using digital panoramic radiographs, the prevalence, distribution, and patterns of DAs in a sample of Lebanese children aged between 8 and 15 years old. **Methods:** 112 digital panoramic radiographs of patients aged between 8 and 15 years (60 males and 52 females) from the year 2017 till 2022 attending the department of Pediatric Dentistry and Dental Public Health at the Faculty of Dental Medicine at the Lebanese University were assessed for DAs of number (hypodontia, oligodontia, hyperdontia), of size (microdontia, macrodontia), of shape (fusion, gemination, dilaceration, taurodontism), of position (transposition, ectopia, impaction), and of structure (dentin dysplasia, amelogenesis imperfecta, dentinogenesis imperfecta). The data were analyzed statistically using Chi-square and Fisher's exact tests. **Results:** Out of 112 patient radiographs, 84 showed at least one DA, which suggests a very high prevalence (75%). Among them, 36.9% exhibited multiple types of anomalies. These 84 patients showed a total of 274 DAs, distributed equally among males and females. **Conclusion:** Dentists should be alerted to the presence of DAs. Their high prevalence requires careful clinical and radiological examinations for early detection. Regular monitoring is mandatory and could guide preventive approaches to minimize associated dental complications.

Keywords: dental anomalies, digital panoramic radiograph, Lebanese population, prevalence.

1. BACKGROUND

Dental anomalies (DAs) represent a significant chapter in pediatric dentistry with a lot of practical relevance (1). Primary and permanent dentitions may be affected (2). DAs may comprise anomalies of number (hyperdontia, oligodontia, hypodontia), size (macrodontia, microdontia), shape (gemination, fusion, dilaceration, taurodontism), position (transposition, ectopia, impaction), and structure (dentin dysplasia, amelogenesis imperfecta, dentinogenesis imperfecta) (2–5).

The precise etiology of DAs is complex and not completely understood (6). Congenital, developmental, or acquired disturbances during tooth formation have been considered to be the main etiological factors. Developmental malformations occur during the stages of tooth development, congenital anomalies are inherited genetically, and acquired anomalies happen after dental improvement (3, 4).

DAs' identification is crucial because they can lead to complications, for instance, malocclusion, disorganization of the dental arches, root resorption of adjacent teeth, increased sensitivity, increased susceptibility to caries, and aesthetic and functional issues (5–9). In addition, they might complicate dental procedures such as tooth extraction or root canal treatment (7–9). Thus, by being aware of the diagnosis and occurrence of DAs, dental professionals can improve their treatment plans, leading to less extensive intervention and a more favorable prognosis (6–8, 10).

Dental abnormalities can be a single defect or a part of specific disorders (3–6). Dentists' early diagnosis of DAs can contribute to the

	Dental Anomaly	Criteria
Anomalies of number	Hypodontia	Absence of less than six teeth (excluding third molars)
	Oligodontia	Absence of six or more teeth (excluding third molars)
	Hyperdontia	Presence of teeth in addition to the normal dentition, regardless of whether they were in occlusion or impacted
Anomalies of size	Microdontia	A tooth that seems smaller than the normal ranges of variation
	Macrodontia	A tooth that is larger than the average size
Anomalies of shape	Fusion	Joining of the dentine and/or enamel of two or more separate developing teeth
	Gemination	Partial development of two teeth from a single tooth germ following incomplete separation
	Dilaceration	An abrupt modification in the axial inclination between the tooth's crown and root
	Taurodontism	A change in tooth shape that is identified by a vertically elongated pulp chamber, a prolonged crown, an apical displacement of the root furcation and an absence of constriction at the cementoenamel junction level
Anomalies of position	Transposition	Exchange of positions of two adjacent teeth in the same quadrant
	Ectopia	Drifting or deviation of a tooth during the eruption process from its route of eruption
	Impaction	A tooth that was prohibited from erupting into the right position due to lack of space, malposition or other barriers

Table 1: Criteria used for dental anomalies diagnosis

identification of the syndromes or other associated abnormalities (5, 6, 9, 11).

DAs are mostly asymptomatic, and their identification is commonly made via clinical or radiographic examination (5, 6). In fact, a panoramic radiograph is considered a crucial tool in helping to establish a thorough diagnosis (6).

Early detection of dental defects in young patients has a substantial impact on treatment plans and prognosis (6). However, the literature is unclear regarding the most ideal age for identifying DAs in children (6).

2. OBJECTIVE

The prevalence and distribution of DAs have been investigated in various communities and ethnic groups via numerous studies. In the Lebanese pediatric population, no data is available regarding DAs. The aim of the present retrospective study is to evaluate, using digital panoramic radiographs, the prevalence and distribution of DAs in a Lebanese sample of children, aged between 8 and 15 years, referred to the Department of Oral Medicine and Maxillofacial Radiology, Faculty of Dental Medicine at the Lebanese University, from the year 2017 to 2022.

3. MATERIALS AND METHODS

Study population and sample size

The present retrospective study was conducted in the department of Pediatric Dentistry and Dental Public Health at the Faculty of Dental Medicine, Lebanese University, after approval by the research committee (31/2022). The study consisted of 132 digital panoramic radiographs of patients aged between 8 and 15 years (mean age 10.5 ± 1.79 years), from 2017 to 2022. From the 132 files initially analyzed, 112 subjects (60 males and 52 females) met the inclusion criteria.

Inclusion criteria:

- Lebanese children aged between 8 and 15 years
- Children with a free medical history
- No history of previous permanent tooth extraction
- Good-quality digital panoramic radiographs

Exclusion criteria

- Children with any significant medical history
- Digital panoramic radiographs showing traumatic injuries or jaw fractures that may affect the normal growth of permanent dentition
- Third molars were excluded from the study
- Poor-quality digital panoramic radiographs

Sampling technique

The digital panoramic radiographs for the study were obtained from the archives of the Department of Oral Medicine and Maxillo-Facial Radiology of the Faculty of Dental Medicine at the Lebanese University. All orthopantomograms were taken with the same x-ray device (Orthophos xg by Sirona, kV 64, mA 8, time 14.1 s) and processed by one digitizer (Lenovo Ideapad 310, Windows 10).

Radiographic analysis

Computerized screening (Lenovo Ideapad 310, Windows 10) of the digital panoramic radiographs was done to determine DAs. The analysis, under standardized lighting conditions, screen brightness, and resolution, was performed by two examiners, a pedodontic resident and a radiologist, with a limit of 25 radiographs daily. Both primary and permanent dentitions were considered. The DAs investigated on panoramic radiographs in this study were categorized as anomalies of number (hypodontia, oligodontia, hyperdontia), anomalies of size (microdontia, macrodontia), anomalies of shape (fusion, gemination, dilaceration, taurodontism), anomalies of position (transposition, ectopia, impaction), and anomalies of structure (dentin dysplasia, amelogenesis imperfecta, dentinogenesis imperfecta) (Table 1). Information concerning age, gender, medical and dental history was recovered from the patients' files.

Data collection

Data collection was performed on a Microsoft Excel

Anomaly	Number of Anomalies	Percent among Anomalies
Dilaceration	44	16.1
Ectopia	57	20.8
Gemination	3	1.1
Hyperdontia	3	1.1
Hypodontia	40	14.6
Impaction	65	23.7
Macrodontia	3	1.1
Microdontia	8	2.9
Taurodontism	51	18.6
Total Anomalies	274	100.0

Table 2: Distribution of anomalies (n=274)

spreadsheet [Microsoft Office Excel (Microsoft Corporation, Redmond, WA, USA)] and then transferred for subsequent analysis into SPSS version 25.0 (Armonk, NY: IBM Corp.).

Data analysis

The collected data was transferred from Microsoft Excel for subsequent analysis into SPSS version 25.0 (Armonk, NY: IBM Corp.). Continuous and categorical variables are presented as mean/standard deviation and frequency/percentages, respectively; analysis was conducted on a per-patient basis as well as per anomaly. Graphical quantile plots were used to evaluate the normality of age and the number of anomalies. The chi-square test and Fisher's exact test were used to evaluate associations between gender and anomalies, solitary or multiple occurrences and each anomaly, as well as among anomalies themselves; furthermore, anomalies were described collectively according to type (shape, number, size, position), as well as specifically per each subtype. Finally, logistic regression analysis was used to adjust for gender differences when evaluating the solitary or concomitant occurrence of the anomalies. All reported p values refer to two-sided tests, and statistical significance was set below an alpha of 5%.

4. RESULTS

A total of 112 patients were included in the study, with a mean age of 10.5 ± 1.79 years; there were 60 (53.6%) males and 52 (46.4%) females. Out of 112 patients' radiographs, 84 showed at least one DA, which suggests a very high prevalence (75%). Of these 84 patients, 31 (36.9%) suffered from multiple types of anomalies, for a total of 274 DAs. The distribution of DAs is summarised in Table 2. Anomalies of position were found in 50 patients (44.6%) and anomalies of shape in 40 patients (35.7%), with 26 patients (23.2%) suffering from dilaceration. Hypodontia was the most common anomaly of number seen in our patients, occurring in 18 (16.1%) of all patients. Anomalies of size were the least common, observed in only 8 patients (7.1%). Taurodontism (11 patients, 9.82%), ectopia (15 patients, 13.39%), and impaction (14 patients, 12.5%) were commonly found affecting two teeth.

The most common combination of multiple anomaly types was the combination of anomalies of shape and position (15 patients, 13.39%).

Out of all anomalies (274), only 13 occurred in a solitary fashion (4.7%), while the majority occurred as multiples (95.3%). Impaction was the most common anomaly (23.7%), followed by ectopia (20.8%) and taurodontism (18.6%). Macrodontia, gemination, and hyperdontia were the least common observed anomalies (1.1%). Furthermore, oligodontia, fusion, and transposition were not observed at all in our sample.

Among impacted teeth, maxillary canines were the most affected (37.84%), whereas first molars were the most commonly ectopic teeth (40.01%). As for hypodontia, mandibular second premolars had the highest rate of agenesis (49.09%).

	Patients with Single type of Anomalies	Patients with Multiple types of Anomalies	Total Patients with Anomalies
	Frequency	Frequency	Frequency
	% within those with single type of anomalies	% within those with multiple types of anomalies	%
Female	23	19	42
	43.40%	61.30%	50.00%
Male	30	12	42
	56.60%	38.70%	50.00%
Total Patients	53	31	84
	100.00%	100.00%	100.00%

Table 3: Distribution of patients with single or multiple types of anomalies

In our study, females had more multiple types of anomalies than males (61.30% and 38.70%, respectively), but this difference wasn't statistically significant (Table 3). Several differences in anomaly distribution were seen between females and males, but none of the anomalies showed a significant predilection. For example, female patients showed a higher prevalence of anomalies (80.8%) than males (70%), but this difference was not statistically significant (p = 0.189). Specifically, females showed a higher prevalence of anomalies of number (23.1% of females versus 11.7% of males), of size (11.5% of females versus 3.3% of males), and of position (52.9% of females' patients versus 38.3% of males' patients). On the other hand, males showed higher anomalies of shape (38.3%) than females (32.7%). As mentioned, none of these differences was significant.

When adjusted for gender, binary logistic regression suggested that patients with hypodontia were at three times higher odds of suffering from additional pathologies (p = 0.029). In addition, patients with taurodontism had three times higher odds of suffering from multiple pathologies (p = 0.014). As for anomalies of position, patients with either ectopia or impaction were significantly more likely to have at least one other anomaly, regardless of the pathology type (ectopia: p = 0.006 – impaction: p = 0.01).

Therefore, a patient with hypodontia, taurodontism, ectopia, or impaction has a higher chance of having

another anomaly or more, whether this anomaly is the same as the first one or different.

5. DISCUSSION

This is the first study to evaluate the prevalence and distribution of DAs in a sample of Lebanese children. Anomalies in tooth number, size, position, structure, and shape can have an important clinical influence, such as periodontal diseases, occlusion problems, and increased caries susceptibility (6). Digital panoramic radiographs represent a well-tolerated technique with low-dose radiation and low cost. They help screen DAs, mainly those undetected from clinical examination, such as dental agenesis (3, 6).

Our results demonstrated that 75% of the evaluated patient radiographs presented at least one dental anomaly, revealing an elevated prevalence of DAs in the present sample. Numerous investigations have been carried out to study the frequency of DAs using panoramic radiographs in different populations. Considerable variations in DAs' prevalence have been detected, ranging from 5.6 to 74.7% within the general population (4, 5, 12–19). The inconsistency in these frequencies might be explained by genetic differences, racial changes, sample size, and types of DA variations.

The most common types of DAs were, respectively, positional (44.6%), morphological (35.7%), and numerical (17%) anomalies. Anomalies of size were the least common, with a frequency of 7.1%.

In the literature, the most commonly impacted teeth are the upper canines, third molars, mandibular and maxillary premolars, as well as the upper central incisors (20). In the current study, impaction was the most frequently recorded dental anomaly, with a prevalence of 23.7%. A study conducted by Bilge et al. showed similar results with a higher frequency (45.5%) (4). This disparity may be caused by the inclusion of third molars as impacted teeth in the previous study; however, they were excluded in the present one. Our results demonstrated that the upper canine was the most common impacted tooth (37.84%). The present findings are in agreement with earlier reports by Gupta et al. (12) and Afifi and Zawawi (21), who also found that the upper canines were the most frequently impacted teeth, excluding the third molars. Early detection of tooth impaction is imperative from a therapeutic perspective.

In this study, ectopia was one of the most prevalent DA (20.8%), similar to that found by Baron et al. in a study on 18-years-old patients or younger, but with a lower prevalence (11.43%) (22). Frequencies' differences can be explained by the variations in the numbers of patients examined in each research study. Our data indicated that the first permanent molars were the most affected teeth (40.01%). In fact, in the literature, the ectopia of the first permanent molars was widely mentioned. This condition has different etiological factors, such as a small or posteriorly positioned maxilla relative to the cranial base, abnormally large second primary and first permanent molars, a mesially directed route of eruption of the permanent molar with inadequate anterior movement of the primary dentition, and asynchronization between tuberosity growth and eruption of the upper first permanent molar (23, 24).

The statistical data in this study showed a prevalence of taurodontism of 18.6%. The results are consistent with previous ones among an Indian population (18%) (17). Conversely, when analysing panoramic radiographs, Goncalves-Filho et al. reported a higher prevalence of taurodontism among the Brazilian population (27.19%) (25). Another study conducted in Turkey showed a lower frequency of taurodontism (11.2%) (4). The etiology of taurodontism is uncertain and may appear mostly in patients with genetic syndromes, even though, in our sample, syndromic subjects were excluded. The controversial results may be associated with racial variations and modifications in the criteria selection.

In the present study, hypodontia constituted 14.6% of all of the DA, similar to that found by Patil et al. in 2013 (16.3%) (18); though a study conducted in Saudi Arabia on patients aged between 12 and 30 years reported a higher prevalence (25.7%) (21). The present data showed that the missing teeth were, respectively, the mandibular second premolars (49.09%), the upper second premolars (25.45%), the upper lateral incisors (9.09%), and the first premolars (9.08%). Similar findings by Tent et al. detected that the second premolar agenesis was the most frequently encountered, followed by the lateral incisors (1). However, a study conducted by Kathariya et al. among schoolchildren in India showed that lateral incisors were the most common absent teeth, followed by second premolars (26). Differences in the data between studies may be due to ethnic, sampling, and human evolution processes.

It is worth mentioning that the prevalence of DA was only assessed based on orthopantomograms. Even though some DA are perceived exclusively in radiographic examination, others, such as amelogenesis imperfecta or dentinogenesis imperfect, might be better seen in a clinical intraoral exam. In this study, no cases of amelogenesis imperfecta or dentinogenesis imperfecta were detected. These DA are infrequent, with the highest reported prevalence rates being 1:700 and 1:6000, respectively (27, 28). Furthermore, a study conducted by Cassia et al. on 8830 patients in France detected a very low prevalence of dentinogenesis imperfecta (0.057%) (29).

In the present study, several differences in anomaly distribution (number, size, shape, position, and structure) were seen between females and males, but none of the anomalies showed a significant predilection. The distribution of DA between genders presented a higher prevalence in females (80.8%) when compared to males (70%), with no statistically significant difference ($P > 0.05$). These findings corroborate other studies conducted by Altug-Atac and Erdem, Laganà et al., and Vani et al. (13, 14, 16). Moreover, studies by Bilge et al. and Shokri et al. reported a higher frequency of DA in female patients (4, 15).

DA can occur as a solitary (single) anomaly or as multiple anomalies associated with other DA. In the present data, among all DA (75%), only 4.7% occurred in a soli-

tary manner, while the majority occurred as multiples or with another dental anomaly (95.3%). In fact, patients with hypodontia, taurodontism, ectopia, or impaction showed a higher chance of having one additional dental anomaly or more, whether the latter was similar to the first one or different. Patients with hypodontia ($p = 0.029$) or taurodontism ($p = 0.014$) had three times higher probabilities of suffering from additional pathologies. This is compatible with a study by Schalk et al. showing 28.9% of taurodontism in screened patients with oligodontia, whereas the frequency of subjects without oligodontia was 9.9% (30). In fact, taurodontism may be the outcome of an ectodermal abnormality in subjects with oligodontia (3). As for anomalies of position, patients with both ectopia and impaction were significantly more likely to have at least one other anomaly, regardless of the pathology type (ectopia: $p = 0.006$– impaction: $p = 0.01$).

Compared to other studies, the sample size in the present study is relatively limited. It could be explained by the patient selection, as the digital panoramic radiographs studied were part of the faculty dental screening program. In fact, no systematic indication for taking orthopantomograms for children is carried out. Children were referred for panoramic radiographs only when bitewings and periapical images were insufficient to complete a diagnosis. According to the American Academy of Pediatric Dentistry (AAPD), a radiographic examination should be based on each child's individual circumstances. Consequently, the dentist is responsible for following the ALARA (as low as reasonably achievable) principle to decrease the patient's exposure (31).

Some criteria, in the context of DA, are more objective and inflexible, for instance, the absence of a dental germ for tooth agenesis. However, the screening of some DA, like microdontia and root dilaceration, is subject to the assessor's interpretation even in the existence of established criteria. Nevertheless, to overcome this matter, the assessors were previously calibrated and achieved a good inter-examiner agreement.

This retrospective study evaluated archived orthopantomograms. A prospective study with patients' clinical investigations would have allowed a higher detection of DA and raised the sensitivity of the research, particularly for the diagnosis of anomalies of structure and size.

The diagnostic capacity might also be significantly influenced by the quality of the panoramic radiographs. In this study, digital panoramic radiographs were used. The advantages of digital radiography go beyond the opportunity to improve images to reach a more precise diagnosis. Compared to conventional films, the digital technique allows for less radiation exposure and causes less environmental contamination (32, 33).

The clinical importance of our findings lies in the early detection of some DA, ultimately allowing for more conservative interceptions associated with a better prognosis (34). This applies mostly to DA such as teeth agenesis, supernumerary teeth, and impacted teeth. A particularly important aspect of these anomalies is that, besides having significant clinical relevance, they can only be identified through imagining examinations. Nevertheless, early diagnosis of other DA, such as root dilacerations, might not bring important benefits to the patient; however, the main implications of radicular dilacerations are associated with extraction or root canal treatment, and both procedures require a preceding periapical radiograph that could detect the dilaceration (35).

The prevalence of DA in the present pediatric sample was considered to be particularly high. The most common DA (impacted teeth, dental agenesis, taurodontism, and root dilacerations) can only be diagnosed in imaging examinations, demonstrating the importance of panoramic radiographs to detect these conditions. Patients diagnosed with DA in the present study had a mean age of 10.5 ± 1.8 years. We believe that around this age, a child might benefit from a panoramic examination since the most common DA can be detected, avoiding future complications in dental and orthodontic treatment.

To confirm the findings of the current study, additional prospective investigations are necessary. Within the limitations of the present study, we can conclude that further investigations are essential with a larger sample of Lebanese children to determine the impact of racial, genetic, and environmental factors.

6. CONCLUSION

Our data concluded that 75% of the subjects had at least one dental anomaly. Out of all DA, only 13 occurred in a solitary fashion, while the majority occurred as multiples or with another dental anomaly. The prevalence of DA was distributed equally among males and females.

Teeth impaction was the most common finding, followed by ectopia, taurodontism, dilaceration, hypodontia, and microdontia. Macrodontia, germination, and hyperdontia were the least common observed anomalies.

The presence of one anomaly should alert dentists to the probable existence of other anomalies. The high prevalence of DAs requires careful and regular monitoring to detect them earlier. It is essential to increase awareness about their diagnosis, intervention, and management as they may complicate the treatment of other dental abnormalities.

Therefore, careful clinical and radiographic examinations during visits and consultations are mandatory and could guide preventive approaches, contributing to minimizing the associated dental complications. Complex cases frequently necessitate multidisciplinary planning and treatment.

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