RESEARCH ARTICLE

Cephalometric Analysis of Sagittal Lip Position in Different Skeletal Classes for Sudanese Adults

Sama Hamid[1]*, Ghassan Baher[2]

[1]Department of Orthodontics, Faculty of Dentistry, Uruk University, Baghdad, Iraq
[2]Department of Orthodontics, Faculty of Dentistry, Al-Bayan University, Baghdad, Iraq

Received: 22nd November, 2021; Revised: 09th January, 2022; Accepted: 14th February, 2022; Available Online: 25th March, 2022

ABSTRACT

Background: Since the cephalometry was introduced, many studies presented normal values for Caucasian populations. While in Africa, most studies have established normal values and ethnic differences associated with the skeletal pattern. The objectives of this study were to evaluate the anteroposterior lip position for Sudanese adults with Class I, II and III malocclusion by Burstone, Ricketts and Stiener analysis.

Materials and Methods: Lateral cephalographs for 218 [120 females and 98 males] Sudanese patients, were taken in natural head position, all were manually traced, categorized according to the skeletal Class I, II and III malocclusion. Three reference lines; Burstones, Ricketts and Steiners were traced and the linier distance between line and tip of the lips were measured by digital caliper. Data were analyzed using SPSS [statistical package of social science] software version 25. Descriptive analysis was done for each variable of each subject, Independent sample t-test to verify the gender difference in each skeletal class. One-way ANOVA test: to compare the measured variables among the skeletal classes in each gender and in total sample. Tukey HSD test: to test any statistically significant difference between each skeletal classes.

Results: More protrusive lips were recorded when compared to Caucasian norms, significant difference in the sagittal lip position in different skeletal occlusions, with the skeletal class II having the more protrusive lips and differed significantly from class I and III. In class I group males had significantly more protrusive lips than females related to the three reference lines, also in class III related to Burstones line.

Conclusions: The sagittal lip position was associated with the pattern of skeletal occlusion. Sudanese have more protrusive lips than Caucasians, and should be dealt with accordingly.

Keywords: Cephalogram, Lip, Reference line, Sagittal, Skeletal classes, Sudanese.

International Journal of Drug Delivery Technology (2022); DOI: 10.25258/ijddt.12.1.17

How to cite this article: Hamid S, Baher G. Cephalometric Analysis of Sagittal Lip Position in Different Skeletal Classes for Sudanese Adults. International Journal of Drug Delivery Technology. 2022;12(1):89-94.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

The facial soft tissue evaluation has been an area of concern to orthodontist and facial surgeons due to its important role in diagnosis and treatment planning, as well as to forensic anthropologist for facial reconstruction.[1,2] Since the soft tissue position and mass influence malocclusion, facial esthetics and tooth stability, many orthodontists studied facial soft tissue profile among norms as well as among different skeletal occlusions,[1-5] the major components that compose the facial profile are the nose, lips and chin, each has its important role in the facial profile. The lips, in orthodontics may affect the treatment plan, moreover orthodontic treatment may alter the lip position afterward. Number of reference lines; Rickets esthetic line, Steiners line, Burstones line and many others are used to evaluate the anteroposterior lip position.[6]

Nowadays patients providing more attention to aesthetics, orthodontics is an aesthetic world, as the majority of chief complains is seeking for pleasant appearance. A face could be described as unattractive or attractive when compared to certain population average values obtained from various studies, and there is an undeniable psychosocial impact of attractiveness, and as seen through the last years health care has been shifted from disease prevention to life quality preservation, or what is called health related quality of

*Author for Correspondence: sama2hamid@yahoo.com

life [HRQoL], as malocclusions are not to be considered as pathologic conditions, so treatment goals should aim at maintenance or improvement of life quality.[7,8]

In 1993, a study conducted in Oklahoma University, orthodontic department to assess the role of the nose, lips and chin that will lead to a well-balanced soft tissue facial profile by developing a series of facial profile created on an ideal built facial profile for evaluation by members of the dental profession, it has been found that the lip position modifies the orthodontic treatment plan, for example; fuller lips and more protrusive dentition are more acceptable if the patient had a relatively large nose and chin, in such border line cases the clinician must go for a non-extraction approach, while the profile with the most retrusive lips accompanied with a relatively large chin esthetically was considered to be the worst.[6,9] Therefore, orthodontic goals as well as plastic surgeries, should aim to achieve some harmonious and balanced facial features along with the standard and average skeletal and dental factors and from an esthetic point of view the dentition should be treated to the face not the opposite.[9]

Burstones soft tissue analysis, Holdaway line and Ricketts esthetic plane, studies considered the soft tissue profile for normal facial profile in Caucasians, but it has been seen that these averages are different among ethnic groups and different regions of the world, as well as in the same group it is different among different skeletal malocclusions, and each should be dealt with accordingly.[9,10] Therefore, the current study aimed to use the soft tissue analysis of Burstone, Ricketts and Stiener analysis as baseline data for sagittal lip position in Sudanese adults, to compare the sagittal lip position among skeletal Class I, II and III malocclusions and gender and to compare sagittal lip position of Sudanese adults with other reported study among different populations.

MATERIALS AND METHODS

A retrospective study for 258 cephalograms were collected from the Orthodontic department, Faculty of dentistry, University of Khartoum and private orthodontic clinics in Khartoum from the period 2007–2014. All cephalograms were screened and the one fulfilled the inclusion criteria were collected for the analysis; Sudanese nationality, no facial deformity, age range 18–35 year, no previous orthodontic or prosthodontic treatment and the cephalogram should be in a good condition. The number of the cephalograms fulfill the inclusion criteria was 218 [120 females and 98 males], were included in the current study. Each cephalogram was fixed on the x-ray view box with a celluloid tape on the top, with the lateral profile to the right, 0.5mm lead pencil were used to mark the different points and lines, both the skeletal and soft tissue features were traced in a darkened room while the peripheral light from the view box was blocked. All tracings were prepared by the main investigator. First the cephalograms were traced and classified to skeletal class I, II and III according to the **ANB** angle which represents the position of the maxilla related to the mandible:[7]

Point A: The deepest point on the line between the anterior nasal spine and prosthion.

Point N: Nasion, is located on the suture between the frontal and nasal bones.

Point B: The deepest point of the line between the infradentale and poganion.

Skeletal class I: ANB= 2°–4°
Skeletal class II: ANB > 4°
Skeletal class III: ANB < 2°

Cephalometric Soft Tissue Landmarks:

- **Pronasale [Pn]** The most prominent point of the nose
- **Subnasale [Sn]** The point where the lower border of the nose meets the outer contour of the upper lip
- **Labial superius [Ls]** The median point in the upper margin of the upper membranous lip.
- **Labial inferius [Li]** The median point in the lower margin of the lower membranous lip
- **Soft tissue pogonion [Pos]** the most prominent point on the soft tissue contour of the chin

After the cephalograms were categorized according to the skeletal class I, II and III, the three reference lines were drawn, Ricketts "E' line was drawn from the tip of the nose to the skin pogonion. Steiner's line drawn from the center of the S-shaped curve between the tip of the nose and the skin subnasale to the soft tissue pogonion [S line]. Burstone [B line] line was drawn from the soft tissue subnasale to the pogonion as the lower point of the reference line.[11] By the use of a digital vernier caliper the linear distance between the most prominent point on each upper and lower lips and the reference lines where measured, giving the lips a positive value when they were in front of the line, and a negative value if positioned behind the line, and zero when the lips were positioned on the line (Figure 1).

Randomly 35 cephalograms were retraced and measured by the main investigator 10 days after the initial measurement, no difference readings were found.

Statistical Analysis

Data were analyzed using SPSS [statistical package of social science] software version 25. Descriptive statistics; means, standard deviations and statistical tables were used and Inferential statistics**;** Independent sample t-test: to verify the gender difference in each skeletal class, one-way ANOVA test: to compare the measured variables among the skeletal classes in each gender and in total sample and Turkey HSD test, to

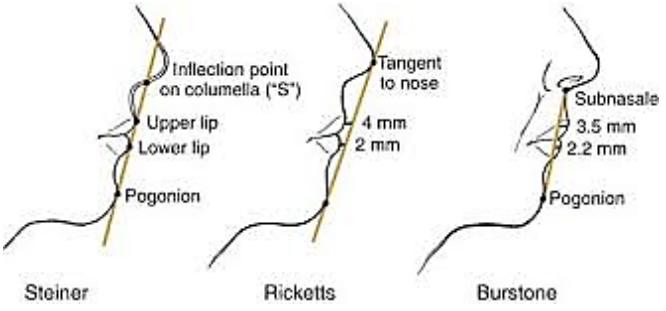

Figure 1: Reference lines related to soft tissue landmarks

test any statistically significant difference between each two skeletal classes. For all test, a p-value ≤ 0.05 significant level

RESULTS

Table 1 shows the statistical analysis and the mean and standard deviation of skeletal class I, II and III, Post hoc Turkeys test, was used to compare the cephalometric means of the three skeletal classes, showing the differences between them. The ANOVA (An analysis of variance) test was performed on different skeletal occlusions.

Burstones Line [B-Line]

According to Burstone, the upper lip was placed approximately 3.5 mm in front of the Burstone line [that was drawn from the subnasale to the pogonion soft tissue], while the lower lip was 2.2 mm in front of it.[3] In the present study, skeletal class I group, the upper lip was [7.619 ± 2.219 mm] ahead of the B line, while the lower lip [7.447 ± 2.732 mm] ahead of the B line, it means that the class I group in this study has more protrusive lips than the average Caucasian norm values given by Burstone. In skeletal class II group, upper lips [9.376 ± 2.536 mm], while lower lips [9.835 ± 2.986 mm] ahead of the B line, which are more protrusive then Burstone average's, and statistically significant differences was seen when compared to both skeletal class I and III groups with upper and lower lips being more protrusive in skeletal class II. Meanwhile, in skeletal class III, upper lip [7.152 ± 2.497 mm], and lower lip [7.945 ± 3.138 mm] in front of Burstones line, are both more protrusive than the norms given by Burstone. However, no statistically significant differences were seen between skeletal class I and class III groups in case of Burstone line to upper and lower lips.

Ricketts line [E line]

According to Ricketts when the line is drawn from a tangent to the nose to the pogonion soft tissue, the lips should lie behind that line, 3–4 mm for the upper lip and 1–2 mm for the lower lip.[12] In the current study, in skeletal class I, both the upper lip [-0.697 ± 3.214 mm] and lower lip [2.601 ± 3.396 mm] are more protrusive than norms provided by Ricketts, in skeletal class II group both upper [2.366 ± 3.237 mm] and lower [5.851 ± 3.396 mm] lips are more protrusive than class I and III. While in skeletal class III group, the upper lip is more retrusive than in both class I and II, while in lower lip [2.860 ± 3.582 mm], it's more retrusive than in class II. Statistically significant differences are seen when comparing skeletal class II to skeletal class I and III in the case of Ricketts line to upper and lower lips being more protrusive.

Steiners Line

According to Steiner, both upper and lower lips should be on the line drawn from the columella to the pogonion soft tissue,[10] in the current study the skeletal class I group both upper lip [3.385 ± 2.837 mm] and lower lip [4.997 ± 3.046 mm], were more protrusive than the average values given by Steiner. In skeletal class II group both upper lip [5.399 ± 2.787 mm] and

Table 1: Means, standard deviations and classes' difference for the variables measured in total sample

		Descriptive statistics ANOVA			*Classes difference Tukey HSD*			
Variables	*Classes*	*N*	*Mean*	*S.D.*	*F-test*	*p-value*	*Classes*	*p-value*
	I	74	7.619	2.219			I-II	0.000
Burstone ul	II	79	9.376	2.536	17.408	0.000	I-III	0.494
	III	65	7.152	2.497			II-III	0.000
	I	74	7.447	2.732			I-II	0.000
Burstone ll	II	79	9.835	2.986	13.946	0.000	I-III	0.583
	II	65	7.945	3.138			II-III	0.000
	I	74	-0.697	3.214			I-II	0.000
Ricketts ul	II	79	2.366	3.237	31.001	0.000	I-III	0.161
	III	65	-1.722	3.414			II-III	0.000
	I	74	2.601	3.393			I-II	0.000
Rickets ll	II	79	5.851	3.396	20.787	0.000	I-III	0.898
	III	65	2.860	3.582			II-III	0.000
	I	74	3.385	2.837			I-II	0.000
Steiner ul	II	79	5.399	2.787	26.650	0.000	I-III	0.013
	III	65	2.018	2.787			II-III	0.000
	I	74	4.997	3.046			I-II	0.000
Steiner ll	II	79	7.410	3.097	15.306	0.000	I-III	0.997
	III	65	4.958	3.227			II-III	0.000

Non-significant NS P > 0.05
Significant S 0.05 ≥ p > 0.01
Highly significant HS p ≤ 0.01 * All measurements in millimeter

lower lip [7.410 ± 3.097 mm] were significantly more protrusive than lips in class I and III. In skeletal class III upper lip [2.018 ± 2.787 mm] was more retrusive than in class I and II, while lower lip [4.958 ± 3.227 mm] it was more retrusive than in class II.

However, there was statistically significant differences when comparing between skeletal class I, II and III in the upper lip, while in the lower lip significant differences were seen when comparing between class II with class I and III.

Gender Difference Related to the Reference Lines

As seen in Table 2, when comparing between males and females, there was a highly significant difference in class I group, with the female lips being more retrusive to the three reference lines. While in class II group, both genders had nearly similar readings related to the three reference lines, meanwhile in the class III group, there was a highly significant difference with the females having more retrusive lips when related to Burstones line, also that was seen in the female upper lip related to Steiners line, while the other readings were closely related.

DISCUSSION

The present study was designed to study the sagittal lip position related to three reference lines, Burstone [B line], Ricketts [E line] and Steiner [S line], in three different skeletal malocclusions for Sudanese patients, unlike most studies that were based on class I and pleasing profiles that doesn't represent a particular randomized population.[6,13-15] Additionally, soft tissue norms differ among different populations as Erbey *et al*. concluded that each race has its own features of nose and chin.[16] Accordingly, the use of one population norms will be unreliable in diagnosis and treatment planning for another population, also relating the different reference lines to the different skeletal occlusions will donate precise results. Therefore, it would be useful to assess the reliability of these three reference lines in a sample of Sudanese population, hopefully to input as a baseline data for diagnosis and treatment planning, although more studies are desirable for Sudanese population owing to racial diversity.[2,17,18]

Comparison of Sudanese Skeletal Class I with Caucasians and other Population Norms

Due to the fact that there is a significant difference in the craniofacial morphology between various populations,[17,18] our present study has supported that diversity, showing more protrusive upper and lower lips in class I group when related to Caucasians [using Burstones, Ricketts and Stieners lines as reference lines], comparable to Chinese adult harmonious face had both upper and lower lips positioned more anteriorly to Burstones line,[19] study among Chinese men showed protruded lips that are positioned more anteriorly to the Ricketts line.[20]

In a comparative study of sagittal lips position for Korean and European-American sample, the results revealed that the former had greater lip protrusion, with no significant gender difference regarded to Steiner and Ricketts analysis,[21]

Table 2: Means, standard deviations and gender difference for the variables measured in each skeletal class

		Descriptive statistics					
		Males		*Females*		*Gender difference*	
Classes	*Variables*	*Mean*	*S.D.*	*Mean*	*S.D.*	*t-test*	*p-value*
Class I	Burstone ul	8.884	1.841	6.707	2.027	4.735	0.000
	Burstone ll	8.871	2.175	6.421	2.648	4.223	0.000
	Ricketts ul	0.671	3.235	-1.684	2.846	3.316	0.001
	Rickets ll	4.319	2.873	1.363	3.220	4.074	0.000
	Steiner ul	4.597	2.600	2.512	2.700	3.328	0.001
	Steiner ll	6.490	2.513	3.921	2.963	3.916	0.000
Class II	Burstone ul	9.772	2.486	9.044	2.558	1.276	0.206
	Burstone ll	9.994	2.931	9.702	3.059	0.431	0.668
	Ricketts ul	2.553	3.563	2.209	2.971	0.467	0.642
	Rickets ll	5.842	3.481	5.858	3.365	-0.021	0.983
	Steiner ul	5.569	2.961	5.256	2.661	0.496	0.622
	Steiner ll	7.428	3.186	7.395	3.058	0.046	0.963
Class III	Burstone ul	8.020	2.247	6.409	2.489	2.720	0.008
	Burstone ll	8.823	3.225	7.191	2.898	2.149	0.036
	Ricketts ul	-1.030	3.759	-2.314	3.018	1.527	0.132
	Rickets ll	3.760	3.606	2.089	3.426	1.914	0.060
	Steiner ul	2.857	2.772	1.300	2.629	2.321	0.024
	Steiner ll	5.757	3.524	4.273	2.822	1.884	0.064

Non-significant NS $P > 0.05$
Significant S $0.05 \geq p > 0.01$
Highly significant HS $p \leq 0.01$
* All measurements in millimeter

dissimilar Bangladeshi females had less protruded lips than Japanese, while more protruded lips than Caucasians.[22] Moreover, a Nigerian study recorded a significant sexual dimorphism with females having less protrusive lips than males, which in line to class I sample in the present study, also similarly, Nigerian males and females had more protrusive lips when compared to normal values of Caucasians, based on analyses of Burstone, Ricketts and Steiner.[23]

A study among Anatolian adults with normal occlusion had similar results to study confirmed on white Caucasians, both reported female lower lip was more protrusive according to Steiner and Ricketts analysis.[13,14,23] A cephalometric study for Pakistani Population lip morphology, showed that male had slightly protruded upper lip and slightly retruded lower lip as compared to females.[24]

In orthodontics, the Burstones analysis is essential aid in facial analysis, it superlative among Ricketts, Steiners, Holdaway and Sushners analysis in terms of sensitivity to differentiate between attractive and unattractive profiles.[14,22,25]

Burgman concluded that in a harmonious face, the distance of upper lip to B-line should be 1mm more anteriorly than the lower lip to B-line, which coincides with the normal values reported by Burstone [3.5 mm for UL and 2.2 mm for LL].

In the present study, considering the Burstone analysis, no significant difference between UL and LL, while opposite results were observed in the Nigerian population, the LL was more protrusive than the UL regarding Burstones line.[24]

In the current study all genders with the different skeletal occlusions, had more protrusive upper and lower lips when compared to the normal values presented on Caucasians, the same finding had been recorded Nigerian study.[24] This is results may be attributed to the more protrusive dentoalveolar relationship together with the bimaxillary proclination as well as thicker soft tissue thickness of lips and chin in African population.[27-31]

Nowadays the modern world has the current trend in the facial beauty concept towards more prominent lips[32] so the readings in this study are reflecting the modern beauty trend. The lip position variety among different populations reinforce the fact that each ethnicity and race have its own soft tissue features and each should be dealt with accordingly, we also should put in mind the sample size variation.

Comparison among Different Skeletal Classes

In the present study, there was a significant difference when comparing class II to class I and III, in respect to Burrstone's upper and lower lip, and similar to the Chinese population results.[6] all reference lines showed that class II group had the most protruded upper E line unlike the Chinese sample[6] no significant difference between class II and class III, a highly significant difference was seen in this study between class II and both class I and III, as seen according to Steiner in the lower lip. Whereas, the upper lip in relation to Steiner had a highly significant difference among the three skeletal classes, similar to the Chinese population.[6] Ricketts analysis, the E line is effected by the nose. In the present study, the nose and chin analysis were not implemented, if so, more precise results can be acquired.

CONCLUSION

In the present sample, skeletal class I group, both upper and lower lips are more protrusive than the three reference line norms. While in skeletal class II group the upper and lower lips were the most protrusive as compared to class I and III groups, and it's also more protrusive than the three reference line norms, and that fuller profile coincides with the trend of beauty nowadays.

ETHICAL CLEARANCE

The research ethical committee at scientific research by ethical approval of both MOH and MOHSER in Iraq.

REFERENCE

1. Kamak H, Celikoglu M. Facial soft tissue thickness among skeletal malocclusions: is there a difference? Korean J Orthod. 2012;42:23-31.
2. Hamid S, Abuaffan AH. Facial soft tissue thickness in a sample of Sudanese adults with different occlusions. Forensic Sci Int. 2016;266:209-214. doi:10.1016/j.forsciint.2016.05.018
3. Burstone CJ. Lip posture and its significance in treatment planning. Am J Orthod. 1967;53[4]:262-84.
4. Celikoglu M, Buyuk SK, Ekizer A, Sekerci AE, Sisman Y. Assessment of the soft tissue thickness at the lower anterior face in adult patients with different skeletal vertical patterns using cone-beam computed tomography. Angle Orthod. 2015;85[2]:211-217. doi:10.2319/040114-237.1
5. Utsuno H, Kageyama T, Uchida K, Kibayashi K. Facial soft tissue thickness differences among three skeletal classes in Japanese population. Forensic Sci Int. 2014;236:175-180
6. Joshi M, Wu LP, Maharjan S, Regmi MR. Sagittal lip positions in different skeletal malocclusions: a cephalometric analysis. Prog Orthod. 2015;16:8. doi:10.1186/s40510-015-0077-x
7. Proffit W, White RP, Sarvar DM. Psychosocial aspects of dentofacial deformity and its treatment. In Contemporary treatment of Dentofacial Deformity. St. Louis Missouri Mosby; 2003. p.70-3
8. Arshad T, Shaikh A, Fida M. Comparison of nasal profiles in various skeletal patterns. J Ayub Med Coll Abbottabad. 2013;25[1-2]:31-35.
9. Czarnecki ST, Nanda RS, Currier GF. Perceptions of a balanced facial profile. Am J Orthod Dentofacial Orthop. 1993;104[2]:180-187. doi:10.1016/S0889-5406[05]81008-X
10. Steiner CC. The use of cephalometrics as an aid to planning and assessing orthodontic treatment. Am J Orthod 1960; 46: 721-35.
11. Taipei, Taiwan R.O.C. Comparisons of the five analytic reference lines of the horizontal lip position: Their consistency and sensitivity. American Journal of Orthodontics and Dentofacial Orthopedics. Volume 104, Issue 4, October 1993, Pages 355-360
12. Ricketts RM. Esthetics, environment, and the law of lip relation. Am J Orthod 1968;54:272-89.
13. Sachan A, Srivastav A, Chaturvedi TP. Soft-tissue cephalometric norms in a north Indian ethnic population. J Orthodont Sci 2012;1:92-7.
14. Kenneth K.K. Lew, K.K. HO, S.B. KENG, Soft-Tissue Cephalometric Norms in Chinese Adults With Esthetic Facial

Profiles. Journal of Oral and Maxillofacial Surgery, 1992: 50: 1184-89.
15. Elif F. Erbay, Cem M. Canikliogl u, Soft tissue profile in Anatolian Turkish adults: Part II. Comparison of different soft tissue analyses in the evaluation of beauty .Am J Orthod Dentofacial Orthop 2002;121:65-72]
16. Erbay EF, Caniklioglu CM, Erbay SK. Soft tissue profile in Anatolian Turkish adults. Part 1: Evaluation of Horizontal lip position using different soft tissue analysis. Am J Orthod Dentofacial Orthop 2002; 121: 57-64
17. Marwa M. Hamid & Amal H. Abuaffan [2020]: Soft tissues cephalometric norms for a sample of Sudanese adults. Part II: Arnett's analysis, Orthodontic Waves, DOI: 10.1080/13440241.2020.1770561
18. Salah, Muhja & Higzi, Higzi & Ali, Raouf & FB, Naini. [2014]. The Sudanese female face: Normative craniofacial measurements and comparison with African-American and North American White females. Journal of Cranio-Maxillofacial Surgery. 42. 10.1016/j.jcms.2014.06.003.
19. Lew K.K. Soft tissue changes following surgical treatment of Chinese adults with bimaxillary protrusion. Journal of Dental Research [USA] 1989; 68:743
20. Chan GKH: A cephalometric appraisal of the Chinese [Cantonese]. Am J Orthod 61:279, 1972
21. Hwang, Hyeon-Shik & Kim, Wang-Sik & McNamara, James. [2002]. Ethnic Differences in the Soft Tissue Profile of Korean and European-American Adults with Normal Occlusions and Well-Balanced Faces. The Angle orthodontist. 72. 72-80. 10.1043/0003-3219[2002]072[0072:EDITST]2.0.CO;2.
22. Ahsan A, Yamaki M, Hossain Z, Saito I. Craniofacial cephalometric analysis of Bangladeshi and Japanese adults with normal occlusion and balanced faces: A comparative study. J Orthod Sci. 2013;2[1]:7-15. doi:10.4103/2278-0203.110327.
23. Isiekwe, Ikenna & Dacosta, Oluranti & Isiekwe, Michael. [2012]. A cephalometric invesigation of horizontal lip position in adult Nigerians. Journal of orthodontics. 39. 160-9. 10.1179/14653125 12Z.00000000026.
24. Khan, Fahad & Mahroof, Verda & Kamran, A. & Shafiqullah, & Alam, Mohammad & Qamruddin, Irfan. [2017]. Cephalometric Lip Morphology in a Sample from Pakistani Population. International Medical Journal [1994]. 24. 140-143.
25. Hsu BS. Comparison of the 5 analytic lines of the horizontal lip position, their consistency and sensitivity. Am J Orthod Dentofacial Orthop 1993; 104: 355-60.
26. Bergman RT. Cephalometric soft tissue facial analysis. Am J Orthod Dentofacial Orthop. 1999;116[4]:373-389. doi:10.1016/s0889-5406[99]70222-2
27. Isiekwe MC. A cephalometric study of incisor angulations in a Nigerian population Br J Orthod 1989; 16: 177-81.
28. Drummond RA. A determination of cephalometric norms for the Negro race. Am J Orthod 1978; 73: 152-60.
29. Cotton WN, Takano WS, Wong WM. The Downs analysis applied to three other ethnic groups. The Angle Orthodontist. 1951 Oct;21[4]:213-220. DOI: 10.1043/0003-3219[1951]021<0213:tdaatt>2.0.co;2.
30. William Bacon, Pierre Girardin, Jean Christophe Turlot, A comparison of cephalometric norms for the African Bantu and a caucasoid population, European Journal of Orthodontics, Volume 5, Issue 3, August 1983, Pages 233-240.
31. Flynn TR, Ambrogio RI, Zeichner SJ. Cephalometric norms fororthognathic surgery in black American adults. J Oral Maxillofac Surg. 1989;47:30-39.
32. Battle Y, Schneider M, Magder L, Pae EK. Disparity in opinions on lip protrusiveness in contemporary African American faces. Korean J Orthod. 2018;48[1]:23-29. doi:10.4041/kjod.2018.48.1.23