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CHANGES OF LIP MORPHOLOGY IN RELATION TO DIFFERENT SKELETAL INDEX: IN MALAYSIAN MALAY AND MALAYSIAN CHINESE POPULATION

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ABSTRACT

The main objective of this study is to evaluate the lip morphology changes in relation to different skeletal index between Malaysian Malay and Malaysian Chinese population. A total of 140 subjects were divided into Malaysian Malay and Malaysian Chinese groups. Each group consists of 70 males and females with all skeletal classes of malocclusions. Cephalometric radiograph were taken from subjects 56 males and 84 females with the age range 18 to 25 years. Cephalometric linear and angular measurements were carried out in relation to skeletal index and lip morphology. Descriptive statistics, racial and sexual dimorphism were evaluated. Three out of fourteen lip morphology variables showed significant difference between this two ethnic group and five out of fourteen lip morphology variables showed the differences between males and females. Changes in skeletal index associated with changes in lip morphology were found which considered as an important factor in orthodontic diagnosis and treatment planning.

KEYWORDS: Lip morphology, skeletal index, Malaysian Malay, Malaysian Chinese, linear and angular measurements.

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INTRODUCTION

Facial esthetics and a well designed functional occlusion are the two essential objectives of any orthodontic treatment. In orthodontic treatment, Angle[1] highlighted the significance of soft tissue and facial esthetic. According to him the synchronization and equilibrium of the face depends on beauty of the mouth. Extensively orthodontists motivated on lip morphology as per it is the most important feature in defining beauty. To determine the esthetic quality of profile a number of lines (S line[2], E line[3], H line[4] etc.) have been acquainted with the lip position. To achieve patient's satisfaction, orthodontic diagnosis and treatment planning should forecast the facial aesthetics according to the patient's gender, morphological and racial background. In addition, there is an obvious question for the orthodontist regarding conceivable profile and lip morphology changes followed by precise treatment. Hence, to predict the soft tissue profile after orthodontic treatment it is essential to comprise hard tissue variables as well[5]. Anteroposterior jaw relationship evaluation is a crucial step for the orthodontic treatment planning. Cephalometric analysis is an important tool for diagnosis of skeletal, profile or lip morphology. Moreover, to observe the human morphology and racial difference cephalometric index plays a vital role[6]. There are several studies found regarding association between this jaw relationship and soft tissue profile[7, 8]. After inventing the lateral cephalometric radiograph, it is becoming an important and required diagnostic utensil to find out the soft tissue and skeletal divergences[9, 10]. Different cephalometric surveys showed that there are variations in dentofacial structures in different races and different ethnic groups[11-14]. Any correction of skeletal deformity, results the changes of overlying soft tissue. However, it is not clear in what direction and up to what ranges the soft tissue changes occur[15]. Meanwhile there were many studies done to find out the soft tissue responses resulting hard tissue movement like mandibular setback [16-24] and mandibular advancement[25-29]. Among the facial soft tissue structures, lip is a vital soft tissue structure for portraying the personal features of an individual's face. Before making a treatment plan, it is important to estimate the post treatment of lip position in advance. With the different types of hard tissue changes and jaw relationship, is the lip also changes following hard tissue? Hence, the aim of this study is to find out the changes of lip morphology in relation to different skeletal index in Malaysian Malay and Malaysian Chinese population. Evaluation of soft tissue index by ANB has been done in previous study[30]. In this study we are evaluating lip morphology using all old (ANB and Wits appraisal) and new (Beta angle, W angle and Yen angle) approaches to find out the association.

MATERIALS AND METHODS

This study involved total 140 samples from two different races in Malaysian population. They are Malaysian Malay and Malaysian Chinese. Table 1 showed the distribution of subjects according to race and sex. Subjects were taken following inclusion and exclusion criteria.

Table 1
Distribution of subjects according to race and sex

Variables	Male	female	All
Sex, n (%)	56 (40)	84 (60)	140
Race, n (%)			
Malay	29 (51.8)	41 (48.8)	70
Chinese	27 (48.2)	43 (51.2)	70

Inclusion criteria

a) Aged 18 to 25 years old
b) Pretreatment cephalometric radiograph
c) Radiograph with visible landmarks
d) No facial deformity

Exclusion criteria

a) Cleft lip and palate
b) Craniofacial malformation
c) Facial asymmetry
d) History of orthodontic treatment
e) Interracial marriage

Figure 1 showed the Cephalometric measurements in relation to skeletal index and lip morphology. All measurements were done using Romexis™ Software 2.3.1.R (Planmeca, Finland).

Landmarks and analysis of linear and angular measurements for skeletal and lip morphology showed in table 2, 3, 4 and 5.

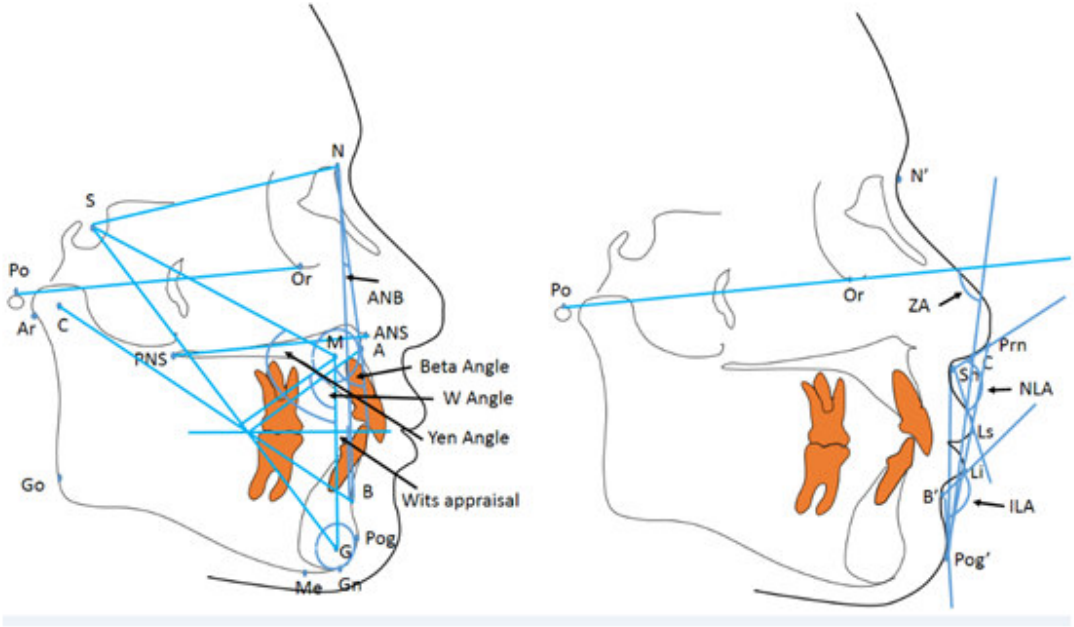

Figure 1
Cephalometric measurements in relation to skeletal index and lip morphology

Table 2
Landmarks used for skeletal indexes

Variables	Description
S	Center of sella turcica
N	Fronto nasal suture at its most superior point
A	Deepest point at concavity on maxillary alveolar bone
B	Deepest point at concavity on mandibular alveolar bone
O	Line passing through the occlusion of molars and premolars
M	Midpoint of pre maxilla
C	Centre of the condyle
G	Centre of mandibular symphysis

Sella (S); Nasion (N); Point A (A); Point B (B); Functional occclusal plane (O)

Table 3
Landmarks used for lip morphology

Variables	Description
N`	Soft tissue nasion
A`	Soft tissue A point
B`	Soft tissue B point
Prn	Most prominent or anterior projection point of nose
Sn	Junction of columella and upper cutaneous lip
Pog`	Most anterior point of soft-tissue chin
Ls	The muco cutaneous junction or midpoint of the upper vermilion line
Li	The muco cutaneous junction or midpoint of the lower vermilion line
C	The most anterior and highest part of the columella

Pronasale (Prn); Subnasale (Sn); Soft tissue Pogonion (Pog'); labiale superius (Ls); Labiale inferius (Li); Columella point (C).

Table 4
Linear and angular measurements used for skeletal index

Variables	Description
ANB Angle	Angle between SNA and SNB
Wits Appraisal	Horizontal distance between two lines (AO and BO) drawn perpendicularly from point A and point B to functional occlusal plane
Beta angle	C-B line joins center of condyle and point B. A perpendicular line is Drawn from point A to C-B line angle. Beta angle is angle between this perpendicular line and C-B line
W angle	A perpendicular line is drawn from point M to S-G line. W angle is angle between this perpendicular line and M-G line.
Yen angle	Angle between M-G line and S-M line

Table 5
Linear and angular measurements used for lip morphology

Variables	Description
Ricketts line or E line	Line drawn from pronasale to soft tissue pogonion
UTEL	line from upper lip superious to E line
LTEL	line from lower lip superious to E line
Steiners line or S line	Line drawn from Midpoint between subnasale and pronasale to soft tissue pogonion
UTSL	line from upper lip superious to S line
LTSL	line from lower lip superious to S line
Legan and Burstone line or B line	Line drawn from soft tissue subnasale to soft tissue pogonion
UTBL	line from upper lip superious to B line
LTBL	line from lower lip superious to B line
ULPA	Angle formed between line connecting soft tissue pogonion and the most protrusive upper lip
LLPA	Angle formed between line connecting soft tissue pogonion and the most protrusive lower lip
ILA	Angle formed by profile points labialis inferior, soft tissue B point and pogonion
NLA	Angle formed by profile points columella breakpoint, subnasale and labiale superius
ZA	The angle between Frankfort horizontal line and S line

Dalhberg's[31] formula was applied to check the reliability. The formula is **ME = √Σ(x1-x2)2/2n**

Here, x1 = first measurement x2 = second measurement n = the number of repeated records This formula defines the difference concerning two measurements which are taken minimum one month distant. Cephalometric radiographs were selected randomly and re-measured to calculate the reliability from each race. Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines were followed to design and conduct this study[32].

STATISTICAL ANALYSIS

Data were analyzed using STATA 10.0. Summary of statistics were obtained for all variables. Sexual and racial dimorphisms were carried out using t-test, relationship between the soft tissue and the skeletal indexes were carried out using regression method.

RESULTS

The summary statistics are as presented in Table 6. The sample consisted of an equal proportion of Malay and Chinese ethnic group but with a higher proportion of females (60%). The males have higher upper to B line, upper lip protrusion angle and lower to B line but narrower naso-labial angle. Variations between the ethnics were seen for upper to S line, lower to E line, and lower to S line. Table 7 and 8 present the results for the relationship between skeletal and soft tissues indexes in males and female respectively. The naso labial angle was found to be significantly associated with all skeletal indexes in males. In the females, the upper to S line was found to be significantly associated with all skeletal indexes. According to the table 7 and 8, increase in the skeletal variables associated with decrease in naso labial angle (NLA) for males and increase in the skeletal variables associated with increase in upper to S line (UTSL) for females. Race was not a confounder, mediator or suppressor for the relationship between W and Yen in UTSL. Table 9 also showed that multivariate regression analysis was adjusted for the effect of age and race, and there was a statistically difference in the UTSL between Malaysian Malay and Malaysian Chinese.

Table 6
Summary statistics of the parameters by sex and race

Variables	Male	Female	All
	Mean (sd)	Mean (sd)	Mean (sd)
ANB, °(sd)	3.06 (3.573)	3.58 (3.248)	3.37 (3.379)
WITS, °(sd)	-0.14 (4.014)	0.64 (4.021)	0.33 (4.022)
BETA, °(sd))	34.06 (6.313)	33.32 (6.333)	33.61 (6.313)
W, °(sd)	52.30 (4.955)	52.10 (4.497)	52.18 (4.669)
YEN, °(sd)	117.96 (7.043)	117.36 (6.798)	117.60 (6.878)
UTEL, mm(sd)	-0.20 (1.278)	-0.07 (1.351)	-0.12 (1.319)
UTSL#, mm(sd)	-0.71 (2.059)	-0.28 (1.801)	-0.45 (1.913)
UTBL*, mm(sd)	3.52 (1.005)	2.92 (1.093)	3.16 (1.095)
ULPA*, °(sd)	29.86 (7.121)	25.75 (8.46)	27.39 (8.177)
LTEL#, mm(sd)	-1.23 (2.203)	-0.70 (1.615)	-0.91 (1.883)
LTSL#, mm(sd)	-1.09 (3.119)	-0.38 (2.383)	-0.66 (2.713)
LTHL*, mm(sd)	1.67 (1.108)	1.25 (0.835)	1.42 (0.972)
LTBL*, mm(sd)	3.80 (1.63)	3.04 (1.222)	3.35 (1.444)
LLPA, °(sd)	15.31 (4.656)	14.00 (5.091)	14.52 (4.956)
NLA*, °(sd)	85.43 (11.555)	90.56 (10.655)	88.51 (11.268)
ILA, °(sd)	122.27 (17.435)	125.27 (17.259)	124.06 (17.331)
ZA, °(sd)	64.99 (9.598)	66.49 (11.586)	65.89 (10.823)

p≤0.01 for differences between males and females, #P<0.001 for difference between Malay and Chinese

Table 7
Association between the skeletal and soft tissue parameters in males (Regression coefficients)

Variables	ANB	WITS	BETA	W	YEN
UTEL	0.005	0.021	-0.021	-0.023	-0.014
UTSL	-0.018	0.012	-0.050	-0.085	-0.053
UTBL	0.010	-0.00	0.006	-0.002	-0.001
ULPA	0.244	0.013	-0.027	0.105	-0.006
LTEL	0.064	0.069	-0.087	-0.111	-0.054
LTSL	0.020	0.086	-0.104	-0.146	-0.088
LTHL	-0.015	-0.004	0.035	0.040	0.022
LTBL	-0.034	-0.045	0.055	0.061	0.031
LLPA	-0.133	-0.011	0.123	0.163	0.087
NLA	-0.925*	-1.009**	0.961**	0.649*	0.643**
ILA	0.569	0.353	-0.152	-0.303	-0.121
ZA	0.317	0.253	-0.148	0.033	-0.067

p<0.05; **p<0.01; ***P<0.001

Table 8
Association between the skeletal and soft tissue parameters in females (Regression coefficients)

Variables	ANB	WITS	BETA	W	YEN
UTEL	0.054	0.052	-0.041	-0.045	-0.035
UTSL	0.139*	0.138**	-0.087**	-0.104*	-0.057*
UTBL	0.007	-0.030	0.017	0.026	-0.001
ULPA	0.285	-0.015	-0.033	0.016	-0.125
LTEL	0.063	0.060	-0.050	-0.059	-0.038
LTSL	0.061	0.068	-0.062	-0.086	-0.035
LTHL	-0.038	-0.027	0.016	0.040	0.027*
LTBL	-0.014	-0.048	0.025	0.048	0.022
LLPA	0.116	-0.022	-0.011	0.076	-0.018
NLA	-0.518	-0.480	0.331*	0.426	0.155
ILA	0.921	0.302	-0.272	-0.307	-0.345
ZA	0.389	0.450	-0.289	-0.424	-0.217

p<0.05; **p<0.01; ***P<0.001

Table 9
Significant association between the skeletal and soft tissue parameters in multivariate analysis (Regression coefficients)

Variables	NLA for male (p value)	UTSL for female (p value)
ANB	-.823 (.066)	.144 (.012)#
Wits	-.945 (.020)	.134 (.004)#
Beta Angle	.699 (.004)	-.079 (.007)#
W angle	.772 (.014)	-.133 (.001)#
Yen Angle	.669 (.002)	-.067 (.015)#

 # P value for race; P< 0.05

DISCUSSION

For successful orthodontic treatment, the soft tissue profile has a vital role. A well-balanced face and optimal functional occlusion are the main objectives for a fruitful treatment. Concerning this stable and functional occlusion various kind of treatment plan could done including extraction or without extraction. Hayashida et al[33] predicts that in case of class II division 1 with premolar extraction, there are changes in lip position after retracting the teeth. Another study stated that, before treatment of class II division 1 both lower and upper lip positioned downward during smiling compare to the normal occluded control group. However, the feature improved after orthodontic treatment[34]. In case of class III malocclusion,

the lower lip positioned downward during smiling. However, after orthognathic surgery, the horizontal direction of mouth corner got significant difference during smiling than before treatment[35]. Another study also explained that there is significant forward movement of upper lip after proclining the upper incisors[36]. This study consists of multiple measurements to execute lip morphology analysis with different skeletal indexes. Previously linear and angular measurements are done by Alam et al.[37-40] and found that in linear measurements there is a significant difference in LLH, LLB in Malaysian Malay and Malaysian Chinese population. The study concluded that lips are more protruded in Malaysian Chinese population compare to Malaysian Malay. However, there is no significant difference in angular measurement between these two races. To investigate jaws in sagittal plane there were lot of efforts have been made but none can be relied completely. At first Riedel[41] used nasion (N) to express skeletal association between maxilla and mandible with angle ANB. In original research[30] the norms of Caucasians for ANB is 2^{o}. But for Malaysian Malay and Malaysian Chinese, Kathrivan et al.[42] and Gu et al.[43] stated that the ANB value is 3.25° and 3.9° respectively. Another study showed among 100 Chinese teenagers, the ANB is 4.91 which indicated that the tendency towards class II[44]. ANB also found (2.5^{o}) in other research which involves only Malaysian Malay[45]. Compare to all landmarks for lip morphology this study showed that there is significant difference between Malaysian Malay and Malaysian Chinese in UTSL, LTEL, and LTSL. For male there is a difference in NLA and for female difference was found in UTSL with ANB angle. Greater ANB causes narrower NLA for male and greater ANB causes increase UTSL. Nevertheless, due to the displacement of Nasion and jaw rotations in ANB angular measurement Jacobsson suggested another method named 'wits appraisal' (+3 to -3 mm) which uses functional occlusal plane rather than cranial base[46]. Kathiravan et al.[42] found that for adult Malaysian Chinese the wits appraisal is 1.08 mm where the teenagers' Chinese were closer to the original values[44]. According to the study, there is a significant difference in NLA with wits appraisal in male and UTSL in female. Like ANB greater the wits appraisal causes narrower NLA for male and greater ANB causes increase UTSL. Due to some limitations regarding measurement in mixed dentition period, another method established called beta angle. While for both population, the mean value of Beta angle is comparable with Caucasians[47, 48]. This study showed with the changes greater beta angle increase NLA for male and greater the beta angle decrease the UTSL for female. This Beta angle uses condylar axis to assess the divergence. As the reproducibility of condyle is doubtful[49], W angle and Yen angle were developed. W angle is constant with the vertical growth[50]. Yen angle also showed consistent valuation for measuring the discrepancies[51]. We found with the change of W angle and Yen angle, increase the both angle causes NLA increase for male and decrease the UTSL for female in case of lip morphology. For female LTHL also increase with the increase of Yen angle.

CONCLUSION

Based on the findings of the present study, the following conclusions were reached:

- There were significant differences in the lip morphology among different genders, ethnicities, and /or types of malocclusion in relation to different skeletal index.
- For orthodontic diagnosis and treatment planning, the variables to predict the lip morphology may perhaps constructive for orthodontist to treat according to the respective ethnic norms.

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