ORIGINAL RESEARCH

Lip Dimensions of an Adult Nigerian Population with Normal Occlusion

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ABSTRACT

Introduction: The soft tissue paradigm is placing greater emphasis on the importance of the soft tissue profile to orthodontic treatment planning. The purpose of this study was to determine the lip dimensions of a Nigerian adult population; compare the male and female values and to compare the values obtained for Nigerians with those reported for other population.

Methodology: Lateral cephalometric radiographs of 100 students (44 males and 56 females) of the College of Medicine, University of Lagos, aged 18 to 25 years were taken. Selected subjects were of Nigerian ancestry with normal occlusion and a harmonious facial appearance. The radiographs were manually traced and the upper and lower lip length and thickness of each subject was measured. Statistical analysis was carried out using SPSS, while the male and female values were compared using student's t-tests.

Results: Mean values for the lip dimensions were computed for the entire sample. Marked sexual dimorphism was observed with the males having thicker and longer upper and lower lips than the females. The Nigerian sample also had a longer upper lip and a thicker and shorter lower lip than that reported for Caucasians. However, both population had a similar upper lip thickness.

Conclusion: Cephalometric norms were developed for the lip dimensions of a Nigerian population. Marked sexual dimorphism was observed in the Nigerian population studied with the males having longer and thicker lips than the females. The lip dimensions of the Nigerian population studied differed from that reported for Caucasians and other racial groups.

Clinical significance: The lip dimensions established in this study would aid in orthodontic and orthognathic surgery treatment planning for Nigerians. Furthermore, due to the marked sexual dimorphism observed in the Nigerian population studied, gender specific and not generalized norms should be used.

Keywords: Lip dimensions, Nigerian population, Cephalometry.

INTRODUCTION

Orthodontic diagnosis and treatment planning is in a period of remarkable change, away from a previous focus on dental occlusions and hard tissue relationships and toward greater emphasis on soft tissue adaptation and proportions.[1] A balanced profile should be one of the key factors in deciding on the methods of treatment for any form of malocclusion, as good occlusion does not necessarily mean good facial balance.[2]

As early as 1907, Edward H Angle,[3] who was one of the first to write about facial harmony, emphasized the importance of soft tissue. He considered the mouth as a most potent factor in making or marring the character of the face, with the form and beauty of the mouth itself depending on the occlusal relation of the teeth. His chief concern was finding or establishing a harmonious relationship between the mouth and other features.

Holdaway[4] stated that 'usually as we correct malocclusion, we bring about changes in appearance that are pleasing to all concerned. However, most orthodontists who have practiced for even a few years have had the unpleasant experience of finding that some patients' faces looked better before the orthodontic corrections were made'. He further stated that 'better treatment goals can be set, if we quantitate the soft tissue features which contribute to or detract from that physical attractiveness stereotype which has been ingrained into our culture'.

Burstone[5,6] studied the soft tissue thickness of the lips and the relationship of facial soft tissues to the position of the teeth and bones. He realized that because of the variation in the soft tissues that covered the teeth and bones, there was no system of hard tissue cephalometric measurements that could predict good facial esthetics.

A close relationship exists between the tissue thickness of the upper and lower lips for, if there is a significant

difference in their thickness, the facial contour will not be in harmony. In addition, lip thickness is an important factor in the response to orthodontic movement.[2] Oliver[7] found that patients with thin lips or a high lip strain displayed a significant correlation between incisor retraction and lip retraction; whereas patients with thick lips or low lip strain displayed no such correlation.

Burstone[5] described the ideal upper lip thickness based on his study of young Caucasian adults as 15.1 ± 1.92 mm and 11.8 ± 1.54 mm for males and females respectively; while he reported ideal lower lip thicknesses of 16.3 ± 1.45 mm and 13.4 ± 1.68 mm for both genders respectively. In another study, also carried out in a Caucasian population, Burotone[6] described the ideal upper and lower lip lengths as 21.67 ± 1.7 mm and 48.15 ± 3.95 mm respectively.

Different values have been reported for the lip thickness and lengths of different population.[2,4,5,7,8] With respect to the Nigerian population, several studies have been carried out to develop cephalometric norms for this population.[9-13] However, these studies have been restricted to hard tissue (dentoskeletal) relationships with no emphasis placed on the soft tissue profile. Thus, there is a need to develop baseline values for the lip morphology of Nigerians, which would aid in diagnosis and treatment planning for both orthodontic treatment and orthognathic surgery.

The purpose of this study was to establish norms for the lip dimensions of a Nigerian population with normal occlusion; to compare the male and female values and to compare the values obtained for Nigerians in this study, with those reported for other population.

METHODOLOGY

The subjects were students of the College of Medicine, University of Lagos, Idi-araba, Lagos, Nigeria. The first step of the selection process involved clinical examinations and interviews to determine those who met the selection criteria: Nigerians with Nigerian grandparents; 18 to 25 years; presence of all permanent teeth except third molars; Class I canine and molar relationships, normal overjet and overbite; harmonious facial appearance, no previous orthodontic or prosthodontic treatment and no craniofacial deformities or history of trauma. Female subjects who were pregnant or likely to be pregnant were excluded from the study.

The sample comprised 100 subjects (56 males and 44 females); mean age 21.63 years, who met the selection criteria. Ethical approval for the study was obtained from the Ethical committees of the College of Medicine, University of Lagos and the Lagos University Teaching Hospital, Idi-araba, Lagos. In addition, informed written

consent was obtained from each subject after the nature and purpose of the radiographs had been explained.

Lateral cephalometric radiographs were taken of all subjects in natural head position with the eyes straight ahead, the teeth in centric occlusion and the lips in relaxed contact. The radiographs were taken using a Planmeca Publication Part Number 10014593 revision 7, digital orthopantomo-graph/cephalostat machine (Planmeca OY, Helsinki, Finland 2009-06) at 68.0 Kv, 5.0 mA for 17 secs at 18.5 mGy/cm^2; at the Lagos University Teaching Hospital Dental Clinic, Idi-araba, Lagos, Nigeria. The same operator took all the radiographs.

The lateral cephalometric radiographs were manually traced on 0.003 mm matte acetate sheets (MASEL, 2034-007, AR-MED Ltd, UK), with a 0.5 mm lead pencil. All radiographs were manually traced by the first author and then reviewed by the second author for accurate landmark identification.

Definition of landmarks, necessary for measuring the lip dimensions (Fig. 1).

- *Subnasale (Sn):* The point at which the columella (nasal septum) merges with the upper lip in the midsagital plane.
- *Labrale superius (Ls):* The most anterior point of the upper lip.
- *Stomium superius (Sts):* The lowermost point on the vermillion of the upper lip.
- *Stomium inferius (Sti):* The uppermost point on the vermillion of the lower lip.
- *Labrale inferius (Li):* The most anterior point of the lower lip.
- *Soft tissue menton (Me'):* Lowest point on the contour of the soft tissue chin. Found by dropping a perpendicular from horizontal plane through skeletal menton.
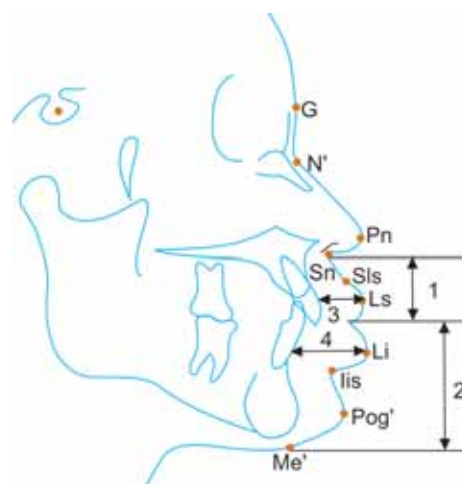

Fig. 1: (1) Upper lip length; (2) Lower lip length; (3) Upper lip thickness; (4) Lower lip thickness (G: Soft tissue glabella; N': Soft tissue nasion; Pn: Pronasale; Sn: Subnasale; Sls: Superior labial sulcus; Ls: Labrale superius; Li: Labrale inferius; Iis: Inferior labial sulcus; Pog': Soft tissue pogonion; Me': Soft tissue menton)

Table 1: Dahlberg's values and paired t-tests for 20 randomly selected cephalograms							
	First tracing		Second tracing		Dahlberg value	Significance	
Measurements (mm)	Mean	SD	Mean	SD		t-value**	p-value
Lip lengths							
1. Upper lip length (ULL)	25.18	2.88	22.86	7.58	0.68	1.53	0.14
2. Lower lip length (LLL)	44.70	3.61	44.45	3.65	0.80	0.78	0.46
Lip thicknesses							
1. Upper lip thickness (ULT)	13.23	2.20	13.95	2.32	0.89	-2.81	0.010*
2. Lower lip thickness (LLT)	16.68	3.29	17.28	2.31	0.80	-1.63	0.120

*p < 0.05, significant; **Paired t-test

The following four measurements were then made as depicted in Figure 1.

1. *Upper lip length:* This is the distance from the soft tissue subnasale to the stomion superius.
2. *Lower lip length:* This is the distance from the stomion inferius (highest point on the vermillion of the lower lip) to the soft tissue menton.
3. *Upper lip thickness:* The linear distance from the labrale superius (Ls) to the labial surface of the upper incisors.
4. *Lower lip thickness:* The linear distance from the labrale inferius (Li) to the labial surface of the lower incisors.

STATISTICAL ANALYSIS

The statistical package for social sciences (SPSS) version 17, Chicago III, was used for analyzing data. From the data collected, descriptive statistics including mean, standard deviations, minimum and maximum values were computed for each of the four measurements. In addition, the student's t-test was used for comparison of the mean cephalometric values of males and females. The level of significance for the analysis was set at $p < 0.05$.

In order to determine the methodological cephalometric tracing error, repeat measurements for intraexaminer errors were carried out on 20 randomly selected cephalograms by the first author, 1 week after the initial measurements. The error was then calculated by using Dahlberg's equation.[14] Paired t-tests were also carried out between the initial and repeat measurements to determine the significance of any error. The level of significance was also set at $p < 0.05$.

RESULTS

The methodological cephalometric tracing error calculated using Dahlberg's equation was found to range from 0.68 (upper lip length) to 0.89 (upper lip thickness). Except for the upper lip thickness, the measurement error recorded for all measurements fell within the range reported by Baumrind and Frantz,[15] as normal (0.43 to 0.86 mm) for linear measurement errors in cephalometric studies. In addition, a paired t-test between the initial sample and 20 randomly selected radiographs showed a statistically significant difference between the first and second tracings (p < 0.05) for the upper lip thickness, while no difference was observed for the other measurements (Table 1). Thus, the upper lip thickness was remeasured for the entire sample and an average of the first and second readings used for the study.

The mean age of the subjects was 21.63 ± 2.04 years and a modal age of 21years was recorded. The mean values and minimum and maximum values for the lip dimensions are shown in Table 2. The upper lip lengths recorded for Nigerian males and females in this study were 25.58 ± 3.11 mm and 23.66 ± 2.31 mm; while the lower lip lengths were 47.83 ± 4.53 mm and 45.56 ± 4.07 mm respectively. With respect to lip thickness, upper lip thicknesses of 15.06 ± 1.67 mm and 18.45 ± 2.26 mm were recorded, while lower lip thicknesses of 18.45 ± 2.26 mm and 15.97 ± 2.37 mm were recorded for the males and females respectively (Table 3).

A comparative analysis of the lip dimensions of the Nigerian males and females, using student's t-tests showed marked sexual dimorphism, with the males having significantly longer and thicker upper and lower lips than the females (p < 0.05) (Table 3). Further comparison of the lip dimensions recorded for Nigerians in this study with that reported for Caucasian population by Burstone shows that the Nigerian population studied had a longer upper lip and a shorter lower lip than the Caucasian population. In addition, the Nigerian population also had a thicker lower lip compared to the Caucasian population. However, the only variable which was similar in both population was the upper lip thickness (Table 4).

Table 2: Mean, standard deviation, minimum and maximum values for the lip dimensions of the Nigerian population studied				
Measurements (mm)	Mean	SD	Min	Max
Lip lengths				
1. Upper lip length (ULL)	24.50	2.87	30.00	19.00
2. Lower lip length (LLL)	46.56	4.40	36.00	56.00
Lip thicknesses				
1. Upper lip thickness (ULT)	13.87	2.13	10.00	19.00
2. Lower lip thickness (LLT)	17.07	2.63	11.00	22.00

Table 3: A comparison of the lip dimensions of Nigerian males and females						
Measurements (mm)	Males (44)		Females (56)		Significance	
	Mean	SD	Mean	SD	t-value**	p-value
Lip lengths						
1. Upper lip length (ULL)	25.58	3.11	23.66	2.31	3.50	0.001*
2. Lower lip length (LLL)	47.83	4.53	45.56	4.07	2.63	0.010*
Lip thicknesses						
1. Upper lip thickness (ULT)	15.06	1.67	10.93	1.99	5.69	0.000*
2. Lower lip thickness (LLT)	18.45	2.26	15.97	2.37	5.29	0.000*

*p < 0.05, significant; **Student's t-test

Table 4: A comparison of the lip dimensions of the Nigerian population studied with that of a Caucasian population as reported by Burstone[28]				
Measurements (mm)	Nigerian population		Caucasian population	
	Mean	SD	Mean	SD
Lip lengths				
1. Upper lip length (ULL)	24.50	2.87	21.96	1.07
2. Lower lip length (LLL)	46.56	4.40	48.15	3.95
Lip thicknesses				
1. Upper lip thickness (ULT)	13.87	2.13	13.50	1.73
2. Lower lip thickness (LLT)	17.07	2.63	14.85	1.57

DISCUSSION

In this study, means values of 24.50 ± 2.87 mm and 46.56 ± 4.4 mm were recorded for the upper and lower lips lengths respectively, indicating that the Nigerian sample had longer upper lips and shorter lower lips than that reported for Caucasians by Burstone.[6] This finding may explain the common Jackson lip pattern of 3/1 reported in Nigerians by Isiekwe,[16] as compared to 2/2 reported in Caucasians, by Jackson.[17]

The upper lip length to lower lip length ratio obtained was 1:1.9, which compares favorably with the ratio of 1:2 reported by Legan and Burstone,[18] as being ideal. While the upper lip length of Nigerians in this study is comparable to those reported for other black population, the lower lip length is relatively shorter than those reported for other black population. Naidoo and Miles,[19] in a study carried out in Black South Africans, reported mean values of 25.5 ± 3.1 mm and 50.9 ± 3.9 mm; while Flynn et al[20] in a study of Black Americans reported means values of 25.9 ± 3.0 mm and 51.5 ± 6.0 mm; for the upper and lower and lower lip lengths respectively.

The lip lengths recorded in this study also showed marked sexual dimorphism, with the Nigerian males having significantly longer, upper and lower lips than the Nigerian female. The upper lip length obtained for Nigerian males in this study (25.58 ± 3.1 mm) is also higher than that reported by Zylinski et al[21] for Caucasian adult males (23.7 ± 2.3 mm); Shalhoub et al[22] for Saudi Arabian males (22.16 ± 3.29 mm)

and Kalha et al,[23] for South Indian males (22.33 ± 3.57 mm). While the lower lip length of Nigerian males is comparable to that reported for South Indian males[23] (48.82 ± 7.15 mm) but less than those reported for Caucasian adult males[21] (57.5 ± 3.0 mm) and Saudi-Arabian adult males[22] (49.37 ± 8.12 mm) respectively.

Furthermore, the upper lip length of Nigerian females (23.66 ± 2.37 mm) was also higher than that reported for Saudi Arabian females[22] (21.60 ± 3.5 mm) and South Indian females[23] (19.62 ± 3.77 mm) respectively. On the other hand, the lower lip length of Nigerian females in this study (45.56 ± 4.07 mm) is greater than that reported for South Indian females[23] (41.13 ± 9.65 mm), but less than that reported for Saudi Arabian[22] females (48.9 ± 4.43 mm).

The thickness of the upper lip is an important factor to consider when assessing the soft tissue profile prior to orthodontic treatment. Ideally, the upper lip should follow the tooth movement, as the incisors are retracted.[2] However, Holdaway[4] reported that when upper lip thickness exceeds 18 mm at the vermillion border, the upper lip changes very little if at all, when the upper incisors are retracted. He further stated that when the upper lip is within the common range of 13 to 15 mm, it usually follows the tooth movement quite well, while when the thickness is 12 mm or less and it is not due to stretching the lips over protrusive teeth, the lip usually moves back just as fast as the teeth are moved. Thus, thickness of the lips is an important factor in the response to orthodontic movement.

In this study, values of 15.06 ± 1.67 mm and 12.92 ± 1.99 mm were reported for the upper lip thickness of Nigerian males and females respectively. This was the only measurement in which no significant difference was found between the Nigerian and Caucasian norms, thus showing that both groups have similar upper lip thickness. Fonseca and Klein[24] also reported similar findings in a study comparing the soft tissue profile of American Negro women to that of Caucasian women. They discovered no significant difference between the lip thicknesses of both groups, thus the Negroid and Caucasian women had essentially the same lip thickness values. Basiftci et al[25] also reported comparable

values for upper lip thickness to those obtained in this study, in a study carried out in a Turkish population. They reported upper lip thickness values of 15.22 ± 2.39 mm and 12.28 ± 1.9 mm for Turkish males and females respectively. Despite a similarity in upper lip thickness, a previous study had reported a much greater upper lip protrusion in Nigerians as compared to Caucasians.[26] This finding can be ascribed to the protrusive pattern of the underlying skeletal and dental framework in Nigerians,[9-13] which has also been reported for other black population.[8,20,27-30] Freitas et al[28] reported similar findings in a study comparing the soft tissue characteristics of black and white Brazilians. They observed that the upper and lower lips were more protruded in blacks, despite a similarity in lip thickness between both groups. Fonseca and Klein[24] also highlighted this in explaining similar findings observed in their study. They further stated that what clinically appears to be an increase in lip thickness in the Negro woman is possibly an eversion of the lips revealing more lip tissue between upper and lower vermillion borders. In this study, Nigerian males had significantly thicker upper lips than Nigerian females, and this may be as a result of greater muscle mass in males than females. Sexual dimorphism with greater values in males has also been reported in Caucasian[5] and South Indian[23] population.

With respect to the lower lip thickness, much higher values of 18.45 ± 2.26 mm and 15.97 ± 2.37 mm were obtained for Nigerian males and females respectively as compared to that reported for Caucasians by Burstone. Thus, indicating that Nigerian sample had thicker lower lips than Caucasians. Fonseca and Klein[24] reported a lower lip thickness of 13.1 mm for American Negro women, which is less than that reported for Nigerian females in this study. Lower lip thickness in South Indian males and females were also lower than that of Nigerians being 14.08 and 13.03 mm respectively.

These differences in the lip dimensions of Nigerians as compared to those of various population show the importance of defining what is normal for a particular ethnic group or population. In addition, the differences also highlight the importance of gender specific norms as compared to group norms for the Nigerian population, with respect to soft tissue treatment planning for both orthognathic surgery and orthodontic treatment.

CONCLUSION

Based on the results obtained in this study, the following conclusions can be made:

1. The average values for the lip dimensions of an adult Nigerian population were established.

2. There is marked sexual dimorphism in the lip morphology of this Nigerian adult population, with the males having significantly longer and thicker upper and lower lips than the females.

3. The lip morphology for the Nigerian population studied, differs from that reported for Caucasians and other racial groups.

CLINICAL SIGNIFICANCE

The lip dimensions established in this study would serve as baseline data for treatment planning, for both orthodontic treatment and orthognathic surgery in the Nigerian population. Furthermore, due to marked sexual dimorphism observed in the lip morphology of the Nigerian population studied, gender specific and not generalized norms should be used.

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