A Cephalometric Evaluation of Incisor Positioning with the Begg Appliance

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Much discussion has been undertaken in recent years concerning what lines, angles, or tooth positions contribute most to the successful orthodontic case.[1-5] An equal amount has been presented to describe just what the ideal result should be in regard to lip position, profile, chin position, etc.[6-10] The multitude of information has certainly made evident that teeth, jaws and faces can be improved through tooth movement. However, it has shown that they can also be changed unfavorably when the anatomical and physiologic characteristics of a child's growing face are directed to a mathematical ideal that is not related to the child's genetic pattern.

History and experience have indicated that specific goals of treatment are necessary, but that modification of goals and ideals is, in the final analysis, determined by the heredity and the morphology of the individual.[11,12] It was this feeling toward the patient's innate influence on his treatment, through heredity and growth, that prompted the investigation being discussed in this paper. Another purpose was to analyze treatment results in relation to the patient's physiologic and morphologic influence on the basic Begg force system.

For several years the author has utilized either the edgewise appliance or the Begg appliance in the treatment of orthodontic cases. It has been a clinical feeling that the results achieved seemed to show very pleasing facial characteristics and more consistent stability in the cases finished with the Begg appliance. Posttreatment cephalometric analyses showed variation in angular and linear measurements, but it was apparent that some specific relationships were occurring to a high degree of consistency. Cursory evaluation of cephalometric films indicated that the incisor-AP position seemed to be very consistent after treatment, regardless of the incisal position before and regardless of the type of treatment, extraction or nonextraction.

These clinical findings posed several questions. Is Begg technique consistently producing any specific incisal position? Are the relationships compatible with the patient's health, function and esthetics? Is the light-tipping action of the treatment so physiologic that the skeletal pattern and muscle action are directing the limit of incisor movement?

In reviewing the literature, several articles were found directly related to anterior tooth positioning. Many have presented information on specific incisal positions which they deemed most desirable. Tweed[13] specified an FMIA angle of 65° and a mandibular incisal angle of 90° as the desired position of the lower incisors. He based his position in reference to his facial triangle. Some authors have substantiated Tweed's angle as an indication for lower incisor position.[5] Steiner[15-17] suggested that the lower incisors be measured both with linear and angular measurements, thereby attempting to compensate for irregular angular changes in the incisors which are produced by root apical movement. He related the incisor to the facial plane (NB) and was one of the first to relate the influence of the environment of the face to the incisors. Downs,[18-20] Ricketts[10,21] and Williams[22] further advanced the thinking of an en-

vironmentally placed incisor when they recommended relating the incisor to the AP plane. The relationship of the incisor to AP enables the operator to have a means of compensating the incisal position with the skeletal base relationship. Schudy[4] related lower incisors to AP and took into consideration the FMA. He found that high angle cases, over 20° occlusal plane angle, were showing a 3.1 mm lower incisor-AP measurement while the lower angle cases, under 11° occlusal mandibular angle, showed a lesser incisor-AP measurement of 1.3 mm. In another attempt that related incisors to the facial profile, Holdaway[2,8] related the incisors to pogonion and to NB. He established a relationship or ratio of incisal edge to NB to pogonion in cases with specific AB angles.

The relationships of upper incisors, as well as upper to lower incisors, have also been studied intensively.[6,9,10,15,17,18,20,23] The majority of the investigators have based the upper incisal findings on the relationship to a facial plane AB or AP, to sella-nasion, and to the interincisal angular relationships. Some slight variation occurs between the values these men have presented and those described by Goldsman.[3] The relationship of upper incisors to S-N was found to be 104° by Riedel and 105 by Goldsman. The upper to lower incisal angle was 136.1° by Goldsman and 135.4 by Downs. The incisal edge of the upper incisor to AP was 3.6 mm by Goldsman, 2.7 mm by Downs and by Ricketts, 5.7 mm.

Material and Method

Eighty cases were selected at random from the orthodontic records of the author. All cephalometric films were taken in a Wehmer cephalostat using a standard film subject distance and a fixed film-target distance. All tracings were made by one investigator and all were re-evaluated for accuracy and double determination measurements by a second investigator. Angular and linear measurements were made by fine line instruments to .5 mm accuracy.[24]

It should be noted that these cases included 49 females and 31 males which were highly representative of the general case load in the practice. No distinction was made between extraction or non-extraction, first premolar extraction or second premolar extraction, male or female in the selection. All cases were carried through the three stages of Begg treatment and were finished in a special finishing period, Stage IV.[31] The author uses cervical type extraoral anchorage in severe skeletal discrepancy cases and this modification in technique was evident in a few cases. After review of the work by Dangremond,[29] it was not felt that the use of the headgear would change the reliability of our results. The following measurements were utilized in this study:

Lower incisor to mandibular plane, lower incisor to A-pogonion, upper incisor to lower incisor, upper incisor to A-pogonion, upper incisor to sella-nasion, nasion to B to pogonion, and lower incisor to nasion-B.

Discussion and Findings

Several authors have commented upon the degree of variability seen in skeletal or facial measurements of their samples. In this investigation eighty cases were utilized to increase the reliability of the study; great variation was found and wide ranges occurred in several of the measurements. Table I shows ranges, means, and standard deviations of the seven measurements before and after treatment.

The findings for the initial means and ranges are comparable with similar measurements of other investigators. The IMP mean is slightly higher than that registered by Brodie,[32] but the

TABLE I
SUMMARY VALUES
RANGE, MEAN AND STANDARD DEVIATIONS FOR
80 CASES BEFORE AND AFTER BEGG ORTHODONTIC CARE

	RANGE		MEAN and S.D.	
	before	after	before	after
IMPA (deg)	75 - 112	78 - 112	93.5 (8.0)	91.9 (7.1)
$\bar{1}$:AP (mm)	6 - (-5)	5 - (-3)	1.1 (2.9)	0.7 (1.8)
$\underline{1}$:$\bar{1}$ (deg)	168 - 97	150 - 111	124.6 (12.3)	131.8 (10.4)
$\underline{1}$:AP (mm)	14 - (-2)	8.5 - (-1)	8.3 (3.2)	3.4 (1.9)
$\underline{1}$:SN: (deg)	121 - 73	113 - 83	106.6 (9.7)	98.2 (6.1)
$\overline{NB}$:P (mm)	(-1)- 7	10 - 0	2.2 (1.7)	3.6 (2.2)
$\bar{1}$:NB (mm)	12 - (-1)	11 - 0	5.0 (2.8)	4.4 (2.1)

range seems to cover that of the types of malocclusion which he studied. His mean values of IMPA were 89.3 for Class II, Div. 1 and 86.6 for Class II, Div. 2., the range being 28 for Class II, Div. 1 and 42 for Class II, Div. 2. Speidel and Stoner reported IMPA of 92.64°, S.D. 6.15 in normal adults with superior occlusion. The range established was 28°. Downs showed a mean of 91.4°, S.D. 3.78 for IMPA with a range of 16.5.

In this study it was found that great variation occurs in the IMPA with Begg treatment (Table I). A reduction of 3 degrees occurred in the size of the range after treatment suggesting that the angular pattern of the lower incisors was not greatly changed during the treatment program. A reduction of 1.6 degrees occurred in the mean IMPA during treatment. A slight decrease in the standard deviation is evident which indicates a concentration of cases approaching a more vertical position of IMPA after treatment.

The findings of Wylie[7,11,12] Mills,[25-27] and Litowitz[28] show that not only is there great variability in the lower incisor angulation before and after treatment, but also a definite tendency for these teeth to return to their original positions after the appliances were removed. These changes are explained as a result of functional forces placing the teeth in a stable position for each specific child. Litowitz shows both angular and bodily changes of lower incisors tending to return toward the original pretreatment position. Apparently, as was suggested by Wylie and Lindquist, the angular position of these teeth is not an important relationship. It has been suggested by Mills and Ricketts that there is a more important position of the lower incisors to the mandibular plane. The wide range of posttreatment readings of IMPA found in this study appears to substantiate these ideas. It also appears that the Begg technique does not establish the position of lower incisors to the mandibular plane at any specific angular relationship.

The lower incisor to AP relationship provides a different approach to incisal repositioning since it relates the incisor to the environment of apical base differences and to growth changes at pogonion. Ricketts, Schudy and Williams have indicated great satisfaction with the stability of incisors when they are related to the AP line. Ricketts has suggested a mean position of 0.5 mm plus or minus 2.7 mm.

Wide variation in this relationship was evident before treatment in the eighty cases studied (Table I). These findings would be expected due to the number of muscular, skeletal, and functional irregularities affecting the teeth

in the maloccluded state. After treatment, however, the lower incisor-AP position was greatly and consistently changed toward the mean described by Ricketts and others. Those incisors behind AP before treatment tend to go forward to the AP line and those ahead of the AP line tend to be retracted to the AP line during treatment. Over 85% of the cases finished within plus or minus 2 mm from the position of stability described by Ricketts. The findings suggest that the incisors may have been favorably affected by the forces applied during Begg therapy and that they assumed a position that was in harmony with the tongue, lip and skeletal profile for each specific child.

The relationship of upper and lower incisors before treatment compares with the angular and millimetric description of Schudy, Dangremond and Tweed. The before-treatment position of the incisors in our sample was 124.6°. Such acute angular position is usually seen in Class II, Div. 1 malocclusions. The accepted means for upper and lower incisor angulation varies from 131° to 135.4°. The posttreatment mean of our sample was 131.8 suggesting that the technique favorably repositioned the incisors.

The inability to find a consistent angulation of upper to lower incisors after treatment was surprising to the author. Clinical investigation of other cases had suggested that the incisors were being affected considerably by muscle action. It was obvious that tongue-thrusts or undesirable lip action in cases where the technique had opened the bite seriously affected the final positioning of the anterior teeth. It had been found that retraction of incisors with the light one to two ounce forces was almost impossible in the presence of any form of tongue-thrusting action or lip habit. Perhaps the technique is influenced in establishing the incisal position through muscle action and environment but, as with the lower incisor alone, it is not the angular position but the linear anteroposterior relationship of the incisors which is the important consideration during treatment.

Many investigators have considered the upper incisor to AP with a considerable difference in the mean values: 3.6 mm Goldsman, 2.7 Downs, 5.5 Riedel and 5.7 Ricketts. Our study shows extreme variation in the pretreatment malocclusions with a mean of 8.3 ± 3.2 and a range of 16 mm. The posttreatment position gives a mean of 3.4 mm and reduced standard deviation of 1.9. Thus the posttreatment means of the upper incisor to AP in the Begg cases compare favorably with the recommended means of the other investigators. Before treatment the upper incisor-AP position was 3 to 5 mm ahead of the AP line in less than 15% of the cases. After treatment the upper incisor was 3 to 5 mm from AP in over 74% of the cases. In fact, 41% of the cases after treatment were plus or minus .5 mm from the mean of 3.4.

These findings indicate a strong tendency for the Begg treatment program to retract or reposition the incisal edge of the incisors in a specific relationship to AP. It would again seem that incisal position is dependent not on any specific angular position, but on the anterior-posterior relationship to the lip, tongue and skeletal profile.

To compare tipping changes in the incisors with bodily repositioning of teeth, the upper incisor relation to SN was done. The pre- and posttreatment means were similar to those by Dangremond who did a comparable study with a modified Begg treatment technique. He reported the upper incisor to SN at 103.4° before treatment and 98.46 after treatment. These figures are similar to ours, 106.6° and 98.2.

It appears that insufficient torque action occurred in some cases and the upper incisor to SN of 104° was not consistently obtained. It should be noted that routine cephalometric radiographs were not taken after Stages III or IV to check the upper incisor to SN position before the appliance was removed. Since torquing incisors is not difficult with the Begg technique, it may be concluded that the lack of reaching 104° was not due to poor torquing mechanics of the appliance but rather the cessation of treatment when it appeared clinically that the incisor position was compatible with the child's cosmetic alignment, his incisal guidance, and his protrusive movement. It appears that these conditions were believed to have been obtained when the treatment had set the incisors in the area of 98° to SN. Since torque action is one of considerably high force, it seems that the upper incisor to SN angular relationship is more directly related to the operator's choice of position than on any physiologic influence the skeleton or muscle action could have on the light-wire forces.

The final phase of measurements in the study was made to evaluate the incisor position relative to the accepted profile as described by Holdaway.[2,22,29] Since the Begg force system appeared to be favorably repositioning incisors within the skeletomuscular environment, we were anxious to see if the final mandibular incisor position was within the currently accepted 1 to 1 ratio described by Holdaway. Of the eighty cases studied, it was determined that the Holdaway ratio improved after treatment in fifty-six (70%) of the cases. The mean ratio before treatment was 2.2 to 5 and after, 3.6 to 4.4. A great degree of change in pogonion occurred in several cases and it is interesting to note that the ratio was also favorably improved by this change. Some reduction also occurred in the incisor-NB part of the ratio indicating a tendency for Begg treatment to reposition lower incisors into a more favorable position within the growing matrix of the incisor area. It would appear that physiologic forces of the lip and face may have again influenced the light Begg forces by aligning the lower incisors in a more favorable anteroposterior linear relationship to their environment.

Summary and Conclusions

The investigation was undertaken to evaluate a clinical impression that specific patterns of incisal position were occurring in cases treated with the Begg force system. The changes did not seem limited to any one sex or type of treatment, extraction or nonextraction. The series of eighty cases were evaluated cephalometrically with before and after radiographs. Seven measurements of incisal and skeletal relationships were made. It appeared from the favorable posttreatment findings that the Begg force system may be significantly influenced by the physiologic and morphologic environment that surrounds the incisors. Such an influence may produce a more individual and compatible relationship of incisors for each specific patient.

1. The Holdaway ratio for the lower incisors to the skeletal profile was improved in 70% of the cases studied.

2. The IMP angle showed great variation before and after treatment but the lower incisors approached a more vertical position to mandibular plane during treatment.

3. Lower incisors consistently approached the AP line during treatment. After treatment over 85% of the cases were within 2 mm from the usually accepted mean of .5 mm for lower incisor to AP positioning.

4. Upper incisors were retracted to a mean position of 3.4 mm ahead of the AP line and 74% of the cases ended at a point between 3 and 5 mm ahead of the line.

5. Angular position of upper to lower incisors approached a mean of 131.9° after treatment. Considerable variation was found in a standard deviation of this measurement.

6. The angulation of the upper incisors to SN of 98.2° was found to be a consistent posttreatment result. It should be noted that this degree of torque was determined as being clinically acceptable and it should not be misinterpreted as inability of the Begg torquing apparatus.

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