Floating Norms as Guidance for the Position of the Lower Incisors

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In the treatment plan of orthodontic cases the position of the lower incisors is used as a basis for the discussion of the dentobasal and dentoalveolar objectives.[6]

Several angular and linear measurements have been introduced as bases for their positioning.[9-13] However, norm problems are expected in individual cases because measurements of the positions of the lower incisors in a group of ideal occlusions, treated or untreated, will approximate a normal distribution pattern.[2,3,4,9]

With his acceptable compromises Steiner[10] introduced the ANB angle as a *guiding variable* to describe the incisor position and in this way brought into practice *floating norms* for the incisors. The weight of the ANB angle as a guiding variable in Steiner's analysis can be expressed by the equation:

$$y_{\bar{1}\text{-NB(mm)}} = 0.25x_{ANB} + 3.50$$

The ANB angle was later used by Tweed to modify the norm values of the diagnostic triangle,[13] and the strong guiding value of this angle has also been demonstrated in other investigations.[1-4]

Further, Steiner introduced the configuration of the bony chin, expressed by Holdaway's ratio, into his analysis. The chin was characterized by the distance from pogonion to the NB line (Pg-NB). As an additional guiding variable, Norderval[7] introduced the N angle, which proved to describe the bony chin configuration more accurately.

Applying Steiner's analysis to the individual case, it has been demonstrated that the vertical dimensions of the face must be taken into consideration. In high angle cases a larger $\bar{1}$-NB(mm) distance should be aimed at, in comparison to cases with low or normal vertical configurations.[2,3] However, no individualized rules have been provided.

The aim of the present investigation is to clarify whether two additional variables, ML-NL and the N-angle (Fig. 1), could be used in conjunction with the ANB angle as guid-

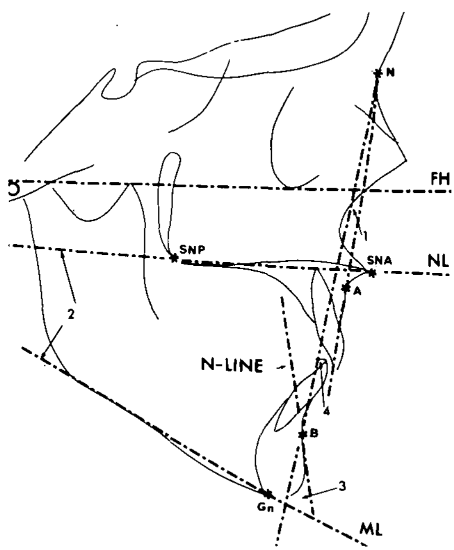

Figure 1

Reference lines and measured variables. NL, the nasal line: the line through spina nasalis anterior and spina nasalis posterior. ML, the mandibular line: a tangent to the mandibular border through gnathion. N line, a tangent to the bony chin passing through B point. NAL, the line through nasion and A point. NBL, the line through nasion and B point.

The angles ANB (1), ML-NL (2) and the N angle (3), as well as the linear distance $\bar{1}$-NB(mm) (4), are measured.

ing variables by extending the linear equation of Steiner to a multiple linear equation:

$$y_{\bar{1}\text{-NB(mm)}} = a_3x_{ANB} + a_2x_{ML\text{-}NL} + a_1x_{N\text{-angle}} + a_0$$

Material and Method

The sample consisted of 74 Norwegian adults, 37 males and 37 females, who were selected according to the following criteria:

1. No orthodontic treatment had been undergone.
2. All the cases displayed a Class I occlusion, with normal incisal position, normal transversal relationships, and optimal intercuspidation. The dentitions were complete except for the third molars.
3. A harmonious soft-tissue profile was evident.

The data were obtained from lateral cephalometric radiographs. The angular variables, ANB, ML-NL, and the N angle, and the linear variable $\bar{1}$-NB(mm) were measured with accuracies of 0.5 degrees and 0.1 mm, respectively (Fig. 1). A linear radiographic magnification of 5.6% was not corrected.

All the measurements were done twice, and in the further statistical evaluation the mean of the double registrations was utilized.

The errors of measurement varied between 0.14 and 1.01 for $\bar{1}$-NB and the N angle, respectively. The short distance between B point and the tangent point on the bony chin will probably explain the relatively great error of the N angle. Standard statistics were used to describe the distribution of the different variables, and the linear correlation coefficient (r) was calculated to examine the linear relationship between pairs of variables. Furthermore, the multiple linear regression model:

$$y = a_nx_1 + a_{n-1}x_2 + \ldots + a_1x_n + a_0 \qquad (1)$$

was used to investigate the relation between one or more of the angular variables, ANB, ML-NL, and the N angle, and the linear variable $\bar{1}$-NB. To test if the model (1) was appropriate, an analysis of variance was made.

Before the different independent variables (x_1, x_2, . . . x_n) were introduced as guiding variables, the linear correlation coefficients between pairs of these variables were calculated. Two variables were combined in the regression analysis only if the absolute value of the correlation coefficient between the two was less than 0.5. If the absolute value was higher, only the one having the strongest influence on the variation of the distance $\bar{1}$-NB was included in the multiple regression analysis. Finally, only those variables exhibiting significant partial regression coefficients were utilized in the final equation.

Results and Discussion

The statistical distribution of the present material is given in Table I. None of the variables deviated significantly from the normal distribution regarding skewness and kurtosis.

The edge of the lower incisors was on the average positioned 4.09 mm in front of the NB-line [$\bar{1}$-NB], ranging from 0.0 to 9.4 mm. It should be

TABLE I

Statistical description of a group consisting of 74 Norwegian adults with ideal occlusion

Variable	$\bar{x}$	s_x	x_{min}	x_{max}	$\sqrt{b1}$	a
ANB	1.67	1.88	—3.00	6.00	—0.219	0.786
ML-NL	22.00	5.27	7.50	34.25	0.110	0.806
N angle	55.35	6.04	40.00	74.00	0.105	0.787
$\bar{1}$-NB(mm)	4.09	1.81	0.00	9.40	—0.199	0.797

TABLE II

Linear correlation coefficients (r) between possible guiding variables and the position of the lower incisors, $\bar{1}$-NB(mm). ($n = 74$)

Variable	*$\bar{1}$-NB(mm)*
ANB	0.55
ML-NL	0.29
N-angle	0.29

TABLE III

Linear correlation coefficients (r) between the individual guiding variables. ($n = 74$)

Variable	*ANB*	*ML-NL*
ANB	—	0.03
N angle	0.25	−0.15

noted that, even though the group investigated is classified as having ideal occlusion, $\bar{1}$-NB displayed a range of 9.4 mm. Using APg as a reference line, Ricketts observed approximately the same range.[9]

In the particular individual demonstrating the most labially-positioned lower incisors, a difference of 5.31 mm was found between the group mean ($\bar{x}$) and the actual value. Using the mean as "norm" in such a case, more than 10 mm of space would be needed in the mandibular arch to place the lower incisors in proper position related to this "norm." To achieve such a treatment goal, extractions would be necessary which demonstrates the need for floating norms.

The ANB angle exhibited a mean value of 1.67 degrees, indicating a straight hard-tissue profile. The individual values, however, varied from −3.0 to 6.0 degrees. In addition, the interbasal angle (ML-NL) showed a great variation ranging from 7.5 to 34.25 degrees with a mean of 22.0 degrees. The N angle revealed a well-pronounced bony chin ($\bar{x} = 55.35$) and also demonstrated a wide range from 40.0 to 74.0 degrees. All three prospective guiding variables corresponded well with results observed in other studies from our ethnic group.[8]

In Table II the linear correlation coefficients (r) between $\bar{1}$-NB and the three basal variables, ANB, ML-NL and the N angle, are found. The correlation analysis confirmed that the three basal variables separately could be accepted as guiding variables. The ANB angle is explaining more of the variation in $\bar{1}$-NB than the interbasal angle and the N angle, hence the ANB angle can be classified as most important.

This investigation indicated that "nature" is able to achieve an ideal occlusion even in cases exhibiting a basal configuration quite different from what is expected to be ideal, and it seems as if "nature" in these cases is using the variation in incisor position to compensate for different basal, sagittal and vertical relationships.

The same variety of basal configurations can also be demonstrated in groups including individuals with malocclusions.[4] The basal parts of the face may be influenced by orthodontic means; however, a total normalization can only be expected in a minority of cases. Consequently, a wide range in the lower incisor position must be expected in treated cases.

In Table III the linear correlation coefficients (r) between the three guiding variables are shown. No coefficient displayed an absolute value higher than 0.25; consequently, all three variables can be combined in the multiple regression equation.

Applying the three basal variables, the following multiple regression equation was found:

$$y_{\bar{1}\text{-NB(mm)}} = 0.47x^{**}_{ANB} + 0.11x^{*}_{ML\text{-}NL} + 0.06x^{*}_{N\ angle} - 2.40$$

All three partial regression coefficients are significantly different from zero at the one** or five* percent level, hence the three angular variables can be classified as guiding variables, and a system of floating norms is established. The multiple correlation coefficient (R) was equal to 0.65, indicating that about 42% of the variation in $\bar{1}$-NB may be explained from the three guiding variables.

When the equation is to be applied in treatment planning, the anticipated values for ANB, ML-NL and the N angle, as they appear at the end of treatment, have to be used as bases for the calculation. The guidance, therefore, is dependent upon the ability to formulate a good growth prognosis. This is of special importance for ANB which can be dramatically changed during treatment.

The N angle may show an alteration of ±4 degrees depending upon the rotation of the mandible. In relation to its size and a partial regression coefficient of 0.06, only a limited variation may result from growth changes in this variable.[5] The ML-NL angle remains unchanged in most of the cases.

When the equation is employed to individualize the position of the lower incisors, it therefore should be utilized with caution. The general and individual character of the malocclusion treated must always be considered in addition to the guiding variables. On the other hand, the use of the equation seems to be more reliable than trying to individualize the standard Steiner's analysis.

The present investigation was made on a sample of adults only. It would be of interest to test the model using a group of younger individuals with ideal occlusion to further examine its validity.

Conclusion

1. The incisor position should be evaluated in relation to the sagittal and vertical configurations of the face, as well as to the shape of the bony chin.

2. A *floating norm* for the positioning of the lower incisors is established based upon the *guiding variables* ANB, ML-NL and the N angle with the introduction of a multiple regression equation. The anticipated values for the guiding variables at the *end* of the treatment are used in the calculation.

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