Malocclusion prevalence in an ethnic Chinese population

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Key words: Chinese, malocclusion, prevalence.

Abstract
Population norms derived from one ethnic group may not necessarily be valid and accurate for other ethnic groups. With the increasing number of ethnic Chinese immigrants in Australia, Europe, and America, it would be useful for dental practitioners to be informed about malocclusion prevalence among Chinese. This study was carried out on 1050 Chinese school children (aged 12-14 years) to assess both qualitatively and quantitatively certain occlusal features. The population was found to have a high incidence of Class III malocclusions compared with Caucasians. However, the incidence of Class II malocclusions was quite similar to those reported in Caucasians. Normal occlusions occurred in about 7 per cent of this population. Although this percentage was much lower than those reported in blacks, it was similar to those reported in Caucasians. Crowding occurred in about 50 per cent of cases, which was slightly less than for those reported for Caucasians. Increased overbites were also less common in this Chinese population compared with Caucasians. Compared with Caucasians, crossbites were also less frequent in this Chinese population.

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Introduction
Although the Chinese ethnic group comprises close to a quarter of the world’s population, no malocclusion study on a large sample of Chinese school children in the early permanent dentition stage has been published. Johnson¹,² in his evaluation of 210 school children has provided some data on the malocclusion status in Chinese. However, because his sample was comprised of children with ages ranging from 7 to 13 years, with possibly only 36 subjects in the permanent dentition stage (that is ≥ 12 years), the assessment of some malocclusion parameters may not be representative of the true malocclusion status in the Chinese racial group.

One of the biggest problems in assessing malocclusion is the choice of an index which is both reliable and repeatable. In an attempt to distinguish patients in need of orthodontic care, several systems of classifying malocclusions have been proposed.³⁻⁴ The determination of objective signs of malocclusion have been studied by either clinical examination of patients and/or from plaster casts of the patients’ dental arches. Orthodontic treatment indices attempt to quantify dentofacial attractiveness and serve as epidemiological tools for assessment of malocclusion prevalence or changes in its disease pattern. Morphological characteristics of malocclusion when evaluated in the light of psychosocial information may allow epidemiologists to project national treatment needs.⁵ However, because of the varying impact of similar malocclusions under dissimilar cultural and social milieux, it is not surprising that no present index is universally accepted as a means of assessing treatment needs.⁶
Current epidemiologic data are necessary to detect trends and changes in the prevalence of malocclusions. While some areas of dentistry such as caries prevalence are declining in importance from a treatment perspective, orthodontic care will continue to increase in importance as more children and adults seek treatment, especially in the more affluent societies. The purpose of this study is to provide local data on the prevalence of malocclusion in a group of Chinese children at an age when orthodontic treatment is usually carried out in Singapore. The morphological and morphometric characteristics of malocclusion will also be investigated. The results from this study may be used by both clinicians and epidemiologists to project preventive and interceptive orthodontic needs in the Chinese racial group which comprises 77.7 per cent of Singapore's population of more than 3 million people.

Materials and methods

The sample consisted of 1050 Chinese school children (520 boys, 530 girls) aged 12-14 years (mean age 13.1 ± 0.9 years) (Table 1). The subjects chosen exhibited the presence of permanent teeth from first molar to its antimere in both arches, had no history of orthodontic treatment, no history of early loss of deciduous teeth, no extractions of permanent teeth, no history of skull/facial operations or skull fractures or systemic conditions which could affect craniofacial growth and occlusal development.

Each subject, seated on a dental chair, was initially examined intra-orally with a dental mirror, periodontal probe and millimetre rule. The assessments were carried out in a centralized dental clinic over a period of five weeks. With the exception of the assessment of crowding and spacing where the mouths were wide open, the other parameters such as overjet-overbite and the presence of crossbite were assessed when the subjects were in maximum intercuspation. A score card with the subject's particulars and examination results was completed for each subject. The following malocclusion parameters (which were quite similar to Foster and Day's study) were measured and recorded by one investigator.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>100</td>
<td>99</td>
<td>199</td>
</tr>
<tr>
<td>13</td>
<td>260</td>
<td>310</td>
<td>570</td>
</tr>
<tr>
<td>14</td>
<td>160</td>
<td>121</td>
<td>281</td>
</tr>
<tr>
<td>Total</td>
<td>520</td>
<td>530</td>
<td>1050</td>
</tr>
</tbody>
</table>

1. Dental arch relationship

The anterior-posterior arch relationships were assessed according to Angle's criteria. They were classified into Class I normal occlusion, Class I malocclusion, Class II division 1, Class II division 2 and Class III malocclusions.

2. Dental arch crowding/spacing

This was assessed from first molar to its antimere in both arches. Crowding was classified as present when there was overlapping of teeth while spacing was classified as present when diastemas were evident between the teeth. If crowding and spacing was present in the same arch, then the crowding and spacing was measured to the nearest 0.5 mm and the nett amount of crowding spacing was determined. The crowding spacing was recorded separately for each arch.

3. Incisal overjet

This was the measure of the horizontal overlap of the four incisors. Overjets were measured to the nearest 0.5 mm. The mean overjet of all 4 incisors was determined and categorized as follows.

(a) Normal: Mean positive overjet up to 3 mm.
(b) Increased: The mean positive overjet was greater than 3 mm.
(c) Edge to edge: The mean overjet was edge-to-edge in occlusion.
(d) Reversed: The mean overjet was negative.

4. Incisal overbite

This was the mean vertical overlap of the four incisors. The overbite of each incisor was measured to the nearest 0.5 mm. Overbites were classified as follows.

(a) Normal: The mean upper incisal overlap was between 15-40 per cent of the clinical crown length of the lower incisors.
(b) Increased: The mean upper incisal overlap exceeded 40 per cent of the clinical crown length of the lower incisors.
(c) Decreased: The upper incisors overlapped less than 15 per cent of the clinical crown lengths of the lower incisors.

5. Crossbite

This was the transverse relationships of the upper first molars to those of the lower first molars in maximum intercuspation. A buccal crossbite was deemed to exist when the buccal cusps of the upper molars were lingual to the buccal cusp of the lower molars, and a scissor bite when the palatal cusps...
of the upper molars were buccal to the buccal cusp of the lower molars. Buccal crossbites and scissor bites were classified as unilateral or bilateral.

Results
The results of the study are shown in Figs. 1-5.

1. Dental arch relationship (Fig. 1)
Normal occlusion accounted for 7.1 per cent (n = 75) of the sample, whilst Class I malocclusions had the highest incidence at 58.8 per cent (n = 616). Class II division 1 and Class II division 2 malocclusions were recorded at 18.8 per cent (n = 197)
1. Incisal overjet (Fig. 3)

Ideal overjet was noted in 68.2 per cent (n = 716) of the sample, while increased overjet was found in 19.2 per cent (n = 202) of the sample. The incidence of edge-to-edge incisal relationship was 2.7 per cent (n = 28) while negative overjet was recorded at 9.9 per cent (n = 104).

2. Dental arch crowding/spacing (Fig. 2)

Maxillary arch crowding was observed in slightly less than half of the sample at 49.7 per cent (n = 522), whereas crowding in the mandibular arch was observed in 52.7 per cent (n = 533) of the sample. Spacing was more prevalent in the maxillary arch at 5.2 per cent (n = 55) as compared with the 7.2 per cent (n = 76) found in the lower dentition.

3. Incisal overbite (Fig. 4)

Ideal overbite accounted for 46.5 per cent (n = 488) of the sample. While 28.4 per cent (n = 298) of the sample had an increased overbite,
25.1 per cent (n = 264) of the sample had decreased overbite.

5. Posterior crossbite (Fig. 5)

The majority of the sample (91.9 per cent, n = 965) did not have any form of posterior crossbite. Unilateral buccal crossbite was found in 6.1 per cent (n = 64) while 1.3 per cent (n = 14) of the sample had bilateral buccal. Unilateral and bilateral scissor bites were relatively rare and accounted for only 0.5 per cent (n = 5) and 0.2 per cent (n = 2) of the sample, respectively.

Discussion

Numerous problems are encountered when comparing studies on malocclusion status, particularly regarding the varying systems used by different investigators to classify and quantify occlusal status. Most studies in their attempt to determine the prevalence of malocclusion have divided malocclusion into five components: (1) crowding; (2) anteroposterior incisor relation (overjet/reverse overjet); (3) anteroposterior molar relationship; (4) vertical incisor relationship; and (5) crossbite relationship. The morphologic components of malocclusion in children, adolescents and adults have been reported. These studies demonstrate that the morphologic and morphometric components of malocclusion vary with age and racial type. Heikinheimo, Salnis and Myllarniemi, in a longitudinal study of Swedish children from 7 to 10 years old, found that severe maxillary overjets increased from 17 per cent to 27.2 per cent with age, while maxillary and mandibular incisor crowding decreased from 26.7 per cent to 18.2 per cent, and 34.1 per cent to 10.2 per cent respectively. Minimal changes were reported in deepbite, Class II relationships and crossbite during the period from 7 to 10 years of age. About 70-75 per cent of adolescents were judged to have malocclusion of some degree.

The prevalence of Angle's malocclusion types among different ethnic groups such as Americans, British, Danes, Indians, Africans, Polynesians has been described. On limited sample sizes, malocclusion incidence in Chinese and Malays has also been reported. The Chinese and Malays, Black Africans, Egyptians and Eskimos appear to have a higher incidence of Class III malocclusions compared with the caucasian races (Table 2). In general, the incidence of malocclusion in descending order of prevalence is Class I malocclusion, Class II malocclusion, Class III malocclusion. The exception to this trend is noted in Chinese, Malays and, to a lesser extent, Eskimos and Swedes. Although some of these differences in incidences reflect ethnic trends, a host of other factors also contribute to these variations. Some of these include differences in age, sex and definition of evaluation criteria and the lack of standardization amongst examiners.

The study by Johnson, Seetemat, and Winoto on 210 Singapore Chinese children aged 7-13 years showed the incidence of Class I, Class II and Class III malocclusions to be 62 per cent, 16 per cent and 22 per cent, respectively. Woon, Thong, and Kadir, studying 154 Malaysian Chinese subjects with a mean age of 16.5 years, found Class I molar relationships in 52 per cent, 15 per cent having Class II molar relationships and 33 per cent having
Table 2. Malocclusion in the permanent dentition among different ethnic groups

<table>
<thead>
<tr>
<th>Ethnic group</th>
<th>Sample size</th>
<th>Normal occlusion</th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Caucasians</td>
<td>718</td>
<td>6.8</td>
<td>65.2</td>
<td>22.5</td>
<td>5.5</td>
</tr>
<tr>
<td>American Blacks</td>
<td>445</td>
<td>31.3</td>
<td>44.0</td>
<td>16.0</td>
<td>8.7</td>
</tr>
<tr>
<td>British</td>
<td>1000</td>
<td>52.0*</td>
<td>52.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>154</td>
<td>52.0*</td>
<td>15.0</td>
<td>33.0</td>
<td></td>
</tr>
<tr>
<td>Egyptian</td>
<td>501</td>
<td>34.3</td>
<td>33.3</td>
<td>21.0</td>
<td>10.6</td>
</tr>
<tr>
<td>Eskimo</td>
<td>100</td>
<td>18.0</td>
<td>64.0</td>
<td>8.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Indian</td>
<td>42</td>
<td>67.0*</td>
<td>22.0</td>
<td>11.0</td>
<td></td>
</tr>
<tr>
<td>KiKuyu Kenyan</td>
<td>505</td>
<td>16.8</td>
<td>51.7</td>
<td>7.9</td>
<td>16.8</td>
</tr>
<tr>
<td>Malay</td>
<td>151</td>
<td>57.0*</td>
<td>14.0</td>
<td>29.0</td>
<td></td>
</tr>
<tr>
<td>Swedish</td>
<td>301</td>
<td>10.0</td>
<td>83.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Lew (present study)</td>
<td>1050</td>
<td>7.1</td>
<td>58.8</td>
<td>21.5</td>
<td>12.6</td>
</tr>
</tbody>
</table>

*Includes normal occlusion.
†Based on molar relationship.

Class III molar relationships. In the present study, the incidence of Class III malocclusions was 12.6 per cent. Although the percentage of Class III malocclusions was high compared with Caucasians, this value was lower than those reported by Johnson et al. and Woon et al. on Chinese populations. Such differences could arise because of variation in sampling techniques and diagnostic criteria. The incidence of Class I malocclusions and Class II malocclusions appeared quite similar to those reported by other authors on Chinese samples.

Slightly over 7 per cent of the subjects in the present sample had perfect Class I occlusions (normal occlusion). This compares favourably with those reported on American Caucasians (6.8 per cent), but is much less than those reported in American Blacks (31.3 per cent) and Black Africans in a rural isolated community (82 per cent). This increased incidence of normal occlusions can partly be explained by Gardiner who found that in genetically pure races, malocclusion is almost non-existent.

Table 3. Percentage distribution of occlusal features between Caucasians and Chinese

<table>
<thead>
<tr>
<th>Occlusal condition</th>
<th>Caucasians (n = 1000, aged 12 years)</th>
<th>Chinese (present study) (n = 1050, aged 12-14 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dental arch relationship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>44.3</td>
<td>7.1</td>
</tr>
<tr>
<td>Class I</td>
<td>58.8</td>
<td></td>
</tr>
<tr>
<td>Class II division 1</td>
<td>34.5*</td>
<td>7.1</td>
</tr>
<tr>
<td>Class II division 2</td>
<td>17.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Class III</td>
<td>3.5</td>
<td>12.6</td>
</tr>
<tr>
<td>2. Dental arch crowding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxillary</td>
<td>61.1</td>
<td>49.7</td>
</tr>
<tr>
<td>Mandibular</td>
<td>57.5</td>
<td>52.7</td>
</tr>
<tr>
<td>3. Incisal overjet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>48.9</td>
<td>68.2</td>
</tr>
<tr>
<td>Increased</td>
<td>47.7</td>
<td>19.2</td>
</tr>
<tr>
<td>Edge-to-edge</td>
<td>1.7</td>
<td>5.8</td>
</tr>
<tr>
<td>Reverse</td>
<td>1.7</td>
<td>6.8</td>
</tr>
<tr>
<td>4. Incisal overbite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>29.1</td>
<td>46.5</td>
</tr>
<tr>
<td>Increased</td>
<td>55.9</td>
<td>28.4</td>
</tr>
<tr>
<td>Decreased</td>
<td>15.0†</td>
<td>25.1</td>
</tr>
<tr>
<td>5. Posterior crossbite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>87.2</td>
<td>92.9</td>
</tr>
<tr>
<td>Buccal (unilateral)</td>
<td>8.7</td>
<td>6.1</td>
</tr>
<tr>
<td>Buccal (bilateral)</td>
<td>4.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Scissor (unilateral)</td>
<td>-</td>
<td>0.5</td>
</tr>
<tr>
<td>Scissor (bilateral)</td>
<td>-</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*Includes Class II indefinite.
†Refers to incomplete overbite and anterior or open bite.

In this study the assessment criteria were intentionally modelled after those of Foster and Day so that a comparative study of malocclusion incidence between Chinese and Caucasian could be drawn (Table 3). The present study showed that crowding was seen in about 50 per cent of subjects, with minimal differences in the incidence of crowding between arches. Foster and Day, in their study of 1000 British 11-12 year olds, reported crowding in 60 per cent of their sample. Crowding in the Chinese population appeared to be lower. This finding corroborates with those of Gardiner who studied the relation between cephalic index and crowding. Gardiner found that the larger the cephalic index (that is, brachycephalics) the lesser the degree of crowding. Enlow, in his study on craniofacial skeletons, has revealed a greater proportion of brachycephalics in Mongoloids (which includes the Chinese racial type) compared with Caucasians. Findings of crowding compare favourably with those of Woon et al. on Malaysian Chinese but were less than the 61 per cent of crowded arches observed by Foster and Day in...
12 year old caucasians. The incidence of spacing in the present study was 6 per cent and 7 per cent in the maxillary and mandibular arches, respectively. These findings were similar to those reported by Woon et al. on Chinese.

Consistent with the findings on dental arch relationships, the present sample exhibited a greater percentage of edge-to-edge relationships and reversed overjets compared with Foster and Day. In their study, the authors reported incidence of edge-to-edge relationships and reversed overjets to be less than 4 per cent. While the majority of caucasians had increased overbites, the majority of Chinese appeared to have normal overbite relationships. This could be related to the higher percentage of Class II malocclusions in Caucasians compared with this Chinese sample, as pointed out by Foster and Day.

Buccal crossbites were seen in almost 13 per cent of caucasian but only in 7.5 per cent of Chinese. The lower incidence of buccal crossbites in Chinese could be related to the tendency for the Chinese racial type to be brachyfacial and therefore possess comparatively larger maxillary arches. Consistent with the findings of Foster and Day on Caucasians, scissor bite (lingual crossbite) was rare in this present Chinese sample.

The present investigation highlights the need for undertaking similar malocclusion surveys on subjects of mixed Asian-Caucasian heritage, since there appears to be an increasing trend of such individuals in many countries with large immigrant populations.

Conclusion

Specific differences between Caucasian and Chinese malocclusions are evident. With Chinese immigrant populations increasing in Australia, America, and Europe, treatment of patients of Chinese origin will increase. Because of this trend, knowledge of the morphometric differences in occlusal parameters among different ethnic groups will be useful both from the epidemiological standpoint of dental health treatment needs as well as for the clinician carrying out orthodontic treatment.

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References


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