Cephalometric Appraisal Of The Open-bite Case

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INTRODUCTION

The skeletal and denture configuration of patients exhibiting a lack of occlusion in anterior or lateral regions is of interest. This lack of occlusion can and does occur in any of the following ways: as an open bite in the anterior area, an open bite in the lateral areas, and as a combination of the two.

The purpose of this paper is to attempt to locate and describe, by means of cephalometric measurements, significant skeletal and denture differences found in the open-bite case.

The classifications of malocclusion by Angle[1] were well conceived and still remain as an integral part of orthodontic description. However, since the advent of roentgenographic cephalometry, they are in need of expansion or considerable modification. Broadbent,[2] 1931, with his introduction of cephalometric study of skeletal relations of the head, authored a completely new approach to orthodontic analysis. However, it was not until 1938[3] that a cephalometric analysis of treated cases appeared in the literature. This work was followed by an extensive growth study of the head by Brodie[4] in 1941.

In 1948 an attempt to provide a yardstick with which to measure craniofacial relationships was presented by Downs.[5] This paper is credited with giving impetus to extensive research directed to provide normal ranges for varied age groups as evidenced by the work of Baum,[6] Lande,[7] Riedel[8] and Hapak.[9]

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Wylie and Johnson[10] in a joint article concerned themselves with facial dysplasia in the vertical plane. Since the open-bite case quite frequently appears to be associated with vertical dysplasia, a comparison of their findings and ours will be enumerated later in the paper.

As the volume of cephalometric research papers increased, so did the use of statistical techniques. The need for a method to assimilate a great number of measurements without subjecting the reader to tedious perusal of raw data was and is needed. Logically, statistics became the vehicle to provide a clearer and more concise data presentation. Thurow[11] and Garn[12] quite aptly discussed the use and misuse of statistical presentation—specifically as it affects the orthodontist's interpretation of statistical measures.

Unquestionably the use of statistical measures simplifies the digestion of reams of data. To bring these measurements into even clearer focus, Vorhies and Adams[13] portrayed graphically Downs' means and ranges through the use of their polygon. This graphic picture enables a quick and precise interpretation. The presentation of means and ranges derived from our study will be presented in a similar manner.

Facial growth, good and bad, is equally important to the orthodontist since he wants the good growth to continue and the unfavorable to be interrupted or eliminated. This study is concerned with the open-bite case. Is the open bite a product of disoriented growth? Or, is the disoriented growth a manifestation of abnormal function? Perhaps, as Straub[14] reports in his

article on malfunction of the tongue, the open bite is the usual result of an abnormal swallowing habit. In the same paper he also states that the abnormal swallowing habit interfered with normal growth of the dentition. A cephalometric study of open-bite cases may indicate how or where this misdirection of growth occurs.

Findings and Discussion

A static analysis was undertaken utilizing a group of fifty-two untreated cases, all of which exhibited a lack of occlusion in the anterior area, the lateral areas, or both. The sample was procured from this writer's office and supplemented from the offices of three other Indianapolis orthodontists.

The cases selected were Caucasians with an age range of ten to sixteen years. The mean age of the fifty-two cases was 12.3 years. Of these, thirty one were girls and twenty-one were boys. No cases were used which exhibited congenital or acquired trauma, such as cleft palate, facial injury, etc.

Lateral cephalometric roentgenograms in occlusion were obtained for this study. Subsequently, tracings were made of significant structures from each head film.

The tracings were made in accordance with Downs' method of analysis along with some additions and deletions as noted in Figures 2 and 3. Since most orthodontists using cephalometrics

Table I

Open Bite Sample

Measurement	Mean	Range	Standard Deviation	Standard error of the mean
Facial Angle	81.53	72.0 to 88.5	4.05	.57
Angle of Convexity	5.53	-5.5 to 14.5	5.29	.74
A B Plane	-5.41	-11.0 to 2.0	4.43	.62
Mandibular Plane	33.43	22.5 to 48.5	6.95	.97
Y-Axis	65.92	58.5 to 76.5	4.20	.59
Upper Central Incisor to Lower Central Incisor	120.67	99.5 to 142.0	10.49	1.47
Lower Central Incisor to Mandibular Plane	.42	-14.0 to 19.0	7.83	1.09
Upper Central Incisor to A P Plane (mm)	9.04	3.5 to 15.0	3.07	.43
S N A	79.27	75.0 to 89.5	3.24	.45
S N B	75.79	70.0 to 84.5	3.21	.45
N S - Go Gn	38.56	29.0 to 49.5	7.19	1.01
Upper Face Height (mm)	50.46	44.0 to 56.5	3.00	.42
Total Face Height (mm)	117.78	105.5 to 142.0	17.88	2.50
Lower Face Height (mm)	68.31	60.0 to 86.0	11.06	1.55
Alveolar Height in Lower Central Incisor area (mm)	40.45	35.0 to 49.5	6.54	.91
Age (years)	12.33	10 to 16	1.61	.23

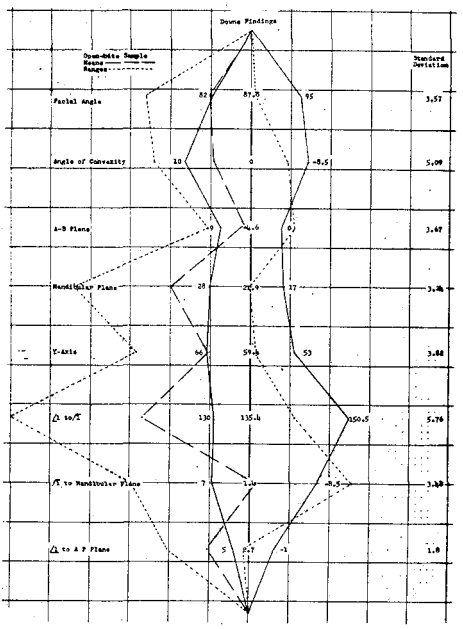

Fig. 1

are familiar with the writings of Downs, Riedel and Wylie, it will not be necessary to elaborate any further on the majority of the measurements. A new measurement for which we have no comparison has been added; it is labeled the alveolar height in the lower incisor area. It is used to measure the alveolar height of each mandible in the lower incisor area, from the lower border of the mandible to the tip of the lower incisor.

A table of the means, ranges, standard deviations and standard error of the means of these open-bite cases is given in Table I.

Another table (Table II) was prepared to submit for comparison additional measurements which are thought to be of significance in assessment of the open-bite case. These measurements are compared with those of Riedel and Wylie.

A polygon was constructed using the means and ranges of Downs (Fig. 1). This was done to compare the means and ranges of this study with his findings.

Examination of Figure 1 reveals an interesting pattern. Generally the polygon of Downs' means and ranges with the open-bite sample means and ranges superimposed upon it tends to show the definite Class II tendency of this sample. The only mean reading which falls to the right of the Downs' means is lower incisor to mandibular plane, 1.4 degrees compared with this sample's .4 degrees. One other reading closely compares and that is the AB plane which is —5.4 compared with Downs —4.6. Two other mean readings fall within the confines of the polygon formed by Downs' minimums and extremes, these being the angle of convexity (5.5) and the Y-axis (65.9). The remaining four readings, namely: facial angle, mandibular plane, upper central incisor to lower central incisor and upper central incisor to AP plane, fell outside and to the left of the polygon.

The greatest deviation to the left is exhibited by the upper central incisor to lower central incisor. This in itself is interesting, but not unexpected in this sample, since the axial inclination of the upper and lower anteriors is a contributing factor to the lack of occlusion in the anterior area in a great number of cases. Assuming the upper and lower incisors pivot on a fulcrum at the root apex, any labial movement of the anterior teeth would be associated with a corresponding superior or inferior movement of the incisor tips depending upon whether they were upper or lower incisors. It is not too hard to visualize this occurring when the labial forces exhibited by the tongue thruster or thumb sucker are taken into consideration.

Of great significance is the Frankfort mandibular plane angle mean which is markedly to the retrognathic side of

the polygon. A mean of 33.4 degrees is in itself severe but even more appalling is the extreme side of the range which is 48.5 degrees. Usually the severity of skeletal imbalance is greatly influenced by the mandibular plane angle. Consequently it can be assumed that most of the open-bite cases in the sample have a poor skeletal pattern.

The upper incisor to AP plane mean is also markedly toward the Class II side of the polygon. However, here again this measurement is probably influenced by the axial inclination of the upper central incisor. The same forces influence its behavior as those previously mentioned in discussing the upper central incisor to lower central incisor measurement.

The Y-axis as an index of growth direction concurs with the general Class II tendency of this sample. The mean of 65.9 is indicative of excessive downward growth which is in keeping with the excessive Frankfort mandibular plane angle.

In accord with previously described tendencies toward the left side of the polygon is the facial angle. The range of swing to the left side is almost identical with that of Y-axis in direction and amount.

A very small difference separates the two mean readings of lower incisor to mandibular plane. However, there is a considerable extension beyond the Downs' range on both sides by the open-bite sample. The excessive ranges of the lower incisor in the Class II direction can possibly be explained by the tongue-thrust force. The excessive range in the opposite direction can be due to the posterior or lingual force on the lower incisors by some thumb suckers or to the case exhibiting a Class III tendency.

It appears that the AB plane varies the smallest amount when compared with Downs' findings. The measure of central tendency is very slightly toward the Class II side. This would tend to substantiate the contention that some of the open-bite cases have essentially a tooth inclination problem due to improper muscular function or balance.

Table II

Measurement	Riedels Findings (8 to 11 years) Means	Std. Dev.	Open-bite Means	Std. Dev.
S N A	80.79	3.85	79.27	3.24
S N B	78.02	3.06	75.79	3.21
NS - Go Gn	32.27	4.67	38.56	7.19
	Wylie-Johnson Good Faces Means	**Std. Dev.**	**Open-bite Means**	**Std. Dev.**
Upper Face Height	50.65	2.58	50.46	3.0
Total Face Height	113.02	4.55	117.78	17.88

The angle of convexity also shows a tendency toward the left side of the polygon. However, here again the mean is well within the polygonic limits. This range of measurement would have to be considered within the area of acceptable.

Table II is a comparison of additional means of measurements thought to be of importance when considering open-bite cases.

SNA has a mean measure of 79.2 in the open-bite sample while the mean SNA measure of Riedel's sample is 80.7. The mean SNB measure of the open-bite sample is 75.7. SNB of the Riedel sample is 78.0. These differences are not considered to be of significance.

NS Go-Gn differs from the two previous readings in that there occurs a sizable difference (6.3 degrees) between the Riedel mean and the open-bite mean. This difference is not as great as that between the open-bite sample and Downs' sample. However, it is of importance in that it, too, points toward the retrognathic face.

The comparison of the upper face height reading on the Wylie-Johnson sample (good faces) is strikingly similar. However, one would not expect too great a difference in these samples since

upper face height does not usually vary greatly.

The comparison of the total face height measures of the two samples is interesting. Since there is so little difference in the upper face height means, it becomes readily apparent that whatever difference we might have could very well be attributed to a difference in the lower face height. The difference is 4.7 mm with the open-bite sample mean being the longer. The Wylie-Johnson sample is not as widely dispersed as the open-bite sample as shown by a comparison of standard deviations of the two samples (Table II).

By gross observation it appeared that the alveolar height of the mandible in the lower incisor area increases as the Frankfort mandibular angle increased. It appeared to be a reflex type growth to the increased Frankfort mandibular angle or an attempt by growth to close the open bite. Frankfort mandibular angle was correlated with alveolar height in the lower incisor area with a resultant coefficient of +.69 and a "t" score of 6.73. This bore out the initial observation that, as the Frankfort mandibular angle increased, the alveolar height also increased.

Inspection of data accumulated on the open-bite sample shows a trend for certain measurements to behave in an orderly or compensatory manner when compared with the variation of certain other readings. Of course, this suggested a possible mathematical relation, direct or inverse.

Whenever a trend toward correlation exists, an appraisal of this trend is in order. By gross inspection a group of measurements were chosen which exhibited the tendency mentioned. This group was subjected to the Pearson (r) correlation test.

The Frankfort mandibular plane angle was correlated with the three heights, lower, total and alveolar. Positive correlation was found (.78, .78 and .69 respectively) among all three of the above measurements when plotted against the Frankfort mandibular plane angle. The "t" scores were 8.80, 8.80 and 6.73.

Essentially what is being said by the results of the correlation coefficient is that, as the Frankfort mandibular plane angle increases, there is frequently an increase in lower face height, total face height, and alveolar height in the lower incisor area. However, the increase is not necessarily of the same magnitude. This orderly behavior is not by chance since the odds against chance become astronomical when considering "t" scores of this magnitude.

To recheck the above correlations lower face height, total face height, and alveolar height in the lower incisor area were plotted against NSGoGn, resulting in positive correlations of .82, .83 and .81. The "t" scores were 10.13, 10.54 and 9.77 respectively.

Perusal of the "t" scores indicates significance beyond the one per cent level of confidence. NSGoGn against lower face height, total face height, and alveolar height in the lower incisor area behaves in essentially the same manner as does the Frankfort mandibular angle, the only difference being that the coefficients of correlation are even more positive. The result of this check is not unexpected but nonetheless reassuring.

Moore[15] in his article on facial growth called our attention to characteristics of Class II malocclusion. A point of emphasis in his paper was that there is a great deal of skeletal variation within specific groups of malocclusion. We find that variety in the open-bite sample far outweighs uniformity. With this observation a discussion of three specific cases follows.

Case S. M. (Fig. 2) is a female, age 15 years, who has a tongue thrust. There

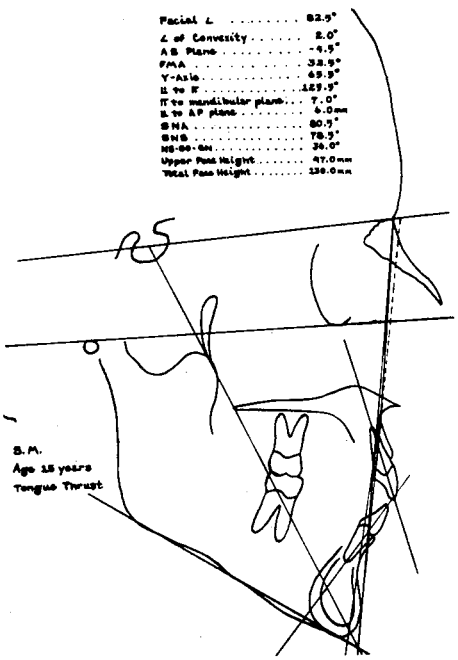

Fig. 2 Typical tracing showing various points and planes used in the study.

are three readings which fall outside the confines of Downs' polygon on the Class II side, Frankfort mandibular angle, upper incisor to lower incisor, and upper incisor to AP plane. The remaining readings fall within the confines of the polygon but to the left of the means. SNA and SNB also are within acceptable limits and NSGoGn is 36.0 degrees. Frankfort mandibular angle is excessive being 32.5 degrees. In support of this we have an upper face height of 47.0 mm and a total face height of 130 mm. This makes the lower face height much greater than that found in the Wylie and Johnson sample. Case S. M. has an upper to lower incisor inclination of 125.5 which is not unexpected because of the tongue thrust.

Case A. D. (Fig. 3) is a female, age 11, who is a thumbsucker and also has a tongue thrust. The skeletal pattern of her case leans toward the Class II side of the polygon. The chief site of discrepancy is the upper incisor. The thumb keeps this incisor in its exaggerated position with an assist from the tongue and lack of restraint of the lips. Her most deceiving reading is that of lower incisor to mandibular plane, being 4.0 degrees. Inspection of the patient reveals that the lower incisors are depressed to the lingual by the reciprocal force of the thumb pushing the upper incisors labially. Cessation of thumb sucking would probably produce a labial movement of the lower incisors. It appears that in this particular situation a part of the answer to the problem lies within well-circumscribed area in the anterior portion of the upper and lower jaws.

Case P. P. (Fig. 4) is a female, age 14 years, who has a tongue thrust. This individual possesses a typical Class II, Division 1 face according to Angle's

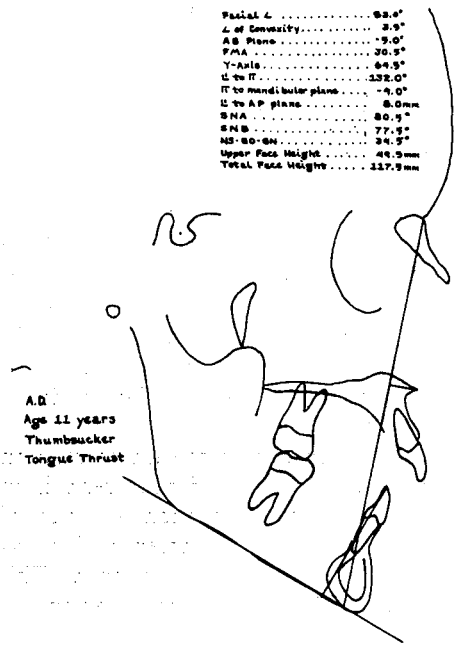

Fig. 3 Tracing showing method of measuring upper face height, total face height, lower face height and alveolar height in the lower incisor area.

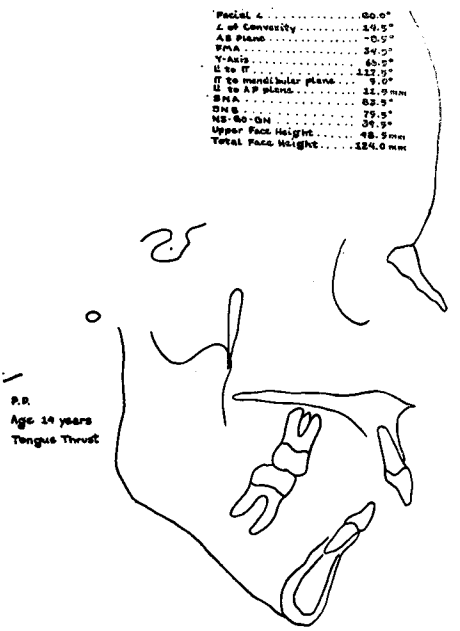

Fig. 4 Typical open-bite case with a relatively severe Frankfort mandibular plane angle and excessive lower face height.

classification. However, superimposed upon this skeletal and denture pattern is an open bite. Facial angle, angle of convexity and AB plane readings are in the Class II range; FMA and NSGoGn are considered to be approaching a severe range. Lower incisor to mandibular plane is within acceptable limits while upper incisor to AP plane is much beyond the range. Upper face height is 48.5 mm and remains strikingly constant varying but 2.5 mm among the three cases. Total face height is 124.0 mm which is excessive.

There is a great dispersion of readings when considering the open-bite sample total face height measurements as indicated by a standard deviation of 17.88. Of course, we would expect the sigma for total face height to be greater than the sigma for upper face height by virtue of the greater variation of lower face height.

The Y-axis reading of case P. P. is just outside Downs' Class II-side range. SNA is anteriorly located as indicated by a reading of 83.5 degrees; SNB is 75.5 degrees, a difference of 8 degrees between the two angles.

Grossly, the three cases have a similar appearance because they have a common problem. Close inspection of the cases brings to mind the aphorism, "They are like fingerprints in that they all look alike but actually are all different".

Conclusions

1. Fifty-two children's lateral headplates were traced and subjected to a cephalometric evaluation of their facial and denture patterns. All of the above children possessed an open bite.

Means, standard deviations, and a standard error of the mean were established for a series of skeletal and denture readings.

Correlation tests were conducted on measures thought to be reacting in a compensatory manner.

2. A modified polygon was constructed, using a majority of Downs' findings, to compare the open-bite sample with that of Downs.

The remaining craniofacial dimensions thought to be important were compared with those of Riedel and Wylie-Johnson.

3. Reflection upon the previous data, findings and discussion reveals that open bite occurs in a variety of skeletal patterns.

This open-bite sample has a Class II tendency as evidenced by the polygon. However, it is not implied that it is confined to Class II faces since we know this is not the situation.

4. The Frankfort mandibular plane angle mean is 33.4 degrees. This indicates the general type of skeletal pattern found in our sample.

Y-axis and facial angles are similar

in behavior when comparing them with Downs' means and ranges. Both readings are on the retrognathic side of the polygon.

5. The effects of the thumb habit and tongue thrust upon the axial inclinations of the upper and lower incisors are such that they produce extensive variations from the normal with resultant open bite. The lower incisor to mandibular plane readings range from —14.0 degrees to 19.0 degrees.

6. AB plane and angle of convexity indicate a very small deviation from Downs' findings and would have to be considered to be within acceptable limits.

7. The mean NSGoGn reading of the open-bite sample is 6.3 degrees greater than the mean of Riedel's sample of excellent occlusions.

8. There is essentially no difference in the upper face height of the open-bite sample and the Wylie-Johnson group.

Yet, the total face height difference between ours and the Wylie-Johnson sample is significant. The mean total face height of the open-bite sample is 4.7 mm greater than that of Wylie and Johnson.

9. Frankfort mandibular plane when correlated with lower face height, total face height, and alveolar height in the lower incisor area produced significant positive coefficients of correlation. These coefficients show that, as the Frankfort mandibular angle increases, the lower face height, total face height and alveolar height in the lower incisor area increase.

10. NSGoGn, when correlated with the same heights, behaves essentially in the same manner as Frankfort mandibular plane angle.

11. There appears to be reciprocal growth or balancing growth to attempt to preserve harmony in dentofacial relations. It is when this mechanism fails that a malocclusion results.

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