

CORRELATION AMONG DIFFERENT PROFILE PLANES USED TO EVALUATE LOWER LIP POSITION

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ABSTRACT

The objective of this study was to correlate the soft tissue profile planes proposed by Rickett (E-line), Steiner (S-line), Burstone (B-line), and Holdaway (H-line) used to determine the lower lip position. Pretreatment cephalograms of 150 patients (age 16.2 ± 4.1 years) were evaluated. Lower lip (labrale inferiorus) position was measured relative to Rickett's E-line, Steiner's S-line, Burstone's B-line and Holdaway's H-line. Pearson correlation was used to determine the degree of correlation between the lower lip positions determined by the four reference planes. All the pairs of variables showed statistically significant correlation ($p < 0.01$). Strong correlation was found between E-line and S-line (0.868), and between S-line and B-line (0.733). Rest of the pairs showed moderate to weak correlations. H-line showed weak correlations with rest of the reference lines. This study found little difference in validity among Rickett's E-line, the Steiner's S-line or Burstone's B-line. Holdaway's H-line may be used in conjunction with these reference planes.

Key words: Profile planes, Cephalometrics, Soft tissue analysis

INTRODUCTION

The soft tissue profile has always played a significant role in orthodontic diagnosis and treatment planning.¹ Nowadays a balance facial profile has been recognized as one of the most important goal of orthodontic treatment because physical attractiveness of patient's face has a major psychosocial effect on acceptance and perceived success in society.² Treatment planning procedures based only on hard tissue measurements can produce unwanted soft tissue profile changes resulting in patient's disappointment.³ Careful examination and documentation of soft tissue features will permit the reversal of negative traits and the maintenance of positive features of individuals, thus enhancing clinical treatment.⁴

Soft tissue profile is determined by various factors including skeletal foundation, dental support system, and soft tissue components (nose, chin and lips). Among the different soft tissue profile measures, position of the lips is one of the most important as it is confined to the lower third of the face and can be altered by orthodontics. Lip posture is affected by a combination

of incisors position, skeletal pattern, size of nose and chin, lip thickness and lip tonicity.^{3,5}

Multiple methods have been used to describe horizontal lip positions. Several lines have been introduced to assess the anteroposterior position of the lips and the esthetic quality of the profile. Steiner⁶ attempted to evaluate the soft tissue profile by drawing a line (S line) from the middle of the S-shaped curve between the tip of the nose and subnasale to the soft tissue pogonion and stated that the lips should touch the reference line. Rickett's lip analysis⁴ consists of a line (E line) drawn from the tip of the nose to the soft tissue pogonion. Rickett reported that normally the upper and lower lips lie behind this line a mean distance of 4 mm and 2 mm, respectively. Burstone's B line⁷ was drawn from soft tissue subnasale to soft tissue pogonion. Burstone concluded that the upper and lower lips were located anterior to this line a mean distance of 3.5 and 2.2mm, respectively. Holdaway⁸ related the position of the lower lip to the H-Line, which extends from the ST pogonion to the vermilion border of the upper lip. According to him a reading of 0mm was the ideal with a range of -1 to +2mm was regarded as normal. A

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negative reading indicates that lips are behind the H-line and a positive reading indicates that lips are ahead of H-line.

These reference lines used to evaluate the lip positions involve different reference points which are themselves affected by multiple factors, and thus are viable to produce dissimilar diagnosis regarding position of lips. Thus when properly understanding the amount of correlation that exists among them, they can be better applied to our diagnosis and treatment planning.³ The aim of this study is to correlate the soft tissue profile planes proposed by Rickett (E-line), Steiner (S-line), Burstone (B-line), and Holdaway (H-line) used to determine the lower lip position.

METHODOLOGY

The subjects for this study were selected from the patients reporting at orthodontic OPD of Islamic International dental hospital Islamabad. A total of 150 patients were included in the sample irrespective of the age, gender and skeletal malocclusion. These patients were non-syndromic and had no history of previous orthodontic treatment.

The cephalograms of the selected sample were all taken by the author using the same cephalostat, positioned 60 inches from the patient's midsagittal plane, with the film cassette positioned to lightly touch the patient's head. The cephalometric landmarks of the sella, nasion, ST pogonion, labrale inferiorus, labrale superioris, subnasale, S-point, and pronasale were traced on cephalogram (Table 1). For each patient, four different reference lines were drawn, including the following: Rickett's E-line, Steiner's S-line, Burstone's B-line, and Holdaway's H-line (Figure 1-4). To measure the lower lip position the shortest distance from the labrale inferiorus to each of the reference line was measured on the cephalometric tracing. Measurement was taken as positive if the labrale inferiorus (Li) lies anterior to the reference lines and negative when it is posterior to the reference lines.

To rule out measurement error, 20 lateral cephalograms were randomly selected and retraced after one month by the principal investigator and a second observer for intra- and inter-examiner reliability, respectively. Descriptive statistics were calculated for each variable. Pearson correlation was used to determine the degree of correlation between the lower lip positions determined by the four reference planes. A significance level of 0.05 was used for all of the statistical tests.

TABLE 1: DEFINITIONS OF LANDMARKS

Landmarks	Definition
Sella (S)	The midpoint of the cavity of sella turcica
Nasion (Na)	The anterior point of the intersection between the nasal and frontal bones
Soft tissue pogonion (S Pog)	The most prominent point on the soft tissue contour of the chin
Labrale inferiorus (Li)	The most anterior portion on the margin of the lower lip
Labrale superiorus (Ls)	The most anterior portion on the margin of the upper lip
Subnasale (Sn)	The point where the lower border of the nose meets the outer contour of the upper lip
S – point	Midpoint on the S curve formed by the lower border of the nose and the upper lip
Pronasale (Pr)	The most anterior point of the nose

PROFILE PLANES

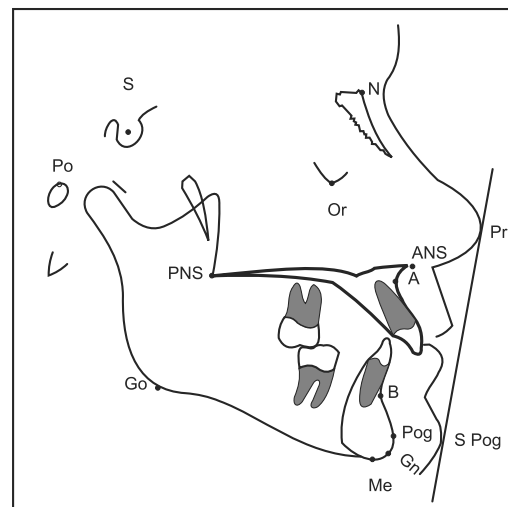


Fig 1: E-line

RESULTS

The study group consisted of total 150 patients. The mean age of the entire sample was 16.2 years (S.D 4.1), with a range of minimum of 8 years and maximum of 26 years. Figure 5 shows patients gender distribution. Sagittal stratification of the sample into class I, II and III is shown in Table 2.

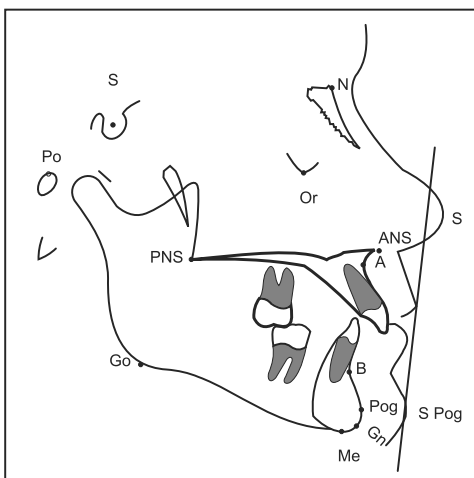


Fig 2: S-line

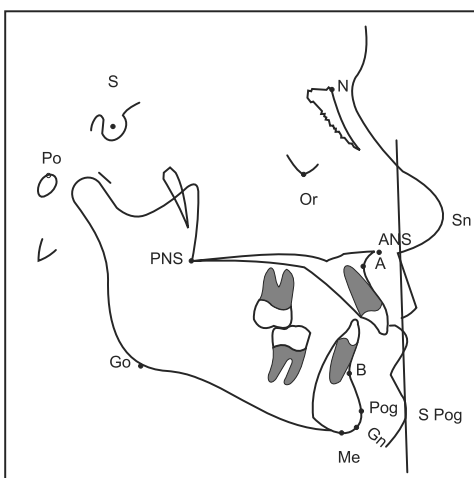


Fig 3: B-line

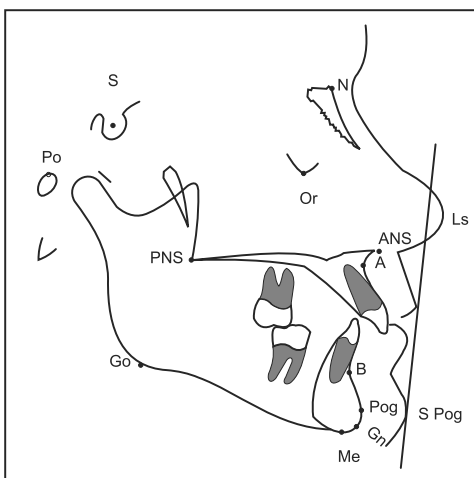


Fig 4: H-line

Paired t-test was used to evaluate intra-examiner and inter-examiner reliability, the results for which showed no significant differences between the sets of measurements (p value >0.05).

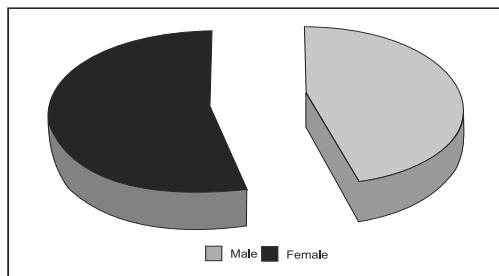


Fig 5: Gender distribution of the sample

The arithmetic means and standard deviations for all four parameters describing lower lip position assessed in the sample are shown in Table 3.

Pearson correlation coefficient was used to compare the four parameters describing the lower lip position. Table 4 shows the correlation matrix for the anteroposterior jaw relationship parameters, where all the pairs of variables showed statistically significant correlation ($p < 0.01$). Strong correlation was found between E-line and S-line (0.868), and between S-line and B-line (0.733). Rest of the pairs showed moderate to weak correlations. H-line showed weak correlations with rest of the reference lines.

TABLE 2: DISTRIBUTION OF SAMPLE ACCORDING TO SKELETAL MALOCCLUSION

Skeletal malocclusion	Frequency	Percent
Class I	69	46
Class II	66	44
Class III	15	10
Total	150	100

TABLE 3: MEANS AND STANDARD DEVIATION OF LOWER LIP POSITION MEASURED WITH DIFFERENT REFERENCE PLANES OF THE ENTIRE SAMPLE

	Mean	S.D	Minimum	Maximum
Li to E-line	0.92mm	3.88	-7mm	10mm
Li to S-line	2.79mm	3.60	-4mm	12mm
Li to B-line	4.39mm	3.32	-1mm	14mm
Li to H-line	1.91mm	2.58	-3mm	8mm

TABLE 4: CORRELATION OF PARAMETERS USED TO DETERMINE LOWER LIP POSITION

	E-line	S-line	B-line	H-line
E-line		0.868**	0.654**	0.508**
S-line			0.733**	0.581**
B-line				0.532**

DISCUSSION

While evaluating patient's soft tissue it is necessary to consider the anteroposterior posture of the lips. Various profile lines have been introduced to determine the relative position of the lips in order to decide if an individual's profile is esthetically pleasing or not.^{7,9}

In this study horizontal position of the lip in relation to four reference planes was evaluated. Lip position measured by these four reference planes showed weak to high intercorrelations. Variation in these correlations are most probably because these reference planes measure the lower lip position with respect to different landmarks on the contours of nose and chin. So Lip position and prominence may be effected by multiple factors including lip thickness and tonicity, chin thickness, incisors protusion or retrusion or the skeletal pattern.^{3,10}

In the present study highest correlation was found between S-line and E-line (0.868), suggesting very less difference in the lower lip position measured by both the reference planes. Erbay et al⁹ while evaluating horizontal lip position of Turkish adults also showed high similarity in the results shown by E-line and S-line. A similar study evaluated the horizontal lip position with various soft tissue analysis and showed that both Steiner's and Rickett's reference lines indicated protrusive lips.¹¹

In this study while correlating B-line with other reference planes we found moderately high correlation between S-line and B-line (0.733) and a moderate correlation between B-line and E-line (0.645). Relatively high correlation of B-line with S-line as compared with E-line was probably due to close proximity of subnasale to S point (collumela) than Pronasale. Burstone⁷ questioned selection of any landmark on the nose for the assessment of the lip position. He selected this plane as a plane of minimal variation in the area of the face. In literature¹² it has been suggested that B-line is the best in terms of sensitivity to differentiate attractive and unattractive profiles, in regards to S-line, E-line and H-line.

Similar to the results of present study Buschang et al¹³ correlated growth changes with profile planes and found high correlations between S-line, E-line and B-line but low correlation with the actual lip changes measured with true horizontal plane. He also recommended that these profile lines are more effective in evaluating the relative position of lower lip at single point in time and should not be used to determine the growth changes in lower lip during orthodontic treat-

ment. The present study measured the lip position only at pretreatment stage.

In the present study the H-line only moderately correlated with other lines of reference. This line utilizes soft tissue pogonion and the most prominent point on the upper lip as reference points. Buschang¹³ et al while correlating profile planes found high correlation of H-line with other profile planes. This could be because their sample contained large population of class I patients in contrast to our sample which contained only few class I patients. They also concluded that the H-line was the only measure that showed statistically significant difference between extraction and non extraction treatment which is most probably related to relatively larger growth changes that occur at the nose and chin.

CONCLUSION

This study found little difference in validity among Rickett's E-line, the Steiner's S-line or Burstone's B-line. However Holdaway's H-line may be used in conjunction with these reference planes

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