

Assessment of Anteroposterior Lip Position in Various Sagittal Skeletal Malocclusions in District Solan Population and Its Comparison with Sudanese Population-A Cephalometric Study

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ABSTRACT

Introduction: The horizontal position of upper and lower lips has been of great concern when planning a treatment plan of an orthodontic patient, because the purpose of orthodontic treatment is to establish both an aesthetic facial profile and a functional occlusion.

Objectives: To determine differences in anteroposterior lip position in different skeletal malocclusions in district Solan population and to compare these values with those of Sudanese population.

Materials and Method: Pre-treatment lateral cephalogram of 114 subjects were taken in natural head position. The subjects were then divided into 3 groups on the basis of ANB angle. 5 reference lines (Steiner, Burstone, Sushner, Holdway, and Ricketts) were traced and their linear distance w.r.t upper and lower lips were measured for all the 3 groups. Then the results were compared to the distance of upper and lower lips from S1, B and E line in the Sudanese population in the 3 different skeletal malocclusion groups.

Results: Skeletal class II was found to have the more protrusive lips and differed significantly from Class III. The distance of these lines showed variance in the Solan population and Sudanese population.

Conclusion: The sagittal lip position was associated with the pattern of skeletal occlusion.

Key words: Sagittal lip position, ANB angle, Soft tissue.

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INTRODUCTION

Soft tissue analysis as an integral part of diagnosis and treatment planning has also been developed to assist clinicians in quantitatively evaluating facial morphology which involves the nose, lips, and chin. Lip position has been one of the most important soft tissue analyses as it affects occlusion, tooth stability, and facial aesthetics. Orthodontic treatment plan can alter the lip positions. For the purpose of evaluating the facial profile before orthodontic and orthognathic treatment planning, a cephalometric analysis of a lateral cephalometric radiograph is required.

The consideration of aesthetic aspects and estimation of facial profile according to soft tissues has a major role in planning orthodontic treatment. It can be considered as among one of the limitations in orthodontic treatment and also an essential decisive factor to attain success or failure of treatment. Lip prominence, incompetent lips, lip fullness, lip strain, nasolabial angle, philtrum height and labiomental angles all have a significant impact on the treatment strategy [1].

The smile is one of the most important facial expressions and is essential in expressing friendliness, agreement, and appreciation. A smile when pleasing and attractive to observer enriches not only the one who smiles but also those who view it. An attractive or pleasing smile clearly enhances the acceptance of an individual in the society by improving the initial impression in interpersonal relationships [2].

Considerably, orthodontists have brought attention to the horizontal position of lips as a significant feature for people to appear beautiful and appealing. There are different cephalometric lines used to assess lip positions, such as Rickett's line 'E', Steiner's line 'S1', Holdaway's line 'H', Burstone's line 'B' and Sushner's line 'S2'.¹ Orthodontists often use these lines to analyse the lips for diagnosis and treatment planning. Nevertheless, each orthodontist has a preferred reference line for determining the lip position. This is of great concern in establishing a treatment plan as purpose of an orthodontic treatment is to also establish an aesthetic facial profile and not only a functional occlusion [3].

AIM

To evaluate the anteroposterior lip position in different sagittal skeletal malocclusion groups in district Solan population.

MATERIALS AND METHOD

The study was conducted on 114 pre-treatment lateral cephalogram of young patients aged 15-30 years who were selected from the pool of patients who underwent fixed mechanotherapy in the Department of Orthodontics and Dentofacial Orthopaedics, Bhojia Dental College, Baddi.

Inclusion Criteria

- Skeletal Class I malocclusion (ANB 1°- 4°)
- Skeletal Class II malocclusion (ANB ≥ 5°)
- Skeletal Class III malocclusion (ANB < 0°)
- Good quality radiographs [4].

Exclusion Criteria

- History of trauma

Previous orthognathic surgery

Previous orthodontic treatment

No craniofacial deformity

In Table 1, the sample was divided into 3 groups on the basis of ANB angle as Group I (Class I), Group II (Class II) and Group III (Class III) with 38 subjects in each group.

All the radiographs were traced by the same operator and various cephalometric landmarks (Table 2, Figure 1) and planes (Table 3, Figures 2a-2e) were identified and marked.

Various linear parameters (Table 4) were recorded to analyse the anteroposterior lip position in 3 different types of skeletal malocclusions.

STATISTICAL ANALYSIS

All data were analyzed using the Statistical Package for the Social Sciences software (SPSS version 24.0 Inc., Chicago, IL, USA). The arithmetic mean and standard deviation were calculated for each variable. The level of significance in comparison was considered at $p < 0.05$. A One-way Analysis Variance (ANOVA) test was performed to determine differences among groups. Independent t-test was used to compare Solan and Sudanese population.

RESULT

Table 5 shows descriptive statistics of various parameters. The UL-E line value is maximum in Class III (3.50 ± 2.13) followed by Class II (1.05 ± 1.86) and least in Class I (0.01 ± 3.02) whereas LL-E value is least in Class III (-0.60 ± 3.10) and maximum in Class II (1.97 ± 2.71) followed by Class I (1.13 ± 2.73). The UL-S1 value

Table 1: Grouping Of Samples.

Group I	Group II	Group III
Skeletal Class I N=38	Skeletal Class II N=38	Skeletal Class III N=38

Table 2: Landmarks Used In the Study.

LANDMARKS	DEFINITIONS
Tip of nose	Most anterior point on the soft tissue of nose
Subnasale (Sn)	Merged point of the nasal septum inferior border and upper cutaneous lip on the midsagittal plane
Soft tissue Pogonion (Pog')	The most anterior point on the chin in the midsagittal plane on the soft tissue
Labrale Superius (Ls)	Superior border of upper lip vermilion on the midsagittal plane
Soft tissue Nasion (N')	Most anterior point of frontonasal suture in midsagittal plane is called as nasion. Its soft tissue analogue is called as soft tissue nasion. It is the point of greatest concavity in the midline between the forehead and the nose.
Labrale Inferius (Li)	Inferior border of upper lip vermilion on the midsagittal plane



Figure 1: Landmarks used in the study.

Table 3: Planes Used In the Study.

PLANES	DEFINITION
Steiner's line (S1)	Beginning at the middle of the S-shaped curve, amid the tip of nose and subnasale towards pogonion soft tissue
Rickett's line (E)	Tip of nose to pogonion of soft tissue
Burstone's line (B)	Subnasale to soft tissue pogonion
Holdways's line (H)	Soft tissue pogonion to labrale superius of upper lip
Sushner's line (S2)	Soft tissue nasion to pogonion soft tissue

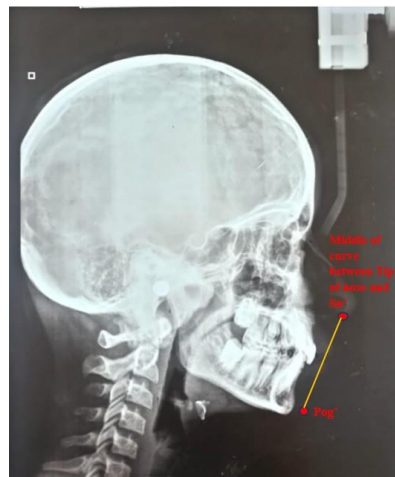


Figure 2a: Steiner's line S1.

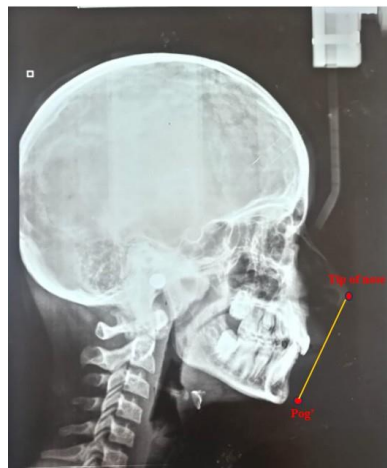


Figure 2b: Rickett's line E.

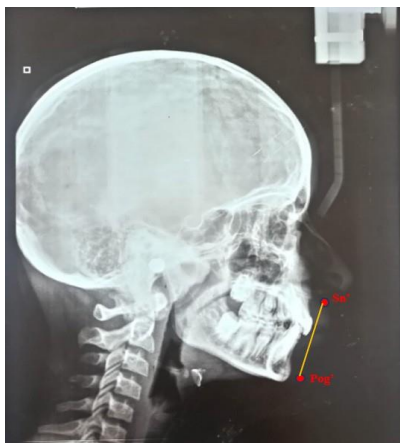


Figure 2c: Burstone's line B.



Figure 2d: Holdaway's line H.

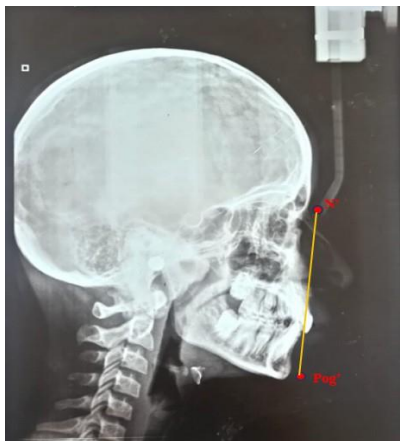


Figure 2e: Sushner's line S2.

Table 4: Linear Parameters Used In the Study.

LINEAR PARAMETERS	DEFINITIONS
UL- S1	Linear distance between upper lip (UL)and Sushner line (S1)
LL-S1	Linear distance between lower lip (LL) and S1 line (S1)
UL-E	Linear distance between upper lip (UL) and E line (E)
LL-E	Linear distance between lower lip (LL) and E line (E)
UL-B	Linear distance between upper lip (UL) and B line (B)
LL-B	Linear distance between lower lip (LL) and B line (B)
LL-H	Linear distance between lower lip (LL) and H line (H)
UL-S2	Linear distance between upper lip (UL) and S2 line (S2)
LL-S2	Linear distance between lower lip (LL) and S2 line (S2)

Table 5: Descriptive Statistics of Various Parameters in Different Skeletal Malocclusion Groups.

Parameters	Group I (Class I) (Mean± S.D)	Group II (Class II) (Mean± S.D)	Group III (Class III) (Mean± S.D)
UL-E	0.01 (± 3.02)	1.05 (±1.86)	3.50 (±2.13)
LL-E	1.13 (± 2.73)	1.97 (±2.71)	-0.60 (±3.10)
UL-S1	2.16 (±2.46)	3.23 (±2.02)	0.62 (±1.79)
LL-S1	2.40 (±2.74)	3.37 (±2.82)	1.45 (±2.18)
UL-S2	11.61 (±5.33)	13.12 (±2.55)	9.07 (±2.83)
LL-S2	9.01 (±4.64)	10.93 (±3.83)	7.26 (±2.44)
LL-H	1.35 (±1.77)	1.97 (±1.87)	1.01 (±1.94)
UL-B	3.92 (±2.03)	4.91 (±2.06)	3.50 (±1.33)
LL-B	4.00 (±2.72)	5.02 (±2.34)	3.48 (±2.46)

is maximum in Class II (3.23 ±2.02) and least in Class III (0.62±1.79) and LL-S1 value follows the same pattern with maximum value in Class II (3.37±2.82), followed by Class I (2.40 ±2.74) and minimum in Class III (1.45±2.18). The value of UL-S2 is maximum in Class II (13.12 ±2.55), followed by Class I (11.61±5.33) and least in Class III (9.07±2.83). LL-S2 values are maximum in Class II (10.93±3.83), followed by Class I (9.01±4.64) and least in Class III (7.26 ±2.44). The LL-H value is greatest in Class II (1.97±1.87), lesser in Class I (1.35±1.77) and minimum in Class III (1.01±1.94). The UL-B value is high in all 3 skeletal classes with highest value in Class II (4.91±2.06) followed by Class I (3.92 ±2.03) and least in Class III (3.50±1.33). The LL-B value is highest in Class II (5.02 ±2.34), followed by Group I (4.00 ±2.72) and least in Class III (3.48 ±2.46).

Inference: The distance of Steiner's (S1), Sushner's(S2), Burstone's(B) and Holdaway's(H) line from the upper and lower lip is maximum in Class II followed by Class I and is minimum in Class III showing that lips are most protrusive in skeletal Class II cases in Table 6.

When the means of the parameters were analyzed by comparing between class I,II and III malocclusions it was found that upper and lower lips to E line ($p=0.00$), Upper lip to Steiner's line ($p=0.00$), Lower lip to Steiner's line ($p=0.01$) Upper and lower Lips to Sushner's line ($p=0.00$), Upper lip to B line ($p=0.00$), and Lower lip to B line ($p=0.05$) were found to be statistically significant whereas lower lip to H line was found to be non-significant ($p=0.08$) [5].

When the parameters were compared between Solan and Sudanese population in Class I in Table 7, it was found that the distance of upper lip to B line was statistically significant ($p=0.01$) with increased value in Solan population (3.92±2.03)

than in the Sudanese population (1.07±7.00). The distance of lower lip to B line was greater in the Sudanese population (7.11±0.36) than in Solan population (4.00±2.72) and was found to be statistically significant ($p=0.00$). The distance of upper lip to E line was greater in Sudanese population (0.63±0.04) than Solan population (0.01±3.02) and was found to be statistically non-significant ($p=0.08$). The distance of lower lip to E line ($p=0.00$), Upper lip to S1 line ($p=0.00$) and lower lip to S1 line ($p=0.00$) were found to be statistically significant when these values were compared between Solan and Sudanese population. The distance of lower lip to E line was greater in Sudanese population (2.53±0.10) than in Solan population (1.13±2.73). The distance of upper lip to S1 line is greater in Sudanese population (3.26 ±0.09) than in Solan population (2.16 ± 2.46). The distance of lower lip to S1 line was greater in the Sudanese population (4.74±0.27) than in the Solan population (2.40±2.74).

When the parameters were compared between Sudanese and Solan population in Class II malocclusion Table 8, it was found that the distance of upper and lower lips to B line was statistically significant ($p=0.00$) with increased value in Sudanese population (9.35±0.01), (9.77±0.06) than in Solan population (4.91 ±2.06), (5.02 ±2.34) respectively. The distance of upper and lower lips to E line was statistically significant ($p=0.00$) with increased value in Sudanese population (2.19±0.15), (5.33±0.27) and lesser in Solan population (1.05±1.86), (2.53±0.10) respectively. The distance of upper and lower lips to S1 line was found to be statistically significant ($p=0.00$) with increased value in Sudanese population (5.30±0.05), (7.37±0.03) than in Solan population (3.23±2.02), (3.37±2.82) respectively.

Table 6: Comparison of Various Parameters in Different Skeletal Malocclusion Groups.

Parameters	Group I (Class I) (Mean± S.D)	Group II (Class II) (Mean± S.D)	Group III (Class III) (Mean± S.D)	p Value
UL-E	0.01 (± 3.02)	1.05 (±1.86)	3.50 (±2.13)	0.00*
LL-E	1.13 (± 2.73)	1.97 (±2.71)	-0.60 (±3.10)	0.00*
UL-S1	2.16 (±2.46)	3.23 (±2.02)	0.62 (±1.79)	0.00*
LL-S1	2.40 (±2.74)	3.37 (±2.82)	1.45 (±2.18)	0.01*
UL-S2	11.61 (±5.33)	13.12 (±2.55)	9.07 (±2.83)	0.00*
LL-S2	9.01 (±4.64)	10.93 (±3.83)	7.26 (±2.44)	0.00*
LL-H	1.35 (±1.77)	1.97 (±1.87)	1.01 (±1.94)	0.08
UL-B	3.92 (±2.03)	4.91 (±2.06)	3.50 (±1.33)	0.00*
LL-B	4.00 (±2.72)	5.02 (±2.34)	3.48 (±2.46)	0.05*

Table 7: Comparison of Parameters between Solan and Sudanese Population in Class I.

Class I	Solan (Mean±SD)	Sudanese (Mean±SD)	P value
UL-B	3.92 (±2.03)	1.07 (±7.00)	0.01*
LL -B	4.00 (±2.72)	7.11 (±0.36)	0.00*
UL-E	0.01 (±3.02)	0.63 (±0.04)	0.08
LL-E	1.13 (±2.73)	2.53 (±0.10)	0.00*
UL-S1	2.16 (± 2.46)	3.26 (±0.09)	0.00*
LL-S1	2.40 (±2.74)	4.74 (±0.27)	0.00*

Table 8: Comparison of Parameters between Solan and Sudanese Population in Class II.

Class II	Solan (Mean ±SD)	Sudanese (Mean ±SD)	P value
UL-B	4.91 (±2.06)	9.35 (±0.01)	0.00*
LL -B	5.02 (±2.34)	9.77 (±0.06)	0.00*
UL-E	1.05 (±1.86)	2.19 (±0.15)	0.00*
LL-E	2.13 (±2.76)	5.33 (±0.27)	0.00*
UL-S1	3.23 (±2.02)	5.30 (±0.05)	0.00*
LL-S1	3.37 (±2.82)	7.37 (±0.03)	0.00*

Table 9: Comparison of Parameters between Solan and Sudanese Population in Class III.

Class III	Solan (Mean ±SD) (n=38)	Sudanese (Mean ±SD) (n=65)	P value
UL-B	3.50 (±1.33)	7.11 (±0.05)	0.00*
LL -B	3.48 (±2.46)	7.87 (±0.03)	0.00*
UL-E	3.50 (±2.13)	1.69 (±0.03)	0.00*
LL-E	-0.60 (±3.10)	2.79 (±0.04)	0.00*
UL-S1	0.62 (±3.11)	2.78 (±0.03)	0.00*
LL-S1	1.45 (±2.18)	4.88 (±0.05)	0.00*

When the parameters were compared between Sudanese and Solan population in Class III in table 9 it was found that the distance of upper and lower lips to B line was found to be statistically significant ($p=0.00$) with increased value in Sudanese population (7.11 ± 0.05), (7.87 ± 0.03) than Solan population (3.50 ± 1.33), (3.48 ± 2.46) respectively. The distance of upper lip to E line was found to be statistically significant ($p=0.00$) with increased value in Solan population (3.50 ± 1.33) than in the Sudanese population (1.69 ± 0.03). The distance of lower lip to E line was found to be statistically significant ($p=0.00$) with increased value in the Sudanese population (2.79 ± 0.04) than in the Solan population (-0.60 ± 3.10). The distance of upper and lower lips to S1 line was found to be statistically

significant($p=0.00$) with increased values in the Sudanese population (2.78 ± 0.03), (4.88 ± 0.05) than in the Solan population (0.62 ± 3.11), (1.45 ± 2.18) respectively.

DISCUSSION

Soft tissues, as well as hard tissues influence the evaluation of orthodontic treatment success. Cephalometric measurements of face in terms of aesthetics can be difficult and misleading due to various factors. Facial balance and harmony are often compromised or compensated in relationship with skeletal, dental and soft tissue component of the face. This study is designed to determine the sagittal lip positions in relation to the 5 reference lines in 3 different skeletal malocclusions. Erbay et al. (2002) [6] found

that soft tissue analysis differs according to population. Every race has its nose and chin characteristics. Sushner (1977) [7] developed his norms for black population. Ricketts (1957) [8] norms are applied to Caucasians and not to all ethnic and racial groups. Here we are checking the reliability of these lines in District Solan population.

In this study, 5 reference lines were selected because they are the most commonly used during treatment planning and diagnosis. When all the 3 groups were compared, it was found that upper and lower lips to E line had significant values with least in skeletal class III group where lips were found to be more retrusive than in the skeletal class I and class II groups. This result was in line with the research of Godt, et al (2013) [9] which reported that there was a decrease in overjet with a more concave profile in the skeletal class III group compared to the Class I and II. The study done by Abdul Jabbar and Madiha et al (2022) is consistent with our results. Whereas, the study done on Sudanese population by Anam Rehan and Rabia Iqbal (2014) [10] showed variable and inconsistent results.

The values of upper and lower lips to S1 were significant with more protrusive lips in Skeletal Class II group and least in Class III, this is because the most retrusive upper lips are present in Class III followed by Skeletal Class I and then in Skeletal Class II. This result was in line with the study by Murthy (2018) [11], Godt et al. (2013) and Joshi et al. (2015) which stated that Class II malocclusion had been proven to be associated with a more anterior upper lip position. This is consistent with the study done by Sama Hamid and Ghassan Baher (2022) [12] whereas the study done by Merina Joshi et al. (2015) is against our study.

The distance of upper and lower lip to S2 line was statistically significant with more protrusive lips in Class II, as this malocclusion had been proven to be associated with a more anterior upper lip position and this result is similar to the one obtained in the study done by Abdul Jabbar and Madiha et al. (2022). The S2 line can be used to decide the sagittal position of upper lip in various situations. H line showed insignificant value in all skeletal groups. This is different from the study by Merina Joshi et al. (2015), where H line showed significant statistical differences between all skeletal classes.

The distance of upper and lower lips to B line showed a statistically significant value with more protrusive lips in Class II as the upper jaw is more anteriorly placed in Class II and this result was similar to the one obtained in study done by Anam Rehan and Rabia Iqbal (2014).

Soft tissue norms differ among different populations as Erbay et al. (2002) concluded that each race has its own features of nose and chin. More protrusive lips were found in the Sudanese population than the Solan population. The values of distance from various lines were more protrusive for the Sudanese population than the Solan population except the distance of upper lip to B line in Class I and distance of upper and lower lips to E line in Class III. This was similar to the study done by Sama Hamid and Ghassan Baher (2022) where the Sudanese population had more protrusive values than the Caucasian population; except for the values of upper lip from B line in Class I and E line from upper lip in Class III which were more protrusive in the Solan population. This is different from the study done by Sama Hamid and Ghassan Baher (2022). Hence, 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.

Due to a variety of variables, cephalometric measures of the face in terms of aesthetics can be complex and deceptive [13, 14]. Multiple investigations have found a significant relationship between soft and hard tissue characteristics. Facial symmetry and equilibrium are frequently affected or balanced in respect to the skeletal, soft tissue and dental aspects of the face. Dental factors including the angle of the upper and lower anterior teeth in relation to the mandibular and palatal planes, respectively, have an effect on lip position [15, 16]. Changes in the positioning of the upper lip in the horizontal position were significantly influenced by changes in the cervical point of the upper incisors or incisor retraction with translation. Since many of the vertical analysis considered in face examination either via the nose or chin, the size and morphology of the nose and chin would have a big influence on lip position [16, 17].

CONCLUSION

The sagittal lip position was associated with the patterns of skeletal occlusion.

In profile analysis, the S2 line is the preferred line for figuring out how the lips are positioned horizontally in skeletal class I and II and III.

The E line can be preferred to check the retrusion of lips in Class III cases.

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