Original Article

Occlusal Status in Asian Male Adults: Prevalence and Ethnic Variation

Jen Soh^a; Andrew Sandham^b; Yiong Huak Chan^c

Abstract: The purpose of this study was to determine the occlusal status in young Asian male adults of three ethnic groups. Study models of a sample of male army recruits (N = 339, age 17-22 years) with no history of orthodontic treatment were assessed. The ethnic proportions of the sample were Chinese 76.1% (n = 258), Malay 17.7% (n = 60), and Indian 6.2% (n = 21). British Standard Institute (BSI) and Angle's classification were used to determine incisor and molar relationships, respectively. Chi-square test or Fisher's Exact test was performed to compare the occlusal traits between ethnic groups. The distribution of incisor relationships of the total sample consisted of Class I = 48.1%, Class II/1 = 26.3%, Class II/2 = 3.2%, and Class III = 22.4%. Right Angle's molar relationships were 49.9%, 24.5%, and 24.2% whereas left Angle's molar relationships were 53.1%, 25.1%, and 21.2% for Class I, II, and III, respectively. Comparison between ethnic groups found that Indian subjects were more likely to have Class II/1 malocclusions and clinically missing permanent teeth (P < .05). The study found that the overall prevalence of malocclusion (BSI) was Class I, Class II/1, Class III, and Class II/2 in descending order of proportions. Angle's Class I molar was most prevalent followed by Class II and Class III relations. A significant difference in occlusal status between the ethnic groups was found regarding incisor relationship and missing permanent teeth (P < .05). (Angle Orthod 2005;75:814–820.)

Key Words: BSI incisor classification; Angle's molar classification; Chinese; Malay; Indian

INTRODUCTION

Malocclusion has been defined as a deviation from normal occlusion. Good documentation of occlusal status is valuable from an epidemiological standpoint because it describes the range of occlusal variations within the community in which orthodontic treatment may be instituted. Prevalence studies on malocclusion have also been closely associated with the assessment of orthodontic treatment need in various communities.^{1–5} Information from such studies provided the basic information for the planning and progress of orthodontic delivery service to the public as well as the training of orthodontic specialists to meet the orthodontic need and demand.

The methods of recording occlusal traits can be broadly divided into qualitative and quantitative measurements.6 Qualitative methods commonly used include British Standard Institute (BSI) of incisor classification⁷ and Angle's classification for molar relationship.8 These methods are useful in describing the occlusal traits for means of categorizing various types of dental malocclusions for quick and easy documentation as well as providing a common channel of communication among dental professionals. Literature shows that these methods have been used extensively in numerous malocclusion prevalent studies. Quantitative methods such as overjet and overbite measurements in millimeters had also been used in population studies.9-11 These methods are useful in describing the extent of deviation of an occlusal trait in a numerical format as an independent descriptor or as a component in the scoring of a malocclusion for the purpose of establishing the severity of malocclusion and treatment prioritization.12-14

A study on a sample of 389 Swedish men between

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the ages of 21 and 54 years found that 75% had malocclusions and 45% had dental crowding with dental rotations being the most common occlusal trait.15 Another Swedish study on Caucasians found that distribution of malocclusions for the total sample was 71%, 23%, and 5% for Angle's Class I, II, and III, respectively. Spacing and unilateral crossbite were found to be more prevalent in males than females.¹⁶ A Dutch study found that 78% of the males had overjet between zero and four mm, and 21% of the males had overiet greater than five mm. The prevalence of malocclusion for the total sample was 69%, 28%, and 2% for Angle's Class I, II, and III, respectively.¹⁷ Class III malocclusions were more commonly associated with male adult orthodontic patients.¹⁸ The molar relationships found in Hong Kong Chinese male adults were 64.8% Class I, 15.7% Class II, and 19.4% Class III. The overjet measurements showed that 71.3% had Class I incisors, 13% Class II, and 15.8% Class III.19 The occlusal distribution found in Australian Caucasian adults was 67.1% Class I, 28.7% Class II, and 4.2% Class III.20 A recent large-scale survey on malocclusion status in the United States found that only 35% of adults had well-aligned mandibular incisors and 15% had severe incisor irregularity that was potentially handicapping in terms of social acceptability and occlusal function. The survey also detected an ethnic difference in the prevalence of incisor irregularity and severity of Class II and III malocclusions between Mexican-Americans and the rest of the population.9

The aims of this study were to (1) describe the occlusal status in Asian male adults and (2) compare the ethnic variation in occlusal status.

MATERIALS AND METHODS

A sample of male army recruits (N = 339, age = 17–22 years) with no previous history of orthodontic treatment participated in this research on a voluntary basis with informed consent. Subjects with craniofacial anomalies (eg, cleft lip or palate, or both) were excluded. Data collection was carried out once a week for a period of 11 weeks at the only preenlistment recruitment center that performed medical and dental examinations. The first 30 consecutive subjects of the day who volunteered had alginate impressions taken, with the subsequent study casts used to assess the occlusal traits. Subjects with missing permanent teeth were interviewed for their history of dental extractions. The incisor relationship was classified according to the British Standard Institute (1983)⁷ as described below:

• Class I—the lower incisal edges occlude with or lie immediately below the cingulum plateau of the upper incisors.

- Class II—the lower incisor edges lie posterior to the cingulum plateau of the upper central incisors.
 - Division 1—the overjet is increased, and the upper central incisors are proclined.

Division 2—the overjet is minimal or increased with retroclined upper central incisors.

• Class III—the lower incisor edges lay anterior to the cingulum plateau of the upper central incisors. The overjet is reduced or reversed.

Overjet and overbite measurements were also made using a metal ruler (accurate up to 0.5 mm) and adopting the method proposed by Brunelle et al.¹⁰ Recording of the other occlusal traits were as follows:

- Crossbite—anterior crossbite was recorded when one or more upper incisor teeth were palatal to the lower incisor teeth at maximum intercuspation. Buccal crossbite was recorded when one or more lower posterior teeth in any quadrant distal to the lateral incisor were placed buccal to the upper posterior teeth at maximum intercuspation. Lingual crossbite/ scissors bite was recorded when one or more lower posterior teeth in any quadrant distal to the lateral incisor were lingually placed with respect to the upper posterior teeth at maximum intercuspation.
- Molar relationship—right and left molar relationships were classified based on Angle's classification.
- Missing teeth and retained deciduous teeth—missing tooth or teeth except clinically absent third molars were recorded. Dentitions with retained primary molars were assumed to have missing permanent successors. Retained deciduous tooth or teeth were recorded.
- Incisor crowding—linear contact point displacement between adjacent incisors of the maxillary and mandibular arches were measured using a ruler and summated to give a total score. The scores were categorized into ideal (zero mm), mild (1–3 mm), moderate (4–6 mm), and severe (>7 mm) crowding.

Statistical analysis

All statistical analyses were performed using SPSS 11.0. Descriptive statistics for the distribution of occlusal traits of the total sample and between ethnic groups was presented using frequencies, percentages, and 95% confidence interval (CI). A goodness-of-fit test on the ethnic distribution of the sample with the population census²¹ was performed. The association between occlusal traits and ethnic groups was assessed using Chi-square or Fisher's Exact test with odds ratios presented where applicable. Statistical significance was set at P < .05 unless otherwise adjusted for multiple comparisons (Bonferroni corrections).

Malocclusion Types:				
BSI Incisor Classification	Chinese (n = 258)	Malay (n $= 60$)	Indian* (n = 21)	Total (N = 339)
Class I	48.1 (41.8–54.3)	51.7 (41.6–64.8)	38.1 (18.1–61.6)	48.1 (42.7–53.5)
Class II/1	25.6 (20.4-31.4)	18.3 (7.1–26.6)	57.1 (34.0-78.2)	26.3 (21.6-31.3)
Class II/2	3.5 (1.6-6.5)	3.3 (0.4–11.5)	0 (0–16.1)	3.2 (1.6-6.7)
Class III	22.9 (17.9–28.5)	26.7 (14.7–37.9)	4.8 (0.1–23.8)	22.4 (18.1–27.2)

TABLE 1. Distribution of Malocclusion Types (Incisor [BSI] Classification) of Total Sample and Among Ethnic Groups (%)^{a,b}

^a Indian subjects were more likely to have ClassII/1 malocclusion when compared with the others (P = .001, OR = 4.2, 95% Cl 1.7 to 10.3).

^b Indicates British Standard Institute; CI, confidence interval; OR, odds ratio.

* *P* < .05.

TABLE 2.	Distribution of	Overjet and	Overbite	(in mm) for the	Total San	nple and	Among	Ethnic	Groupsa
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Overjet							
		<2	2–3	>3≤6.5	>6.5		
Total sample (N = 339)	Frequency	71	122	125	21	$P = .001^{b}$	
	%	20.9	36.0	36.9	6.2	P = .001*	
	95% CI	16.7-25.7	30.9-41.3	31.7-42.3	3.9-9.3		
Chinese (n = 258)	Frequency	56	98	91	13		
	%	21.7	38.0	35.3	5.0		
	95% CI	16.8-27.2	32.0-44.2	29.4-41.4	2.7-8.5		
Malay (n = 60)	Frequency	14	19	25	2		
	%	23.3	31.7	41.7	3.3		
	95% CI	13.4-36.0	20.3-45.0	29.1-55.1	21.8-66.0		
Indian (n = 21) ^b	Frequency	1	5	9	6		
	%	4.7	23.8	42.9	28.6		
	95% CI	0.1-23.8	8.2-47.2	21.8-66.0	11.3–52.2		

			Overbite				
		<0	0–0.5	1–2	>2≤4	>4	
Total sample (N = 339)	Frequency	13	42	119	127	38	P = .875
	%	3.8	12.4	35.1	37.5	11.2	
	95% CI	2.1-6.5	9.2-16.5	30.0-40.5	32.0-42.6	8.0-15.2	
Chinese (n = 258)	Frequency	12	30	91	96	29	
	%	4.7	11.6	35.3	37.2	11.2	
	95% CI	2.4-8.0	8.0-16.3	29.3-40.3	31.2-43.3	7.7–15.9	
Malay (n = 60)	Frequency	1	10	19	22	8	
	%	1.7	16.6	31.7	36.7	13.3	
	95% CI	0.04-9.1	8.4-29.0	20.6-45.6	23.6-49.1	6.0-25.0	
Indian (n $= 21$)	Frequency	0	2	9	9	1	
	%	0	9.5	42.9	42.9	4.7	
	95% CI	0–16.1	1.2-30.4	21.8-66.0	21.8–66.0	0.1–23.8	

^a CI, confidence interval; OR indicates odds ratio.

^b Indians were more likely to have overjet greater than 6.5 mm (OR = 8.1, 95% Cl 2.7–23.8), *P < .01.

RESULTS

The distribution of malocclusion types for the total sample according to incisor classification was 48.1%, 26.3%, 22.4%, and 3.2% for Class I, Class II/1, Class III, and Class II/2, respectively, as shown in Table 1. Indian males were four times more likely to have Class II/1 malocclusion when compared with Chinese and Malay males (P = .001, odds ratio [OR] 4.2, 95% Cl 1.7 to 10.3). No significant difference in the distribution of malocclusion types between Chinese and Malay ethnic groups was found (P > .05), implying that the

pattern of distribution of incisor occlusal status was similar, although Chinese males had a higher prevalence of Class II/1 malocclusion and a lower prevalence of Class I malocclusion when compared with Malay males (Table 1).

Table 2 shows the distribution of overjet and overbite measurements. Thirty-six percent of the total sample had an overjet of two to three mm, which could be regarded as normal anteroposterior incisor relationship, 20.9% had overjet less than two mm, and 43.1% of four mm or more. About 6% of the total sample had

TABLE 3.	Distribution of Crossbites	of Total	Sample and	Among Ethnic	Groups in Fre	quencies and Percenta	agesª
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	F	requency (%) Ethnic	ity		
Type of Crossbite	Chinese $(n = 258)$	Malay (n = 60)	Indian (n = 21)	Total Sample (N = 339)	Р
Anterior crossbite	35 (13.6)	13 (21.7)	2 (9.5)	50 (14.7)	.23 NS
Posterior buccal crossbite Posterior lingual/scissor bite	40 (15.5) 35 (13.6)	12 (20.0) 5 (8.3)	5 (23.5) 4 (19.0)	57 (16.8) 44 (13.0)	.41 NS .36 NS

^a NS indicates not significant.

TABLE 4.	Distribution of Angle's Molar	Relationships of	Total Sample and Among	Ethnic Groups	in Frequencies and	Percentages
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	F	Frequency (%) Ethnicity	/		
Angle's Molar Relationship	Chinese $(n = 258)$	Malay (n = 60)	Indian (n = 21)	Total Sample (N = 339)	P
Right					
Unclassified	2 (0.8)	2 (3.3)	1 (4.8)	5 (1.5)	.09 NS
Class I	129 (50.0)	28 (46.7)	12 (57.1)	169 (49.9)	
Class II	63 (24.4)	13 (21.7)	7 (33.3)	83 (24.5)	
Class III	64 (24.8)	17 (28.3)	1 (4.8)	82 (24.2)	
Left					
Unclassified	2 (0.8)	0	0	2 (0.6)	.158 NS
Class I	135 (52.3)	32 (53.3)	13 (61.9)	180 (53.1)	
Class II	63 (24.4)	14 (23.3)	8 (38.1)	85 (25.1)	
Class III	58 (22.5)	14 (23.3)	0	72 (21.2)	

^a NS indicates not significant.

TABLE 5. Missing Permanent Teeth and Retained Deciduous Teeth of Total Sample and Among Ethnic Groups in Frequencies and Percentages^a

	Fi	equency (%) Ethnici			
	Chinese $(n = 258)$	Malay (n = 60)	Indian⁵ (n = 21)	Total Sample (N = 339)	Р
Missing permanent teeth Retained deciduous teeth	34 (13.2) 7 (2.7)	6 (10.0) 3 (5.0)	7 (33.3) 1 (4.8)	47 (13.9) 11 (3.2)	.04* .41 NS

^a NS indicates not significant.

^b Pairwise comparisons (adjusted *P* value = .0167) indicated that Indian male adults were more likely to have missing permanent teeth (P = .016, OR = 3.5, 95% CI 1.3 to 9.1).

* *P* < .05.

overjet greater than 6.5 mm that could be considered as severe and potentially handicapping. Indian males were eight times more likely to have an overjet greater than 6.5 mm than Chinese or Malay males (P < .001, OR = 8.1, 95% Cl 2.7 to 23.8). Normal (1–2 mm) to moderately increased (>2 mm to ≤4 mm) overbite accounted for a large proportion of the total sample. About 4% had openbite whereas 11% had deep overbite greater than four mm. Thus 15% of the total sample had overbite that could be regarded as severe deviation from the norm. Minimal overbite (0–0.5 mm) accounted for 12.4%. No significant difference in overbite distribution was found among the ethnic groups (P> .05).

The distribution of crossbites is shown in Table 3. Posterior buccal crossbite (16.8%) was the most prev-

alent, followed by anterior crossbite (14.7%), and posterior lingual/scissor bite (13.0%) for the total sample. No significant difference in the distribution of crossbites was found between the ethnic groups, although anterior crossbites and posterior buccal crossbites were more commonly seen in Malay and Indian males, respectively, when compared with Chinese males.

Table 4 shows the Angle's molar relationship of the total sample and ethnic groups. Class I molar relationship was the most prevalent followed by Class II and III for both right and left sides. There was no significant difference in the distribution of molar relationships between the three ethnic groups (P > .05). Clinically missing permanent teeth accounted for 13.9% of the total sample as shown in Table 5. A significant difference in the prevalence of missing teeth was found be

layes					
	F	requency (%) Ethnici	ity		
Incisor Crowding	Chinese $(n = 258)$	Malay (n = 60)	Indian (n = 21)	Total Sample (N = 339)	Ρ
Maxillary arch					
No crowding	49 (19.0)	13 (21.7)	5 (23.8)	67 (19.8)	0.72 NS
Mild crowding (1–3 mm)	41 (15.9)	6 (10.0)	3 (14.3)	50 (14.7)	
Moderate crowding (4-6 mm)	86 (33.3)	24 (40.0)	9 (42.9)	119 (35.1)	
Severe crowding (\geq 7 mm)	82 (31.8)	17 (28.3)	4 (19.0)	103 (30.4)	
Mandibular arch					
No crowding	80 (31.0)	11 (18.3)	9 (42.9)	100 (29.5)	0.23 NS

12 (20.0)

22 (36.7)

15 (25.0)

2 (9.5)

5 (23.8)

5 (23.8)

TABLE 6. Distribution of Maxillary and Mandibular Incisor Crowding of Total Sample and Among Ethnic Groups in Frequencies and Percentages^a

Severe crowding (≥7 mm) ^a NS indicates not significant.

Moderate crowding (4-6 mm)

Mild crowding (1-3 mm)

tween the ethnic groups (P < .05). Pairwise comparison (adjusted *P* value at .0167) found that Indian males were 3.5 times more likely to have missing teeth when compared with Chinese and Malay males (P =.016, OR = 3.5, 95% CI 1.3 to 9.1). About 3% of the total sample had retained deciduous teeth with no significant difference found between the ethnic groups (P > .05).

36 (14.0)

67 (26.0)

75 (29.1)

Moderate to severe incisor crowding of the maxillary and mandibular arch accounted for 65.5% and 55.7% of the total sample, respectively, as shown in Table 6. No significant difference in the degree of crowding was found among the ethnic groups for both maxillary and mandibular incisor crowding (P > .05).

DISCUSSION

The study showed that Asian men with Class I malocclusions were most prevalent on the basis of both incisor BSI and Angle's molar classification. In comparison with previous Caucasian studies,^{15–17,20} a lower prevalence of Class I malocclusions in an Asian community was found. However, a much higher prevalence of Class III malocclusions was found in this Asian sample when compared with its Caucasian counterparts.

The clinical implication from this finding could mean that the orthodontic management of Class III malocclusions would be more commonly encountered in an Asian community. Although a higher prevalence of Class III malocclusions have been commonly associated with subjects having Chinese heritage,^{22–26} this study found that Malay ethnic group had a similar prevalence for Class III malocclusions. No significant difference in the prevalence of malocclusion types was found between Chinese and Malay groups (P > .05) implying that the distribution of malocclusion types could be regarded as similar. Woon et al²⁶ also found no difference in the malocclusion pattern between Chinese and Malay ethnic groups, although the results were obtained from adolescents in a multiethnic Asian community. Indian ethnic group in this study had the highest prevalence of Class II/1 malocclusions (P < .05) and the lowest prevalence for Class III malocclusions among the three ethnic groups.

50 (14.7)

94 (27.7)

95 (28.0)

This pattern of distribution displayed by the Indian subgroup resembled that in the results obtained from a recent study that involved Caucasian subjects.⁹ Perhaps the Indian subjects had certain hereditary predisposition²⁷ to certain types of malocclusions in a manner similar to Caucasians whereas Chinese and Malays shared certain common genetic traits. Validation of this observation would require further investigation in the area of genetics. Comparison of overjet measurements found that Indian ethnic group was more likely to have overjet greater than 6.5 mm (P < .01). This finding suggests that Indian males had a greater tendency to exhibit a Class II dentofacial pattern than Chinese or Malay.

The assessment of molar relationship in this study took into account missing permanent first upper or lower molars as a result of extraction based on the observation of the residual extraction site, resorbed alveolar ridge seen on the study models, and the dental history ascertained during data collection. This accounted for the unclassified category of not more than 2% as shown in Table 4. The comparison of Angle's molar relations of Chinese ethnic group with a Hong Kong study²⁴ showed that Class II and III molars were more prevalent in this study. A higher prevalence of Class I molar relation was found in the Hong Kong Chinese male adults. However, this comparison was at best an estimate because of disparities in sample size and research methodology.

Indian adult males were more likely to have clinically

missing permanent teeth than the other two ethnic groups (P < .05). The causes of missing teeth, observed in this age group, would be congenital hypodontia and extraction of teeth because of caries or periodontal problems. No ethnic difference was found regarding retained deciduous teeth that consisted of primary first and second molars. It may be speculated that the permanent successors were either congenitally missing or impacted (radiographic assessment was not within the context of the study).

Dental crossbites were observed for all ethnic groups. The long-term clinical implication of posterior lingual/scissor bite was the supraeruption of the unopposed nonfunctional teeth and the risk of losing them unless orthodontic correction was performed. Posterior unilateral crossbite had been implicated as a potential cause of skeletal and functional deviation in children.^{28,29} Thus, some of these Asian male adults with posterior crossbites could have benefited from orthodontic intervention during their childhood years in retrospect.

A distinct common occlusal feature observed in all three ethnic groups was the severity of incisor crowding. More than 50% of the total sample had moderate to severe maxillary or mandibular incisor crowding with no significant ethnic difference. Thus, moderate to severe dental displacements would be expected in the untreated dentitions of Asian male adults, and the need for extraction therapy would be a common treatment approach in adult orthodontics, should treatment be rendered. A crude comparison with the results from a recent study suggests that Asian men with severe incisor crowding that could be potentially handicapping might be more prevalent than untreated individuals found in the United States.³⁰

A limitation of this study was the relatively small sample size and its possible impact on ethnic group comparison. A goodness-of-fit test showed that there was no significant difference (P = .162) between the observed number of subjects of the three ethnic groups of the sample (258 Chinese, 60 Malays, and 21 Indians) and the expected number (270 Chinese, 48 Malays, and 21 Indians) calculated from the population census reported by Shantakumar.²¹ Statistically, the ethnic proportions of the sample could be considered to be fairly consistent in distribution. However, the authors recognized this limitation and would interpret the conclusions of this study with some degree of caution.

Nevertheless, the study detected a potential difference in occlusal status among Asian male adults of different ethnicity. Much consideration was given to the method chosen in defining and reporting the occlusal status in this study, so that some degree of comparison of findings could be made with the published results from some of the previous studies. It was evident from the literature that there were differences in the methods of assessing and reporting occlusal traits. This had made the comparison of results tedious and dependent on estimation and interpretation at best. A consideration for uniformity in the method of assessing and reporting occlusal status would be timely so that meaningful and more accurate comparisons could be made when planning future studies in this area of research.

CONCLUSIONS

The overall prevalence of malocclusion in Asian male adults on the basis of incisor (BSI) classification was 48.1%, 26.3%, 22.4%, and 3.2% for Class I, Class II/1, Class III, and Class II/2, respectively. Angle's Class I molar relationship was the most prevalent. Indian male adults were more likely to have Class II/1 malocclusions with increased overjet greater than 6.5 mm and missing permanent teeth when compared with Chinese and Malay ethnic groups. Both Chinese and Malay ethnic groups had similar distributions of malocclusion pattern. A higher prevalence of Class III incisor and molar relationship was observed in Chinese and Malay ethnic groups. Maxillary and mandibular incisor crowding was a common occlusal feature found in all three ethnic groups.

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