

WHICH LINE TO KISS?? - A REVIEW OF REFERENCE LINES FOR LIP PROFILE

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ABSTRACT: Orthodontists have their own preferences in selecting the reference line for evaluation of the upper and lower lip in treatment planning and post treatment results. The reference line should provide the orthodontist with objective assessment of the facial esthetics. The reference plane selected should be sensitive, reliable with consistency. The commonly used reference line are: Rickett's E- line, Holdaway's line, Steiner's S1- line, Burstone's B- line and Sushner's S2- line and Merrified Z-angle. This article reviews the planes and the studies evaluating them .

KEYWORDS: lips, Holdway, steiner, Ricketts, Burstone, Sushner, Merifield

INTRODUCTION

The aims and objectives of orthodontic therapy have been summarized by Jackson as the Jackson's triad. The three main objectives of orthodontic treatment are -- 1. Functional efficiency 2. Structural balance 3. Esthetic harmony. The orthodontist should strive to achieve these three main objectives of treatment. Esthetic harmony is related to the balance between hard tissues and the changes they bring about in overlying soft tissues. A balanced facial profile has been recognized as one of the most important goal of orthodontic treatment because consciousness of beauty or physical attractiveness of patient's face has a major psychosocial effect on acceptance and perceived success in society. It also increases the self esteem of the patient. The soft tissue profile has always played a significant role in orthodontic diagnosis and treatment planning. The nose- lip - chin balance of soft tissue component form an intergral part of soft tissue profile that will be effected by orthodontic treatment or it is the beginning itself where patients seek orthodontic treatment. Among this position of the lips confined to the lower third of the face can be altered by orthodontics to large extent. In cephalometric and photographic analysis, several reference lines have been introduced to assess anteroposterior position of the upper and lower lips and objectively the esthetic quality of the profile. This article is an attempt to review the commonly used planes for evaluating the horizontal lip position. The different points and planes used in all these references planes is tabulated(**Table-I**)

Lines of reference

Ricketts' E line¹: In this method the lip analysis consists of a line (E line) drawn from the tip of the nose (pronasale)

to the soft tissue pogonion. According to Ricketts In normal profile, the upper and lower lips lie behind this line a mean distance of 3-4 mm and 2 mm, respectively. The E-plane serves exclusively for assessment of the position of the lips and their mutual relation. During mixed dentition both lips are on the E-line, and over the years their convexity reduces and they retract. In young persons during the early phase of dentition, according to Ricketts, both lips are positioned behind the E-line; the lower by 2 mm and the upper by 3 mm. During analysis of lip position the position of the lower lip is always first examined, because when pressed together the lower lip raises up over the labial surface of the upper incisors by approximately 3 mm. Ricketts recommended that lip position should be read in relation to nose-chin reference. Further this is applied to Caucasians and not to all ethnic and racial groups.(**Fig.1**)

Steiner's S1-line: of reference for determining soft tissue facial balance is widely used in orthodontics today. The lips in well-balanced faces. according to Steiner, should touch a line extending from the soft tissue contour of the chin (soft tissue pogonion) to the middle of an S formed by the lower border of the nose (S-shaped curve between the tip of the nose and subnasale). This line is referred to as the S-line. Ideally the lips should touch the reference line. Lips located beyond this line tend to be protrusive, in which case the teeth and/or the jaws usually require orthodontic treatment to reduce the procumbency. If the lips are positioned behind this line, however, the patient's profile is generally interpreted as "concave". Orthodontic correction usually entails advancing the teeth in the dental arches to build up the lips to approximate the S line.(**Fig.2**)

Table.1. various land marks used the analysis

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

Merrifield profile line or Z-angle³: This is a tangent to the chin and the most prominent lip and extending it to the FH plane. The angle should be 80 ± 9 . Ideally the upper lip should touch the tangent and the lower lip should touch or slightly short of lower lip. This expresses the fullest proclination of lips in malocclusion. (Fig.3)

Burstone's B line⁴: This line is drawn was drawn from soft tissue subnasale to soft tissue pogonion. Burstone also emphasizes the importance of the position of the lips during the treatment planning. According to Burstone, the upper and lower lips were located anterior to this line a distance of 3.5 ± 1.4 mm and 2.2 ± 1.6 mm, respectively. The position of the lips in relation to the Sn-Pg line is of great importance during analysis of soft tissues. The position of the lips in relation to this line depends on maxilla mandibular skeletal base relationship, inclination of the incisors and thickness of the lips. Change in the position of Anterior teeth during treatment changes the position of the lips in relation to the Sn-Pg line and consequently also the overall aesthetic appearance. If possible the treatment planning should be such that the retractions should be avoided in cases when retraction of anterior teeth would result in the retraction of the lips, whereby they would be positioned behind the Sn-Pg line. In the case of saggital disharmony, which manifests with aberrations in overjet (positive or negative), the Sn-Pg line has no value at all. The relation of the lips according to the Sn-Pg line depends on the thickness of the lips, and correct position of the lips according to Burstone, is only possible when the lips are equally thick. Burstone also states that because of differences in the thickness of soft tissue, this tissue does not always follow the skeletal profile (Fig.4)

Holdaway H-line⁵: Holdway has introduced the concept of H-line or Harmony line which is a tangent to the chin and upper lip. He related the position of the lower lip to

the H-Line. This line is drawn extending from the soft tissue pogonion to the vermilion border of the upper lip. According to him the lower lip should touch this plane with a reading of 0 mm being the ideal with a range of -1 to +2mm regarded as normal. A negative reading indicates that lips are behind the H-line and a positive reading indicates that lips are ahead of H-line. Lack of chin may be an important factor which makes the lower lip prominent. (Fig.5)

The upper lip thickness is measured at a point 3mm below point 'A'. The measurement of thickness at this point is useful in measuring the lip strain when patient tries to close the lips over the proclined incisors. The lip strain can be objectively assessed by measuring the horizontal distance from the vermilion border to the most prominent upper incisors. Normally this should be 13 mm-14mm. ideally this should be equal to upper lip thickness with in range of 1mm. The difference is called as Lip strain. More the discrepancy more the is the lip strain. The upper lip retracts by 1mm for every 3mm of incisors retraction.

Sushner⁶ developed a line (S2) from the Soft tissue pogonion to the Soft tissue nasion to measure the position of the lips. He stated that the upper and lower lips were anterior to this line in the black population he analyzed (female, 8.8 mm/6.7 mm; male, 10.3 mm/7.8 mm). (Fig.5)

Factors effecting lines/planes:

"Ricketts E" line is influenced to a large extent deal by the growth of the nose. "Steiner's S" line eliminates half of the change in integumental profile due to the growth of the nose. "Holdway's H" line has the advantage of removing the influence of nasal growth in evaluation of lip posture. Merrifield's "Z" angle expresses the full extent of lip protrusion in malocclusions

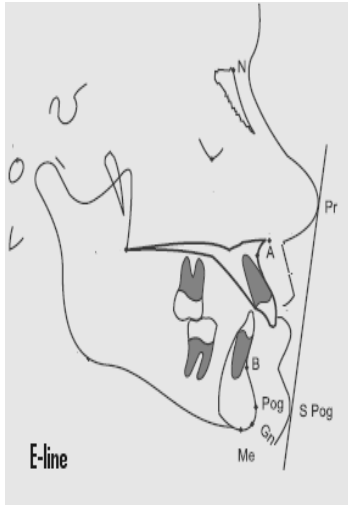


Fig.1. Rickett's E-line

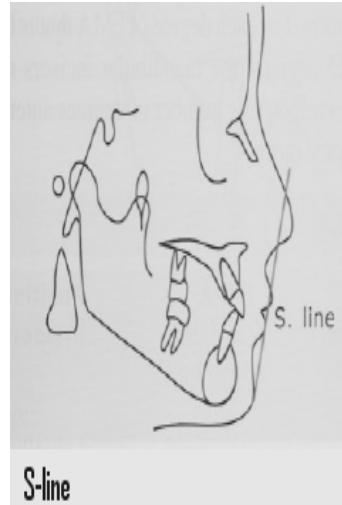


Fig.2. Steiner's S-line

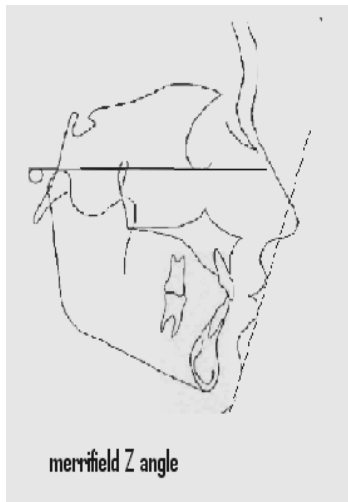


Fig.3. Merrifield - Z-angle

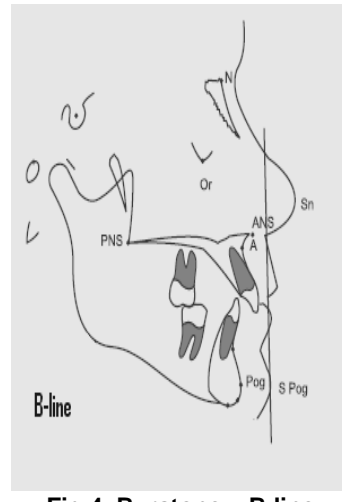


Fig.4. Burststone - B-line



Fig.5. Holdway - H-line



Fig.6. Sushner-S2 line

Comparison and evaluation ⁷⁻¹⁰

In literature 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.

Co-relation between E-Line and S-Line in assessing upper and lower lip was established and statistically significant correlation was found. S2 line, the E line, and the B line had the smallest coefficients of variation and provided the narrowest dispersion and they can be considered to be the best reference lines in terms of judging the horizontal position of the lips in profile analysis. Further the **H line** had the largest co-efficient of variation and therefore is the least dependable to judge lip position. From the clinical point of view or orthodontic treatment planning, the closer the reference line is located anteroposteriorly to the lip, the more convenient it is for clinical judgment. Therefore the E line and H line are reliable in this manner. From the perspective of reliability of reference lines related to judgment those lines passing through the nose are appreciated. Therefore the E-line and the B line which fall in this category are more acceptable than the S2 line which does not show any of the characters.

Anteroposterior positional changes of the lips measured by these reference planes could be confounded by growth changes and sexual dimorphism. Buschang et al ⁸ 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. The five reference planes should not be used to measure the changes in lower lip position that occur during orthodontic treatment. He opined that these profile lines are more effective in evaluating the relative position of lower lip at single point in time preferably at pretreatment stage and should not be used to determine the growth changes in lower lip during orthodontic treatment. Each of the above reference planes has been proven to be affected by the Soft tissue growth that occurs during the adolescent time period, especially in the reference planes associated with the nasal complex. Growth, therefore, produces inaccurate estimates of both the magnitude and direction of lower lip changes that occur during treatment, which are judged relative to the profile lines. They do not reflect the amount or the type of change that takes place. This indicates that the growth that occurs at pronasale, labrale superiorus, and pogonion masks the actual lower lip changes that occur during orthodontic treatment. However Holdaway's "H" line, Burstone's "B" line, and Sushner's line eliminate the influence of nasal growth in the evaluation of lip posture.

Naidu D. L ¹⁰ in an study concluded that B line was found to be the best in terms of consistency and sensitivity followed by the E line and S-Line in terms of consistency but not sensitivity. Lip prominence however was dependent on nasal and chin position. Hence B line

should be the line of choice. The findings of with regard to the B line and the E line which are most consistent as well as sensitive in judging facial profiles, indicate that the lateral facial profile should be judged taking the configuration of the nose in the facial profile. The study also revealed that Burstone's B line to be the most consistent and the most sensitive reference line in assessing both the sexes of the attractive group. The E line is less sensitive indicating the attractive group from the unattractive group for the girls than for the boys. Hence, the consistency and sensitivity of the E line in male groups confirms 'the "law of lip relationship" by Ricketts which states that in a normal person the lips should be contained within a line from the nose to the chin for a pleasing profile. Sushner's S2 was also found to be the most consistent but showed the least sensitivity in assessing the attractiveness in both the sexes. These observations could be due to the fact that the two lines do not transverse any anatomical landmark of the nose, so hence the lip position in the anterioposterior plane is not related to the nose, which form an important part in judging the profile. The Steiner S1 and the Holdaway H line were observed to be the least consistent and the least sensitive reference lines.

H-line can be correlated well with other planes of reference. 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

Orthodontists have their own preferences in selecting the reference line for evaluation of the upper and lower lip in treatment planning and post treatment results. The reference line should provide the orthodontist with objective assessment of the facial esthetics. From the above discussion it is clear that the selection of the Individual plane of reference is entirely the choice of orthodontist. The growth related changes effect all the planes of reference. They are useful as a diagnostic tools of esthetic harmony at a single point of time and not for treatment evaluation.

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