DENTAL SPACE DISCREPANCIES AMONG ADULT ORTHODONTIC PATIENTS IN AN EDUCATIONAL INSTITUTION IN MALAYSIA

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Abstract

Malocclusion is an abnormal occlusion with regard to the position of the teeth and shows varied prevalence in different parts of the world. Crowding and spacing of teeth are two common features of malocclusion and are described as a lack or excess of space between the teeth. This study was conducted to evaluate the prevalence of crowding and spacing of teeth and their severity among Malaysian adults aged 18–25 visiting our institution, as well as their association with gender. A total of 150 adult patients were evaluated for crowding and spacing using the Boley caliper intra-orally. The severity of crowding and spacing was also noted. The study included Malay (70%), Chinese (25%), and Indian (5%) participants. Descriptive statistics were done and it was observed that crowding was more common in the mandibular arch (80%), whereas spacing was a common malocclusion found in the maxilla (14%). Based on the severity of crowding, it was observed that mild crowding (1-3 mm) was most frequent in both the maxilla (45%) and mandible (53%). However, in terms of spacing, moderate spacing (4-6 mm) (5.3%) was common in the maxilla; whereas in the mandible, mild spacing (1-3 mm) (9.3%). The Chi square analysis did not reveal any significant association between crowding and spacing with gender. Based on these results, it can be concluded that crowding is a common malocclusion affecting the mandibular arch, whereas spacing is common in the maxilla in the young Malaysian population visiting our institution. Both of these malocclusions were of the milder type and did not show any association with gender in our study population Studies conducted on a larger population are required to determine the association of these traits between genders and races in our population.

Keywords: Dental Crowding, Dental Spacing, Malaysian Adults, Malocclusion

Introduction

The Dental Practice Board defines malocclusion as “an abnormal occlusion with regards to the position, of teeth not in a normal position which consists of adjacent teeth in the same jaw and/or the opposing teeth when the jaws are closed.” Among orthodontists, malocclusion is well known as ‘an appreciable deviation from ideal occlusion’ (1). After caries and periodontal disease, malocclusion has been considered by the WHO as one of the most important oral health problems (2). Around the world, the prevalence of malocclusion was found to be 56% (95% CI: 11- 99), without significant gender differences. Regionally, the highest prevalence was in Africa (81%), followed by Europe (72%), America (53%), and Asia (48%) (3). It was also evidenced that malocclusion showed a highly variable prevalence and is estimated to be within the range of 39% to 93% in children and adolescents (2).

Most cases of malocclusions are of multifactorial origin, and there is no single etiological cause. However, two main components can be defined in their aetiology, which are genetic predisposition and exogenous or environmental factors (4). There are different types of malocclusions, and one of them results from the discrepancy between the overall tooth size and the arch dimension. Thus, this discrepancy can lead to either dental arch crowding or spacing, depending on whether there is too little or too much space for the teeth (5).

Dental crowding is defined as a lack of space to accommodate the teeth being aligned over the arch. It is a condition in which the teeth are too close together and have abnormal positions such as overlapping and displacement in various directions. It happens when there is not enough space in the jaw bones to accommodate all of the teeth (6). Ectopic eruption or delayed eruption

of the teeth can also cause crowding due to improper growth of the jaws (7, 8). Dental spacing is defined as the amount of space available that exceeds the space needed for the teeth to be aligned over the dental arch, leading to increased spaces between teeth in the same dental arch. It can also be related to the number of teeth in the jaw (9). Tooth discrepancy is a common aesthetic problem for many patients. As is the case with tooth crowding, it is very difficult to clean crowded teeth properly and thoroughly, which results in poor oral hygiene and further dental and medical problems (10). An epidemiological study found a positive association between the prevalence of dental caries and crowding in Hungarian adolescents (11).

Many researchers have conducted studies on the prevalence of crowding and spacing. It is important to know the prevalence, so that dentists can provide treatment accordingly. Knowledge of the prevalence of any disorder helps in the standardization of treatment plans which can also be incorporated into the dental curriculum for training young orthodontists. In this era, aesthetics has become the highest priority for every individual, especially adults, because at this age, they have indeed become more conscious of their looks, and it has also become trendy to wear orthodontic appliances. However, data on the prevalence and severity of crowding and spacing is deficient in the Malaysian population. Hence, this study was conducted to identify the prevalence of crowding and spacing along with its severity among different racial Malaysian adults aged 18–25 years old and to compare the association of crowding and spacing of the maxilla and mandible with gender.

Materials and Methods

This descriptive cross-sectional study was conducted in the Lincoln University College (LUC) Dental Clinic. Ethical approval was obtained prior to conducting the study. A total of 150 participants were involved in this study; 72 were male and 78 were female, with a range of ages between 18 and 25 years old. Informed consent was obtained from the participants (1 week prior).

The sample size for this study was calculated using this formula (12).

$$N = \frac{U^2(P)\,(Q)}{E^2}$$

N: required sample size to be examined

U: the factor according to probability is “e”. This factor equals 1.96, which is equivalent to the level of 95% probability.

P: estimated initial rate

Q: (1-P), estimated initial rate for citizens and not infected

E: maximum error allowed in prevalence estimation (5%)

$$N = \frac{1.96^2(0.915)(8.5)}{5^2}$$

N = 120

U^2: $1.96^2 = 3.8416$

P: 91.5%

Q: 100 – 91.5 = 8.5

E: 5%

In this study, convenience sampling was applied, and a total of 150 participants were included. The sample selection was based on the following inclusion and exclusion criteria. All healthy Malaysian adult orthodontic patients (pre-treatment) visiting the LUC dental clinic, aged 18–25 years old, were included. Participants who were already undergoing orthodontic treatment (currently or previously), had dental spacing due to extraction, or had any syndromic conditions were excluded from this study.

A data collection form was prepared especially for this study. It consisted of two parts. Section A included general demographic information, and Section B included clinical examination findings. Section B was further divided into crowding and spacing. Each category was then further classified into mild, moderate, and severe based on the following readings: mild (1-3 mm), moderate (4-6 mm), and severe (more than 7 mm).

The examiner’s calibration was done before the actual study was conducted. A random selection of 10 subjects among second-year dental students at Lincoln University College was included, and the subjects used in calibration were not included in the research. Each subject was examined for 10 minutes in a supine position on a dental chair, and measurements were taken in this position. The examiner sat in a 7 o’clock position in relation to the subject during the examination of both arches. The teeth examined in the maxillary arch included the right canine, right lateral incisor, right central incisor, left central incisor, left lateral incisor, and left canine. The teeth examined in the mandibular arch were the right canine, right lateral incisor, right central incisor, left central incisor, left lateral incisor, and left canine. The source of light used was natural light. A Boley caliper was used for the measurement of spacing and crowding. It was disinfected with an alcohol solution each time before being used on the next subject. The spacing between two adjacent teeth was measured in millimetres. It was measured by placing the tip of the calipers on the point of spacing on the crest of curvature between two adjacent teeth. The crowding was measured by placing the tip of the caliper at two points of overlapping adjacent teeth. The examiner performed these procedures, which were correlated with the supervisor’s (gold standard) calibration of the technique.

For the main data collection, one examiner was involved, and subjects were examined for 10 minutes in a supine position on a dental chair, and measurements were taken in this position. The examiner was positioned at 7 o'clock with the subject during the examination of both arches. The procedure used for measuring crowding and spacing was the same as that used for the calibration process.

Data was analyzed using Microsoft Excel software and SPSS version 25 (descriptive analysis and Chi-square test). In this study, the variables that were analyzed included crowding, spacing, the level of severity of crowding and spacing, race, and gender. The following statistical analyses were performed. Firstly. descriptive analysis was done since the present study focused primarily on the prevalence of crowding and spacing. Further, evaluation of the level of severity of crowding and spacing was also done using descriptive analysis. Finally, Chi-Square test was done to find the association of crowding and spacing with gender.

Results

Among the total of 150 participants that were included in this study, 52% were male, and the remaining 48% were female. The distribution of the participants based on race is depicted in Figure 1, with Malays being the most common and Indians being the least common. Based on the overall measurements done in our study population (Table 1), it was observed that crowding was prevalent as compared to spacing in the maxilla and mandible. The prevalence of spacing was very low in comparison to that of crowding. In between the arches, it was observed that crowding was more common in the mandible (80%) in comparison to the maxilla (72%). With regards to spacing, the opposite was true, with the maxilla showing a higher prevalence of 14% as opposed to only 11% spacing in the mandible.

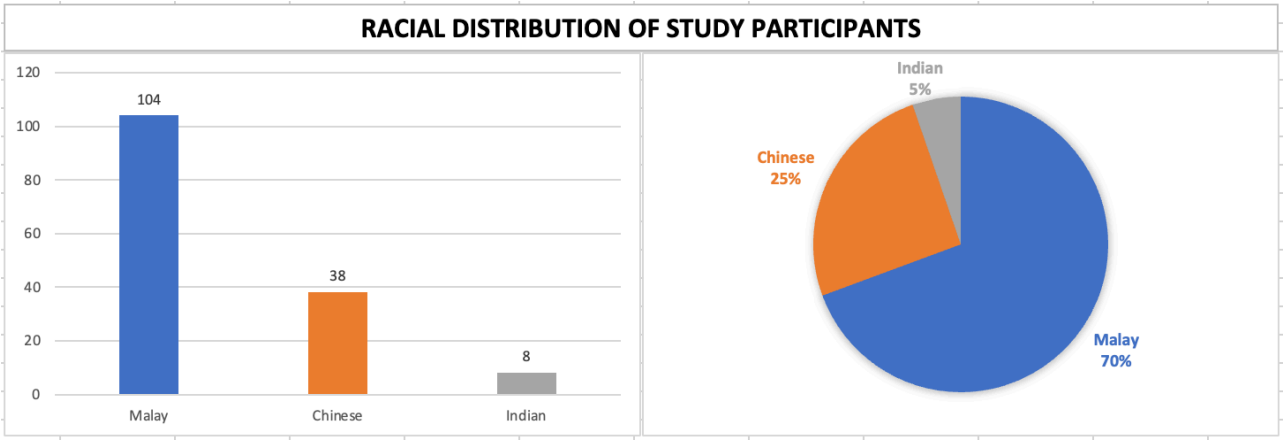

Figure 1: Racial distribution of study participants

Table 1: Prevalence of Crowding & Spacing in Maxilla and Mandible

Positions	Crowding		Spacing	
	n	%	n	%
Maxilla	108	72	21	14
Mandible	120	80	16	11

Further evaluation of study parameters was done in relation to the severity of crowding and space. Within the maxilla, mild crowding was observed in nearly 45% of the study population, moderate crowding in 11%, and severe crowding in 16% of the participants. It was noted that 28% of the individuals did not show maxillary crowding in our study. In the case of the mandible, 53% of cases showed mild crowding, 15% showed moderate crowding, and 12 % showed severe crowding, with almost 20% of the participants showing no crowding in the mandibular arch (Table 2).

Table 2: Level of severity of crowding

Severity	Crowding			
	Maxilla		Mandible	
	n	%	n	%
No crowding	42	28	30	20
Mild (1-3) mm	67	45	80	53
Moderate (4-6) mm	17	11	22	15
Severe (>7) mm	24	16	18	12

On the other hand, evaluation of the severity of spacing revealed that there was no maxillary arch spacing in 86% of the study participants and 89% in terms of the mandible. The Most common form, of spacing was the mild form with 6% seen in the maxillary arch and 9.3% in the mandible. Moderate spacing in the maxilla constituted 5.3% and severe spacing was 2.7%. whereas in the mandible, only 1 case each was observed for moderate and severe spacing,

which comprised only 0.7% of our study population (Table 3).

Table 3: Level of Severity of Spacing

Severity	Spacing			
	Maxilla		Mandible	
	n	%	n	%
No crowding	129	86	134	89
Mild (1-3) mm	9	6	14	9.3
Moderate (4-6) mm	8	5.3	1	0.7
Severe (>7) mm	4	2.7	1	0.7

Further analysis was done to evaluate the association of crowing and spacing of the maxilla and mandible with the gender of the study participant. Chi-square analysis was done for this, and the findings are depicted in Table 4.

Table 4: Cross-tabulation of crowding and spacing with gender.

Position	Gender	Maxilla (%)	p-value	Mandible (%)	p-value
Crowding	Male	70.5	0.673	85.9	0.06
	Female	73.6		73.6	
Spacing	Male	12.8	0.665	7.7	0.219
	Female	15.3		13.9	

It was observed that there was no gender association with crowding in the maxilla (p = 0.673). Similarly, it was observed that there was no association between crowding in the mandibular arch among males and females (p = 0.06). The observation was similar for the gender association of spacing in the maxilla and mandible. There was no association between spacing between males and females in the maxilla (p = 0.665), and in the mandible (p = 0.219) respectively.

Discussion

Crowding and spacing in the dental arch are two of the common causes of malocclusion for which individuals seek orthodontic treatment. The prevalence of crowding and spacing varies according to differences in population across the world, and knowledge of this provides valuable insight into the treatment of malocclusion in line with the standard cephalometric norms of that population (13). In our study, crowding was a feature more common in the mandibular arch in our study population, which comprised 80% of the study population. as compared to 72% crowding observed in the maxillary arch. These findings are similar to those of other studies, which also suggested that crowding was more common in the mandible. Similar studies have been conducted by Kandi et al. (14) where crowding in the lower arch was observed in 64 students, i.e., 29.76% and was the most common type of malocclusion. In a study conducted by Mugonzibwa (15), lower prevalence of crowding in the maxilla and a slightly higher prevalence in the mandibular arch were observed. This was also in agreement with the study conducted by Albakri et al. (16). One of the reasons for the higher prevalence of crowding in the mandibular arch could be due to the smaller mandibular size in this population, which would lead to frequent impaction or crowding within the arch. The findings of our study indicate that it would be beneficial if arch-width analysis were performed at a younger age so as to incorporate interceptive orthodontic measures which could lead to an overall reduction of cases of crowding in the future. The crowding of the maxilla at 23.3% showed a lower value than the mandible at 28%. Erfan et al. (17) in their study observed the prevalence of crowding was 28.6% in the mandible and 12.7 in the maxilla. Further, Yuen et al. (18) and Ling and Wong (19) suggested that in the Asian population, the mesiodistal width of the mandibular anterior teeth is larger compared to the Caucasians. A higher Bolton's value obtained in some studies conducted in the Malaysian population coincides with the finding of crowding in our study (13). However, contrasting reports were found in a study conducted on Lithuanian schoolchildren where crowding was found to be more in the maxilla (44.1%) in comparison to the mandible (40.3%) (20). These findings could be due to the fact that the study population was of the school going age group and hence the growth of the skull would not have reached its conclusion at that age group. Secondarily, the differences may be due to racial differences between the population of Lithuania and that of our study.

Furthermore, in terms of the severity of crowding, it was found in our study that a mild form of crowding was the most common both in the maxillary and mandibular dentition. Similar results were observed in a study conducted by Mulimani et al. (13), where it was found that crowding of less than 3 mm was seen in 33% of their cases in the maxilla and in 40.2% of cases in the mandible. Our study showed a prevalence of 11% of moderate crowding in the maxilla and 15% in the mandible. However, the prevalence of severe crowding was 16% in the maxilla and 12% in the mandible, respectively. The study conducted by Mulimani et al. (13) revealed slightly higher values of severe crowding at 20.5% in the maxillary arches and 15.2% in the mandibular arches. This difference in prevalence could be attributed to the difference in population between these two studies. In a study, it was observed that mild crowding was more common in the incisal segments. They also observed that moderate and severe crowding were more common in the maxillary anterior segments (21). Also, the severity of crowding may be dependent on the length of the maxilla and mandible. A retrospective study conducted by Singh et al. (22) involving 152 patients concluded that the maxillary and mandibular base lengths showed an inverse correlation with the severity of crowding. Further implications related to the occurrence of crowding could

be the presence of an underlying pathology, which could be a causative factor in the development of crowding. In a study conducted by Sembiring et al. (23) in Indonesia, the prevalence of crowding in 9-19 years old school children was 70%, with 30% of the cases showing enamel hypoplasia. However, there was no positive correlation between these two factors.

The prevalence of spacing in our study was the opposite to that of crowding, as seen in our study participants. Spacing was more common in the maxillary arch, with 14% of cases observed compared to only 11% in the mandible. Similar findings were observed in a study conducted by Mugonzibwa (15) among African and Caucasian children. It was observed that spacing was a common malocclusion finding in the maxilla. However, in a study conducted by Albakri et al. (16) among 12–15 years old schoolchildren in Saudi Arabia, it was found that the prevalence of spacing in the maxilla was less than that of crowding. With regards to the severity of spacing in our study, mild spacing (1-3 mm) was more common in the mandible (9.3%) as compared to the maxilla (6%). However, moderate and severe spacing were prevalent in the maxillary arch (5.3% and 2.7% respectively), with only 0.7 each in the mandible. These findings reflect that crowding is a feature of malocclusion common in the mandible, whereas spacing is more common within the maxilla. Further analysis with regards to the skeletal parameters specific to our population is required to corroborate these findings.

A gender-wise analysis of crowding and spacing did not reveal any significant association between sex and crowding and spacing. A larger sample size may be required to determine the association between these variables. Similar findings were observed in studies conducted by Mugonzibwa (15). However, the study conducted by Lux et al. (21), found spacing to be more common in females as compared to males. Jaw size variations are said to exist between males and females which could have an impact on the occurrence of crowding and spacing in this population. The limitations of our study were mainly due to the lower sample size as we included only the population visiting our institution. Hence the findings cannot be considered representative of the entire country of Malaysia. Further, we had evaluated only the prevalence of crowding and spacing in our population. Future studies are recommended, which would include a detailed evaluation of both skeletal and dental parameters and also include the population of the adolescent age group for obtaining more valid results.

Conclusion

Crowding is a common malocclusion affecting the mandibular arch in comparison to spacing is common in the maxilla in the young adult population visiting our institution. The overall severity of crowding and spacing in our population is of the milder type indicating that prophylactic treatment initiated at a younger age group would help in reducing the overall prevalence of crowding in the population. No association of gender with crowding and spacing was found. Studies conducted on a larger population are required to determine the association of these traits between genders and races in our population.

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Competing interests

The authors declare that they have no competing interests.

Ethical clearance

The ethical approval was issued to Dr. Gobinath P. Ganasan by the Lincoln University College Institutional Ethics Committee vide ref. no. LUC/Ethical/LoP/MY/SP/01-07 dated 27th January 2021.

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