

Anomalies of permanent tooth number in three Asian ethnicities

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Objective: The objective of this comparative study was to determine the proportion and distribution of tooth number anomalies in the permanent dentition in a sample of Chinese, Indian and Malay orthodontic patients in Singapore.

Methods: The cross-sectional study was carried out using radiographic and clinical data from the National Dental Centre of Singapore. Panoramic radiographs and clinical records of 1080 (Chinese (N = 415), Indian (N = 317) and Malay (N = 348)) orthodontic patients aged 12 to 16 years were examined for evidence of tooth number anomalies. Fisher's exact test was applied to compare the occurrence of hypodontia and hyperdontia between the ethnicities and genders.

Results: The prevalence of hypodontia in Chinese, Indian and Malay orthodontic patients was 13.7%, 6.0% and 14.4%, respectively. Chinese patients had a significantly higher prevalence of hypodontia compared with Indian patients (OR 2.50, 95% CI 1.29–4.83, $p < 0.001$). Malay patients had a significantly higher prevalence of hypodontia compared with Indian patients (OR 2.63, 95% CI 1.34–5.17, $p < 0.001$). The most commonly missing tooth in the Indian patients was the upper lateral incisor (39.0%), whereas that in the Chinese and Malay patients was the lower second premolar (26.1% and 26.2%, respectively).

The prevalence of hyperdontia in Chinese, Indian and Malay patients was 7.0%, 3.8% and 7.8%, respectively. Male patients had a significantly higher prevalence of hyperdontia compared with female patients (OR 1.87, 95% CI 1.14–3.07, $p = 0.015$). Supernumerary teeth occurred more frequently in the anterior maxilla (34.1%) than in other regions of the jaws. Supernumerary teeth also occurred more frequently in the maxilla (76.9%) than in the mandible (23.1%).

Conclusion: There are significant differences in the presentation of anomalies in tooth number in the permanent dentition of Chinese, Indian and Malay orthodontic patients in Singapore.

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Introduction

A variation in tooth number in the permanent dentition is a developmental anomaly commonly encountered in dental practice.¹ It can present as the absence of permanent teeth, or the presence of extra permanent teeth.

Hypodontia is the developmental absence of up to five teeth, excluding third molars.²⁻⁴ The term oligodontia is used to describe the absence of six or more permanent teeth, and anodontia describes the

developmental absence of all teeth.⁵ The term dental agenesis is preferred by some as it describes the developmental disorder involved.⁶

Hyperdontia is the condition of having supernumerary teeth, or teeth that appear in addition to the expected number.⁷⁻¹⁰ The major types of supernumerary tooth forms include conical, tuberculate, supplemental, and odontomes.¹¹

Despite extensive investigations conducted on the prevalence of hypodontia and hyperdontia in

Caucasian populations, there is minimal information regarding Asian ethnicities and prevalence comparisons between ethnicities. To date, no study has been conducted to investigate the prevalence of hypodontia and hyperdontia in Singaporean Chinese, Malay and Indian orthodontic patients.

Due to a multi-ethnic social population, Singapore is a most suitable location to conduct a comparative study of various ethnicities. Orthodontic treatment is accessible and available to all Singaporean children and adolescents of all ethnic groups. The National Dental Centre of Singapore receives a large number of orthodontic patients from a wide range of ethnic and social-economic backgrounds. The Chinese, Indians and Malays collectively represent the largest ethnic groups in Singapore as well as at the NDCS.

The aim of this comparative study was to determine the proportion and distribution of tooth number anomalies in the permanent dentition, excluding third molars, in a sample of Chinese, Indian and Malay orthodontic patients in Singapore. The null hypothesis was that there were no differences between the three ethnic groups.

Methods

A cross-sectional study was based on radiographic and clinical data obtained from the National Dental Centre of Singapore. Panoramic radiographs and clinical records of patients were examined for evidence of tooth number anomalies. The present study complied with the STROBE guidelines¹² and was conducted with the approval of the SingHealth Centralized Institutional Review Board (CIRB), reference 2014/765/D.

The subjects were selected from the electronic records of 12- to 16-year-old Singaporean Chinese, Indian and Malay patients, who had visited the orthodontic clinic in the National Dental Centre of Singapore between July 2013 and July 2015. The present study applied a sequential sampling method and patient records were retrieved from the NDCS electronic database and were filtered by age, ethnicity and visit date. The patient records were sequenced based on the date of capture of the panoramic radiograph. All past radiographs and clinical charts of the patients were reviewed to improve diagnostic accuracy. The radiographs were taken using the GENDEX Orthoralex 9200 DDE/CEPH system and stored in digital format.

Data collection and data analysis were performed by one clinician. The data collected included age, gender, ethnicity, number and type of missing teeth, number and location of supernumerary teeth, and permanent tooth removal history. Patient ethnicity and gender were recorded according to the National Registration Identity Card and birth certificate.

Agenesis (hypodontia) of a tooth was diagnosed when none of its dental features could be identified on the panoramic radiograph and no evidence of its removal could be found. Hyperdontia was diagnosed based on the radiographic evidence of supernumerary teeth or with a history of supernumerary tooth removal.

Ten percent of the panoramic radiographs were randomly selected for reassessment one month after the initial data collection to determine operator reproducibility of identification.

The results were analysed using SAS 9.3. Fisher's exact test was applied to compare the occurrence of hypodontia and hyperdontia between the ethnicities and genders, respectively. For pair-wise comparisons, a Bonferroni correction method was applied. The level of significant difference was chosen at $\alpha = 0.05$.

Results

A total of 1080 patients were identified, consisting of 415 Chinese, 348 Malay and 317 Indian, of which 649 were female, and 431 were male. The Chinese group consisted of 244 females and 171 males. The Malay group consisted of 204 females and 144 males. The Indian group consisted of 201 females and 116 males. The 10% of the sample cases that were randomly selected and reassessed after one month revealed an identification reproducibility of 100%.

Hypodontia

Overall hypodontia prevalence in the sample was 11.7%. The prevalence of hypodontia in the Chinese, Indian and Malay groups was 13.7%, 6.0% and 14.4%, respectively.

There was no statistically significant association between gender and hypodontia in the entire sample (OR 0.70, 95% CI 0.47–1.04, $p = 0.081$). Neither was there a statistically significant association between gender and hypodontia within the Chinese (OR 0.62, 95% CI 0.34–1.12, $p = 0.147$), Indian (OR 0.31, 95% CI 0.09–1.08, $p = 0.083$) and Malay (OR 0.94,

95% CI 0.51–1.72, $p = 0.878$) groups. The odds ratios compared males with females in displaying hypodontia.

The Chinese group was found to have a significantly higher odds ratio for hypodontia compared with the Indian group (OR 2.50, 95% CI 1.29–4.83, $p < 0.001$). The Malay group was found to have a significantly higher odds ratio for hypodontia compared with the Indian group (OR 2.63, 95% CI 1.34–5.17, $p < 0.001$). There was no significant difference in the odds ratios for hypodontia which compared the Chinese with the Malay group (OR 0.95, 95% CI 0.58–1.57, $p = 1$).

The findings are summarised in Figure 1 and Table I.

The lower second premolar was the most commonly missing tooth in the overall sample, with a prevalence of 27.2% of those diagnosed with hypodontia. The least likely teeth to be congenitally missing were the first molars and upper central incisors as none of the present patients displayed the absence of these teeth.

The lower second premolars in the Chinese group were the most commonly missing teeth (26.1% of those diagnosed with hypodontia). The lower incisors were the second most commonly missing teeth (21.6% of the hypodontia cases). This was followed by the upper lateral incisors in 20.5% of the hypodontia cases.

The lower second premolars in the Malay group were the most commonly missing teeth (26.2% of those diagnosed with hypodontia). The upper lateral incisors were the second most commonly missing teeth (22.6% of the hypodontia cases), following by the lower incisors in 15.5% of the hypodontia cases.

The upper lateral incisor in the Indian group was the most commonly missing tooth, presenting in 39.0% of those diagnosed with hypodontia. The lower second premolar was the second most commonly missing tooth, identified in 31.7% of the hypodontia cases.

Figure 2 and Table I summarise the distribution of hypodontia in the three ethnic groups. Out of 126 patients with hypodontia, 63 (50%) had one missing tooth, 43 (34.1%) had two missing teeth, and 20 (15.9%) had more than two missing teeth.

Hyperdontia

Overall hyperdontia prevalence was 6.3%. Males were found to have higher odds for the presence of hyperdontia compared with females (OR 1.87, 95% CI 1.14–3.07, $p = 0.015$).

Indian males were found to have significantly higher prevalence of hyperdontia compared with Indian females (OR 3.65, 95% CI 1.07–12.39, $p = 0.035$). There was no statistically significant association

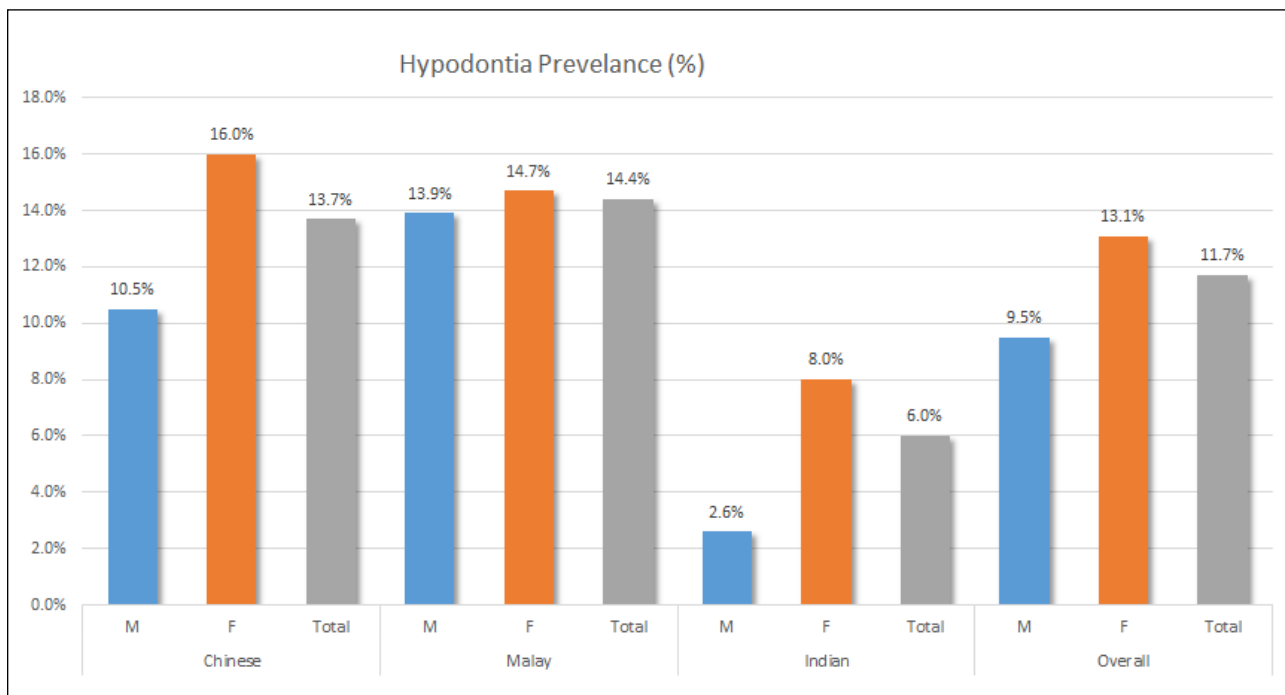


Figure 1. Hypodontia prevalence in the three ethnic groups.

Table I. Ethnic and gender presentation of tooth number anomalies.

Ethnicity	Gender	N	Hypodontia		Hyperdontia	
			Number of cases	Percentage within gender	Number of cases	Percentage within gender
Chinese	F	244	39	16.0%	14	5.7%
	M	171	18	10.5%	15	8.8%
	Total	415	57	13.7%	29	7.0%
Indian	F	201	16	8.0%	13	2.0%
	M	116	3	2.6%	14	6.9%
	Total	317	19	6.0%	27	3.8%
Malay	F	204	30	14.7%	4	6.4%
	M	144	20	13.9%	8	9.7%
	Total	348	50	14.4%	12	7.8%
Overall	F	649	85	13.1%	31	4.8%
	M	431	41	9.5%	37	8.6%
	Total	1080	126	11.7%	68	6.3%

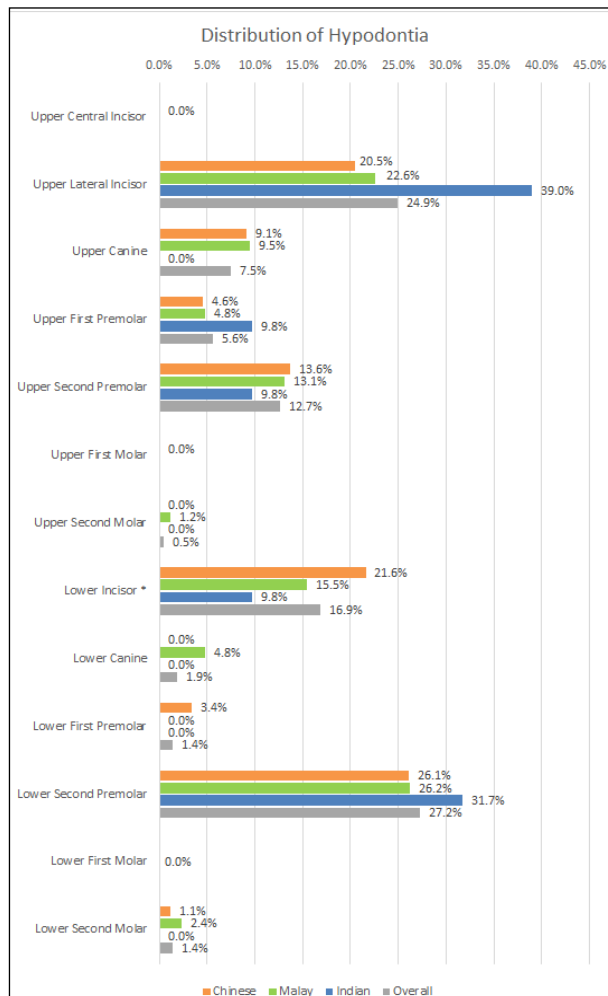


Figure 2. Distribution of hypodontia in the three ethnic groups.

between gender and hyperdontia within the Chinese (OR 1.58, 95% CI 0.74–3.37, $p = 0.246$) and the Malay groups (OR 1.58, 95% CI 0.72–3.48, $p = 0.310$).

There was no statistically significant difference in the odds ratios for hyperdontia when comparing Chinese, Indian and Malay orthodontic patients.

The prevalence of hyperdontia in the three ethnic groups is summarised in Figure 3 and Table I.

Supernumerary teeth were most commonly observed in the anterior maxilla and accounted for 34.1% of all hyperdontia cases in the overall sample. Supernumerary teeth occurred more frequently in the maxilla (76.9%) than in the mandible (23.1%).

Out of 68 patients with hyperdontia, 53 (77.9%) had one supernumerary tooth, 11 (16.2%) had two supernumerary teeth, and four (5.9%) had more than two supernumerary teeth.

Ten patients presented with both hyperdontia and hypodontia of the permanent dentition.

The distribution of hyperdontia is summarised in Figure 4.

Discussion

A radiographic examination is necessary for the diagnosis of dental anomalies. It is currently the least invasive way to identify unerupted and impacted dental

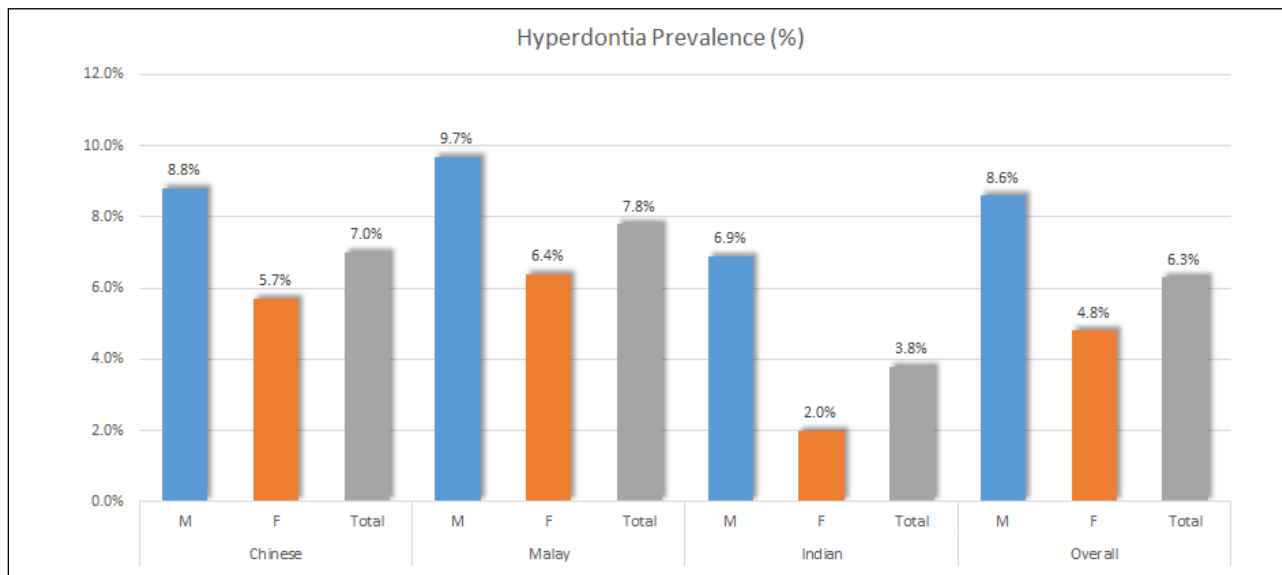


Figure 3. Hyperdontia prevalence in the three ethnic groups.

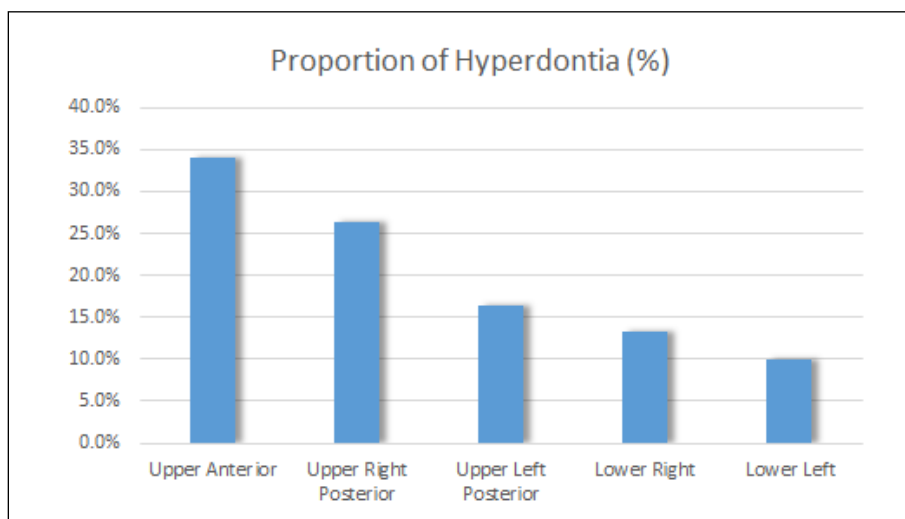


Figure 4. Distribution of hyperdontia in the jaws.

structures. Clinical examination and visual inspection cannot accurately identify unerupted supernumerary teeth, nor predictably differentiate agenesis from impaction within the permanent dentition. Panoramic radiographs may not be indicated in the routine examination of every child.¹³ Designing a cross-sectional study involving a radiographic examination of a random child sample irrespective of treatment needs may expose children to unnecessary radiation. Even though panoramic radiographs have a relatively low level of ionising radiation, it is recommended that clinicians keep the radiation exposure of young patients as low as reasonably achievable.¹⁴ Therefore, the present study was limited to existing radiographic documentation.

The present study involved only orthodontic patients. Patients with tooth number anomalies may have a higher chance of developing a malocclusion and may be more likely to present for orthodontic treatment. Prevalence findings from the present study may, therefore, not be directly applicable to the general population. This may account for the difference between findings of the current study and those conducted earlier on randomly sampled Chinese in schools.¹⁵

The odds ratio for hypodontia comparing females with males was 1.43 with a 95% CI of 0.97–2.13. This was close to the odds ratio in the Caucasian population. However, the difference did not reach

Table II. Number of supernumeraries in each hyperdontia subject.

Number of missing teeth	Frequency	Percentage of total sample (%)
0	1012	93.7
1	53	4.9
2	11	1.0
>2	4	0.4
Total	1080	100.0

statistical significance. This pattern was common to all three ethnic groups investigated in the present study. The odds ratio for hypodontia comparing Chinese females with Chinese males was 1.61 with a 95% CI of 0.89–2.94. The gender distribution and ratio for hypodontia was similar to a previous study on Chinese children in Singapore.¹⁶ However, research on Hong Kong Chinese reported a smaller difference between the genders.¹⁵ There was agreement between the Chinese studies that females presented with a higher prevalence of hypodontia. Within the Malay group, the present study supported the findings of earlier research which indicated that there was no significant hypodontia difference between genders.¹⁷ However, the overall prevalence of hyperdontia was higher in a male (8.6%) than in a female (4.6%) orthodontic population with a ratio of 1.87:1, which produced a statistically significant difference (OR 1.87, 95% CI 1.14–3.07, $p = 0.015$). The overall trend was shared by each of the included ethnic groups in the present study. The data corroborate results from previous studies that examined Chinese and Indian ethnic groups.^{15,18,19}

The prevalence of hypodontia and hyperdontia in the Chinese orthodontic population was identical to the findings from a similar study that assessed Singaporean Chinese.¹⁶ However, it was higher than the prevalence reported for Southern Chinese in Hong Kong.¹⁵ The prevalence of hypodontia in the Chinese had been noted to be higher than for Caucasians.⁶ The prevalence of hypodontia and hyperdontia in the Malay orthodontic population were both higher than previously reported.²⁰ A more recent study by Mani et al. also noted a lower hypodontia prevalence compared with the present study.¹⁷ The difference in prevalence may be attributed to the variations in healthcare policies, research methodology and inclusion criteria. The prevalence of hyperdontia in the Indian orthodontic group was higher than that reported for Southern Indians.¹⁹ This may be due to

the age range of the different samples. Extractions or surgical removal in early life may be less likely recalled by patients of an older age group. The noted prevalence most likely represented an underestimation of the actual prevalence in the present population.

The 10 patients who presented with combined hypodontia and hyperdontia were represented in both the hypodontia group as well as the hyperdontia group. The number involved was too small to form a separate group for statistical analysis in this study.

The mandibular second premolar was the most commonly missing tooth in the Chinese and Malay orthodontic population. The proportion in Chinese, Indian and Malay groups presenting with hypodontia was 26.1%, 31.7% and 26.2%, respectively. It was also found to be the most affected tooth in hypodontia cases according to a meta-analysis of a Caucasian population, accounting for 41.0% of cases presenting with hypodontia.⁶ The second premolars were previously found to be the second most affected tooth in Malay children with hypodontia.¹⁷

The maxillary lateral incisor was the most commonly missing tooth in the Indian orthodontic population. Its prevalence in the Chinese, Indian and Malay groups presenting with hypodontia was 20.5%, 39.0% and 22.6%, respectively. A previous study on Malay children found that the maxillary lateral incisor was the most frequently missing, instead of the mandibular second premolar.¹⁷ It was the second most likely permanent tooth to be missing in Caucasian populations, presenting in 22.9% of cases with hypodontia.⁶

Mandibular incisors were the second most commonly missing tooth in the Chinese orthodontic population. The proportion in Chinese, Indian and Malay groups presenting with hypodontia was 21.6%, 9.8% and 15.5%, respectively. However, a Hong Kong study found that the mandibular incisor was the most likely tooth to be missing in Southern Chinese children.¹⁵ A previous study on Singapore Chinese noted that the mandibular lateral incisor was the most commonly missing permanent tooth.¹⁶ Alternatively, a study on a Japanese population reported that the mandibular central incisor was the most commonly missing tooth.²¹ In the Caucasian population, mandibular incisors were much less likely to be absent.⁶ Hypodontia of the mandibular central and lateral incisors was present in only 3.5% and 2.5% of Caucasian hypodontia cases, respectively.

Difficulty in the discrimination between mandibular central and lateral incisors may have also affected the present results of commonly missing teeth. If a large difference existed between the frequency of a missing mandibular central and lateral incisor, the employed method in the present study may have underestimated one and overestimated the other.

However, differences in the proportion and distribution of tooth number anomalies between the ethnic groups in this study could be applicable to the general population of Singapore as well as to the region. Further studies may be conducted to investigate the socio-economic background, rate of uptake of orthodontic treatment, as well as genetic differences in each ethnic group.

Conclusion

The overall prevalence of hypodontia in orthodontic patients was 11.7%. There was no statistically significant association between gender and hypodontia in the sample (OR 0.70, 95% CI 0.47–1.04, $p = 0.081$).

The prevalence of hypodontia in Chinese, Indian and Malay orthodontic patients was 13.7%, 6.0% and 14.4%, respectively. Chinese patients had significantly higher odds of presenting with hypodontia compared with Indian patients (OR 2.50, 95% CI 1.29–4.83, $p < 0.001$). Malay patients also had a significantly higher chance of presenting with hypodontia compared with Indian patients (OR 2.63, 95% CI 1.34–5.17, $p < 0.001$). There was no statistically significant difference in the prevalence of hypodontia between the Chinese and Malay patients (OR 0.95, 95% CI 0.58–1.57, $p = 1$).

The lower second premolar was the most commonly missing tooth in the sample population, as well as in the Chinese and Malay groups. The upper lateral incisor was the most commonly missing tooth in the Indian group. The least likely teeth to be congenitally missing were the first molars and upper central incisors.

Overall, the prevalence of hyperdontia in orthodontic patients was 6.3%. Male patients had a significantly higher chance of presenting with hyperdontia compared with female patients (OR 1.87, 95% CI 1.14–3.07, $p = 0.015$).

The prevalence of hyperdontia in Chinese, Indian and Malay orthodontic patients was 7.0%, 3.8%

and 7.8%, respectively. There was no statistically significant difference in the incidence of hyperdontia between the three ethnic groups.

Supernumerary teeth occur more frequently in the anterior maxilla (34.1%) than in other regions. Supernumerary teeth also occur more frequently in the maxilla (76.9%) than in the mandible (23.1%).

Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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