Facial Esthetics And Angles

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INTRODUCTION

The search for order and pattern in the world of nature has been a pursuit of man since the dawn of the scientific era. From a mass of apparently unrelated data a certain pattern must be found if useful knowledge is to be gained. In the field of orthodontics, as in many other areas of endeavor, the discovery of this pattern may not at first seem of any particular significance for clinical application, but the knowledge may ultimately prove of value to the profession.

In this study, an objective statistical test is applied in an area usually limited to individual personal opinion: the relationship between facial esthetics and angular measurements from headfilms. Exceptions to the theory that facial pattern becomes poorer as the ANB angle increases prompted questioning the use of this angle as an overall guide to facial pattern. The problem was to find a statistical method of stating the relationship between an angular measurement and the facial appearance of a patient. Once found, the method could be applied to any angle measured on a cephalometric film, and various angles could be pitted against each other to see which correlated best with facial esthetics. Although an angle rating high in such a test could not be considered as telling the whole story by itself, the test might assist the orthodontist in choosing between several angles from different systems of headfilm analysis measuring a given area.

SELECTION OF CASES AND MEASUREMENTS

Lateral facial photographs of 28 boys and 37 girls between the ages 8-12 were used in this study. The cases comprise all of the new patients accepted for orthodontic treatment in a private practice* during an almost one-year period. The sample appears to be representative of the population of orthodontic cases.

For each of the patients a lateral oriented headfilm was taken from which a tracing was made. A number of planes were located and angles measured as suggested by various leaders in the orthodontic profession. The majority were angles utilized in the method of headfilm analysis suggested by Steiner from which the following were taken:

1. SNA. The angle formed by the sella-nasion plane and a line from nasion to point A.
2. ANB. The angle formed between lines from nasion to points A and B.
3. $\underline{\lfloor 1}$ to NA. The angle formed by the long axis of the upper central incisor and the line NA.
4. $\overline{\lceil 1}$ to MP. The angle formed by the long axis of the lower central incisor and the mandibular plane.
5. MP to SN. The angle between the mandibular plane and the sella-nasion plane.

Certain angles derived from the

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*All case records are from the files of Jack R. Smithers, D.D.S.

Downs' analysis were then selected that would be comparable to the Steiner angles:

1. Angle of convexity. The angle formed between the line NA and a line from pogonion through point A, extending beyond it. This was compared to the angle ANB.

2. Frankfort plane—NA angle. This is not the facial angle (Fp-NPo) as suggested by Downs, but is similar to it.

The angle between the lower central incisor and the Frankfort plane ($\overline{1}$ to Fp), as suggested by Tweed, was measured.

The angle between the lower central incisor and the AP plane ($\overline{1}$ to Ap) was suggested by Reidel as being critical in facial esthetics; this angle was included.

Grusd, while studying the Steiner analysis, made the observation that the angle ANB is subject to an apparent geometric error when comparing individuals in which the SNA angle differs. When headfilm tracings are observed with the SN plane at a constant angle to the horizontal, a similar relationship between points A and B and this horizontal will be read as a larger ANB angle in the face with the greater SNA angle. To correct this, Grusd devised a scale by which the measurement of the ANB angle was made from an imaginary point N sliding on a line parallel to the horizontal so that the effective SNA angle was always 82°. The angle (ANB on 82°) is the final one used in this study.

Method

The first procedure was to obtain a subjective appraisal of the facial esthetics of each patient. In order to reduce the personal element as much as possible, the subjective evaluation of each face was obtained from ten different orthodontists. Ten members of the orthodontic staff at the University of California were asked individually to take first the girls' and then the boys' photos and place them in an ordered series ranging from the face liked best to that liked least. The order of the faces in the rank was then recorded, the photos reshuffled, and the next man asked to rank them.

Although only the highest and lowest eight in ranking were utilized in the method of statistical analysis used here, it was originally felt that ranking all the faces was necessary. The members of the panel were given no specific points on which to base their judgment and much of the difference in the various arrangements that resulted can be attributed to the fact that various features weighed differently in the minds of the men.

Using the ten arrangements of the girls' photos and those of the boys', the average ranking of each face was determined. Although faces ranking in the middle of the group were highly variable in position, those in the extreme ranges were quite consistent in each arrangement and were, in fact, the only ones used in the statistical analysis.

A word of explanation about the statistical technique used here and the reason for not using others more familiar is in order.

The widely used coefficient of correlation (Pearson's "r") is not suitable for this purpose because the two series between which we are seeking the correlation must each have a normal distribution if the answer is to mean anything, and the numbers in a rank do not possess a normal distribution. In addition, the coefficient of correlation test requires the use of more definite criteria of selection than is possible with a purely subjective and individual matter such as deciding whether or not you like a face. It also implies that one vari-

able could be predicted with reasonable accuracy when the other is known and this is clearly not the case here.

After some deliberation, it was pointed out that the degree to which an angle differed in extremes of facial pattern could be used as a criterion for comparison purposes.

The test* used here was devised by Wilcoxon to determine if two relatively small samples could be considered to be from the same population. In this application, the degree of dissimilarity between two samples is our primary interest, but the test works equally well for this purpose. The samples used for each angle tested were the measurements of the eight best faces and those of the eight poorest. In Table I that follows, angles which received a Wilcoxon number of 2.00 or higher distinguished clearly between extremely good faces and extremely poor ones. Progressively lower numbers indicate a lessening ability of the angle tested to do this.

Discussion

In each case, the large difference between the boys' and girls' results are immediately striking. The most likely explanation seems to be that the small sample used allowed a considerable difference in the four groups of eight faces at the end of the scale; the difference would probably become much less had a larger total sample been used. The opinions of which girls' faces were best and worst do not show a variation appreciably greater than that of the boys', but there may be some basic difference between boys and girls in the way certain features are weighed in making esthetic judgments. The average of boys and girls together has been calculated and is considered more significant than the values for either taken separately.

The results for angles SNA (2.74) and ANB (2.85) are both quite high, indicating that they are both influential in the conformation of facial features considered important by the orthodontic staff at the University of California. It is interesting to note that the ANB on 82° angle (the angle which was theoretically corrected for more accurate comparison of patients) received a very low result (0.84). The reason for this is that the correction served to reduce the ANB reading as the SNA angle increased, and since both angles tend to be larger in poorer faces, the resultant angle was nearly the same in all the cases and showed little relation to facial esthetics. Furthermore, it appears that faces are judged esthetically on their overall convexity rather than on an absolute antero - posterior discrepancy parallel to a horizontal plane. This is borne out by the result for the angle of convexity (3.74) which is the highest obtained by any angle studied. The reason that it is higher than the value for ANB may be because the chin point (pogonion), which serves as the inferior point for the angle of convexity, is more important to the facial pattern than point B.

*The Wilcoxon Test:

All the numbers in the two groups of eight are ranked continuously according to their magnitude from 1-16, equal values receiving equal rank numbers.

N = total number used
N1 = number in top sample
N2 = number in bottom sample
R1 = sum of top ranks
R2 = sum of bottom ranks
Z = approximately a unit normal deviate (when N1 and N2 = 8 or more and are from the same population).

$$Z = \frac{2\,R1 - N1\,(N+1)}{\sqrt{\frac{N1N2\,(N+1)}{3}}}$$

(The application suggested by Mr. William Kruskal of the University of California Department of Statistics.)

Angle Measured	STEINER					DOWNS	
	SNA	*ANB*	*1 to NA*	*1 to MP*	*SN-MP*	*Angle of Convexity*	*F.H.Pl-NA*
Results from Boys ..	2.32	2.64	0.05	2.53	2.11	2.84	1.79
Results from Girls ..	1.68	1.58	0.95	0.95	0.63	2.53	0.32
Overall Average* ...	2.74	2.85	0.79	2.27	1.77	3.74	1.33

Angle Measured	TWEED	RIEDEL	GRUSD
	1 to F.H.Pl	*1 to AP*	*ANB on S2°*
Results from Boys	1.89	2.00	0.84
Results from Girls	0.42	0.11	0.42
Overall Average*	1.47	1.29	0.84

*Average was obtained by weighing results according to total number of boys and girls measured and dividing the sum of the square roots of the ratios.

Table I

Another very interesting comparison is between the high result received by the angle between line NA and the SN plane (2.74) and the lower result received by the angle between line NA and the Frankfort plane (1.33). This would indicate that the angle to NA from SN showed a greater relationship to facial esthetics as judged by the panel than the angle to NA from Frankfort. How much of this difference is due to the uncertainties of locating Frankfort as compared to the exactness of locating SN and to the sample size used here we do not know. Further studies along this line may give us additional evidence.

The axis of the lower incisor is compared with three planes; its relation to the mandibular plane received the highest result of the three (2.27). This would not indicate that the angle is of extreme importance to facial pattern, but the high result that this angle received from the boys only (2.53) would indicate that it is not a measurement to be overlooked. The angle to the Frankfort plane shows less importance (1.47) and the angle to the AP plane even less (1.29).

The mandibular plane to SN angle shows some importance (1.77) and, since no other angle studied here describes this part of the face, it would be informative in a headfilm analysis.

The upper incisor axis as compared with the line NA did not seem to be critical (0.79) to the facial pattern.

If a system of headfilm analysis is to be of clinical value to an orthodontist, it must be simple enough so that it will be used. On the other hand, oversimplification to the point of measuring only one angle would seem to be losing much that could be gained from headfilm analysis. If one were to base his selection of angles on the results obtained in this study, it would seem well to include at least the angle of convexity, the angle SNA, the angle between the lower incisor and the mandibular plane, and the angle between the SN plane and the mandibular plane.

SUMMARY

1. Lateral facial photos of 28 boys and 37 girls were rated as to facial esthetics by ten members of the University of California orthodontic staff.
2. Ten angles as recommended by various orthodontists were measured on oriented lateral headfilms of each of the patients.
3. A statistical test (Wilcoxon) was applied to the angular measurements to show which differentiated between the extremes in facial esthetics as judged here.
4. The results obtained indicate that these angles would be preferable to others studied here on the basis of correlation with facial pattern: NA-Po, SNA, SN-mandibular plane, and lower incisor-mandibular plane.

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BIBLIOGRAPHY

Grusd, Harold: Apparent Geometric Error of ANB Angle, Unpublished 1955.

Johnson, E. L.: Frankfort-Mandibular Plane Angle and the Facial Pattern, *Am. J. Ortho.* 36:516-533, July 1950.

Riedel, R. A.: Relation of Maxillary Structures to Cranium in Malocclusion and in Normal Occlusion, *Angle Ortho.* 22:142-145, July 1952.

Riedel, R. A.: An Analysis of Dento-Facial Relationships, *Am. J. Ortho.*, 43:103-119, Feb. 1957.

Steiner, C. C.: Cephalometrics for You and Me, *Am. J. Ortho.*, 39:729-755, Oct. 1953.

Tweed, C. H.: Evolutionary Trends in Orthodontics, Past, Present and Future, *Am. J. Ortho.*, 39:81-108, Feb. 1953.

Walker, M. H., and Lev, J.: Statistical Inference, Holt, Chap. 18, p. 434, 1953.

White, Colon: The Wilcoxon Test, Biometrics Bulletin, 8:33-41, 1952.

Wylie, Wendell L.: Personal Communication, 1956.