

Characteristics and Association of Gender to Dental and Occlusal Anomalies in Malaysian Primary School Children

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Received: 24 September, 2020
Accepted for publication: 27 October 2020

DOI: <https://doi.org/10.24191/cos.v8i0.17485>

ABSTRACT

Aim: To describe the distribution and association of dental and occlusal anomalies to gender in children of mixed and early permanent dentition. **Methods:** It is a cross-sectional study with stratified random sampling based on the main ethnic composition involving 413 subjects aged between 9 and 11 years old enrolled in 7 national primary schools in Sungai Buloh, Selangor. A calibrated operator carried out clinical examinations, and study models were fabricated. All dental and occlusal anomalies were recorded accordingly and were analysed using SPSS version 21.0. Pearson chi-square test was used to determine the gender-based differences for various parameters. **Results:** The reported dental anomalies were supernumeraries and clinically missing teeth (impacted or hypodontia) with a prevalence of 1.5% and 6.3%, respectively. The occlusal abnormalities were: crowding (54.0%), sagittal discrepancies (overjet; increased, reduced, and reversed overjet: 55.5%), vertical discrepancies (overbite; increased, reduced, and open bite: 37.5%) and transverse discrepancies (unilateral and bilateral posterior crossbite: 5.1%). Gender-based differences were not statistically significant to all reported dental and occlusal anomalies ($p > 0.05$). **Conclusions:** Children in the mixed and early permanent dentition showed various dental and occlusal anomalies with crowding being the highest anomaly. Gender was not associated with any type of dental or occlusal characteristics in the studied population.

Keywords: Dental anomalies, Malocclusion, Mixed dentition, crowding, Overjet, Overbite

INTRODUCTION

The understanding of the classification of malocclusion and occlusal anomalies are essential for the diagnosis and treatment plan. Epidemiological studies on the characteristics and prevalence of malocclusion have been investigated tremendously in many years throughout different countries (Fu et al., 2002; Brito et al., 2009; Borzabadi-Farahani et al., 2009; Rapeepattana et al., 2019; Kharbanda, 2019). A recent systematic review reported that most of the prevalence of malocclusion studies were published between the 1940s and 1990s (Alhammadi et al., 2018). In recent years, studies concentrate more on the determination of treatment need, treatment mechanics and outcome of orthodontic treatment. However, it was proven that prevalence studies were essential as they play an indispensable role to determine the health status of a studied population. Determination of the distribution of



malocclusion among the community may be carried to determine the individual treatment need and priority and to gather beneficial information for the planning of fund allocation and facilities for orthodontic treatment (Foster & Menezes, 1976). The data determines the resources required for the provision of orthodontic treatment, such as human resources, skill, time, facilities, and orthodontic materials.

Dental epidemiological surveys were conducted under the Ministry of Health Malaysia to plan and evaluate oral health care services since the 1990s. Dental surveys on common dental pathology and verbal health-related behaviour as recommended by the World Health Organization (WHO) were carried out regularly with ten years interval on the index age groups. The age groups involved in these national surveys were growing individuals (5, 12 and 16 years of age) and adults. The main variables of the studies were dental caries and periodontal disease in all groups with the addition of the edentulous area and the need for a prosthesis in an adult group. At present, 16 surveys have been undertaken on a national basis.

Following a great effort by the Malaysia Ministry of Health, there has been a decreasing trend of oral disease including dental caries and periodontal disease in the last two decades, whereby in the year 1995 the oral disease was reported to involve 87.1% of Malaysian children, followed by 76.2% and 71.3% in the year 2005 and 2015, respectively (Oral Health Division, 2015). This data was found to agree with a global pattern of reduction in oral diseases among children (World Health Organization, 2003). However, malocclusion is not included in the surveys and study on the malocclusion among Malaysian children are lacking. Currently, the majority of cases seen in the Orthodontic Clinic, Faculty of Dentistry UiTM are adults, and some of them came with more complex cases which require a more complicated and comprehensive treatment which could have been intercepted if they were recognised early.

Therefore, this study aimed to investigate the distribution and association by gender of dental anomalies and occlusal characteristics in all three planes of dimension and other occlusal anomalies seen among primary school children in Sungai Buloh, Selangor.

MATERIALS AND METHODS

This cross-sectional study was conducted over 10 months between January 2018 and October 2018 in Sungai Buloh, Selangor. These findings are part of a study in developing an index. The study was approved by the Research Ethics Committee Universiti Teknologi MARA (UiTM), Malaysia (600-IRMI (5/1/6), 29th March 2017) and written informed consent was obtained from their parents/guardians. The sample size was calculated using “Single Proportion Formula” based on a previous study, with the statistical power of 97% (Zreayat et al., 2013). Acceptable margin of error was set at 5%. Therefore, the minimum sample size was 385. The probability of the non-participation rate was considered; hence, the sample size was increased by 30% to 500.

Seven national primary schools were conveniently selected after approval obtained from the Ministry of Education and the Selangor Department of Education. Following that, stratified random sampling was performed for the subjects’ recruitment based on the Malaysian main ethnic composition (Department of Statistic Malaysia Official, 2018). Inclusion criteria were: (1) Standard 3 until Standard 5 (age 9 to 11 years), (2) obtained written parental consent. To potential confounding factors, such as children with syndromes, or those with a history of orthodontic treatment were excluded.

A single operator (NNZ) performed all clinical examinations to avoid inter-examiner bias. Calibration of the operator was carried out against an orthodontic specialist (SDS) for inter-examiner reliability testing for the assessment of occlusal characteristics. Intra-examiner reliability testing was done 14 days afterwards. A total of 20 study models were examined and calibrated. As the occlusal features were categorical, the results were analysed using the Kappa Coefficient Analysis.

Data collection involved clinical assessments and analysis of fabricated study models. The occlusal characteristics were measured and recorded in the malocclusion assessment form, which was designed based on an orthodontic assessment form. A detailed description of the criteria adopted for each dental and occlusal anomaly is given in Table 1.

Table 1: Descriptions of the parameters used to record dental and occlusal anomalies

Dental Anomalies	Descriptions
Clinically missing teeth	<ul style="list-style-type: none"> Clinically missing (not due to extraction), could be due to impaction or hypodontia. The appropriate eruption time had already passed, or any bulge could not be seen intraorally.
Supernumerary	<ul style="list-style-type: none"> Clinically presence or absence
Occlusal Anomalies	Descriptions
Anteroposterior <input type="checkbox"/> Increased Overjet (OJ) <input type="checkbox"/> Reduced OJ <input type="checkbox"/> Reversed OJ <input type="checkbox"/> Anterior Crossbite	<ul style="list-style-type: none"> Increased OJ $>3.5\text{mm}$: ($3.5 < \text{OJ} \leq 6\text{mm}$), ($6\text{mm} < \text{OJ} \leq 9\text{mm}$), $\text{OJ} > 9\text{mm}$ Reduced OJ: Edge to edge (ETE) $\leq \text{OJ} < 2\text{mm}$ Reversed OJ: All 4 incisors were in crossbite Anterior crossbite: At least 1 anterior tooth in crossbite, not all incisors
Vertical <input type="checkbox"/> Increased Overbite (OB) <input type="checkbox"/> Reduced OB <input type="checkbox"/> Openbite	<ul style="list-style-type: none"> Increased OB: $\text{OB} > 1/2$ Reduced OB: $\text{OB} < 1/3$, not exceed ETE Openbite: Absence of vertical overlap
Transverse Posterior crossbite	<ul style="list-style-type: none"> Posterior crossbite: With or without mandibular displacement
Other occlusal anomalies <input type="checkbox"/> Crowding <input type="checkbox"/> Midline shift <input type="checkbox"/> Generalised spacing <input type="checkbox"/> Midline diastema <input type="checkbox"/> Scissors bite	<ul style="list-style-type: none"> Crowding: Presence of irregularity of teeth of either the upper or lower arch or both. Midline shift: Deviation of the dental midline from the facial midline Spacing: Presence of space except spacing due to the normal eruption process Midline diastema: Presence of thick and low frenal attachment or palpable bulge ($>2\text{mm}$) Scissors bite: Presence or absence

All variables were documented as categorical and the results presented as percentages. Pearson chi-square tests were used to analyse the association between gender and each occlusal characteristic. Statistical significance was defined as $p\text{-value} < 0.05$. All analyses were performed using Statistical Package for Social Sciences (SPSS) version 21.0 (IBM, Armonk, New York).

RESULTS

The inter and intra-examiner reliability test showed a high level of agreement (kappa statistic 1.00). The demographic characteristics of this study in percentage are shown in Figure 1. A total of 413 school children were successfully examined and included in this study (82.6% participation rate). The highest percentage of participation was Standard 3 (9 years old), female and Malays. The ethnic proportion was as the result of stratified random sampling. Hence, it reflected the Malaysian ethnic composition.

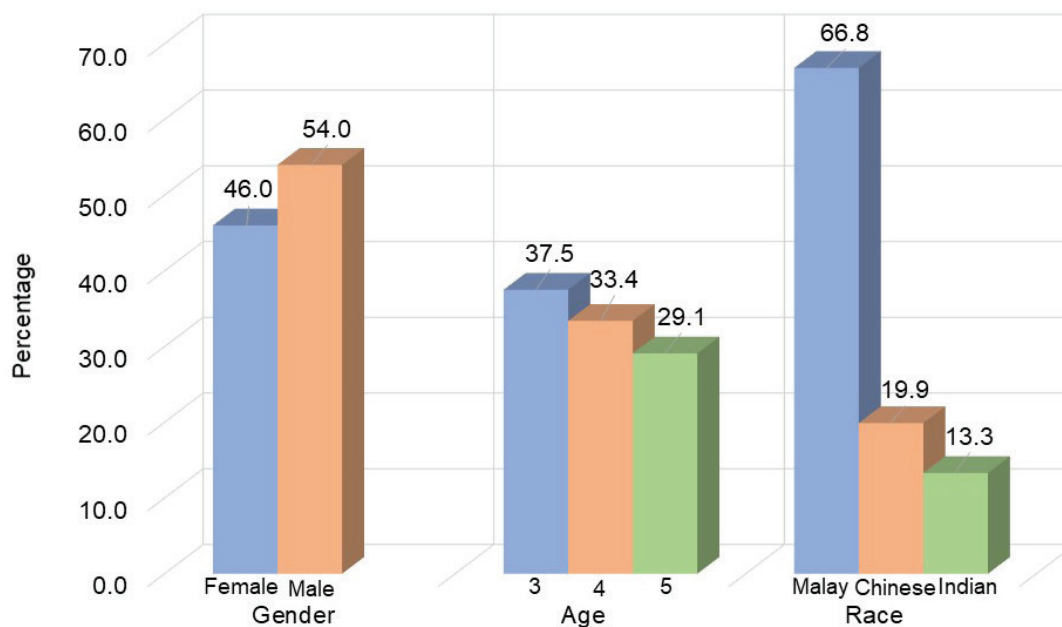


Figure 1: Demographic characteristics of the studied population

The distribution of dental anomalies by gender, including supernumerary and clinically missing teeth, are shown in Table 2. The clinically missing teeth could be due to impaction or hypodontia. Supernumerary and clinically missing teeth were reported to be present in 1.5% and 6.3% of the studied population, respectively. The distribution of the occlusal anomalies in all three planes and other occlusal anomalies based on gender are shown in Table 3-4.

Table 2: Distribution of Dental Anomalies and Their Association to the Gender

Anomalies	Gender		Total (n=413)	*p-value
	Male (n=190)	Female (n=223)		
Clinically missing teeth	6.3%	6.3%	6.3%	0.99
Supernumerary	2.1%	0.9%	1.5%	0.31

*Significance level set at p-value <0.05 (Pearson Chi-square Test)

In the sagittal plane (Table 3), overall findings showed a little over half of the studied population had an overjet within the normal range. Among those with the sagittal discrepancy, increased overjet was more common than reduced overjet (increased overjet (OJ >3.5mm): 28.8%; reduced overjet (OJ <2mm): 16.7%), with the highest frequency was overjet of 3.5mm<OJ≤6.0mm. Whereas, overjet of >9mm was almost equivalent with reverse overjet in which they became the least prevalent sagittal discrepancy. Despite some differences in the distribution of sagittal discrepancy between genders, the Pearson chi-square test revealed that there was no statistically significant difference ($p = 0.88$). Moreover, 14.3% of all subjects had anterior crossbite either with or without displacement in which anterior crossbite with mandibular displacement being predominant (Table 4), with no statistically significant difference reported between genders (p -value = 0.674).

Table 3: Distribution and Association Between Gender to the Sagittal and Transverse Discrepancy

Gender	Overjet Category, %						<i>p</i> -value
	Normal	Increased			Reduced		
		3.5<OJ≤6.0	6.0 <OJ≤9.0	>9.0	2>OJ≤ETE	Reverse overjet	
Male	53.2%	22.1%	4.7%	2.6%	15.3%	2.1%	0.88
Female	55.6%	19.7%	7.2%	1.4%	14.8%	1.4%	
Total	54.5%	20.8%	6.1%	1.9%	15.0%	1.7%	

Gender	Normal Overbite	Reduced Overbite			Increased Overbite		<i>*p</i> -value
		1/3rd >OB≤ ETE	Anterior Open Bite	Posterior Open Bite	With Palatal Trauma	With Palatal Trauma	
Female	65.0%	13.5%	3.1%	0	11.7%	6.7%	
Total	62.5%	13.1%	2.9%	0	15.2%	6.3%	

*Significance level set at p -value <0.05 (Pearson Chi-square Test)

Note: Increased overjet category is based on IOTN-DHC grades

In the vertical plane (Table 3), the finding showed that 37.5% of the subjects showed some degree of vertical discrepancy with more subjects having an increased overbite. The increased overbite was found to be predominant in both genders. The frequency of anterior open bite was found to be almost equivalent between genders. The Pearson chi-square test revealed that there was no statistically significant difference ($p = 0.22$) between genders to the vertical anomalies.

In the transverse plane, subjects who had posterior crossbite either with or without functional shifts were recorded and analysed (Table 4). Overall results demonstrated that 5.1% of the population had posterior crossbite. The prevalence was found to be slightly higher in female than male subjects. Amongst those with the transverse discrepancy, posterior crossbite without displacement predominates. There was, however, no statistically significant difference reported with regards to the gender distribution of the transverse discrepancy (p -value = 0.74).

Table 4: Association of Transverse and Other Occlusal Anomalies to the Gender

Anomalies	Gender		Total (n=413)	*p-value
	Male (n=190)	Female (n=223)		
Crowding	52.6%	55.2%	54.0%	0.88
Anterior crossbite	15.8%	13.0%	14.3%	0.67
Midline shift	13.2%	11.2%	12.1%	0.55
Generalised spacing	8.9%	7.6%	8.2%	0.63
Midline diastema	8.4%	4.0%	6.1%	0.06
Transverse anomaly (posterior crossbite)	4.2%	5.8%	5.1%	0.74
Scissors bite	1.6%	1.3%	1.5%	0.84

*Significance level set at p-value <0.05 (Pearson Chi-square Test)

The distribution of other occlusal anomalies that included crowding, generalised spacing, midline diastema, midline shift and scissors bite based on gender are described in Table 4. Amongst all, crowding was the most common occlusal anomaly in both genders, which represented the highest frequency of occlusal discrepancy in this study. In contrast, scissors bite was the least common anomalies. Statistical analysis revealed that there were no significant differences between other occlusal anomalies and gender.

DISCUSSION

This study on the prevalence of malocclusion in Malaysian children fills the existing lacunae on information about dental anomalies and occlusal characteristics among Malaysian children. The findings of this study showed that children exhibited various types of dental and occlusal discrepancies. In terms of sample distribution, this study showed a higher percentage of females, which contradicted with the gender ratio of the Malaysian population. The difference could be since this study involved a specific age group while the Malaysian statistic of gender proportion involved all age groups (Department of Statistics Malaysia Official, 2018).

This study demonstrated no significant differences between gender to all occlusal anomalies described. The most predominant occlusal discrepancy was crowding, affecting 54.0% of children, which compliments with an earlier study investigating malocclusion in subjects aged 10 to 16 years old, reporting 52.3% of crowding (Siddegowda & Rani, 2014). When we compare it with a study that was conducted in an early mixed dentition stage (6-8 years old), the prevalence of crowding in their study population was significantly lower (26.3%) (Tausche et al., 2004). The crowding at this stage has not developed with the presence of mostly deciduous teeth only. In contrast, another study reported a higher prevalence of crowding (65.2%) in an older age group with permanent dentition (12-17 years) compared to our study (Gelgör et al., 2007). Nevertheless, crowding is a common malocclusion that manifests early, and orthodontic treatment can be initiated first or delayed based on other factors and the expected outcome (Gianelly, 2002; Winnier & Nayak, 2014).

To report the prevalence of increased overjet, based on IOTN-DHC (Brook & Shaw, 1989), an increased overjet of >3.5 mm was used. This reference was chosen as it is the index that has been widely used among Malaysian dental practitioners in both public and private settings for orthodontic referral and guidance. Our findings are in agreement with earlier reported studies for increased overjet (Tausche et al., 2004; Brito et al., 2009). They reported that 29.7% of 9-12 years old Brazilian and 31.4% of 6-8 years old children had increased overjet of >3.5mm, respectively. However, it was much lower than a study that was conducted among Thai children aged 8-9 years old in which they reported that 47.7% of had overjet of >3.5mm (Rapeepattana et al., 2019). Some studies used a lower overjet reference (>3mm) (Gelgör et al., 2007; Yu et al., 2019). On the other hand, there was also a study that used >4mm as reference overjet (Thilander et al., 2001). Nevertheless, the frequencies of overjet in the majority of the mentioned studies were found to be comparable with our result, except for a study conducted among children in Shanghai, China where they reported a predominantly high percentage of increased overjet (40.8%) (Yu et al., 2019). The study involved children aged between 7 and 9 years old and the reference for increased overjet was >3mm.

This study reported that 37.5% of subjects had a discrepancy in the vertical dimension, mostly involving an increased overbite (21.5%). In agreement with our result, there was another study which reported that 21.6% of children aged between 5 and 17 years old had increased overbite (Thilander et al., 2001). Comparing our work with studies that were conducted among a younger age group, they reported a predominantly higher frequency of subjects with an increased overbite (Tausche et al., 2004; Rapeepattana et al., 2019). These studies conducted among 8-9 and 6-8 years old, reporting 48.2%, and 46.2% of their subjects had increased overbite, respectively. In contrast, another study conducted among the older age group (12-17 years) demonstrated a little lesser frequency (18.3%) (Gelgör et al., 2007). A comparison between our study and the above-mentioned studies indicates that increased overbite was higher in the younger age group than the older age. To support the above findings, another study reported a significant reduction of overbite from 9 to 18 years of age (Baccetti et al., 2011).

The reported prevalence of anterior openbite (2.9%) was equivalent to a study conducted in Karnataka state, Bangalore, which was 2.5% (Siddegowda et al., 2014). It was lower compared to a study with a similar age group (7.8%) (Brito et al., 2009). Comparing our results with studies among younger age groups (below 5 years old) and (6-8 years old), they reported a distinctly higher prevalence of anterior openbite, which were 12% and 17.7% (Tausche et al., 2004; Machado et al., 2014). In agreement, a study revealed an improvement of open bite tendency during the pre-pubertal stage, indicating a reduction of open bite with growth (Phelan et al., 2014).

The prevalence of anterior crossbite was 14.3%. The corresponding value reported by a previous study was relatively equivalent (15.0%) (Siddegowda et al., 2014). In a study of Chinese and Brazilian children, the prevalence was reported to be lower, which were 10.5% and 10.1%, respectively (Brito et al., 2009; Yu et al., 2019). In contrast, a study among Thai children revealed a higher prevalence of anterior crossbite (19.0%) (Rapeepattana et al., 2019). In this present study, amongst subjects with an anterior crossbite, 61% of them had mandibular displacement. It was higher than a study that investigated the prevalence of anterior crossbite in preadolescent children, which reported that 48.2% had anterior crossbite with displacement (Vithanaarachchi & Nawarathna, 2014). The purpose of the interceptive orthodontic treatment was to avoid several complications caused by anterior crossbite as if left untreated, it may cause attrition to the labial surface of the upper incisors, fracture, or mobility of incisor teeth and gingival recession (Borrie & Bearn, 2013). Moreover, it may contribute to the alteration of mandibular function and lead to more complex management in the future (Fleming, 2017).

In the transverse plane, posterior crossbite was presented in 5.1% of this studied population. The result relatively coincided with previous studies: 5-8% (Bell & Kiebach, 2014), 5.7% (Thilander et al., 2001) and 4.6% (Gelgör et al., 2007). In contrast, studies among Indian and Thai children demonstrated a lower prevalence of posterior crossbite, which were 0.9% and 1.0%, respectively (Siddegowda et al., 2014; Rapeepattana et al., 2019). In contrast, other studies reported a higher percentage: 12.0% (Perrotta et al., 2019) and 19.0% (Brito et al., 2009). The untreated, posterior crossbite may also result in a few complications, as mentioned above. Hence, these characteristics should be concerned as an urgent need for interceptive orthodontic treatment in the mixed dentition stage.

Another common occlusal anomaly was midline shift, affecting 12.1% of all subjects. Few previous studies reported a higher prevalence of midline shift ranging between 32% and 44% (Siddegowda et al., 2014; Mohamed et al., 2014; Yu et al., 2019). In contrast, another study demonstrated a little less percentage (7.0%) (Thilander et al., 2001). The previous study suggested that this condition permits interceptive treatment to alleviate developing malocclusion. If it is left untreated at the early stage, it may lead to prolonged orthodontic treatment, and more complex management as midline corrections can be time-consuming (Mohamed et al., 2014). Nevertheless, diagnosing the midline discrepancy is not incorporated in the IOTN, which led to the underestimation of developing malocclusion in mixed dentition children.

Dental anomalies such as supernumerary and clinical missing teeth were recorded. In this study, the prevalence of erupted supernumerary was 1.4%, which is relatively equivalent to the prevalence of supernumerary reported by other studies: 1.8% (Thilander et al., 2001) and 1.0% (Rapeepattana et al., 2019). A study investigating the prevalence of supernumerary and its association between genders reported that the prevalence was 2.14%, and it was significantly higher in females than males (1.28:1) (Demiriz et al., 2015), which contradicted with our findings. The prevalence of supernumerary in our study was slightly low, and the difference between genders and ethnicity to this anomaly was not significant. Moreover, as this study was conducted based only on the clinical assessment, the possibility that supernumerary was impacted and unerupted was unable to be ascertained and not included in this study. Nevertheless, the presence of supernumerary should be recognised as early as possible to alleviate the potential complications such as failure of eruption of permanent teeth, displacement or rotation, crowding, abnormal diastema or premature space closure, dilaceration, delayed or abnormal root development of permanent teeth and cystic formation (Rajab & Hamdan, 2002).

Clinically missing teeth were also recorded. This may include hypodontia or impacted teeth because it was purely assessed clinically during screening, and further investigations were not carried out at the point of assessment. The reported prevalence was higher compared to a study among younger age group (Yu et al., 2019). A study investigating malocclusion among children aged between 6 and 8 years old reported that 3.2% of their subjects had missing teeth (Tausche et al., 2004). This could be due to the difference in age group, in which there were lesser permanent teeth that could have been erupted developmentally compared to ours. Therefore, this condition is more pronounced in our study.

We investigated the presence of midline diastema based on the presence of thick and low frenal attachment with $>2\text{mm}$ space. It was consistent with the general guideline stating that maxillary midline diastema exceeding 2mm is unlikely to close spontaneously following the eruption of the canine and lateral incisors (Gkantidis et al., 2008; Abraham & Kamath, 2014). Our result was in agreement with another study that reported midline diastema of $>2\text{mm}$ affecting 7.0% of their studied population (Thilander et al., 2001). An earlier investigation provides a reference on a clinical assessment for the prediction of the closure of midline diastema (Sanin et al., 1969). They reported that for 1.85mm diastema, the possibility of spontaneous space closure was 50%, and the percentage dropped to 1% if space was 2.7mm or more (Rajab LD, et al 2002). Therefore, we excluded the presence of minimal midline diastema due to physiological spacing. Furthermore, a study conducted among the similar age group of subjects with a midline diastema reference of $\geq 1\text{mm}$ reported a higher prevalence compared to our study (Brito et al., 2009). This could be due to the inclusion of subjects with diastema of physiological factors such as the ugly duckling stage in their study as the reference value was lower.

CONCLUSIONS

1. Children in mixed and early permanent dentition demonstrated various types of dental and occlusal anomalies.
2. Crowding was the predominant occlusal anomaly, followed by increased overjet and overbite.
3. For dental anomalies, the prevalence of clinically missing teeth was higher than supernumeraries.
4. None of the anomalies demonstrated an association with gender.
5. Due to the various types of occlusal anomalies present in the groups of children, it is recommended to carry out early orthodontic screening to allow timely orthodontic consults and appropriate interceptive interventions if required.

CONFLICT OF INTEREST

All authors reported no conflict of interest.

ACKNOWLEDGEMENT

The authors thank the Malaysia Ministry of Education, State Department of Education, the respective school administration for their assistance and the Faculty of Dentistry UiTM for approving the Postgraduate Research funding.

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