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Full Length Research Paper

Cephalometric evaluation for Malaysian Malay by Steiner analysis

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Many researchers tried to define and put cephalometric norms for different ethnics groups. However, these studies may be specific to an ethnic group and cannot always be applied to other ethnic types. The aim of this study is to obtain cephalometric norms for Malaysian Malay by Steiner analysis and compare with Caucasian norms. The method involved clinical examination, collection and analysis of 60 lateral cephalometric radiograph of Malaysian Malay subjects from pure ethnic group (30 males and 30 females, 20 to 24 years old). All cephalometric landmarks were located and determined and subsequently tracing had been done according to Steiner analysis. Statistical comparisons between the groups were done using t-test. The result of this study show that the Malaysian Malay maxilla and mandible is set more forward than Caucasian. They also show bimaxillary dental protusion when compared to Caucasian. The Malaysian Malay has more protrusive upper and lower lips, the chin is less prominent when compared to Caucasian. Malaysian Malay have higher cant of both the occlusal and the mandibular planes, mandibular posterior rotation when compared to the Caucasian. In conclusion, these ethnic differences should be considered during treatment, especially in prosthodontics and orthodontics where arch dimension can be modified appreciably.

Key words: Lateral cephalometric radiograph, facial profile. Steiner analysis, Caucasian norms, Malaysian Malay population.

INTRODUCTION

Many researchers tried to define and to prove a certain correlation between the different components of biometric anatomical landmarks, facial features and the malocclusion properties in Granada and Spain population (Baca-Garcia et al., 2004), Chinese population (Zeng et al., 2007; Lew et al., 1992; Cooke and Wei, 1988), Caucasian (Mill, 1982), Japaneese (Miyajima et al., 1996; Iizuka and Ishikawa, 1957), American Aferican (Drummond, 1968, Fonseca and Klein, 1978; Conner and Moshiri, 1985), Arab (Al-Awwad, 2006; AlBarakati and Baidas, 2010; AlBarakati and Talic, 2007; Al-Jasser, 2005; Al-Khateeba and Abu, 2006). These types of experiment are advantageous for predicting the features and later the need of the different racial groups for different orthodontic treatment, in addition to the development of orthodontic service in general. The biometric radiographic analysis of the craniofacial skeleton is a mathematically originated method for diagnosing malocclusion and planning orthodontic treatment. Also, it can be used any where and for any population like for example the Malaysian Malay population.

Previous researches included the use of Chinese and Caucasian ethnic groups and the common descriptions between these ethnic groups, depending on same and fix criteria of systems used in their research; trying to find the relationship of the biometric analysis between the major ethnics in Asian regions in order to resolve and treat the cases of malocclusion in orthodontic dentistry in that areas (Wu et al., 2006; Zeng et al., 2007).

A large number of studies demonstrated the presence of specific dentofacial characteristics in each ethnic group, leading professionals to consider these differences in orthodontic and surgical diagnosis and

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treatment planning. Remarkable differences have been identified in both skeletal features and soft tissue profile among white Americans, Europeans, African-Americans, Koreans, Japanese and Chinese populations. Facial differences between white populations of distinct continents or countries have been reported previously.

Among the several numeric facial analyses currently employed, the analysis proposed by Steiner has been used broadly by orthodontists and maxillofacial surgeons. However, the measurements proposed for these analyses were achieved based on a white American sample and may not be applicable as a reference for diagnosis and treatment of other ethnic groups. White Americans descend mostly from English, Polish, Dutch, and French populations. Scottish, Spanish, and Scandinavian populations are also part of the immigration history of North America. On the other hand, Malaysian Malay population considering these background differences, the facial standards for them might be distinct from the norms of white Americans. It is important to have data concerning relevant human group for purposes of clinical diagnosis and planning of treatment. These data may also be useful in forensic dentistry. The ethnic differences in facial profile and skeletal features should be considered during treatment, especially in orthodontics, maxillofacial surgery and prosthodontics where arch shape can be modified appreciably (Burris and Harris, 2007).

MATERIALS AND METHODS

Ethical approval for this study was obtained from UiTM Research Ethics Committee on 12th May, 2010. The subjects were all volunteers. Consent forms as well as an outline of the proposed research were distributed to all chosen subjects in a subject information sheet. The consent forms included an outline of the research, the risks involved in participating in the study and the privacy terms. Patients were free to participate or refuse participation even if they met all of the criteria necessary.

The total sample were collected from the students of University Technology MARA and dental patient in the Faculty of Dentistry University Technology MARA. The study sample consisted of 70 subjects from Malaysian Malay pure ethnic groups. The ages ranged between 20 to 24 years old, equal from both genders (35 females and 35 males). All subjects were screened, and then appointed for a full record appointment at Klinik Rawatang Utama, Faculty of Dentistry. Ten subject's records were excluded from total 70 subjects due to poor quality of the records; therefore, a total of 60 subjects (30 males and 30 females) were included in this study. The patients were selcted according to the following criteria:

1. Both parents of each subject were from the same ethnic group without any inter racial marriage at least for two generation.
2. All of the subjects were between 20 to 24 years of age.
3. Class I according to British Standards Institute classification
4. All of the subjects had full set of permanent teeth in both jaws regardless of the third molars.
5. Normal growth and development, well aligned maxillary and mandibular dental arches.
6. All of the subjects had good facial symmetry and balanced facial profiles.
7. No symptoms related to TMJ disorder.
8. No significant history related to the growth.
9. No need for orthodontic treatment according to index of orthodontic treatment need (IOTN) for both health and esthetic component.
10. Have no previous history of any types of orthodontic treatment or plastic surgery.
11. Have no previous history of any types of surgical treatment.
12. Have no previous history of any types of prosthetic treatment or major conservative treatment.

Dental history of each participant in this study has been taken such a history of TMJ problem and facial trauma. Major maxillofacial surgery, orthodontic treatment and medical history were conducted to insure the participants compatibility with this study. Clinical examination was conducted for each patient to determine if the participant meet all the inclusion criteria. The examination comprised an extraoral inspection including the soft tissues and an intraoral inspection of the teeth and occlusion. Lateral cephalometric radiograph was taken for each individual by digital cephalometric machine (Planmeca, ProMax cephalostat with Dimax3, Asentajankatu) under standard conditions (68 KV, 10 mA and 1.13 magnifications). All radiographs were taken by the same operator with the same cephalometric setup and the same X-ray machine in order to maintain the standardization of radiographs. All subjects were positioned in natural head position with Frankfort horizontal plane of the patient parallel to the floor and the teeth in the maximum intercuspation with relaxed lips. By using a special software program (VistaDent Oc ver. 4.2.61© 2006, Bohemia) each subject information was launched (patient's name, age, gender and lateral cephalometric radiograph). Then, all cephalometric landmarks were located and determined; subsequently tracing was done according to Steiner analysis as shown Figures 1 to 3.

Ten angular and six linear measurements from Steiner analysis in addition to E Rickett's plane were measured. Steiner analysis have been chosen to analyze all the measurement because it takes into account not only the relation of the teeth to each other and to their respective dental bases but also recognized the importance of the soft tissue cover as it deals with skeletal, dental and soft tissue analysis. Fifty-six landmarks were chosen from Steiner analysis to digitize the cephalometric radiographs of the selected subjects as shown in Figure 4.

RESULTS

The significance level for this study was set at $p < 0.05$ and highly significant at $p < 0.001$. The descriptive statistic of all lateral cephalometric radiographs for ten angular measurements and six linear measurements for the entire sample (60 subjects) from both genders of Malaysian Malay population illustrated in Tables 1 and 2. For each variable, mean, standard of deviation and standard of error were obtained.

The descriptive statistics for angular and linear measurements among Malaysian Malay and the Caucasian were obtained from one-sample t-tests as shown in Tables 3 and 4. The p-values for all the comparisons were statistically significant (increase) which were less than 0.05, except for Max1_SN was more than 0.05 (not significant). The means for SNA, SNB, ANB, SDN, SN-OcP, SN_GoGn, Max1-NA and Mand1NB are higher among the Malays compared to the Caucasians. The means for Inter Incisal Angle II is lower among the

Figure 1. VistaDent OC software.

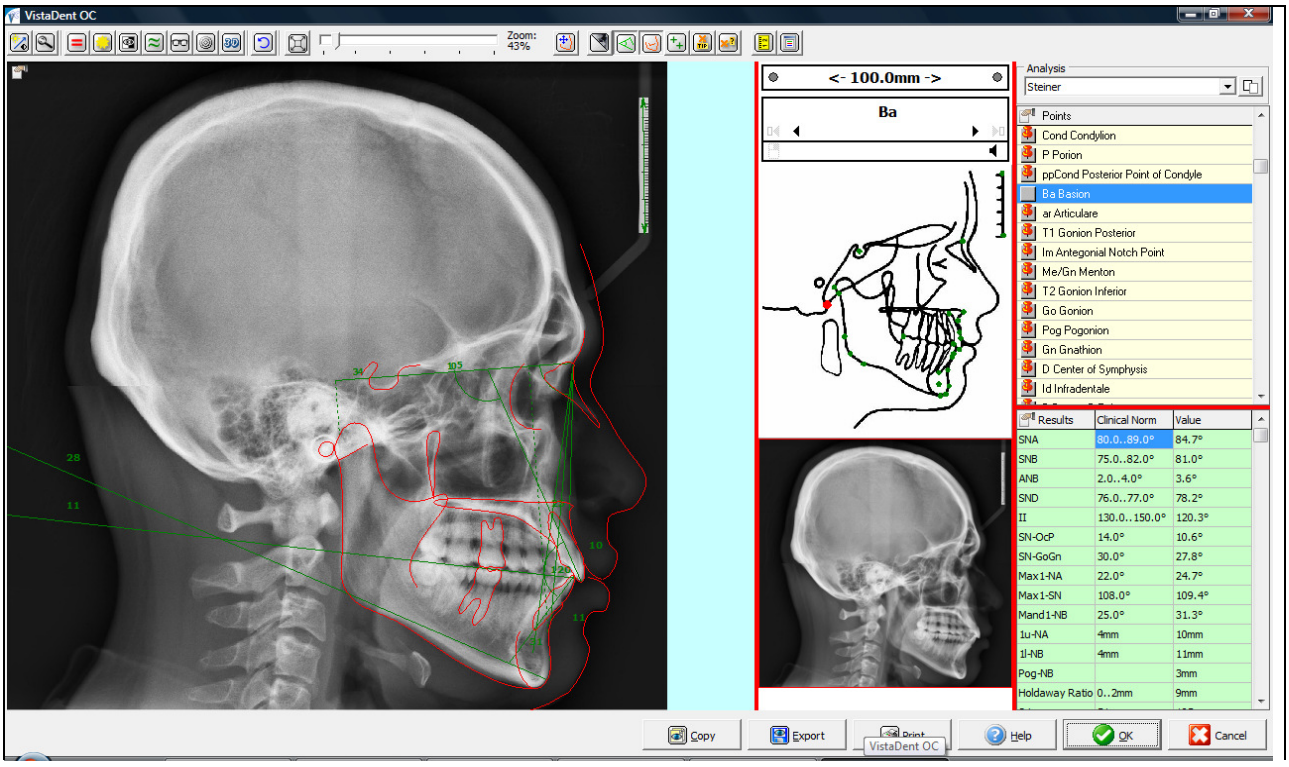

Figure 2. Lateral cephalometric tracing by VistaDent OC.

Malays compared to the Caucasians.

The p-values for all the comparisons of linear measurements are less than 0.001 (statically highly significant). Thus, all the linear measurements differ from that of the Caucasians. The mean Pog-NB for Malaysian Malay (0.8 mm) is less than the mean for the Caucasians

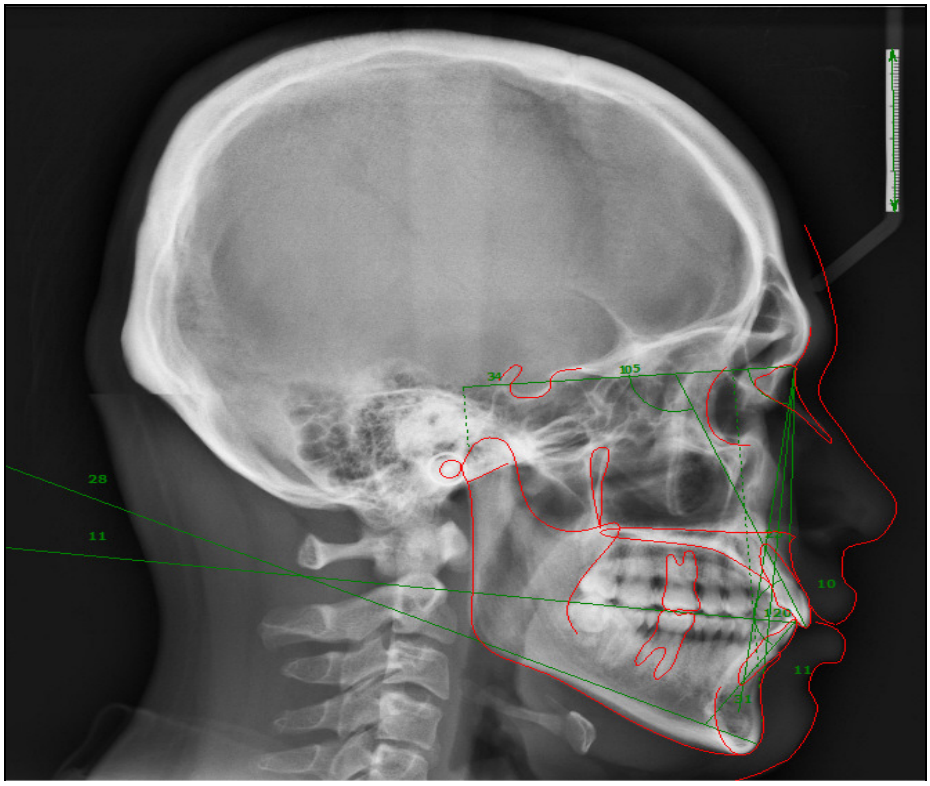

Figure 3. Cephalometric tracing.

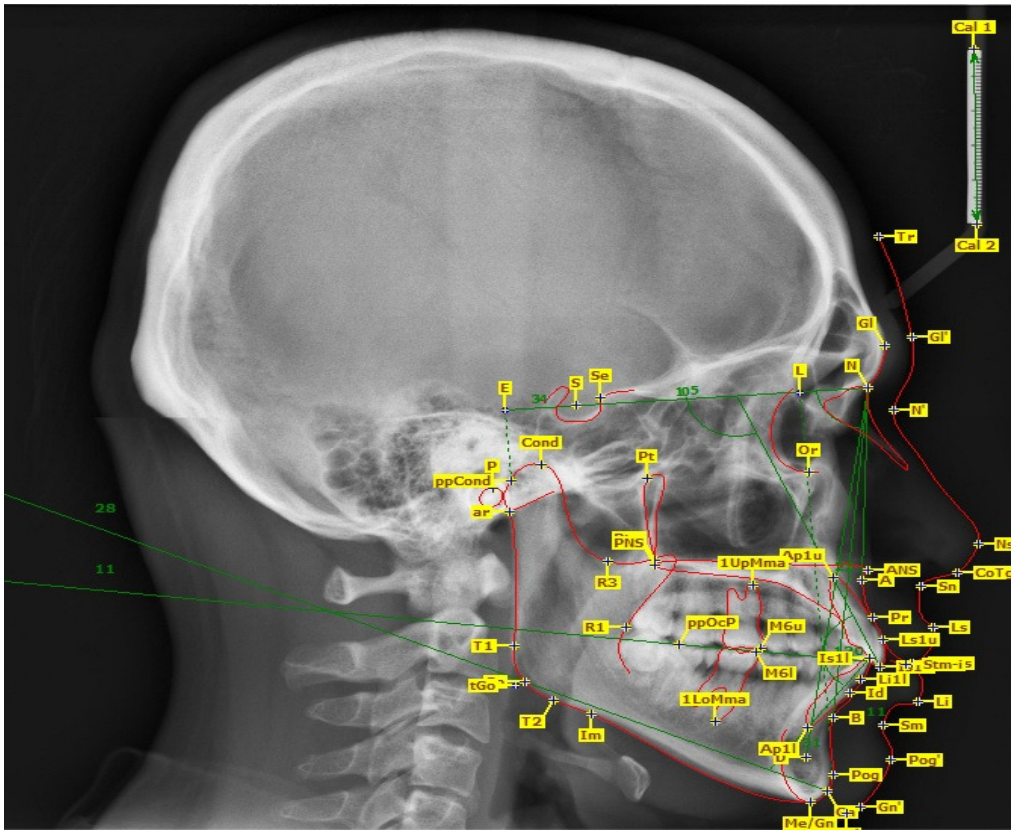

Figure 4. Cephalometric landmarks and measurements.

Table 1. Results for angular measurements of Malaysian Malay.

Variable	Mean	S	SE
SNA	83.7	2.82	0.36
SNB	81.2	2.86	0.37
ANB	2.5	1.58	0.20
SDN	77.5	2.96	0.38
II	121.0	8.29	1.07
SN_OcP	16.7	3.73	0.48
SN_GoGn	34.5	4.27	0.55
Max1_NA	24.1	5.63	0.73
Max1_SN	107.3	6.25	0.81
Mand1_NB	32.3	5.20	0.67

Table 2. Linear measurement of Malaysian Malay.

Variable	Mean	S	SE
1u-NA	11.6	4.09	0.53
1l-NB	11.0	2.94	0.38
Pog-NB	0.8	2.75	0.36
Holdway Ratio	10.4	4.93	0.64
Ls-Ns Pog	-2.0	2.79	0.36
Li-Ns Pog	2.2	3.32	0.43

(4 mm). The means for all other measurements are higher in Malaysian Malay than the means for the Caucasians.

DISCUSSION

Cephalometric studies on Malaysian Malay ethnic group indicated there were measurable skeletal and dental differences when compared to Caucasians.

The anteroposterior relationship of the jaws in relation to the Nasion was measured using SNA and ANB angles. The SNA of Malaysian Malay was higher than that of Caucasian which indicates that the maxilla is set more forward when compared to the Caucasian. The SNB for the Malaysian Malay also higher than that of Caucasian. This indicates the mandible is also prognathic when compared to the Caucasian. ANB represent the difference between SNA and SNB. It defines the mutual anteroposterior relationship for both maxilla and the mandible. There was no significant difference between Malay and Caucasian in ANB angle. This indicates that the Malay have skeletal class I pattern. This finding could result from different factors that include cranial base length, the position of the jaws anteroposteriorly and rotation of the occlusal planes (Jacobson, 1975). This finding is consistent with data from other studies on populations of close geographic proximity, and ethnic background to Malay such as Lew (1994) on Singaporean Malay, Hassan (1998) on Malaysian Malay ethnic groups, Munandar and Snow (1995) on Indonesian Malay population, Moldez et al. (2006) on Filipino population and Lalitha and Kumar (2010) on Indian ethnic group. Despite Hassan (1998) in his study on Malay population take an unequal sample from female and males but still agreed with the results of this study, the same for Lew (1994) which take only the Singaporean Malay female on his study. Also, the position of the sella in the cranial base can affect the angle SNA and SNB without affecting the ANB. Variation in the anteroposterior and vertical position of the Nasion and rotational effect of the jaws relative to the anterior cranial base regarded as important factors in variation of SNA, SNB and ANB angles. SND angle for the Malay was higher than that of the Caucasian. This also indicate that the mandible is set slightly more forward when compared with the Caucasian and this agreed with study of Lew (1994) who did a comprehensive study on Singaporean Malay.

Interincisal angle of Malaysian Malay was 121° and for the Caucasian is 131°. Max1-NA was 24.1° for the Malay and for the Caucasian is 22°, The Mand1- NB angle for the Malay was 32.3° and for the Caucasian is 25°. Significant difference was observed in these entire angles ($P < 0.05$). From these result, it is so obvious that the Malaysian Malay display more procumbent upper and lower incisors in relation to both the NA and NB planes resulting in a mean acute interincisal angle of 121° as compared with 131° found among the Caucasian. This was in agreement with other studies like Munandar (1992), Lew (1994), Munandar and Snow (1995) and Hassan (1998). These findings suggest that re-evaluation to the orthodontic treatment planning which is based on Caucasian norms as Mills (1968) assessed that proclination of lower incisor would result in relapse due to lip pressure and muscular imbalance. There was no significant difference between the Malay and Caucasian reading for the Max1 –SN (the angular relationship between maxillary central incisor to the cranial base). However the SN-OccP angle (which represent the relationship between cranial base and the occlusal plane) for the Malaysian Malay was higher than that of the Caucasian, the same for the SN-GoGn (the angular relationship between the cranial base and mental plane) which was also higher in Malaysian Malay when compared with Caucasian. These findings suggest that the Malaysian Malay have higher cant of both the occlusal and the mandibular planes, mandibular posterior rotation when compared to the Caucasian. These contrasting results could be due to the fact that the posterior growth of the ramus, vertical height and tuberosity region of maxilla in late stage can affect the angular measurement of SN- occlusal plane (Riolo et al., 1979; Rickett, 1982). Also, a larger SN-OccP is often associated with downward growing mandibles and retruded chin. This may tax the clinician who is trying to correct a malocclusion while not accentuating these unfavorable features (Wang, 1983).

Table 3. The differences between Malaysian Malay and Caucasian lateral cephalometric radiographs for angular measurements.

Variable	Malaysian mean	Caucasian mean	SD	SE	t	P
SNA	83.7	82	2.82	0.36	3.491	<0.001**
SNB	81.2	80	2.86	0.37	2.566	0.002*
ANB	2.5	2	1.58	0.20	2.959	0.004*
SDN	77.5	76	2.96	0.38	3.870	<0.001**
II	121.0	131	8.29	1.07	-9.367	<0.001**
SN_OcP	16.7	14	3.73	0.48	5.697	<0.001**
SN_GoGn	34.5	32	4.27	0.55	-6.304	<0.001**
Max1_NA	24.1	22	5.63	0.73	2.820	0.007*
Max1_SN	107.3	108	6.25	0.81	-0.878	0.384
Mand1_NB	32.3	25	5.20	0.67	10.823	<0.001**

All measurements are measured in degree (°). *mean statistically significant.**mean highly significant.

Table 4. The differences between Malaysian Malay and Caucasian lateral cephalometric radiographs for linear measurements.

Variable	Malaysian mean	Caucasian mean	S	SE	t	P
1u-NA	11.6	4	4.09	0.53	14.317	<0.001**
1L-NB	11.0	4	2.94	0.38	18.531	<0.001**
Pog-NB	0.8	4	2.75	0.36	-9.164	<0.001**
Holdway ratio	10.4	0	4.93	0.64	12.264	<0.001**
Ls-Ns Pog	-2.0	-4	2.79	0.36	5.694	<0.001**
Li-Ns Pog	2.2	-2	3.32	0.43	9.687	<0.001**

These findings agreed with previous studies such as Munandar (1992), Lew (1994), Munandar and Snow (1995) and Hassan (1998) (Moldez et al., 2006) on Filipino population and Loi et al. (2007) on japaneese population.

Significant difference was observed for all linear measurements. The most interesting finding was the position of upper and the lower incisors regarding to the NA and NB lines respectively which were significantly greater than the Caucasian. The 1u-NA (which represent the linear relationship of the upper central incisors to the NA line) for the Malaysian Malay was higher than that of the Caucasian and the same for 1l-NB (which represent the linear relationship of the lower central incisors to the NA line). From these finding, we conclude that both the upper and lower incisors of Malaysian Malays are protruded when compared to the Caucasian and the other races as reported. From this finding plus to the inter incisal angle from angular measurement which was smaller than the Caucasian, we can notice the predominance of bimaxillary dental proclination and protrusion in class I occlusion Malaysian Malay. The independent finding in this study agreed with other studies like Munandar (1992) on Indonesian Malay, Lew (1994) on Singaporean Malay, Munandar and Snow (1995), Hassan (1998) Malaysian Malay and (Naranjilla and Janson, 2004) on Filipino population.

Regarding to the chin prominence, as the symphysis morphology has a diagnostic importance to both growing and non-growing patients. Patient with a large chin are usually horizontal growers, and the orthodontist may afford non-extraction treatment approach to the adult with a large chin (Czarnecki et al., 1993).

The result of this study showed that the chin prominence which was calculated by Pog-NB linear measurement can be considered as significantly smaller than that of Caucasian. These measurements revealed that the Malays have less prominent chins than the Caucasian. The behavior of Pog-NB can be explained by the location of B point in the mandible of Malaysian Malay. B point is a dentoalveolar landmark, and is affected by the position of the mandibular incisors. The mandibular incisors of the Malaysian Malay are proclined and that may result in anterior advancement of B point, with Pogonion being posteriorly placed. These findings agreed with each of Hwang et al. (2002) which made their study on Korean population, in comparison to European-American; Naranjilla and Janson (2004) on Filipino and Lew (1994) on Singaporean Malay females only. Based on these finding, the orthodontists should be careful in setting up their orthodontic clinical treatment planning whenever they use Steiner analysis, since in setting up the treatment planning by Steiner analysis, they always assume that the linear distance from lower incisors to NB is equal to that of Pogonion to NB. From the finding of this study, we should compromise slightly

during treatment since Malaysian Malay do not have as prominent chin as Caucasian.

Compared with the Caucasian, The Malaysian Malay's Holdaway ratio was significantly greater thus exhibiting lower lip protrusion. This increase was due to the protrusion of the lower incisor of Malaysian Malays. This finding agreed with results reported by Naranjilla and Janson (2004) and Lew (1994).

In relation to the E-line, Ricketts (1986) found that the upper lip position is -4 mm and the lower lip is -2 mm behind a line drawn from the tip of the nose to the skin pogonion. Lip which protruded beyond the aesthetic plane seemed undesirable in adults. In this study, the Malays showed a significant difference in respect of their upper and lower lips which were more protrusive when compared to the Caucasian. These were somewhat expected difference owing to the fact that both the upper and lower incisors were shown to be more proclined for this ethnic group. In this study, the Malays' Ls-Ns pog and Li-Ns pog were recorded as -2 and 2 mm, respectively. This finding agreed with results reported by Naranjilla and Janson (2004), Hassan (1998) and Lew (1994).

Conclusion

In view of the findings of this study, it is evident that there are some fundamental variations in the craniofacial structure of Malaysia Malay. These differences should be kept in mind to facilitate better diagnosis, and treatment of the Malaysian Malay orthodontic patient. The results of the present study support the idea that a single standard of facial esthetics should not be applied to all racial and ethnic groups. Malaysian Malay maxilla and mandible were set more forward than Caucasian. The results of this study showed that the Malaysian Malay had bimaxillary dental protusion when compared to Caucasian, more protrusive upper and lower lips. The chin of Malaysian Malay was less prominent when compared to Caucasian. Also, they had higher cant of both the occlusal and the mandibular planes, mandibular posterior rotation when compared to the Caucasian.

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