Derivation of Acceptable Arrangements in the Steiner Analysis

Joel M. Servoss, D.D.S.*

Part of Steiner's cephalometric analysis[1-5] is concerned with a predetermination of the position of the maxillary and mandibular incisors (Fig. 1). Although the premise on which this assessment is based relies solely on two subjective judgments, namely, an improvement in the ANB angle and an estimate of the NB-Pogonion distance at the end of treatment, it is not without value for treatment planning.

After prediction of the anticipated change in the two above-mentioned measurements, the clinician can refer to a set of acceptable arrangements (Fig. 2) from which one can be chosen to arrive at the so-called resolved situation. To more clearly understand the derivation of these acceptable arrangements of incisor positioning, a diagram has been constructed (Fig. 3).

This figure consists essentially of two triangles formed by the following four lines:

1. Nasion to *A* point
2. Nasion to *B* point
3. The long axis of the maxillary incisor
4. The long axis of the mandibular incisor.

The angles formed by the intersection of these four lines can be manipulated according to geometric principles to yield the entire spectrum of Steiner's acceptable arrangements. Moreover, the Steiner normative data can be recorded in the diagram in which case the "ideal" position and relationship of the maxillary and mandibular incisors is attained (Fig. 3 and Table 1).

Inspection of the values of the accept-

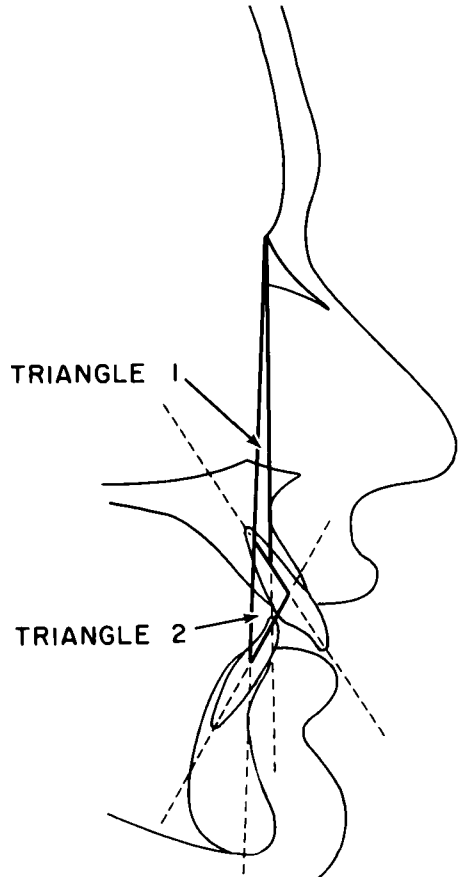* Research Fellow in Orthodontics, Harvard School of Dental Medicine.

Fig. 1   Class II, Division 1 malocclusion showing linear and angular measures utilized in Steiner's analysis for determining the position and inclination of the maxillary and mandibular incisors.

able arrangements for the incisors (Fig. 2) reveals that the differences from the ideal ANB angle, whether due to a positional change of *A* point, *B* point, or both, are accompanied by changes of the same magnitude but in opposite direction in the angle formed by the long axis of the maxillary incisor and the nasion-*A* point line. For example, if the ANB angle is 4 degrees, or 2 de-

TABLE I
Steiner's Data on Incisor Positioning

Features	I	II	III	IV	V	VI	VII	VIII	IX	X
			Acceptable Arrangements							
ANB ANGLE	-1	0	1	2	3	4	5	6	7	8
Inclination of maxillary incisor to NA line (degrees)	25	24	23	22	21	20	19	18	17	16
Interincisal angle (degrees)	134	133	132	131	130	129	128	127	126	125
Inclination of mandibular incisor to NB line (degrees)	22	23	24	25	26	27	28	29	30	31
Distance of maxillary incisor from NA line (mm)	7	6	5	4	3	2	1	0	-1	-2
Distance of mandibular incisor from NB line (mm)	3.25	3.5	3.75	4.0	4.25	4.5	4.75	5.0	5.25	5.5

Note:

1. Columns 1 to 10 represent the data listed from left to right in the graphs of the acceptable arrangements.

2. The graph of acceptable arrangements does not portray changes in the interincisal angles or the inclination of the incisors. In other words, the various arrangements all use the same basic figure. It is however not possible to make a proper graph for each situation because the arrangements shown may result from movement of any of the landmarks (points A and B, as well as the inclinations of the incisors), singly or in combination.

grees larger than ideal, the angle formed by the long axis of the maxillary incisor and the nasion-A point line is decreased by 2 degrees and vice versa. The third angle in triangle 1, the angle formed by the intersection of the long axis of the maxillary incisor and the nasion-B point line, thus remains stable during this change and, in fact, throughout the entire range of acceptable arrangements as the only constant in the diagram.

In triangle 2, a change in the ANB angle will be compensated by a change in both the interincisal angle and the angle formed by the long axis of the mandibular incisor and the nasion-B point line.

Thus, triangle 1 and triangle 2 each have one stable angle (angle 3 in triangle 1 and angle 4 in triangle 2), and because these two angles are formed by the intersection of the same two lines

IDEAL

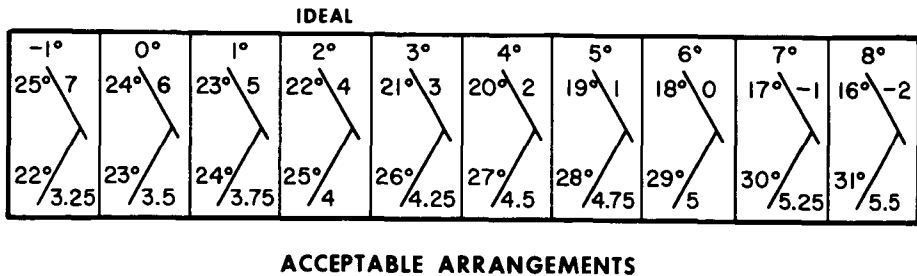| -1°	0°	1°	2°	3°	4°	5°	6°	7°	8°
25° 7	24° 6	23° 5	22° 4	21° 3	20° 2	19° 1	18° 0	17° -1	16° -2
22° 3.25	23° 3.5	24° 3.75	25° 4	26° 4.25	27° 4.5	28° 4.75	29° 5	30° 5.25	31° 5.5

ACCEPTABLE ARRANGEMENTS

Fig. 2 Acceptable arrangements of incisor positioning as presented by Steiner. (From top to bottom in each rectangle as in the case of the ideal arrangement the following figures are given: 2°=the ANB angle, 4=distance in millimeters from the most anterior point on the maxillary incisor to the NA line, 22°=the angle formed by the long axis of the maxillary incisor and the NA line, 4=the distance in millimeters from the most anterior point on the mandibular incisor to the NB line, and 25°=the angle formed by the mandibular incisor and the NB line.)
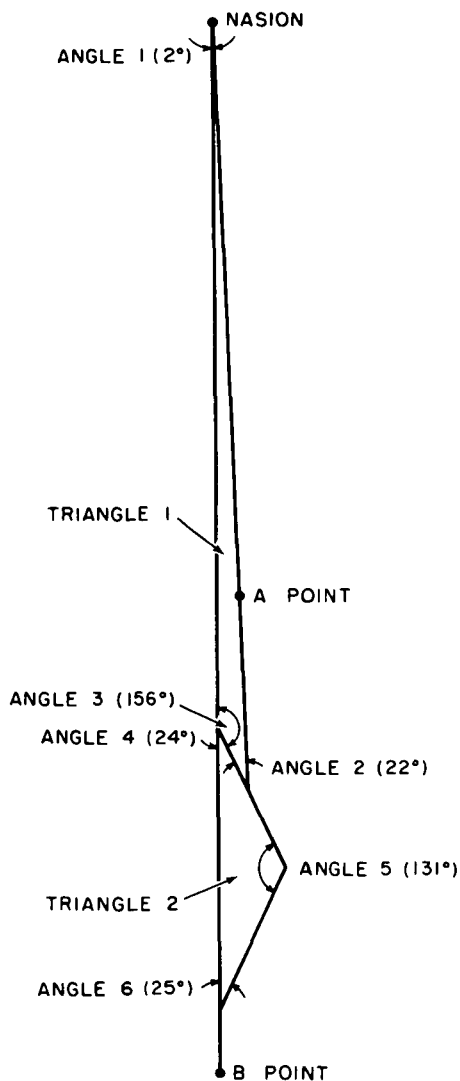
Fig. 3 Diagrammatic representation of the two triangles involved in the derivation of Steiner's acceptable arrangements.

gles in the diagram can be calculated in the case that angle ANB changes. This principle explains the derivation of the acceptable arrangements in the Steiner analysis.

In the biological situation, however, it is of considerable importance to distinguish whether a change in the ANB angle has resulted from repositioning of A point, B point or both. For example, it can be seen in Figure 3 that no changes occur in triangle 2 whatsoever, when the decrease in angle ANB is conditioned only by posterior positioning of A point. In the geometric derivation of Steiner's acceptable arrangements, no allowances have been made to differentiate between the effects of repositioning A and B point, singly or in combination.

In the schematic, the interincisal angle (5), the angle of the lower incisor to NB (6), the angle of the upper incisor to NA (2) and the ANB angle (1) add up to 180 degrees[7] which follows from inspection of Figure 3, because angle 4 in triangle 2 is the sum of angles 1 and 2 (Fig. 3).

Maintenance of a constant relationship of the maxillary incisor to the nasion-B point line at 24 degrees (angle 4, Fig. 3) has been dictated by convenience when designing the schematic on acceptable arrangements in a geometric system. Yet, it does not imply that the angle between the maxillary incisor and the nasion-B point line should invariably measure 24 degrees as is implied in the acceptable arrangements. Actually, additional combinations of incisor inclination should be expected to exist. This schematic on incisor inclinations could also have been derived from a biologic system, namely, by using the range of normal variation in incisor position[6] from a study of individuals with optimal occlusion and esthetically acceptable facial configurations.

they are complementary angles. As angle 1 increases or decreases, compensation is achieved by the one remaining angle (2) in triangle 1, while in triangle 2, compensation results from changes in both angles 5 and 6. Since the sum of the three angles of a triangle and of complementary angles is 180 degrees, the values of the remaining an-

In addition to determining the axial inclination of the incisors, Steiner's acceptable arrangements include a linear measure to define the positioning of the incisors, namely, the distance from the most anterior point on the maxillary incisor to the nasion-*A* point line and the distance from the most anterior point on the mandibular incisor to the nasion-*B* point line. As can be seen from the chart of acceptable arrangements, the maxillary incisor is positioned more closely to the nasion-*A* point line as the ANB angle increases and the maxillary incisor is actually behind the nasion-*A* point line for the higher values of the ANB angle (7 and 8 degrees). In contrast, as the ANB angle increases, the mandibular incisor is positioned progressively forward of the nasion-*B* point point line (Fig. 3).

A template of incisor crown forms of normal size and shape, when placed on the appropriate lines of axial inclination in correct occlusion, can be used to determine these linear values. By measuring the distances from the incisor crown outlines to the respective reference lines at the different ANB angles, the millimetric values in the acceptable arrangements are derived.

In summary, the axial inclinations of the incisor teeth can be manipulated by means of geometric principles in such a way that they are in an "acceptable arrangement" throughout a range of values for the ANB angle. With the known axial inclinations and judicious measuring, the linear distance of the incisors from the two reference lines can also be calculated. Thus, a spectrum of acceptable arrangements of incisor positioning is obtained from both angular and linear measurements.

Forsyth Dental Center
140 The Fenway
Boston, Mass. 02115

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