ORIGINAL ARTICLE

Prevalence and Distribution of Hypodontia and Supernumerary Teeth among Dental Patients in the Northern Region of Malaysia

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ABSTRACT

Introduction: This retrospective and cross-sectional study evaluated the prevalence and distribution of dental anomalies (hypodontia and supernumerary teeth) in the permanent dentition among children by using orthopantomogram (OPG). **Methods:** A total of 4656 OPGs taken from January 2010 until December 2018 were initially screened at a dental referral centre for Malaysian Northern region. Following the inclusion and exclusion criteria, 744 children [mean (SD) age = 12.38 (3.97) years, 272 males and 472 females] were included. **Results:** Hypodontia and supernumerary teeth prevalence were 15.9% and 2.0%, respectively. Hypodontia has higher predilection in females (16.3%) compared to males (15.1%). Besides, males showed higher distribution in mandible while females showed higher distribution in maxilla. The most commonly involved tooth as hypodontia for males was maxillary left second premolar (2.6%) whereas maxillary left lateral incisor (2.5%) was commonly seen in females. Males (4.0%) showed more supernumerary teeth occurrence compared to females (0.8%) with higher observation in the maxillary arch. The most commonly involved tooth in supernumerary was mesiodens (1.6%). A higher occurrence of hypodontia was seen as the age of the subjects increased ($p < 0.000$). For supernumerary teeth, the highest occurrence was found in 7 to 12 years old age group ($p < 0.001$). Supernumerary teeth were found to be strongly associated with gender of the subjects ($p < 0.017$). **Conclusion:** The prevalence of hypodontia was higher compared to supernumerary teeth and its distribution was also higher among female subjects compared to male subjects.

Keywords: Orthopantomogram, Prevalence, Hypodontia, Supernumerary teeth, Children

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INTRODUCTION

Tooth development is a complex procedure of mineralisation involving connective tissues that rely upon different hereditary controls and biochemical cell responses (1, 2). Local and systemic factors may cause disruptions in the early and late stages of tooth development in utero or ex vivo. These disruptions may lead to variation in the number, size, shape or teeth form of the primary and permanent teeth (3). Defective dental lamina development may give rise to the absence of teeth (hypodontia), and hyperactive initiation may result in supernumerary teeth formation (4). In addition, other factors causing these developmental anomalies are genetic (internal) and environmental (external) factors (5). Dental anomalies which affect the normal series of tooth number are present as hypodontia and supernumerary teeth.

Hypodontia is described as the developmental absence of one and more than one tooth (6). It is regarded as the most regularly encountered and commonest dental anomaly which can affect dental function and aesthetics of the children. Hypodontia is the mostly used term to represent the inherently missing teeth in the oral cavity (7). In the context of the genetic causes of hypodontia, PAX9, MSX, AXIN2 and EDA have been identified as the genes causing non-syndromic hypodontia (8). Overall, hypodontia prevalence varies from 0.03% to 11.1% among different populations (6).

Supernumerary teeth are defined as the developmental variation which demonstrates the excessive number of teeth in permanent dentition (9-11). Mesiodens is the most frequent type of supernumerary teeth occuring in the centre of the maxillary arch. The aetiological factors causing supernumerary teeth remain unclear (12). The prevalence of supernumerary teeth in the permanent teeth is in the range of 0.5% to 3.8% (13).

There are many radiological techniques used to examine the dental structures and detect the abnormalities during the development of teeth and related structures. These techniques include the intraoral periapical radiograph (IOPR), bitewing radiograph, panoramic radiograph

(PR), orthopantomogram (OPG), cephalometric radiograph and cone beam computerised tomography (CBCT). All these radiographic techniques are the radiological procedure for delivering a wide picture of both maxillary and mandibular arches, facial structures, and the surrounding supporting structures. From all these techniques, OPG is considered as the most common and widely used technique due to ease of manipulation with a reasonable price that is affordable by the patient. Most dental anomalies will cause problems such as reduce aesthetics and function affecting patients' confidence and their communication with others, work performance and the way they value their life. The patients may also experience some unpleasant effects, for example, malocclusion, periodontal problems and an absence of alveolar bone development. Dental treatments for these anomalies are rather expensive and may need the management of different specialties such as orthodontics, prosthodontics and oral surgery. Thus, it is important to identify this problem earlier and determine the suitable age for patient assessment and management.

Even though numerous studies have indicated the prevalence and distribution of dental anomalies throughout the world, studies reporting the prevalence and distribution of these dental anomalies among Malaysian children are still very limited. Hence, the goal of this study was to determine the prevalence and distribution of hypodontia and supernumerary teeth in the permanent teeth of healthy children in Malaysia within the Northern region. The study also aimed to analyse the association between hypodontia and supernumerary teeth with age and gender of the subjects.

MATERIALS AND METHODS

Study design and samples

For this retrospective and cross-sectional study, a total of 4656 electronic and printed OPGs were initially selected between 1st January 2010 to 31st December 2018 from the Dental Clinic, Advanced Medical and Dental Institute (AMDI), Universiti Sains Malaysia, Penang, Malaysia. Following the inclusion and exclusion criteria, only 744 OPGs were included in the study. AMDI Dental Clinic is the tertiary referral center for the Northern region of Malaysia. Patients were referred from primary dental care (i.e. government and private dental clinics) in the Northern region. There are also cases treated here which have been referred by dentists from other regions in Malaysia.

The inclusion criteria encompassed children aged from 5 to 17 years old and good diagnostic quality radiographs. Syndromic children, those with cleft lip and palate, orthodontic patients, or those who have extractions before OPGs taken were excluded from this study.

The ethical approval to conduct the study was obtained from the Human Research Ethics Committee (HREC), Universiti Sains Malaysia before its commencement (USM/JEPeM/17120689).

Measurements reliability

The main investigator was trained by the experienced researchers and calibrated for radiographic assessment prior to the actual measurements. The similar measurement was repeated after two weeks of interval. Reliability measurements were performed using the Intraclass Correlation Coefficient (ICC), for Trial 1 and Trial 2, respectively. For both trials, the Kappa coefficient was used to assess the reliability of the investigators.

Data collection

The dental anomalies prevalence and distribution in the permanent dentition of children who had attended the Dental Clinic were assessed by using printed and electronic copies of OPG.

The printed OPGs were available as X-ray films and viewed on X-ray viewer (Lumi Vision LED Illuminators, USA) in a room with low light, while most of the other OPGs which were available in the digital format (electronic copies), were viewed using the Universal Viewer Zero Footprint (ZFP) and ProMaxis 2.6.0.R software on the computer.

All the printed and electronic copies of OPG were examined by the principal investigator for the detection of hypodontia and supernumerary teeth. Assessment process started with hypodontia by determining the number of teeth present for each quadrant, excluding third molars. The evidence of crypt formation with calcification or without calcification of the crown would determined the presence of teeth. The missing teeth in the OPGs were confirmed by checking the dental history of the patients from the AMDI electronic database whether they had been extracted. Meanwhile, supernumerary teeth examination was performed by scanning the present of extra teeth in each quadrant of both maxillary and mandibular arches.

All information derived from the OPGs were documented in data collection sheets. Any subjects with missing information such as the date of birth, age, gender of the children, poor-quality image and OPGs of the children who have an orthodontic appliance or undergoing orthodontic treatment during OPGs taken were excluded from this study.

Statistical analysis

SPSS software version 23 (SPSS, IBM, NY, USA) was used for the statistical analysis. Descriptive statistics were tabulated, and comparisons between groups were performed using the Chi-square test. The logistic regression was used to determine relationship between each dental anomaly and factors (age, gender and ethnicity) separately. A p value of less than 0.05 was

considered statistically significant.

RESULTS

The result of ICC for Trial 1 was 0.961 (very good agreement) and the result of ICC for Trial 2 was 0.984 (very good agreement). No significant errors were found between both analyses. Therefore, the inter-examiner agreements were found to be in very good score range (14).

A total of 744 OPGs where 472 females (63.4%) and 272 males (36.6%) were included in the study. The subjects were divided into three age groups with a mean age of 12.38 ± 3.97 years old. The highest number of subjects were in the group of 13 to 18 years old. Malay ethnic constituted the majority of the samples (93.7%) compared with Chinese, Indian and other ethnics (Table I). Out of 744 subjects included in this study, 118 subjects (15.9%) had hypodontia and 15 subjects (2.0%) presented with supernumerary teeth (Table I).

Table I: Sociodemographic characteristics and prevalence of hypodontia and supernumerary teeth of the study subjects (n=744)

Variables		Frequency (N)	Percentage (%)
Age (years)	0-6 years	98	13.2
	7-12 years	198	26.6
	13-18 years	448	60.2
Gender	Male	272	36.6
	Female	472	63.4
Ethnicity	Malay	697	93.7
	Chinese	32	4.3
	Indian	12	1.6
	Others	3	0.4
Types of dental anomaly:			
Hypodontia	Present	118	15.9
	Not present	626	84.1
Supernumerary teeth	Present	15	2.0
	Not present	729	98.0

Hypodontia occurrence was slightly higher in females (16.3%) as compared to males (15.1%) without significant differences with regards to gender. On the contrary, the supernumerary teeth occurrence was higher in males (4.0%) compared to females (0.8%) with significant gender differences (p = 0.003) (Table II).

For hypodontia, the most commonly missing teeth among male subjects were the maxillary left second premolar (2.6%), followed by maxillary right lateral incisor and mandibular left second premolar, both at 1.8%. Meanwhile, the distribution of commonly missing teeth in hypodontia among female subjects, in relation with maxillary and mandibular arches were found to be maxillary left lateral incisor and maxillary right lateral incisor at 2.5% and 2.3%, respectively. This is followed by the mandibular right and left second premolars, both at 1.9% (Table III).

Table II: Distribution of hypodontia and supernumerary teeth towards gender

Types of dental anomaly	Variable	Total (N)	Frequency presnt (%)	Frequency not present (%)	X^2 statistic[a] (df)*	*p* value[a]
Hypodontia	Male	272	41 (15.1)	231 (84.9)	0.199 (1)	0.656
	Female	472	77 (16.3)	395 (83.7)		
	Total	**744**	**118 (36.6)**	**626 (63.4)**		
Supernumerary teeth	Male	272	11 (4.0)	261 (96.0)	8.926 (1)	0.003
	Female	472	4 (0.8)	468 (99.2)		
	Total	**744**	**15 (36.6)**	**729 (63.4)**		

[a] = Pearson Chi-Square for independence
*df = degree of freedom

Table III: Distribution of most commonly missing teeth in hypodontia among male and female subjects in relation to maxillary and mandibular arches

Variable	Male		Female		X^2 statistic[a] (df)*	*p* value[a]
	Present N (%)	Missing N (%)	Present N (%)	Missing N (%)		
Upper right lateral incisor	263 (96.7)	5 (1.8)	457 (96.8)	11 (2.3)	0.818 (2)	0.664
Upper right second premolar	266 (97.8)	3 (1.1)	464 (98.3)	4 (0.8)	0.244 (2)	0.885
Upper left lateral incisor	264 (97.1)	4 (1.5)	457 (96.8)	12 (2.5)	2.201 (2)	0.333
Upper left second premolar	264 (97.1)	7 (2.6)	461 (97.7)	6 (1.3)	2.705 (2)	0.259
Lower right lateral incisor	256 (94.1)	2 (0.7)	455 (96.4)	3 (0.6)	2.300 (2)	0.317
Lower right second premolar	269 (98.9)	3 (1.1)	463 (98.1)	9 (1.9)	0.703 (1)	0.402
Lower left lateral incisor	251 (92.3)	3 (1.1)	446 (94.5)	6 (1.3)	2.045 (2)	0.360
Lower left second premolar	266 (97.8)	5 (1.8)	462 (97.9)	9 (1.9)	0.160 (2)	0.923

[a] = Pearson Chi-Square for independence
*df = degree of freedom

The overall distribution of hypodontia in the maxilla and mandible was higher in female subjects compared to male with regards to gender. In terms of frequency, males showed higher distribution in the mandible while females showed higher distribution in the maxilla. For supernumerary teeth, both males and females had more

distribution in the maxillary arch (Table IV). Mesiodens (1.6%) was the most commonly seen supernumerary teeth, followed by paramolar (0.3%) and distomolar (0.1%) as shown in Table V.

The results showed a higher occurrence of hypodontia as the the subjects' age increased ($p < 0.000$). Meanwhile, distribution of supernumerary teeth presented in the highest number was found in the 7 to 12 years old age group ($p < 0.001$) (Table VI).

Table IV: Distribution of hypodontia and supernumerary teeth between maxillary and mandibular arches in relation to gender.

Types of dental anomaly	Variable	Maxilla freq. (%)	Mandible freq. (%)	N
Hypodontia	Male	49 (30.6)	57 (36.1)	106
	Female	111 (69.4)	101 (63.9)	112
	Total	**160 (100)**	**158 (100)**	**318**
Supernumerary teeth	Male	9 (62.9)	2 (1.5)	11
	Female	3 (35.1)	1 (0.5)	4
	Total	**12 (98.0)**	**3 (2.0)**	**15**

Table V: Illustrates the most commonly involved supernumerary teeth in relation to gender

Variable	Mesiodens N (%)	Paramolar N (%)	Disto-molar N (%)	None of them N (%)	Total N (%)
Gender					
Male	10 (1.3)	1 (0.2)	0 (0.0)	261 (35.0)	272 (36.5)
Female	2 (0.3)	1 (0.1)	1 (0.1)	468 (63.0)	472 (63.5)
Total	**12 (1.6)**	**2 (0.3)**	**1 (0.1)**	**729 (98.0)**	**744 (100)**

Table VI:. The association between hypodontia and supernumerary teeth with the age of the subjects.

Variables	Age group	N (%)	Frequency present (%)	Frequency not present (%)	χ^2 statistic[a] (df)	*p* value
Hypodontia	0-6 years	98 (13.2)	3 (2.5)	95 (15.2)		
	7-12 years	198 (26.6)	25 (21.2)	173 (27.6)	19.586 (2)	0.000
	13-18 years	448 (60.2)	90 (76.3)*	358 (57.2)		
	Total	**744**	**118 (100.0)**	**626 (100.0)**		
Supernumerary teeth	0-6 years	98 (13.2)	2 (13.3.)	96 (13.2)		
	7-12 years	198 (26.6)	10 (66.7)*	188 (25.8)	13.340 (2)	0.001
	13-18 years	448 (60.2)	3 (20.0)	445 (61.0)		
	Total	**744**	**15 (100.0)**	**729 (100.0)**		

*High association

By using the multivariate logistic regression, only factor age was found to be independently associated with the hypodontia status. The only factor gender is found to be independently associated with the supernumerary status (Table VII).

Table VII: The association of dental anomalies with the factors (age, gender and ethnicity)

Types of dental anomalies	Risk factor	β (SE)	Crude OR (95% CI)	*p* value
Hypodontia	Gender	0.092 (0.217)	1.096 (0.717,1.677)	0.671
	Age	-0.127 (0.030)	0.880 (0.830,0.934)	0.001*
	Ethnicity	0.418 (0.375)	1.519 (0.728,3.171)	0.265
Supernumerary teeth	Gender	1.434 (0.599)	4.195 (1.297,13.575)	0.017*
	Age	0.111 (0.064)	1.118 (0.985,1.268)	0.084
	Ethnicity	n.a	n.a	n.a

Hosmer-Lemeshow p=0.212, 0.444, 0.751
Classification table 84.1%
OR = Odds Ratio
n.a = not applicable
*significant value

DISCUSSION

This retrospective study was aimed to assess the prevalence, distribution and the relationship with age and gender for hypodontia and supernumerary teeth in the permanent dentition among healthy Malaysian children within the Northern region. The findings of the current study will help to contribute to the knowledge since there is a lack of recently published data available in the literature with regards to these anomalies.

Malaysia is a multicultural society with a diverse population consisting of different ethnic groups including Malays, Chinese, Indians and the Natives. The sample distribution of this study showed that most of the subjects were Malays compared to other ethnic groups which reflects the actual Malaysian population in which Malays contribute as the group ethnic majority (13, 15). Based on the retrieved OPGs, the sample distribution showed that most of the subjects were females compared to males reflecting that females are more worried about their appearance and thus tend to seek treatment of teeth abnormalities more than males. Subjects aged between 5 to 17 years were selected to exclude the cases where development of third molars might be delayed (16).

There were variations with the previous studies which include a difference in the age, type of study samples, sample size and methods of assessment among different populations (6, 8, 17). This may account for the differences in the prevalence of these dental anomalies. The prevalence rate can be also influenced by the inclusion or exclusion of the third molars. Many studies were conducted to assess the prevalence of dental anomalies in various populations based on radiographs (18-23). There was a study which reported the prevalence of hypodontia (2.8%) for the Malaysian population in 1989 by Nik-Hussein (17) which centered in the central region of Malaysia.

The current study's finding depicts that hypodontia is more commonly seen and gradually increasing among the Malaysian children. Many studies indicated that females have higher incidence of hypodontia compared to males (17, 24, 25). However, in our study, there was no significant difference by gender which is in concordance with other studies (15, 21, 26).

Numerous studies have assessed the distribution of hypodontia between gender. Findings of the current study revealed that female subjects have a higher chance of being diagnosed with hypodontia compared to male subjects. However, there was no statistical difference between gender and occurrence of hypodontia. This result complies with the majority of reported results from previous studies (6, 7, 24, 27). The reason for the higher tendency of hypodontia affecting females more than males may be due to the genetic variation between both gender as a recent study suggested that the incidence of non-syndromic hypodontia may be accrued as a result of genetic influence (8).

Our findings also showed a higher occurrence of hypodontia as the age of the subjects increased. This trend indicates that patients are more concerned about their teeth as they have more permanent teeth and being in teenage life. This may be due to the fact that they have heard more information about oral health. Besides, perhaps parents are also more concerned about their children's teeth as more permanent teeth are already present in the mouth. Therefore, when hypodontia is detected later in life, the treatment can be more complicated and cost for treatment can be higher (28).

The supernumerary teeth's prevalence was found to be 2.0% and mesiodens was the most commonly seen supernumerary teeth in our study. Our findings were in synchrony with Bunyarit et al. (2) where the prevalence was also 2.0%. However, our findings were in contrast with the study by Rani et al. (29) among the Indian population, due to the differences in the number of sample sizes between both studies.

For the distribution of supernumerary teeth towards gender, the current study found that the supernumerary teeth's prevalence was higher in male subjects compared to female subjects. This is in accordance with most of the past studies (4, 30, 31).

More supernumerary teeth were found among subjects aged 7 to 12 years old in the study. Besides, many of the cases were found in the maxillary arch for both gender, this result was in accordance with findings from other studies (2, 13).

The current study was conducted among the Malaysian children in the Northern region and this may not reflect the actual prevalence for the whole Malaysian children in the country. Hence, further study should include many centers especially in hospitals and clinics with available facilities for OPG.

CONCLUSION

The prevalence of hypodontia among Malaysian healthy children was higher compared to supernumerary teeth with higher distribution among female subjects compared to male subjects. There were also significant associations between hypodontia and age of the children. However, supernumerary teeth were significantly associated with the gender of these children.

Therefore, OPG investigation should be conducted consistently among the children to prevent future oral related problem that might affect the children's quality of life. Furthermore, there is a need to educate the parents regarding dental anomalies and urge them to bring their children for a dental examination as early as possible.

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