

Evaluation of lips thickness to the E-line and S-line in a Nigerian population

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ABSTRACT

Background: Soft tissue structures, such as the lips, their positions, and their relative proportions, are important components in clinical analysis of orthodontic, maxillofacial, and plastic surgery patients. Their assessment is usually with a view to arriving at a decision regarding treatment planning as to whether to maintain or to improve the soft tissue profile. Lip length and thickness may affect aesthetic facial proportions by influencing both dental and facial symmetry.

Aim: To investigate the thickness, length and anteroposterior position of the lips using the E-line and S-line in a Nigerian sample.

Method: Ninety-five lateral cephalometric radiographs of patients aged 17 – 38-years with a skeletal pattern I dental base were analyzed. The soft tissue profile outline was traced including the upper and lower lips and the E-line drawn from the pronasale to the pogonium. The S-line was drawn from the subnasale to the pogonium to analyze the lips prominence. Descriptive analysis, chi-square and independent student's t-test was used to study the difference between variables and gender. The level of significance was set at $p = < 0.05$.

Results: The mean age of participants was 18.12 ± 6.69 years. The upper and lower lips lengths were 25.82 ± 2.65 mm and 49.48 ± 5.39 mm, and the thickness was 17.39 ± 2.39 mm and 20.32 ± 2.75 mm, respectively. The prominence of the upper and lower lips with reference to the E-line was 4.37 ± 2.67 mm and 8.14 ± 2.51 mm respectively. The mean gender difference of upper and lower lips prominence to the 'E' line was 2.3mm and 1.6mm and these were statistically significant.

Conclusion: There was a statistically significant difference in upper lip thickness between genders. Both the upper and lower lips were prominent when compared to the Ricketts and Steiners line and were also statistically significant between genders.

Key words: Lip length, Lip Thickness, Ricketts Line, Steiner Line

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INTRODUCTION

The face is divided into thirds with the lips being a prominent soft tissue and key to aesthetics in the lower third. In orthodontics, improvement in soft tissue facial aesthetics is one of the important goals of treatment. The dimensions of facial soft tissue structures such as lips, nose and chin, their positions and their relative proportions are important components in clinical analysis of orthodontic, maxillofacial and plastic surgery patients^{1,2,3,4}. This assessment is usually with a view to arriving at a decision regarding treatment planning as to whether to maintain or try to improve soft tissue profile. Facial aesthetics, particularly concerning orthodontics and orthognathic surgery, greatly rely on measurements of facial features such as the lips because of its contribution to facial attractiveness and beauty. Lip length and thickness may affect aesthetic facial proportions by influencing both dental and facial symmetry. Many researchers have established norm values for lips length and thickness for different population and these values have helped in orthodontics assessment for deviations^{5,6,7}.

Generally, a balanced facial aesthetics would present a lip length that conforms to specific ratios of the lower facial third. For instance, the average upper lip length in adults' ranges between 20-24 mm, while the lower lip averages between 30-35 mm⁸. Lip thickness, particularly the vermilion border thickness could play a crucial role in facial aesthetics and is often correlated with perceptions of youthfulness and beauty. Normative values of 10 – 12 mm for an average upper lip thickness and lower lip thickness reaching approximately 12-15 mm, depending on ethnicity and biological variations have been reported⁹. Individuals of African descent have been documented to have fuller lips when compared with Caucasian and Asian populations^{10,11}. Some studies have reported gender dimorphism relating to thickness and length of lips, which may influence the interpretation of the facial reference lines such as the Ricketts "E-line" and Steiners "S – line"¹². This was earlier reported by Sforza et al¹³ who analyzed 231 white Italian adolescents aged 10-17 years and found that the facial attractiveness was closely related to lip prominence and reduced distances of lips to a line drawn by Ricketts from the tip of the nose to the chin known as the aesthetic 'E' line. The E-line and S – S-lines are reference lines used to assess the antero-posterior position of the lips and facial profile. Some

studies^{14,15} have observed better acceptability to a more prominent lip especially in situations where a larger nose and chin accompany it. Consequently, Orthodontists must exercise cultural sensitivity and awareness when applying these reference lines in treatment planning. Ethnic-specific norms should guide clinical evaluation for optimal aesthetic results while ensuring harmonious proportions that satisfy individual and cultural expectations.

Information on the anatomy of soft tissue such as the lips is important in modern-day orthodontic clinical practice, facial reconstructive surgeries and also in research. Guidelines for treatment planning for improvement in facial appearance till recently existed in the form of evaluation of linear and angular parameters and sometimes, ratios related to the hard tissues in the various cephalometric analyses. Several landmarks have been used to assess the anteroposterior positions of the lips with the E-line (Ricketts)¹⁶ and S-line (Steiner's)¹⁷ being one of the commonest references used. These are important anthropometric guidelines in orthodontics. Surgeons can also use them to achieve better aesthetic outcomes by harmonizing the lips with surrounding structures as they serve as essential frameworks as defined by Ricketts¹⁶ and Steiner's¹⁷ references thereby underscoring their implications in orthodontics, cosmetic surgeries, and anatomical studies. Analyzing lip length and thickness in relation to these lines may serve several purposes including facilitating a better understanding of underlying skeletal relationships and facial balance. For example, a patient with lip protrusion may have to undergo orthodontic treatment to establish a proper relationship between anterior dental arches and lip positions. Hence, both lines have become very essential.

The position of the lips in relation to Ricketts and Steiner lines can indicate facial symmetry or dissonance. Thicker, longer lips tend to be more protrusive relative to the E – line and S – line, often exceeding normative values, especially in African populations¹⁸. For example, if the lower lip is positioned more anteriorly than the Steiner line suggests, this could suggest mandibular protrusion, or if the upper lip measures shorter than normative values relative to the Ricketts line, it may indicate maxillary retrognathism. Therefore, when analyzing lip length and thickness, it is essential to incorporate

measurements of both lines to understand their functional relevance fully¹⁰.

This study is aimed at investigating the thickness, length and anteroposterior position of the lips in relation to the E-line and S-line in an orthognathic Nigerian sample.

METHODOLOGY

The study population utilised ninety-five lateral cephalometric radiographs of patients with skeletal class I dental base pattern aged 17 – 38years seeking orthodontic treatment at the outpatient orthodontic clinic of a tertiary health care facility in the South Western region of Nigeria. The case notes of these patients were recalled and their socio-demographic information was recorded. Other information retrieved from the case note included molar relationship and skeletal pattern. Inclusion criteria included that the participants should be of Nigerian origin, with no missing or loss of teeth and no previous orthodontic treatment

Ethical approval (UI/EC/14/0106) was obtained from the University of Ibadan/University College Hospital Ethical Review board. Written informed consent was obtained from all participants. All data obtained were recorded in a spread sheet and also in keeping with the declaration of the Helsinki ethical standards for human studies.

Each cephalometric radiograph was analyzed by a single investigator manually using a sharp HB pencil, 0.03mm matted cellulose acetate paper. The profile of the soft tissue outline was traced including the upper and lower lips and the E-line drawn from the pronasale to the pogonium and the S-line drawn from the subnasale to the pogonium to analyze the lips prominence. Only five (5) cephalometric radiographs were analyzed daily by a single investigator to reduce fatigue.

The following parameters were recorded;

- Upper lip thickness (ULT): distance between the junction of the contour of the maxillary incisor and the pre-maxilla, and point UL,

located in the anterior-most region of the upper lip contour.

- Upper lip height (ULH): distance between the palatal plane (ANS-PNS) and a parallel line going through a point (located at the bottom of the contour of the upper lip).
- Lower lip thickness (LLT): distance between the junction of the contour of the lower incisor and the anterior contour of the chin, and point LL, located in the anterior-most contour of the lower lip.
- Lower lip height (LLH): distance between the mandibular plane and a parallel line going through a point (located at the upper border of the contour of the lower lip).
- ANB angle to determine the skeletal pattern (A – Is the deepest concavity in the anterior profile of the maxilla, N – Is the suture point between the nasal bone and the frontal bone and B – Is the deepest concavity in the anterior profile of the mandible
- E-Line (Ricketts line) is drawn from Pronasale (Pn) to soft tissue pogonium (Pog) serving as a reference for facial proportions and alignment (Ricketts, 1982)¹⁶. It helps to evaluate the anteroposterior position of the maxilla and mandible, which is fundamental for aligning the facial profile. The line delineates a proper projection of the lips, where the upper and lower lips should rest approximately perpendicular to it, aiding in determining lip protrusion or retrusion.
- S-Line (Steiner line) is drawn from midpoint between subnasale (Sn) and Pronasale (Pn) to soft tissue pogonium (Pog) (Steiner, 1953)¹⁷. It serves as a standardized measure to evaluate sagittal relationships, emphasizing overall facial harmony and balance.

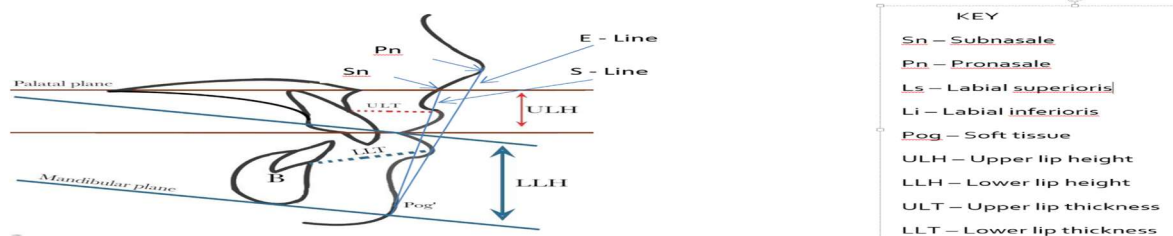


Figure 1 Lateral cephalometric analysis defining E-line, S-line, ULH, ULT, LLH, LLT

The data got and recorded in the spread sheet was subjected to statistical analysis using SPSS statistical software version 19. Descriptive analysis, chi-square and independent student's t-test was used to study the difference between variables and gender. The level of significance was set at $p < 0.05$. Results are presented in tables, graphs and charts.

RESULT

The mean age of participants was 18.12 ± 6.69 years. The gender distribution was 59(62.1%) females and 36(37.9%) male. The upper and lower lip lengths were 25.82 ± 2.65 mm and 49.48 ± 5.39 mm while the thickness were 17.39 ± 2.39 mm and 20.32 ± 2.75 mm, respectively. There was a significant difference in lip thickness between gender with males having a greater upper lip thickness when compared with females ($P < 0.05$) (Table 1). However, this observation was not noticed with the lower lip thickness as there was no significant difference.

The prominence of the upper and lower lips with reference to the E-line was 4.37 ± 2.67 mm and 8.14 ± 2.51 mm, respectively. The mean gender difference of upper and lower lips prominence to 'E' line was 2.3mm and 1.6mm and these were statistically significant with $P < 0.05$ (Table 2). In relation to the S-line, the upper and lower lip prominence was 6.8 ± 2.57 mm and 10.1 ± 2.42 mm with a gender difference of 2.4mm and 1.5mm, respectively. These were also statistically significant with ($P < 0.05$) for upper and lower lips, respectively (Table 2). The upper lip was found to be behind the lower lip by a mean difference of 3.77mm. A correlation between the lips and the "E" and "S" lines showed a strong positive strength ($P < 0.05$) (Table 3). Table A shows the comparison of the lip dimensions in Nigerians, and in some West African countries and Caucasians, while Table B shows Comparisons of the Lips to the "E" and "S" lines in Nigerians and some West African countries

Table 1: Assessment of upper and lower lips length and thickness in the studied population

	Male mean (mm)	Female mean (mm)	Total subject mean (mm)/SD	P-value
(Upper lip)				
• Length	26.03 ± 3.14	25.69 ± 2.32	25.82 ± 2.65	0.555
• Thickness	16.75 ± 2.27	17.78 ± 2.93	17.39 ± 2.39	0.041*
(Lower lip)				
• Length	49.17 ± 5.36	49.68 ± 5.44	49.48 ± 5.39	0.656
• Thickness	20.67 ± 3.17	20.10 ± 2.46	20.32 ± 2.75	0.334

*Statistically significance ($P \leq 0.05$)

Table 2: Comparing the lip thickness prominence in relation to E – line and S – line between gender

	Male mean (mm)//SD	Female mean (mm)/SD	Total subject mean (mm)/SD	P value
Upper lip to E - line	5.75 ± 2.83	3.53 ± 2.18	4.37 ± 2.67	0.000*
Lower lip to E – line	9.14 ± 3.21	7.53 ± 1.74	8.14 ± 2.51	0.008*
Upper lip to S - line	8.33 ± 2.84	5.93 ± 1.91	6.84 ± 2.57	0.000*
Lower lip to S – line	11.08 ± 3.08	9.56 ± 1.68	10.14 ± 2.42	0.009*

Table 3: Correlation between upper and lower lips to E – line and S – line

	Lower lip to E – line	Upper lip to S – line	Lower lip to S – line
Upper lip to E – line	0.739	0.857	0.749
Lower lip to E – line	-	0.640	0.907
Upper lip to S – line	-	-	0.612

For the above r, P = 0.000, (Strong positive strength)

TABLE A
Comparison of the lip dimensions in Nigerians, some West African countries and Caucasians

	Ile Ife /mm(SD)	Lagos /mm(SD)	Ghana /mm(SD)	Senegal /mm(SD)	Caucasian /mm(SD)	Present study /mm(SD)
Upper Lip						
Length	25.86(3.20)	24.50(2.87)	26.03(3.23)	23.21(2.92)	21.96(1.07)	25.82(2.65)
Thickness		13.87(2.13)	-	-	13.50(1.73)	17.39(2.39)
Lower Lip						
Length	53.04(9.31)	46.56(4.40)	51.04(6.91)	50.85(7.53)	48.15(3.95)	49.48(5.39)
Thickness		17.07(2.63)	-	-	14.85(1.57)	20.32(2.75)

TABLE B
Comparisons of the Lips to the “E” and “S” lines in Nigerians, Some West African countries

	Ile –Ife	Lagos	Ghana	Senegal	Caucasian	Present study
Upper Lip - E – Line	1.84(3.26)	3.21(2.69)	0.92(2.81)	1.88(3.86)	-4.00(0.00)	4.37(2.67)
Lower Lip - E – line	5.53(4.45)	6.76(2.83)	5.08(2.79)	3.40(6.10)	-2.00(0.00)	8.14(2.51)
Upper lip – S – Line	-	5.89(2.23)	-	-	0.00(0.00)	6.84(2.75)
Lower lip – S – Line	-	8.19(2.60)	-	-	0.00(0.00)	10.14(2.42)

DISCUSSION

Lip morphology, including lip length and thickness, plays a significant role in facial aesthetics and occlusal harmony in orthodontics. The mean upper lip length in the current study population was comparable to that of a similar study by Fadeju et al¹⁹ and Isiekwe et al²⁰. Our result is in disparity with the results on lip length obtained from a Senegalese population study¹⁹ where their upper lip length was recorded as 23.2mm. Ethnicity and methodology in

relation to measurements might have been responsible for this difference. Studies indicate notable differences in lip morphology among ethnic groups: Nigerians and Africans tend to have thicker and more prominent lips with greater lip length when compared with Caucasian populations^{21, 22}.

The mean lower lip length of this present study though comparable to similar Nigerians and Africans studies, is marginally higher in females than that observed by Isiekwe et al²⁰ in a Lagos study where

they recorded 46.7mm. Though, this difference in lip length between genders does not show any statistical difference. Similarly, a higher value for lower lip length was recorded by Fadeju et al¹⁹ in a multi country study where their reference population was from Ile Ife, Nigeria (53.0 ± 9.31) and in other West African countries (Ghana and Senegal). The thickness of the lips apart from cushioning the anterior dentition during trauma also plays an important role in positioning the teeth in neutral zone, beauty, confidence, personality and self-esteem. The lips thickness measurement from this study is similar to that reported by Isiekwe et al²⁰ and unlike the lip length, the upper lip thickness showed some level of significant gender difference with the female gender having a greater lip thickness compared with males. This difference was also observed by Isiekwe et al²⁰ where they documented the male and female upper lip thickness to be 15.06 ± 1.67 mm and 18.45 ± 2.26 mm respectively. With regards to the lower lip thickness, there was no significant gender difference observed from this study although, this was not so when compared with the Isiekwe study²⁰ where they found 18.45 ± 2.26 mm and 15.97 ± 2.37 mm for males and females respectively. The thickness of the lips which is a factor in relation to the anterior prominence of the lips must be in the appropriate relationship with standard landmarks which were proposed by some researchers. Common and clinically significant landmarks proposed were the E – lines and S – lines. In relation to the “E” lines, the observations from this study were found to be comparable with similar Nigerian studies from Ile Ife and Lagos^{19, 23} though, the upper lip to E line from the former study was found to be low (1.84 ± 3.26). This observation might be as a result of differences in landmark measurements. However, a statistically significant gender difference was observed from the current study in relation to the lips and “E” and “S lines”. This supports earlier documented gender dimorphism by investigators^{24, 25, 26} who reported a more protrusive and vertical lip dimensions relative to these lines in males.

Also, it was observed in this current study that there is a strong positive strength of correlation between the lips thickness and the “E” and “S” lines. Furthermore, a comparison of the current study with other studies relating to the lips to “E” and “S” lines reveals marginal higher values signifying that the

participants in this present study presents with a much more fuller and prominent lips which was collaborated by earlier investigators^{10, 11}. This observation in lip prominence might be as a result of differences in landmark measurements.

The results of lips thickness and length and its prominence to the “E” and “S” lines were compared with other similar studies in Africa and globally as shown in the results section. However, the lips prominence both the upper and lower lips in this current study were found to be more prominent than all the literatures used in comparison.

CONCLUSION

The upper and lower lip thickness for our study was found to be 17.39 ± 2.39 mm and 20.32 ± 2.75 mm with the lower lip been more prominent than the upper. There was also a statistically significant difference in lip thickness among gender.

Source of Support

Nil

Conflict of interest

None declared

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