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A Cephalometric Assessment of the Dentoskeletal Relationship of the Anterior Cranial Base and Mandibular Body Length in the North American Negro and Caucasian Child with a Class II Division I Malocclusion

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A CEPHALOMETRIC ASSESSMENT OF THE DENTOSKELETAL RELATIONSHIP OF THE ANTERIOR CRANIAL BASE AND MANDIBULAR BODY LENGTH IN THE NORTH AMERICAN NEGRO AND CAUCASIAN CHILD WITH A CLASS II DIVISION I MALOCCLUSION

by

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LIFE

Gregory Michael Smoron was born in Chicago, Illinois on November 6, 1940. He was graduated from St. Patrick High School, Chicago, Illinois in June 1958. He entered St. Mary's College, Winona, Minnesota after high school and attended for two years, pursuing a pre-dental curriculum.

He enrolled in the Chicago College of Dental Surgery, Loyola University in September, 1960 and received the degree of Doctor of Dental Surgery in June, 1964.

After two years of service with the United States Air Force Dental Corps, he entered private practice and taught clinical operative dentistry at the Chicago College of Dental Surgery, Loyola University, for a period of 11 months.

He enrolled in the graduate school of Orthodontics at Loyola University, Chicago, Illinois in June 1967.

He is married to the former Lynda Frances Connor and has one child.

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To my parents, for their years of patience, assistance, and love.

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CHAPTER I

INTRODUCTION

Facial prognathism, a common characteristic of the human race, is basically an indication of the convexity of the facial profile. It is considered to be variable among the races, and even among certain ethnic groups.

Today, much emphasis is placed on the concept of facial esthetic beauty. Indeed, by their own admission, some of the foremost orthodontists do not treat their patients primarily for the correction of a pathological condition, but rather the achievement of pleasing esthetic values.

Much research has been done toward determining the "ideal, harmonious occlusion with a well-balanced facial pattern and profile." Realizing that this standard must vary for each race and some ethnic groups, various investigators have determined the "ideal" facial pattern for each group. Voluminous data in the form of cephalometric appraisals has been recorded and a number of rather sophisticated analyses have developed from these studies.

The thought behind these figures and analyses would seem to be a common one in medical science. Before

treating a pathological entity, we must be able to recognize the physiological normal, in this case, the "ideal" normal. We can then treat in an attempt to achieve these ideals, being limited in each case by the individual variables imposed on us.

We have determined, then, that among the races there is a basic facial proportion to the cranio-facial structures that will reflect the race or ethnic group of a given number of individuals within a particular grouping. Will this basic proportion be consistent for each race in the presence of a particular handicapping malocclusion? Is it still possible to identify the race or ethnic group by the severity or degree of prognathism of the malocclusion?

Since the most predominate malocclusion is concerned with maxillary prognathism, it would seem the most logical to deal with. To focus the problem, two races, Negro and Caucasian were chosen. The metric length of the anterior cranial base and mandibular body was chosen as the ratio most likely to reflect the degree of prognathism.

This study will attempt to assess the dentoskeletal relationship of the Anterior Cranial Base and the Mandibular Body Length in the North American Negro and Caucasian child with a Class II Division I malocclusion.

CHAPTER II

REVIEW OF THE LITERATURE

Prognathism has been generally defined as a common characteristic of the human race which basically determines the shape of the facial profile.

For many years, prognathism had been studied exclusively by the anthropologists. Dentistry considered prognathism to be a pathological entity.

Camper (1768) conducted one of the first studies in prognathism. He measured a facial angle which was determined by drawing a line from the external auditory meatus to the ala of the nose and bisected it with a second line joining the most prominent point on the forehead to the alveolar margin of the maxilla. Using an index based on these measurements, he was the first to attempt to classify races and some higher forms of animals by their degree of facial prognathism. After some time, however, this index was found to be somewhat inconsistent.

Von Ihering (1872) introduced a plane to aid in determining facial profile that was accepted by the International Congress on Prehistoric Anthropology and Archaeology in Frankfort in 1884 and was named the Frankfort Plane. This subsequently became the standard for cranial

measurements. It was drawn from the superior periphery of the external auditory meatus to the lowest point on the infraorbital margin.

Angle (1899) published his concept of ideal occlusion and facial harmony, based on the belief that these normally occur together. His ideal facial profile was based on a line drawn through the most prominent points on the frontal and mental bony projections and the midpoint of the ala of the nose. He termed this the "line of harmony". The degree of protrusion was determined by its relation to this line. He further defined the position of the teeth in relation to the facial contour:

> "It is that the best balance, the best harmony, the best proportions of the mouth in its relations to the other features requires that there shall be the full compliment of teeth, and that each tooth shall be made to occupy its normal position, normal occlusion."

Most of Angle's tenets still hold true today, and the concepts they are based on, still sound. The primary criticism of his work seems to be that he assumed constancy of the maxillary denture, and his famous classification of malocclusions was based on this. In essence, he isolated the denture from the cranial superstructures. It was possible to have Angle's Class I

neutroclusion and beautiful dental harmony, but still have a prognathic individual.

Klaatsch (1909) hypothesized a variation in different races based on the position of the maxillary first molar to the key ridge. A prognathic race would have the roots more mesially positioned to the key ridge.

Simon (1922) criticized all the important methods of classification up to his time including those of Carabelli (1842), Weckler (1862), Sternfeld (1902), and Angle. Simon said of Angle:

> "From a purely logical point of view he is not convincing, because of the dearth of his observations. All presumptive knowledge based on experience may be changed by a new experience, may be enlarged, or even disproved. .....The relative position of the upper jaw can only be determined by exact craniometric measurements, which Angle did not even attempt. .....The plea of Angle, that the upper jaw always presents a normal position in the cranial structure of every individual because it is firmly attached thereto, appears untenable."

Simon further criticized the classifications of Case, Lischer, and Pfaff. He then proceeded to his own methods, of which he says, "A classification must be based on morphological principles, so that the form relations of a denture, as well as its relationship to the head, may be understood; and we must invent new

methods of investigation if we would understand dento-cranial relations."

Essentially, Simon based his classification on the principles that today are accepted as being valid. He used three planes in the skull which were at right angles to each other, and then compared the dentition to them. These planes were the Frankfort horizontal, the orbital plane, and the raphemedian plane. He believed that in an ideal relationship, the orbital plane passes through the maxillary canine. If the canine was forward to this plane, the individual was considered protrusive, and behind this, retrusive. This particular system of classification was important because it was the first time that the denture bases had been systematically classified as to their position in relation to cranial superstructures.

Calvin Case, in speaking of protrusion, made mention of the fact that "the teeth are in a protruded or retruded position only in respect to the esthetic standard of the dento-facial relations, and in no instances can this be determined or defined by occlusal relations." However, he goes on to say, "If the teeth are in front of a line which forces the lips or lip forward of the true dento-facial line, they are protruded and this is denoted as upper protrusion, lower protrusion, or bimaxil-

lary protrusion. The same is true in regard to retruded malpositions. He went on to define coronal protrusion (crowns protruded labially), bodily protrusion (crowns and roots positioned labially), and prognathism (jaw protrusion).

Charles Tweed believes that the majority of malocclusions are caused by teeth drifting forward and has added a fourth category to Angle's classification, terming it"Bimaxillary protrusions or double protrusions." He further states that malocclusions are due to failure of basal bone growth for various reasons, many obscure, causing a discrepancy between tooth pattern and basal bone. This, in turn, is due to a lack of osseous growth over which the orthodontist has no control.

Hellman, Broadbent, and Oppenheim disputed the findings of Simon as to the constancy of the canine and the orbital plane.

Oppenheim (1928) conducted a study of "pathological prognathism" based on Angle's Class II Division I malocclusion. His studies included measuring and testing some 346 European skulls. He concluded that

> "It is therefore not possible to make a jaw or tooth, or the relation of both to a point of the skull, the point of departure for a diagnosis. Only the reciprocal relation of both

> jaws, as this is manifested by the teeth, is a valid basis for diagnosis, provided that the teeth in their own jaw are in normal positions."

By this study, Oppenheim proved the position of the canine to be inconstant, with no definite position relative to other anatomic structures. He further concluded that the anomaly known as Class II was not caused by excessive forward growth of the maxilla. He believed that in the Negro race, as in the European, the basic assumption that the maxilla is overdeveloped in prognathism is false. Rather, the cause is underdevelopment of the mandible.

Broadbent (1931) devised a standardized method of roentgenographically surveying the cranio-facial skeleton using a cephalometer. This subsequently opened a new avenue for research. Prior to this time, all research on the skull's growth and development was limited to craniometric measurements.

Todd (1932), in studying facial development, concluded that prognathism is due to active forward growth of the face itself in excess of actual cranial extension. In American Negroes, the face and cranium grow at the same rate, causing prognathism. In Caucasians, however, facial growth lags behind cranial growth causing a more orthognathous appearance.

Krogman (1934) basically agreed with Oppenheim that the range in variability between any facial point, plane, or tooth was too extreme to formulate a hypothesis such as Simon had. He measured 355 adult skulls of different races to lend credence to his findings. He also concluded that the Caucasian race was basically orthognathous and the Negro race was basically prognathous.

Broadbent (1937) validly suggested that certain planes in the skull were more suited to comparison of the same and different individuals than those in use at the time. Among the more important planes were S-N (center of sella turcica to frontonasal junction) and S-B (center of sella turcica to Bolton Point). Since this time, angle N-S-B has been widely employed as the cranial base angle.

Hellman (1939) in using a sample of 308 young adult males concluded that not only was the maxilla not overdeveloped in Class II cases, but if anything, it tended to be underdeveloped. However, in proportion, the mandible is even more underdeveloped. In some cases, the maxilla was more anteriorly positioned in relation to the cranial base than is normal.

Brodie (1941) in a serial cephalometric study, measured the cranial base by dividing it into four parts. From these, he found that the anterior cranial base at

three months was longer than the posterior portion. However, post natal growth of the two was equal. After one and one half years the growth of the parts of the cranial base maintained the same size proportionate to each other. Neither the size nor the relative proportions of the cranial base were shown to have any influence on facial type.

Hooten (1946) observed that Negroes and Australian aborigines were the most prognathic of the races. He noted that in these races, the alveolar ridges of both jaws are oversize and bulge excessively, primarily in the region of the anterior teeth.

Bjork (1947) conducted an anthropological x-ray investigation of 600 Swedish boys and military conscripts. He devised a method of facial analysis utilizing both angular and linear measurements as a means of assessing prognathism. He assessed these measurements individually, in relation to each other, and their integral part in the total cranial picture.

He concluded that prognathism more often occurs in both jaws than it does in only one jaw. A further observation was that maxillary prognathism is based on the size and shape of the cranial base and the shape of the facial skeleton. Bjork professed the belief that the profile is

not primarily determined by the amount of maxillary prognathism but rather by the relationship and prognathism of both jaws.

Another hypothesis resulting from this study was that normal occlusion was more frequently found in prognathic individuals, while there was more crowding in less prognathic individuals.

In another study of cranial base development (1955) Bjork found that the cranial base develops in conformity with the brain and facial structures. By doing so, it must have two growth rates, one on the internal surface and one on the external surface. Though cranial development ceases at approximately 12 years of age, sutural growth in the cranial base must remain somewhat active to compensate for both upper and lower facial growth until the age of 18-20 in females and 20-24 in males.

Adams (1948) in his Master's Thesis at the University of Illinois, studied the mandibular tracings of 54 Class I and 54 Class II cases and found no significant difference in the form or size of the mandible.

G. W. Moore said of Class II Division I cases that "all of these typical cases are apical base deficiencies in both maxilla and mandible, and extraction serves to harmonize the dentition with its deficient base." Of Class III,

Moore stated, "the majority of these cases are based on deficient maxillae of hereditary orgin in combination with normal mandibles; and a small minority on overgrown mandibles with normal or deficient maxillae."

Reidel (1948) in his Master's Thesis at Northwestern University, examined the relation of the maxilla and associated parts to the cranial base in normal occlusion and in malocclusion. He concluded that there was no significant difference in the anterior-posterior relation of the maxilla to the cranial base in patients with normal occlusion and malocclusion. However, the position of the mandible anterior-posteriorly in relation to the Anterior Cranial Base was found to be significantly different in patients having excellent occlusion when they were compared to individuals possessing malocclusions.

Cotton (1949) used the Downs Analysis to study the facial relationships of 20 North American Negroes from 11-34 years of age. He found the negro to have a more protrusive denture base than the Caucasian, though the skeletal patterns of the two races were very similar.

Blair (1952) cephalometrically studied 40 Class I, 20 Class II Division I, 20 Class II Division II malocclusions and found no significant differences in male and female, with the exception of size. He felt this allowed

researchers to group subjects regardless of sex when comparing angular measurements. Like many others, however, in matters of diagnosis, Blair stressed the theme of individual variation.

Ricketts (1955) found that the sella - nasion line increases at the rate of almost one millimeter per year. He used serial cephalometric headplates.

Braun and Schmidt (1956) utilized lateral cephalometric roentgenograms of a cross-sectional sample of 100 Class I and 100 Class II Division I malocclusions. They studied the Curve of Spee, ramus height, gonial angle, and mandible length. They believed that, as a result of this study, the mandible could not be the source of difference between the two occlusions. They concluded that the difference is in the maxilla, and the position of the maxilla and mandible to the cranial base, the relative difference of maxilla to the curvature of Spee, or a difference in the relative position of the maxilla to the mandible.

Sassouni (1959) utilizing an archial analysis, compared composite cephalometric tracings of Negro, Caucasian, and Chinese subjects at eight years, 12 years, and in adulthood. In comparing the Negro and Caucasian, he found that in Negroes the denture is more procumbent.

The overall size of the heads and faces of Negro children were larger. Negroes have a shorter anterior cranial base, the palate has a steeper upward inclination anteriorly, the mandible is larger, and the anterior lower facial height is larger.

Altemus (1960) studied cephalofacial relationships in North American Negro children utilizing the analyses of Downs and Sassouni and compared his findings with Caucasian, Chinese, and Japanese children. He found that the overall size of the heads and faces of the Negro children were larger and that the prognathism attributed to the Negro is a dental prognathism. The chin point in relation to the facial plane was found to be similarly placed in both Negro and Caucasian.

Carlsen (1968) in his Master's Thesis at Loyola University of Chicago, found no significant difference in the mean mandibular body length in a comparison of 50 Class I and 50 Class II Caucasian patients.

CHAPTER III

METHODS AND MATERIALS

A. Materials

Random selection of the lateral cephalometric roentgenograms of thirty-one Class II Division I Negro patients and thirty-one Class II Division I Caucasian patients was made from the patient file of the Loyola University Orthodontic Clinic.

The headfilms of the Negro patients consisted of nineteen males and twelve females with a mean age of thirteen years and two months. The overall range was ten to eighteen years of age.

The headfilms of the Caucasian patients consisted of seventeen males and fourteen females with a mean age of twelve years and eleven months. The overall range was eleven to seventeen years of age. These random samples were representative of the Loyola Orthodontic Clinic patients.

B. Methods

The roentgenographic technique utilized was first described by B. Holly Broadbent in 1931. The relation of the subject and film, and the source of radiation was

standardized. A tracing was made of each lateral headfilm on an acetate overlay.

Six landmarks were located and connected on each tracing. Only headplates with clearly defined landmarks were used. If a double image occurred, as often happens at the posterior border of the ramus, the mean difference between the two images was plotted and used.

All of these landmarks were located and plotted twice to eliminate the chance of human error. All linear measurements were recorded to the nearest millimeter. If any error was found, then the particular measurement was redone and the necessary correction made.

C. Landmarks and Constructed Points

Articulare (Ar): The point at the junction of the external of the basis sphenoid and the posterior contour of the neck of the condylar process. The midpoint of the condyles was utilized when double projections caused two separate points.

Gonion (Go): A constructed point formed by the intersection of the mandibular plane and the ramus plane. The midpoint was used where double projection gave rise to two points.

Gonion one (Go_1): The most inferior point on the lower border of the body of the mandible at the gonial angle.

Gonion two (Go_2): The most dorsal point on the posterior surface of the ramus at the gonial angle.

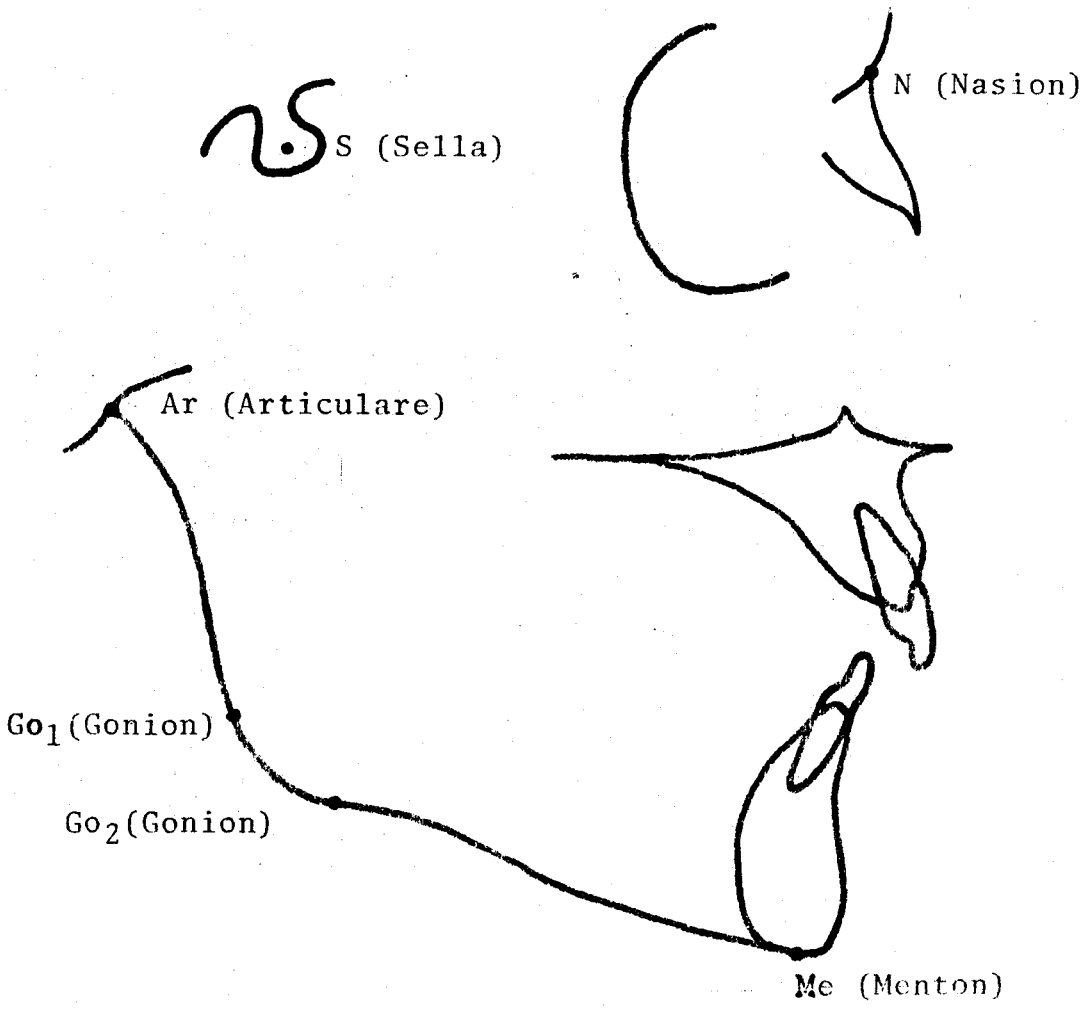
Nasion (N): The most anterior point of the naso-frontal suture.

Sella (S): The center of Sella Turcica (the mid-point of the horizontal diameter).

Menton (Me): The most inferior point on the symphysial shadow.

FIGURE 1

Cephalometric Landmarks



D. Linear Measurements

Mandibular Plane: The line joining Menton (Me) and Gonion (Go).

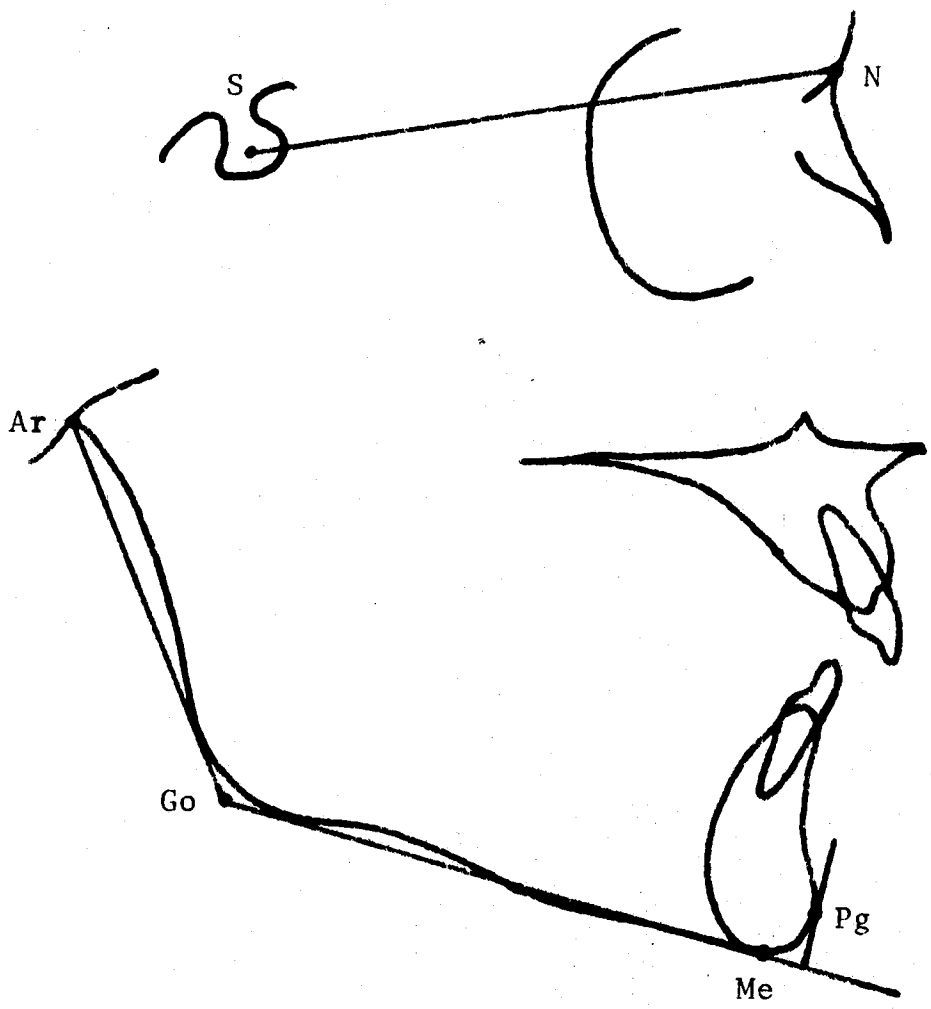
S-N Line: The line connecting point (S) representing the center of sella turcica with the frontonasal junction (N). This line denotes the anterior portion of the cranial base.

Ramus Line: A line intersecting Articulare (Ar) and tangent to the most posterior border of the ramus at the gonial angle (Go_1).

Every line or plane in this study is at right angles to the film surface and is defined by two points in the plane of the film.

FIGURE 2

Linear Measurements



CHAPTER IV

FINDINGS

The statistical analysis of the two linear measurements investigated in this study is represented in Table I. The mean values, standard deviations,and the normal range for the 95 per cent limits are denoted for the Class II Division I Negro and Caucasian population samples. The Student "t" test was utilized for determining the significance between the groups, and is shown in Table II. Table III is concerned with a comparison of the ratios produced by this study and the ratios of Drs. R. Thomas (Master's Thesis-1967) and L. Carlsen (Master's Thesis-1968).

Evaluation of the findings was determined in the following manner. Values of "t" from 0.00 to 2.00 show that there is no significant difference in the compared values. A "t" value of 2.00 or above falls within the 95 per cent confidence limits and is considered to be significant.

A. A comparison of linear values of the Class II Division I Negro and Caucasian subjects resulted in the following (Table I):

TABLE 1

Statistical Evaluation of Linear Measurement of Class II Division I Negro and Caucasian Patients

Measurement		Mean	Standard Deviation	Normal Range (95%)	
				High	Low
Anterior Cranial Base (mm.)	a)	73.71	3.74	81.34	66.08
	b)	71.45	2.05	75.63	67.27
Mandibular Body Length (mm.)	a)	75.80	4.45	84.88	66.72
	b)	79.87	4.75	89.56	70.18

a) Caucasian

b) Negro

1. Anterior Cranial Base (S-N): The Caucasian mean (73.71) was found to be larger than the Negro mean (71.45). The "t" value is 2.95 and indicates a significant difference between the two groups. (Table 2)

TABLE 2

"t" Values For Negro and Caucasian Patients

Measurement	"t" value
Anterior Cranial Base	2.95
Mandibular Body Length	3.48

2. Mandibular Body Length (Go-Po): Comparing the mean values of the Caucasian (75.80) to that of the Negro sample (79.87), it is found that they are significantly different ("t" = 3.48). (Table 2, above).
3. Ratio of Mandibular Body Length to the Anterior Cranial Base: The ratio of these two measurements is found to be 1.11 to 1.0 in the Negro sample and 1.03 to 1.0 in the Caucasian sample. (Table 3).

TABLE 3

Ratio of the Mandibular Body Length to the Anterior Cranial Base in Negro and Caucasian Subjects

	Sample	Mandibular Body Length	Anterior Cranial Base	Ratio
A.	Negro	79.87	71.45	1.11
	Caucasian	75.80	73.71	1.03
B.	Negro	85.11	72.60	1.17
	Caucasian	77.08	73.25	1.05
C.	Caucasian	75.38	73.79	1.02

A.) This study-Class II Division I

B.) Drs. R. Thomas and L. Carlsen-Class I

C.) Dr. L. Carlsen-Class II

4. Ratio of Mandibular Body Length to the Anterior Cranial Base: Comparing the ratio of the Negro sample (1.11 to 1.0) and the Caucasian sample (1.03 to 1.0), it is found that there is a greater variation in the Negro skeletal structure.

CHAPTER V

DISCUSSION

For many years now, dental science has concerned itself with the subject of dental and skeletal prognathism. Even before the advent of what must be today considered sophisticated research armamentarium, investigators have been measuring and studying various angles and planes of the skull in an attempt to determine one or more characteristics of a group, or race of people. Dating back to Camper (1768) and his well-done, though faulty, attempt to classify races and some forms of higher animals by their degree of facial prognathism, men have been attempting to put an average value for this dimension on each race.

Having accomplished this, we could measure a representative number of skulls, and having predetermined a mean, differentiate one race from another. This situation could, of course, only apply to a group within a controlled scientific experiment since there could never be any degree of certainty as far as identification is concerned when dealing with the individual.

The basic purpose of this paper has been to determine whether the already known facial values for the Negro

and Caucasian races would remain proportionate in the presence of a particular malocclusion. Is it still possible to identify a particular race by numerical values of facial prognathism in the same manner as it is possible to do in instances of "normal" occlusion?

The particular malocclusion chosen for this research is the Angle Class II Division I malocclusion. Since it is the most predominate dental deformity in the human race, it would seem to be the logical choice.

The results of this research have been positive. The basic ratios of mandibular body length to anterior cranial base which have been previously determined by other papers (R. Thomas, 1967; L. Carlsen, 1968) for a Class I ideal occlusion in both Negro and Caucasian subjects are very similar to the ratios produced by this study. The previously determined ratios are 1.17 to 1.0 for Negroes and 1.05 to 1.0 for Caucasians. The ratios produced by this study, for a Class II Division I malocclusion, are 1.11 to 1.0 for Negroes and 1.03 to 1.0 for Caucasians.

As a type of control, we find that in a previous thesis (L. Carlsen, 1968) a Class II random sampling of 50 Class II Caucasian subjects produced a ratio of 1.02 to 1.0. This is almost identical to the ratio resulting from this paper (1.03 to 1.0). Apparently, the smaller

sample of this paper (31 subjects vs. 50 subjects) has not greatly affected the accuracy of the findings.

However, there is a need for further investigation and research in this area. It is always possible that individual variability may have been lost through statistical analysis of a random sampling. Only when hundreds, perhaps thousands, of individuals have been considered cab we be somewhat assured of the validity of this study. Other cranio-facial measurements should also be considered as possible parameters. There is some control for the work to be done on Class II Caucasian subjects, but there is no known study done on the Negro Class II Division I malocclusion. Perhaps this paper can serve as such in a future study.

Certainly, these findings assume a certain measure of importance in that the abnormal is always based on what is normal for a particular species. When we are able to determine these values, we are more able to treat an orthodontic problem with a clearer vision of the ends we must attain. We must always remember that each case is an individual problem with a variable set of circumstances surrounding it. A series of numbers, such as those produced by this study can only serve as a guide or rule of thumb. Further, it is safe to say that it has been validly estab-

lished that when we are dealing with different races, a new set of normal values must be used.

By further examination of the figures produced by this study, it can be seen that the mandible is larger (79.87 mm) in the Negro subjects than in the Caucasian (75.80 mm). However, the anterior cranial base in the latter is metrically longer, (73.71 vs. 71.45).

In both instances, it can be seen that both the maxilla and the mandible are metrically shorter in the presence of the malocclusion than they are in the case of the Class I occlusions. These findings would tend to corroborate the observations of Hellman (1939) that the maxilla is not overdeveloped in a Class II malocclusion; rather, it tends to be underdeveloped. But proportionately, the mandible is even more underdeveloped. This would also agree with Moore who states that in a Class II Division I malocclusion there is an underdevelopment of both jaws.

The findings are also consistent with Sassouni (1959) who found a shorter anterior cranial base and a larger mandibular body length in the Negro sample of a study involving Negro and Caucasian subjects with Class I occlusions.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This investigation was a cephalometric analysis of Negro and Caucasian subjects presenting a Class II Division I malocclusion. A cross sectional random sample of 31 Negro and 31 Caucasian patients from the Loyola University Orthodontic Clinic in Chicago, Illinois was utilized. Six landmarks were located and connected on an acetate overlay placed over the roentgenogram. Measurements of the mandibular body length and anterior cranial base were made to the nearest millimeter. The mean and standard deviation for each measurement was calculated. The student "t" test was employed to determine if a significant difference existed between the measurements in each malocclusion.

The following may be concluded from this study:

1. The mean mandibular body length was found to be larger in the Negro sample.
2. The mean anterior cranial base length was found to be larger in the Caucasian sample.
3. Proportionately, the ratios of the mandibular body length and anterior cranial base were found to be nearly the same in this malocclusion

(Class II Division I) as they are in the previous studies concerning patients with an "ideal" Class I occlusion.

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APPENDIX

CAUCASIAN DATA

Patient No.	Sex	Age	Anterior Cranial Base Length (mm.)	Mandibular Body Length (mm.)
1	M	13	80	82
2	F	15	68	74
3	M	11	74	66
4	F	13	70	72
5	M	12	73	79
6	F	13	73	74
7	F	14	72	78
8	M	12	72	72
9	F	15	71	73
10	M	12	74	71
11	F	13	78	80
12	F	13	76	85
13	M	13	78	77
14	M	11	81	72
15	F	12	67	80
16	F	13	78	76
17	F	15	69	78
18	M	13	71	73
19	M	13	75	71
20	M	14	75	73
21	F	13	70	70
22	F	13	70	76
23	F	16	69	82
24	M	12	74	77
25	F	11	70	75
26	F	14	70	81
27	M	15	76	75
28	M	11	69	80
29	F	13	71	82
30	M	13	70	72
31	M	15	77	81

NEGRO DATA

Patient No.	Sex	Age	Anterior Cranial Base Length (mm.)	Mandibular Body Length (mm.)
1	M	15	71	80
2	F	11	64	71
3	M	16	79	84
4	M	12	75	73
5	F	10	70	75
6	M	14	73	88
7	M	12	76	79
8	M	15	74	80
9	M	12	69	81
10	F	12	70	77
11	F	16	70	83
12	M	10	72	78
13	F	13	69	88
14	M	11	70	80
15	M	13	67	79
16	M	12	73	86
17	F	13	69	88
18	F	16	67	86
19	F	12	69	68
20	M	18	73	87
21	M	16	76	84
22	M	13	75	70
23	M	12	80	81
24	F	11	70	80
25	F	12	73	80
26	M	13	76	75
27	M	12	72	77
28	M	14	72	78
29	F	12	75	74
30	M	17	79	82
31	M	11	73	77

APPROVAL SHEET

The thesis submitted by Dr. Gregory Michael Smoron has been read and approved by members of the Department of Oral Biology.

The final copies have been examined by the Director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Science.

May 29, 1969
Date

Joseph M. Lawsing
Signature of Advisor