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ORIGINAL RESEARCH

An Evaluation of Nasolabial Angle and the Relative Inclinations of the Nose and Upper Lip

S Nandini, CS Prashanth, Sanju K Somiah, SRK Reddy

ABSTRACT

Esthetics is one of the major motivating factors for patients seeking orthodontic treatment. Hard tissue and soft tissue drape both determine the facial esthetics. The structures in this region are so variable that the nasolabial angle (NLA) has been drawn differently by various investigators. Variations can lead to erroneous conclusions in orthodontic diagnosis.

Aims and objectives: The study was done to evaluate a reliable method of constructing the nasolabial angle (NLA) and to correlate the soft tissue profile parameters with one another.

Materials and methods: Lateral cephalogram of 50 randomly selected adult patients were taken. The tracings were made and 10 copies of each tracing were randomly distributed to 10 different orthodontists to draw the NLA.

Results: Pearson's correlation coefficient (r) showed both N/FH and L/FH angles to have significant p values when compared with NLA. The regression analysis showed that the nasolabial angle can be calculated for any given value of N/FH or L/FH by the formula: NLA = 80.33° + 1.02° (N/FH) and NLA = 14.2° + 1.04° (L/FH). The mean value of N/FH was 17.42° ± 8.40° and L/FH was 80.68° + 6.45° for this sample. Inter examiner reliability calculated by repeated measures of ANOVA and Dahlerg's formula showed high degree of reliability and reproducibility of the method.

Clinical significance: NLA can be predicted for any given value of N/FH and L/FH. NLA = 80.33° + 1.02° (N/FH) and NLA = 14.2° + 1.04° (L/FH). If an individual has either N/FH or L/FH in the normal range but not the NLA then one could calculate the correct NLA using this formula. Thereby the NLA can be brought within the normal range by altering the other nasolabial parameters by correct treatment planning. Since the nasolabial angle plays a vital role in profile esthetics of a person, the clinician should place greater emphasis in evaluating this area and plan treatment mechanics to place this angle within the accepted normal variation.

Keywords: Nasolabial angle, Facial esthetics, Nose, Upper lip.

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INTRODUCTION

A major motivation for seeking orthodontic treatment is a desire to improve dental and facial esthetics. Facial harmony and balance are determined by the facial skeleton and its soft tissue drape. The structures in this region are so variable that the nasolabial angle (NLA) has been drawn differently by various investigators.[8,13,16,18,23,27] Variations can lead to erroneous conclusions in orthodontic diagnosis. Metropolitan areas of the world have a much diverse patient population, bringing with it a need to recognize that a single standard of facial esthetics may not be appropriate when making diagnostic and treatment planning decisions.[26]

AIMS AND OBJECTIVES

1. To evaluate a reliable method of constructing the NLA that is consistent and reproducible by the same orthodontist and among different orthodontists.
2. To establish mean and standard deviation for the three nasolabial parameters namely;
   a. Lower border of nose to Frankfort horizontal plane (N/FH)
   b. Upper lip to Frankfort horizontal plane (L/FH)
   c. Nasolabial angle (NLA).

MATERIALS AND METHODS

Lateral cephalograms of 50 adults (25 males and 25 females) with well-balanced face (Figs 1 and 2) aged between 20 and 30 years were randomly collected.

Criteria for the Selection of the Sample

1. They were in the age of 20 to 30 years.
2. All exhibited class I occlusion with good facial balance.
3. They had 28 permanent teeth intact. The presence or absence of third molars was not considered essential.

4. Subjects with extensive dental caries, attrition and periodontal disease were ruled out.
5. They had no history of orthodontic treatment, cosmetic surgery of face or orthognathic surgery.

Armamentarium

A standardized 8" × 10" Kodak T-mat™ E gold lateral radiographic head films with intensifying screen were used on Veraview md-cp, advanced panaromic and cephalometric equipment, Kyoto, Japan. Each subject was oriented in natural head position and the films were exposed while operating the cephalostat at a constant of 75 KVP, 9 mA and 2.2 seconds film exposure time. All the exposed films were developed and fixed manually by a single technician using standard procedure. The landmarks and reference planes were marked by a single operator under similar conditions on the same day on a Garware transparent cellulose acetate sheet of 36 microns thickness paper.

Ten cephalometric radiographs were selected by the primary examiner, traced and ten exact duplicates were made of each tracing and randomly distributed to 10 other orthodontists who were to draw the nasolabial angle (Fig. 3) according to the written instructions provided to them.

1. To locate posterior columella point (PCm): Which was described as the most posterior point on the lower border of the nose at which it begins to turn inferiorly to merge with the philtrum of the upper lip.

Fig. 1: Frontal and profile photographs of a patient with a well-balanced face

Fig. 2: Intraoral pictures of the patient

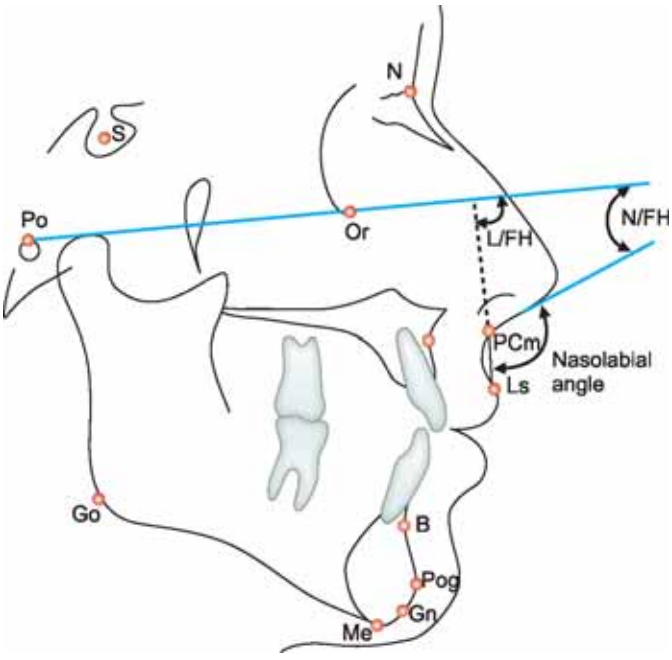

Fig. 3: Locating nasolabial angle on cephalometric tracing

2. PCm tangent: A tangent from PCm anteriorly along the lower border of the nose at its approximate middle third.
3. To locate labrale superius (Ls): Which is the mucocutaneous border on the upper lip.
4. PCm-Ls line: A line connecting posterior columella point and labrale superius.

The nasolabial parameters namely (a) N/FH, (b) L/FH and (c) NLA were also measured and recorded by the primary examiner.

Ten tracings were repeated on separate acetate sheets after a gap of 7 days to find differences between the observations. And the method error was calculated.

RESULTS

Mean, standard deviation and range were established for the data (Group 1—25 male subjects, Group 2—25 female subjects) and the results of the two groups pooled since the t-test showed no statistically significant difference between the two groups (Table 1). The three nasolabial parameters were compared with each other (Table 2) to determine the extent of linear correlation within the nasolabial parameter by calculating Pearson's correlation coefficient (r). Both N/FH and L/FH angles had significant p-value when compared with NLA. N/FH angle and the NLA had a highly significant correlation value of 0.799. L/FH angle and the NLA had a smaller but still a significant correlation value of 0.624.

Table 1: The range, mean and standard deviation for all the angular measurements for 50 adults

Variable	*Range (°)*	*Mean ± SD (°)*	*t-value*	*p-value*
L/FH	65-97	80.68 ± 6.45	0.13	NS
N/FH	3-38	17.42 ± 8.40	0.05	NS
NLA	76-125	98.10 ± 10.75	0.04	NS

The regression analysis was done to predict the change in NLA per unit change in N/FH and L/FH angles. Results revealed NLA to change by 1.02° for every unit change in N/FH and by 1.04° for every unit change in L/FH angles. Hence, the nasolabial angle can be calculated (Table 3) for any given value of N/FH or L/FH by the formula:

NLA= 80.33° + 1.02° (N/FH)

NLA = 14.2° + 1.04° (L/FH)

Interexaminer reliability (Table 4) was calculated by repeated measures of ANOVA and the results show high degree of reliability.

Finally, method error (Table 5) calculated by Dahlberg's formula showed least value for L/FH and highest for NLA with N/FH showing value in between the other two.

However, all the three values were statistically insignificant indicating the reliability and reproducibility of the method.

DISCUSSION

The evaluation of the soft tissue profile is vital in diagnosis and treatment planning of the orthodontic patient. Soft tissue changes have been shown to accompany growth, orthodontic treatment as well as orthognathic or plastic surgery.[1-5,7,11,12,14,15,19,20,24,25,28,31,32] It is for these reasons that the soft tissue profile must be carefully examined before a decision regarding orthodontic treatment and/or orthognathic surgery can be made.

Review of the nasolabial soft tissue is important when contemplating orthodontic treatment since movement of the maxillary incisor in any of the three planes of space influences this area.[3,11,12,15,19,28,31] However, consistent and reproducible methods of evaluating the nasolabial region are lacking.

The nasolabial angle is formed by two lines one from the nose another from the upper lip and both are independent of each other. Therefore, it is important to analyze each component of this angle to assist in the differential diagnosis of normal from its variation. The measurement of this angle alone provides inadequate information as it does not reveal which component is responsible for the variability. It could be the nose, the lip or both. For example, a person may have normal nasolabial angle inspite of proclination of the maxillary incisor and the upper lip. The reason could be an upturned nose. Combination of such variations may lead to erroneous conclusions in orthodontic diagnosis.

All cephalograms in this study were taken in a natural head position since in this position, an individual is

Table 2: Pearson's correlation coefficients for three nasolabial parameters

	L/FH		*N/FH*		*Nasolabial angle*	
L/FH	—	—	0.029	NS	0.624	p < 0.001
N/FH	0.029	NS	—	—	0.799	p < 0.001
Nasolabial angle	0.624	p < 0.001	0.799	p < 0.001	—	—

Table 3: Prediction of nasolabial angle

Variable	*Range (°)*	*Mean ± SD (°)*	*Correlation coefficient*	*Regression coefficient*	*Prediction of NLA (°)*
NLA	—	98.10 ± 10.75	—	—	—
N/FH	5-40	17.42 ± 8.40	0.799	1.02	NLA = 80.33 + 1.02 (N/FH)
L/FH	69-95	80.68 ± 6.45	0.624	1.04	NLA = 14.20 + 1.04 (L/FH)

Table 4: Interexaminer reliability (repeated measure ANOVA)

Source of variation	*Sum of squares*	*Degree of freedom*	*Mean of sum of squares*	*Variance ratio F*	*p-value*	*F-crit*
Between examiners	230.7	10	23.07	0.14	0.999	1.93
Within examiners	15868.0	99	160.28	—	—	—
Total	16098.7	109	—	—	—	—

Table 5: Method error

Variable	*Method error*
L/FH	0.84
N/FH	0.92
NLA	1.10

presented as they appear in life and hence such cephalograms are more meaningful for the clinician. The standards for orthoposition and natural head posture as given by Cooke Micheal S[6] were followed.

The method of locating the PCm, onto which a tangent was drawn to the lower border of the nose as well as the line from the point to labrale superius, proved to be reliable technique for constructing the NLA, as proposed by Fitzgerald.[9] Various methods of constructing the subnasale point are evident in literature as given by Owen[23] and McClintock.[27] The mean value of the nasolabial angle in this sample was 98.1° ± 10.75° and shows smaller values as compared to the nasolabial angle reported in other studies, like:

- Nanda et al,[22] 105.8° ± 9° for men and 110.7° ± 10.9° for women
- Owen[23] 105° ± 8°
- Scheideman[29] 111.4° ± 11.7° for males and 111.9° ± 8.4° for females
- Shalhoub et al,[30] 115.9° ± 15.15° for men and 104.5° ± 12.23° for women
- Zylinski[33] 110.8° ± 7.6°
- Lew Kenneth[17] 95° ± 3°
- Flynn Thomas[10] 91.3° ± 14.1°
- Miyajima Kuniaki et al,[21] 90.7° ± 10.4° for males and 92.2° ± 8.7° for females

The difference in the mean values could be attributed to:

1. Different ethnic race of the sample.
2. Different methods of locating the subnasale point which could alter the nasolabial angle.

The posteroinferior angle formed by the intersection of the Frankfort plane with the line drawn tangent to the lower border of the nose provided a representative inclination of the nose. The anteroinferior angle formed by the intersection of the Frankfort horizontal plane with the line drawn from the PCm, tangent to labrale superius provided a representative inclination of the upper lip.

The mean value of N/FH was 17.42° ± 8.40° and L/FH was 80.68° + 6.45° for this sample. In the study conducted by Hunt and Rudge,[13] the inclination of the upper lip was represented by the angle formed by the intersection of Frankfort horizontal plane and a line drawn tangent to the upper lip passing through subnasale with a normal approximating 90°. However, Scheideman[30] in his study reported the columella tangent to intersect horizon at 26° and upper lip to form an angle of 86° with postural horizontal. The difference between the normal values may be explained by the more posterior location of subnasale as compared with the PCm. The values of N/FH being 18° ± 7° and L/FH being 98° ± 5° is reported by Fitzgerald.[9]

A formula was devised by which NLA can be predicted for any given value of N/FH and L/FH.

NLA = 80.33° + 1.02° (N/FH)

NLA = 14.2° + 1.04° (L/FH)

If an individual has either N/FH or L/FH in the normal range but not the NLA then one could calculate the correct NLA using this formula. Thereby, the NLA can be brought within the normal range by altering the other nasolabial parameters by correct treatment planning.

When the individual measurement of the three nasolabial parameters, as recorded by ten orthodontists were statistically evaluated by repeated measure analysis of variance, a very high coefficient of reliability was revealed for the N/FH, L/FH and NLA. This indicated that any orthodontist who was randomly chosen could evaluate the nasolabial region using this method with a high degree of reliability.

SUMMARY

Lateral cephalograms of 50 adults with good occlusion and well-balanced faces aged between 20 and 30 years were evaluated for three nasolabial parameters (N/FH, L/FH and NLA).

A method of constructing the nasolabial angle was developed that provides a method of determining the relative angulations of the nose and the upper lip as well as their relationship to each other.

From the study, the following conclusions were drawn:

1. A reliable method of constructing the nasolabial angle has been devised.
2. The mean and standard deviation for the three nasolabial parameters were as follows:
   N/FH = 17.42° ± 8.40°
   L/FH = 80.68° ± 6.45°
   NLA = 98.10° ± 10.75°.
3. There was no statistically significant difference between males and females.

NLA = 80.33° + 1.02° (N/FH) and NLA = 14.2° + 1.04° (L/FH).

CLINICAL SIGNIFICANCE

NLA can be predicted for any given value of N/FH and L/FH. NLA = 80.33° + 1.02° (N/FH) and NLA = 14.2° + 1.04° (L/FH). If an individual has either N/FH or L/FH in the normal range but not the NLA then one could calculate the correct NLA using the formula. Thereby the NLA can be brought within the normal range by altering the other nasolabial parameters by correct treatment planning. Since the nasolabial angle plays a vital role in profile esthetics of a person, the clinician should place greater emphasis in evaluating this area and plan treatment mechanics to place this angle within the accepted normal variation.

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ABOUT THE AUTHORS

S Nandini

Professor, Department of Orthodontics, Bangalore Institute of Dental Sciences, Bengaluru, Karnataka, India

CS Prashanth

Professor, Department of orthodontics, RV Dental College Bengaluru, Karnataka, India

Sanju K Somiah

Reader, Department of Orthodontics, Coorg Dental College, Coorg Karnataka, India

SRK Reddy

Professor and Head, Department of Orthodontics, Sibar Dental College, Guntur, Andhra Pradesh, India

CORRESPONDING AUTHOR

S Nandini, Professor, Department of Orthodontics, No. 58, 15th main Sector 4, HSR Layout, Bengaluru-560102, Karnataka, India, Phone: +91-94481-84090, 080-25725503, e-mail: drnandinis@yahoo.com