The Downs Analysis Applied to Three Other Ethnic Groups

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Since Downs presented his method for the roentgenographic assessment of craniofacial pattern, skeletal and dental, this procedure has come into regular use by orthodontists who routinely use cephalometric films in case analysis. The procedure is a workable one, for it involves the measurement of but ten values from tracings, which can be learned readily and executed with no great expenditures of time once one has had sufficient experience with it. No involved paper-work nor lengthy descriptions are required, and practical forms for office use readily suggest themselves to anyone familiar with this method of analysis.

The rationale behind the Downs Analysis is straightforward: utilizing many years of experience with cephalometric films in his own practice, Downs selected 10 quantitative measures (out of a host of possibilities) which have particular clinical meaning for the orthodontist. He then measured these values in a group of individuals possessing excellent occlusion. For each of the 10 values (5 skeletal, 5 denture pattern) he determined minimal and maximal values as found in this selected group, and calculated the mean or average figure for each. These provide a basis for comparison with individual patients in an orthodontic office, making it possible for one to compare the skeletal and dental pattern of a particular individual in need of orthodontic care with numerical data derived from those who have achieved excellent occlusion without orthodontic intervention.

For the same reason we have oversimplified above the description of Downs' statistical procedure, we omit a discussion of the significance of each of the values involved — all of this is set forth at its best in Downs' original publication.[1]

It should be noted that a *range* of figures is provided — it is not suggested that the mean value be considered the only acceptable one. In this the procedure escapes the criticism of being a numerical straitjacket. If this method of assessment were to be used exclusively in populations similar to that from which Downs derived his values (native American, white stock), it would be almost universal in its application.

To three orthodontists, independently, occurred the thought that the applicability of these standards to other than native white Americans should be tested. Cotton at the University of California, Takano at the University of Washington, and Wong at the University of California have applied the methods of Downs to, respectively, American Negroes, Nisei and American Chinese.

METHOD AND MATERIAL

Cotton had 20 San Francisco Bay Area Negro individuals, 10 males and 10 females, ranging in age from 11-34 years. He is careful to point out that his sample did not in every instance represent perfect occlusal relationships; on the other hand no real malocclusions were included. Oriented frontal and lateral photographs, as well as plaster models, supplemented as records

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* Three investigators working independently, whose reports are herewith brought into a single article, with a discussion by Wendell L. Wylie.

the lateral headfilms (centric occlusion) from which the 10 values were measured.

Takano had 20 Seattle Nisei (American-born Japanese), evenly divided as to sex, with a mean age of 21. His description of the material coincides with that given by Downs: clinically excellent occlusion with good facial balance.

Wong's group consisted of 20 American-born Chinese from San Francisco's Chinatown, 10 males and 10 females, ranging in age from 11-16 years. In the examination of 650 Chinese children he could not find "normals" as he had come to apply the term to Caucasians, but he chose as subjects only those having ". . . normal arch relationships and good facial pattern". Wong also supplemented headfilms with models and face photographs (frontal and lateral).

Each investigator measured in each of his subjects the 10 values described by Downs and then determined means and range values, which are brought together in Table I, for comparison with Downs' figures.

Only Takano subjected the data to the usual tests for significance of difference from the corresponding means for whites. He found that in the Nisei skeletal pattern, only the angle of convexity and the Y-axis differed in mean value from that of the white by significant amounts; on the other hand, four of the five denture patterns values (cant of occlusal plane being the one exception) differed significantly from the white means. Takano states: "The greater Y-axis angle in the Nisei groups may indicate a shorter anteroposterior length of the face, or that growth is predominately in a downward direction rather than a forward direction, which would substantiate previous statements made by physical anthropologists. The greatest differences lie in the denture

pattern . . . significantly more protrusive in the Nisei group than in the Caucasian group".

DISCUSSION
Wendell L. Wylie

The decision to bring different papers into one was made not only to avoid the repetition inherent in individual publication, but also to attempt a sort of integration of the three works not otherwise possible. The Editor of The *Angle Orthodontist* has essayed this latter part of the task, and pointedly indicates his authorship of this portion of the manuscript to absolve the primary authors from responsibility for what follows. The discussion is roughly divided into, (1) observations and interpretations taken from the separate manuscripts of Cotton, Takano and Wong, and (2) remarks which the discusser himself thinks appropriate.

A perusal of the reports upon which this paper is based point up the need for a precise definition of the term "normal". Downs carefully describes his cases as having "clinically excellent" occlusion, evidently in recognition of the fact that by some standards of judgment "normal" occlusion has perhaps never existed — a hypothetical ideal which no individual ever attains, since in one or more details perfection is wanting. Parenthetically, in the minds of some, "normal occlusion" deals not only with the interdigitation of the cusps of teeth, but goes further to involve facial balance and harmony, i.e.; "normal occlusion" and "facial balance" are not separate entities, but instead the latter is part of the concept of normal occlusion. At any rate, Cotton's view of "normal" is apparently the opposite of that of Downs', for he says: "All individuals did not possess clinically excellent occlusions, but all possess more or less normal occlusions". Wong's study was done in the same

institution a year later, and he seems to accept Cotton's interpretation of "normal" as something short of "clinically excellent".

A firsthand discussion among the contributors to this work has yet to occur, but such a meeting would be interesting. As it is, the independently written discussions of their findings are at variance. One of Takano's major conclusions is that it is fallacious to apply morphological standards derived in one ethnic group to individuals of another, and he arrives at this conclusion after comparing his data only with that of Downs'. Yet his mean values differ from those of Downs, taken overall, less than do those of the other two groups. Cotton's position, on the other hand, is characterized by almost extreme caution. He repeatedly reminds one that he did not exercise the selectivity which he presumes Downs did, and he advances this as an explanation of the greater ranges which he reports for his group. The validity of this position must be judged by the individual reader, and then only with Cotton's material at hand. It seems safe to assume that minor defects such as rotations and slight aberrations of cuspal interdigitation would not materially affect the criteria as Downs originally defined them, and that therefore the only selectivity of importance is that which is based on facial esthetics. Inspection of each of Cotton's photographs reveals that only 1 of his 20 subjects failed to have the lips closed in repose and without strain; furthermore, in this one individual the interincisal angle coincides with the mean for whites as reported by Downs! To the one person who has had the privilege of comparing all of the original material of the four studies, all of the Negro faces seem to be "good" faces, unless one is to consider Takano's position as worthless and insist that

everyone be judged by the mean facial pattern for whites.

There is good sense inherent in Cotton's position, in spite of the differences between his figure and those of Downs. He appreciates that mean values may be misleading when one generalizes from them to specific individuals — he points out, for instance, that while his mean for interincisal angle is 123°, the median (which is not affected by extreme values is 129°, considerably closer to Downs' mean. With justice he maintains that in Negroes, individuals may frequently be found who conform well with figures reported for whites, and this observation would undoubtedly apply as well to the other two ethnic groups.

Wong arrives at this judgment: ". . . . Downs' analysis does not hold true for the Chinese of San Francisco Chinatown. The Chinese, when compared to Downs' normals, presented a Class II facial pattern even though each exhibited a good facial profile and a normal occlusion of teeth as evident in the photographs . . . one should exercise caution when using Downs' figures on the Chinese as to what is normal for the race".

The difference between the mean facial pattern for Chinese with normal occlusion and that of the Japanese is particularly interesting. Although it must be kept in mind that the samples were selected by two different investigators, the differences between the means are marked enough that it is unlikely that a repetition of the study (wherein one person passed upon normality of occlusion and facial balance in both Japanese and Chinese) would alter the picture in any of its essentials. The present data suggest that the Downs Analysis affords a particularly good method for sharply delineating the difference between these two peoples of the yellow race.

Three Ethnic Groups Assessed Against The White Standards

Facial Angle

Angle of Convexity

A-B Facial Angle

Mandibular Plane

Y-Axis

Occlusal Plan

Interincisal Angle

$\overline{1}$ to Occlusal Plane

$\overline{1}$ to Mandibular Plane

$\underline{1}$ to A-P Plane

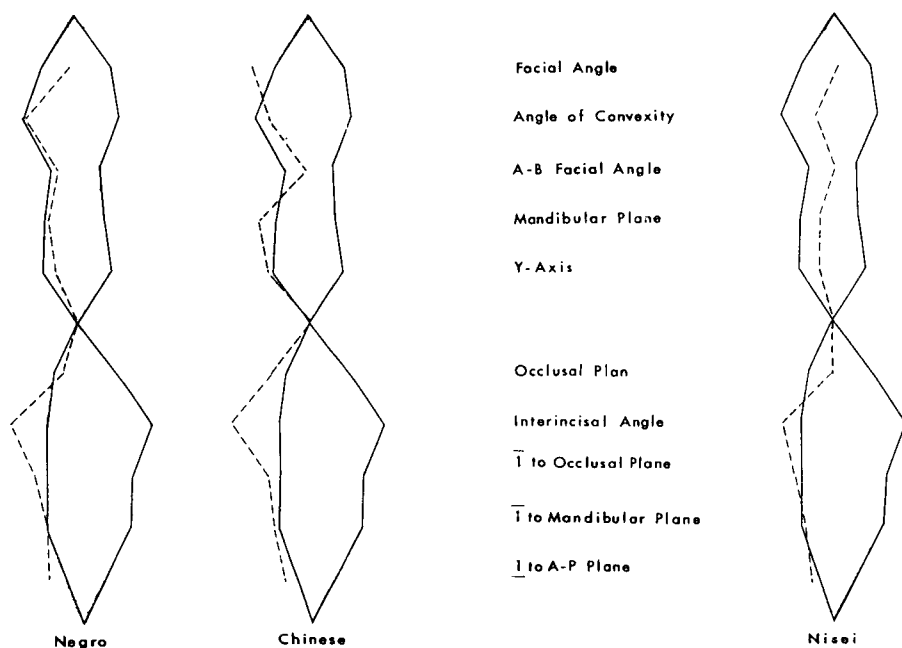Negro   Chinese   Nisei

Fig. 1. The broken line connects mean values for each of the ten Downs values of the chart, for the ethnic group designated beneath the polygon. The three polygons are alike and represent retrognathic (left) and prognathic extremes in white normal occlusions. Mean white values are located on a vertical which passes through the points of the polygon. See p. 193 for a full explanation of the Vorhies-Adams polygon.
For "Occlusal Plan" read "Occlusal Plane".

The recently devised cephalometric polygon of Vorhies and Adams* demonstrates its own usefulness to anyone who will graph a set of Downs Analysis figures upon it, but the device is particularly apt for portraying with visual impact the differences between ethnic groups in the Cotton-Takano-Wong data. Fig. 1 plots Negro, Japanese and Chinese means on the Vorhies-Adams polygon. The left boundary corresponds with the retrognathic extreme of the Downs ranges, the right with the prognathic extreme; the upper half refers to the skeletal pattern and the lower to the denture-skeletal pattern. No scale is provided here, since all the numerical data is available in Table I, and the objective here is

merely to set forth trends, not to pinpoint details. Note carefully that in Fig. 1 it is not individuals but *means* which are plotted; with respect to several of the 10 criteria of Downs, the mean of the group being compared with whites differs not only from the white mean but lies to the other side of the extreme value specified by Downs. This does much to strengthen the impression in the material under comparison that there are real and valid differences in mean facial pattern, since the calculation of mean values suppresses the effect of extreme variables.

Somewhat carried away perhaps by the ingeniousness of the polygon, I have appropriated the idea and given it a different context. In Fig. 2 the

* See page 195 of this issue of the ANGLE ORTHODONTIST.

TABLE I

A Comparison of Means and Ranges for Ten Craniofacial Values in Four Different Ethnic Groups.

Value	American Whites	American Negroes	American Chinese	Nisei
Facial Angle	87.9 82 to 95	87.25 80 to 91	77.5 73 to 89	88.25 83 to 94
Angle of Convexity	0.0 +10 to —8.5	+9.6 +4 to +20	+7.5 +1.5 to +14	3.65 +12 to —1
A-B Plane — Facial Plane Angle	—4.7 0 to —9	—7.7 —3 to —15	—5.7 —2 to —10	—4.35 —1 to —7
Mandibular Plane Angle	21.9 17 to 28	27.25 17 to 35	32.4 22 to 44	24.3 14 to 33
Y-Axis	59.3 53 to 66	63.3 57 to 69	67.1 59 to 75	62.1 56 to 68
Cant of Occlusal Plane	9.2 1.5 to 14	11.8 +8 to +17	+16.9 +8 to +25	9.65 2 to 19
L-1 to U-1 Angle (Interincisal)	135.4 130 to 150.5	123.0 105 to 144	120.8 105 to 137	126.4 114 to 152
L-1 to Occlusal Plane	14.5 3.5 to 20	22.5 12 to 35	22.2 13 to 29	21.5 8 to 31
L-1 to Mandibular Plane	1.5 —8.5 to +7	+6.6 —3.5 to +22	+7.8 0.0 to +18.0	+6.55 —6 to +13
U-1 to A-P Plane (mm.)	3.1 —1 to 5	8.5 6 to 11	7.6 3 to 12	6.6 2 to 10

familiar polygon based on Downs data appears, but three new polygons based on the means and extremes for Negro, Chinese and Nisei have been added to the right. The white man's mean pattern seems quite orderly when it is assessed against his own polygon, but when judged against the standards of any of the other three ethnic groups, the typical white face appears to be jut-jawed, with a dental apparatus retreating back into the face. While these comparisons should do nothing to affect subjective evaluations of what faces should look like, at the same time those with a philosophical turn of mind will pause to ponder the percentage of the world's population which may be properly assessed by the first polygon in Fig. 2, as compared with those who might collectively be evaluated against the other three.

Orthodontists who have adopted Downs' methods of appraisal for routine use have early learned the value of the A-B plane to facial plane relationship. Study of the data combined in this report makes evident once again the fundamental nature of this relationship. Even in ethnic groups which seem to differ elsewhere materially from the others, the A-B measure swings over into conformity. The reason for this is self-evident: the points A and B mark, in the maxilla and the mandible respectively, the anterior limit of each supporting base. Here the labial aspect of the maxillary alveolar process and that of the mandibular alveolar process join the underlying bony structure. Normal arch relationships (here the word "normal" may be used fearlessly) are unattainable unless a harmonious relationship between these points exists. Since every individ-

The Mean White Facial Pattern Assessed Against Three Other Ethnic Groups . . . .

Facial

Convexity

A - B

Mandibular Plane

Y - Axis

O . P .

1̱to1̄

1̄toOP

1̄to MP

1̱to AP

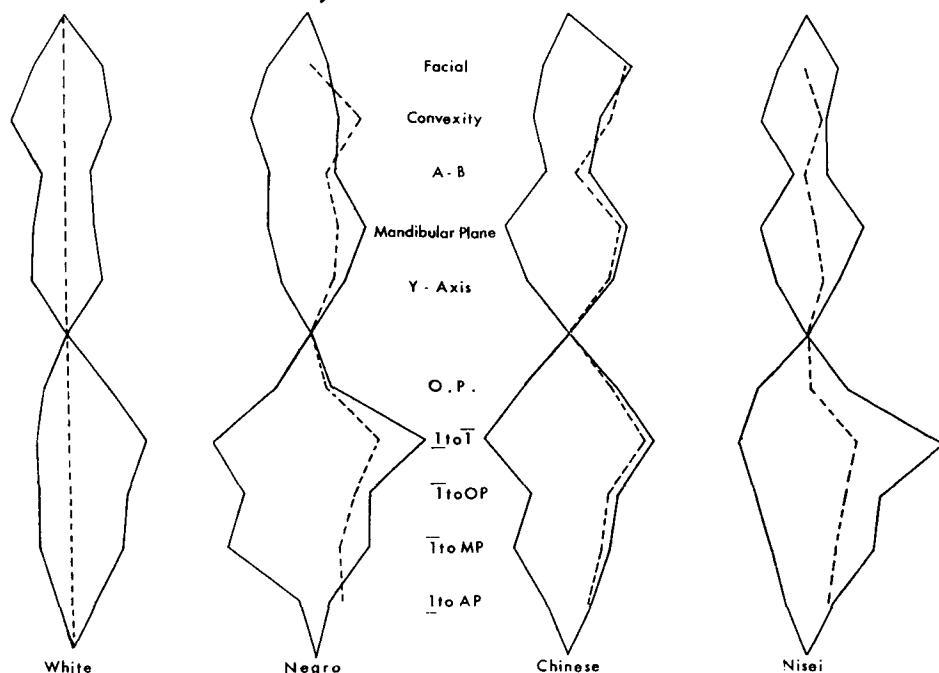White   Negro   Chinese   Nisei

Fig. 2. Three new polygons are created here, using values for Negro, Chinese and Nisei normal occlusions. The white mean (broken line) is plotted on the polygon of the ethnic group indicated below. Note that "one-to-one" Downs' original term, is used here as an equivalent for "interincisal angle", which is perhaps more descriptive.

ual in each of the three separate studies possessed normal occlusion in order to qualify, mean values for the A-B plane to facial plane relationship should show conformity: by the same token, normal occlusal relationships are almost impossible where the points A and B are substantially removed from one another. In either Fig. 1 or Fig. 2 one may see the tendency for the A-B means to hang together, and in Fig. 2 each of the four polygons shows that the high and low extreme for this criterion are relatively close together as compared with the other values in the set. This further demonstrates that the A-B relationship is a crucial one.

This is perhaps as good a place as any for the discussor to express some convictions concerning the extent to which we may with propriety mix our concepts of occlusal relationships and our appraisal of facial balance and harmony. Reference has already been made in the first part of this discussion to the belief held by some that the term "normal occlusion" can be made to embrace facial form — that although in a given person the interdigitation of maxillary and mandibular teeth may be perfect, with good function in various ranges of mandibular movement, the designation of "normal occlusion" must be withheld because the face falls short of an accepted standard of facial esthetics. To one observer, at least, it seems that two separate judgments, and two separate descriptions are required. This is not to say that debate should be restricted on the subject of

facial esthetics; on the contrary, it would seem that the provocative discussions in this area would be more profitable if we could agree that a given case had "normal occlusion" — meaning dental relationships alone — and go on, if need be, to disagree as to facial balance.

To go one step further: how far are we justified in going with the Angle Classification as a system of terminology? Because Wong has been quoted as saying that Chinese normal occlusions have "Class II faces" as compared with whites, this may seem a criticism directed at him. Actually, the precedent of using the Angle Classification as a means of describing basic facial pattern was well established before Wong undertook his project. But is it a precedent that we should continue to follow?

In almost any laboratory where cephalometric films are routine records, there may be found this sort of case: the plaster models display every characteristic ordinarily associated with Class II, Division 1, and the photographs of the patient confirm this judgment. On the other hand, if cephalometric tracings are prepared which omit teeth, alveolar process and soft tissue profile, no difference from the normal can be detected. How shall we classify the case? Until this upstart, the oriented lateral headfilm, was dragged into the discussion all hands would have subscribed to the view that it was Class II, Division 1. Even with the tracing at hand, I would consider ridiculous any attempt to call the case Class I, yet with the same stubbornness I would contend that the tracing is not Class II, Division I. Clearly the distinction must be made: arch relationships and facial appearance are undeniably Class II, Division 1, yet this has occurred in a face where the relationships of basic skeletal points are good. Just as this case points up the need for judging arch relationships and facial balance separately, so one may object to calling faces similar to the Chinese mean pattern "Class II". If we fall into this habit we shall be embarrassed by a plethora of cases which have this retrognathic profile and at the same time have a Class I dental arch relationship.

A final note and I am done. Although two of the primary authors have indicated their unwillingness to use Downs' figures in the ethnic group with which they worked, I would myself trust any of the three to assess a patient, regardless of his ethnic group, against any one of the four polygons. The statement is made not for the sake of introducing a contradiction, but out of firsthand knowledge of the ability of each of the three to handle cephalometric evaluations intelligently. Each of them knows enough to appreciate that the understanding and comprehension of the evaluator is more important than the standards with which he assesses. While it would admittedly be better to use standards derived from the appropriate ethnic group, the exercise of common sense will permit one to find meaningful information from the Downs Analysis, even with the use of a strange standard. Familiarity with headfilms endows one with the ability to make allowance for racial type, and a zig-zag line is a clue to a lack of balance and harmony, regardless of the polygon upon which it is recorded. These standards were never proposed with the intention of regimenting thought, nor of relegating to disuse the orthodontic records which have been with us a longer time. Orthodontists who come to use headfilms will gain from them information available no place else; orthodontists who turn to them with the expectation of finding pat answers to problems may expect instead only disappointment.

Dr. Jack Loughridge of Sacramento, California, before his untimely death in 1950, through generous gifts to the Departments of Orthodontics at California and at Washington, made possible the purchase of capital equipment and supplies in these and other studies.

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