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A Study of the Relationships of the ABO Human Blood Groups, the Rh Factor and Hereditary Malocclusions of the Skeletal Type, Class II, Division 1

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A STUDY OF THE RELATIONSHIPS OF THE ABO HUMAN BLOOD GROUPS, THE Rh FACTOR AND HEREDITARY MALOCCLUSIONS OF THE SKELETAL TYPE, CLASS II, DIVISION 1

BY

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LIFE

Charles Louis Schnibben was born in Aurora, Illinois on October 13, 1938. He was graduated from Naperville Community High School, Naperville, Illinois in June, 1956. He entered North Central College, Naperville, Illinois after high school and was graduated with a Bachelor of Arts degree in June, 1960.

He entered 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 Navy Dental Corps, he enrolled in the graduate school of Orthodontics at Loyola University, Chicago, Illinois in June 1966.

He is married to the former Sylvia Louise Pickell and has three children.

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To G.W. Rapp, Ph.D., Professor of Biochemistry and Physiology, Loyola University, School of Dentistry, who as my advisor, provided the guidance, supervision and the moral support needed to complete this investigation.

To my wife, Sylvia for her understanding, patience and love during my years of graduate work.

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CHAPTER I

INTRODUCTION

A. Introductory Remarks and Statement of the Problem

The purpose of this research is to investigate the possible existence of a relationship between the ABO human blood groups, the Rh factor and hereditary malocclusions of the skeletal type, Class II, division 1. Skeletal type refers to the inherited bony size, position and form of the upper and lower jaw to each other while Class II, division 1 refers to the position of the upper first molar in relation to the lower first molar in an anterior-posterior direction. The upper anterior teeth are generally "bucked" in appearance.

There has been no previous research in this precise area although similar studies have been carried out on other physical characteristics of various peoples.

B. Review of the Literature

Genetics, a study of the science of heredity attempts to explain the inheritance of all bodily characteristics.

Winchester (1951) credits Gregor Mendel for discovering the basic principles of genic inheritance in 1865, which formed the foundation of modern genetics. Since that time there has

been substantiation and extension of his work by means of plant and animal experiments. With the animal experiments it naturally followed that attention would be turned to the study of the blood with its many factors and how it might be related to genetics.

Mourant (1954) states that after the discovery of the ABO blood groups by Landsteiner in 1900, many unsuccessful attempts were made to find associations between the blood group antigens and disease or certain physical characteristics exhibited in the phenotype. Therefore it was assumed that the phenotypes controlled by the genes determining blood group specificity were of neutral selective value. Differences in the distribution of the genes in different peoples of the world was explained by drifting or sampling variation in small populations. Drift was thought responsible for the high frequency of the blood group A (80%) in Blackfoot and Blood Indians compared with 2% in the Ute Indians of North America. In contrast to this, most of the blood group gene frequencies over large areas tend to remain fairly constant or uniform as is seen over northern and central Europe.

Muschel (1966) said that the first, and still the strongest, easily demonstrable evidence against this view of their neutral selective value was provided in 1939-40 by Philip Levine and his associates when they showed that hemolytic

disease of the new-born was caused by immunization of the mother by fetal antigens that she lacked, but which the fetus had inherited from the father. Thus the discovery of the Rh factor and its relationship to hemolytic disease of the new-born and transfusion reactions marked the beginning of renewed interest and subsequent discovery in the field of blood groups' characteristics.

According to Dobzhansky (1959), the individual never fully realizes the genetic pattern in postnatal life. Human potentialities are determined by the inherited or genotype, but their manifestation depends also on environment. With the exception of identical twins, no two people have the exact same genotype.

Dobzhansky (1959) further states that there are three types of transmission of malocclusions from the standpoint of genetics and they are as follows:

1. Repetitive - The recurrence of a single dento-facial deviation within the immediate family and in the progenitors.

2. Discontinuous - The recurrence of a tendency for a malocclusal trait to reappear within the family background over several generations.

3. Variable - The occurence of different but related types of malocclusion within several generations of the same family.

Salzman (1966) states that Lebow and Sawin (1941) presented a pedigree of seven generations, including 42 individuals who manifested a Mendelian segregation or distribution of facial characters. He further says Stockard's (1931) findings on the crossbreeding of pure-bred dogs suggest that one set of genes predetermines the structural pattern of the maxilla and another the mandible. It can be assumed then that the growth of the two jaws is independent of one another. In other words the growth potential for one jaw can come from one set of genes while the growth potential for the other jaw may come from another set of genes.

Neel (1961) found genetic factors responsible for approximately 20% of all physical malformations.

Moorrees (1957), in his discussion of the Aleut dentition stated that the Eastern Aleut exceeded the Western Aleut in having a greater bizygomatic width, greater facial height, and a higher frequency of blood groups O, B and type N.

Muschel (1966) lists such well known diseases as ulcers and cancer of the gastrointestinal tract, rheumatic fever, poliomyelitis, bronchopneumonia, viral infections and many disease syndromes which are related to and affected by the blood groups.

Much has been accomplished in the medical field with the problem of the relation of blood groups to disease as seen by the partial list of forementioned disorders. Many more diseases and disorders related to medicine could be included here, however, they are beyond the scope of this paper.

Cleidocranial dysostosis, mandibulofacial dysostosis, hereditary ectodermal dysplasia, osteogenesis imperfecta and hypertelorism are just a few of the diseases known to affect normal development of the jaws and dentition.

Dahlberg (1961) states that gene effects demonstrated in the progressive changes in morphology have occurred in the past and built up to the polygenetic background which faces us today in analysis of dental characteristics.

In a personal communication from Dahlberg (1967), he stated that he knew of no research which had been carried out relating blood groups or the Rh factor to malocclusion.

CHAPTER II

METHODS AND MATERIALS

A. Selection of Subjects

Subjects for this investigation were selected from patients being treated by the orthodontic department of Loyola University, School of Dentistry and from students attending dental school at Loyola University.

The group studied included both males and females of the Caucasian race who exhibited a hereditary malocclusion of the skeletal type, Class II, division 1. A similar control group was used comprised of subjects exhibiting a Class I, arch length discrepancy type malocclusion.

The clinical manifestation of a skeletal type, Class II, division 1 malocclusion can be characterized by many cephalo-dento-facial morphologic deviations to varying degrees and in various combinations, among which are the following:

1. A forward relation of the body of the maxilla to the anterior base of the cranium from sella to nasion (S-N).

2. A forward relation of the maxilla to the mandible which is at or slightly below the mean of normal range to the facial angle (N-Pg).

3. Mandibular underdevelopment -- a short, retrognathic mandible with a maxilla that is normal in size and relation to the anterior cranial base.

4. A retrognathic mandible of normal size in relation to a maxilla of normal size and in normal relation to the anterior cranial base.

5. High glenoid fossa with a short ramus, resulting in a retrognathic mandible.

6. Short ramus and a gonial angle over 135^{o}, producing a retrognathic mandibular relation to the maxilla.

7. A long ramus and a short mandibular body, resulting in a retrognathic relationship of the mandible to the maxilla.

8. A large ANB difference, usually 5^{o} or greater.

The subjects in the control group exhibited malocclusions of the Class I arch length discrepancy type which is characterized by a molar relationship which is normal (Class I) and an irregularity somewhere else in the dental arch due to a lack of space to accommodate all the teeth. This is usually manifested by irregular incisor alignment, high canines, crossbites in the premolar area, blocked out teeth or generalized crowding. The maxilla and mandible are generally well positioned to each other and to cranial anatomy in these cases.

B. Method of Blood Testing

An understanding of the ABO blood group system and Rh

factor is necessary and helpful when testing for specific blood types.

The antigens determining the four blood groups reside on the surface of the red blood corpuscles and are the result of the expression of three allelic genes, O, A, B, the latter two apparently being dominant to O. The genotypes AA and AO, and the genotypes BB and BO, cannot be distinguished serologically and are classified as phenotypes A and B respectively. Accordingly only four phenotypes can be recognized although six genotypes occur: OO, AO, AA, BO, BB, AB.

Depending on which blood group antigen is present on the red blood corpuscles the reciprocal antibody is found in the plasma. When the A antigen is found on the red blood corpuscle, anti-B will be present in the plasma; when the B antigen is on the red blood corpuscles, anti-A will be found in the plasma. When there are no antigens present on the corpuscles as in blood group O then both anti-A and anti-B antibodies will be found in the plasma. Just the opposite is then true for blood group AB.

Study of heteroimmune sera by Landsteiner and Wiener led to the discovery of an antibody capable of detecting another blood group antigen unrelated to the ABO blood groups. This antiserum had been obtained by injecting red corpuscles from the Rhesus monkey into rabbits, and therefore was called anti-Rh. This antibody was found to have a positive reaction

with approximately 85% of the human red corpuscles it was tested on. These were termed Rh positive, while the 15% left were termed Rh negative. This led to the discovery of the cause of many isoimmunization reactions seen in blood transfusions and child birth by Levine and Stetson in 1939.

Determination of the blood groups of the subjects was made with anti-A, anti-B and anti-D sera. Anti-A sera was used to determine the presence of the A antigen, anti-B sera to determine the presence of the B antigen and anti-D sera to determine the presence of the Rh factor.

The following procedure was used to determine the blood type and Rh factor of each of the subjects.

1. Three large drops of blood were obtained from each subject's finger by piercing the skin with a sterile lancet. The blood was placed on a glass slide by "milking" or squeezing the finger until three separate and distinct drops were present in a row on the slide.

2. One drop of anti-A sera was added to the first drop of whole blood.

3. One drop of anti-B sera was added to the second drop of whole blood.

4. One drop of anti-D sera was added to the third drop of whole blood.

5. Each was mixed using a clean toothpick and the slide was tilted back and forth.

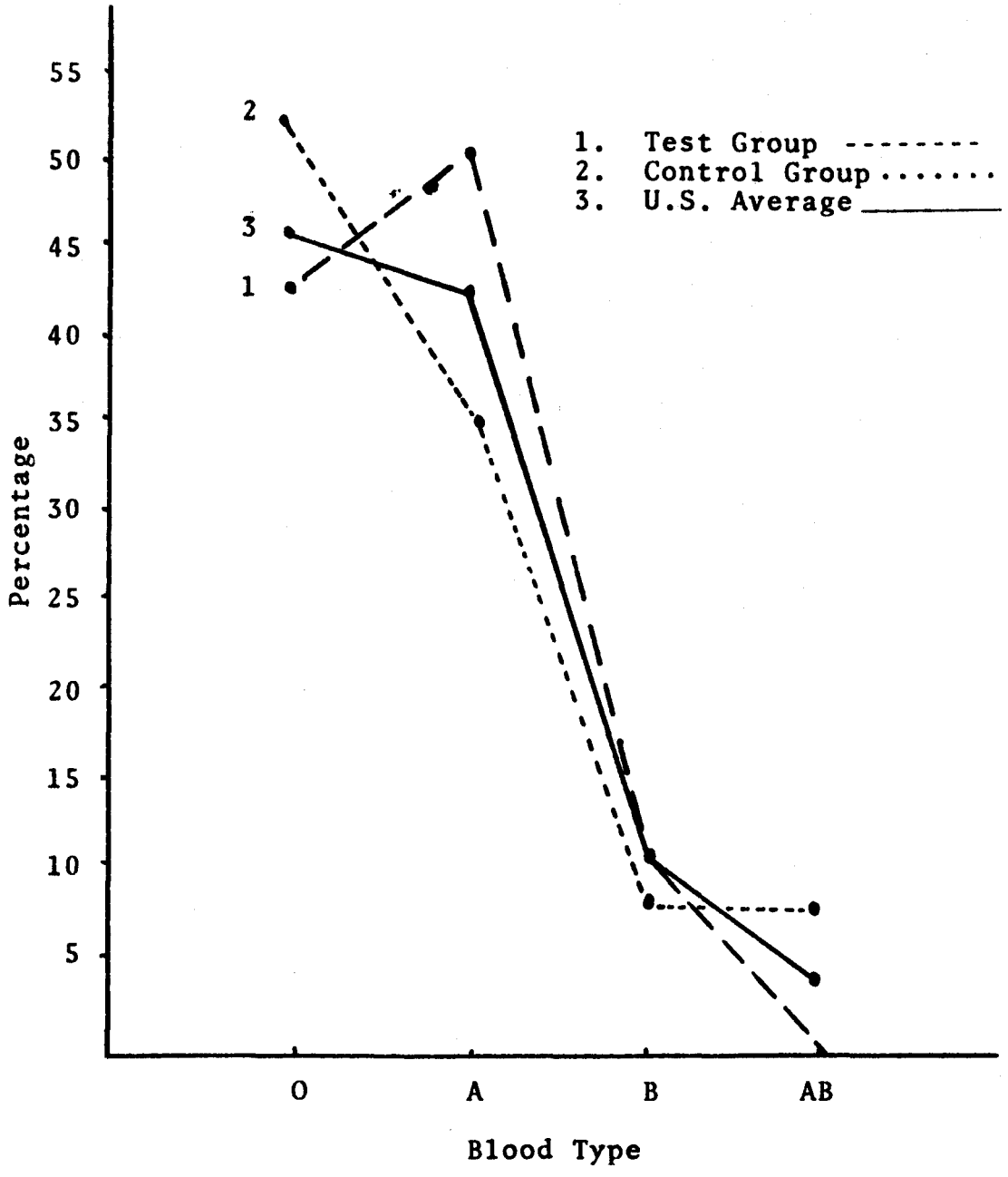
6. The slides were examined for agglutination of red blood corpuscles.

This direct method was chosen for its speed and simplicity. The agglutination reactions for the ABO blood types were usually rapid and easily identifiable. The Rh factor testing generally required about one minute while tilting the slide over a warm light bulb which was turned on. The agglutination in the testing for the Rh factor was generally more difficult to detect and sometimes required repeating.

The results were put in graph form as seen in Table 1. The figures for the skeletal test group and the Class I control group were compared to each other and to the United States National Averages for Caucasions using the Chi square formula, $X^2 = \leqslant \frac{(O - T)^2}{T}$.

Table 1

Graph Depicting Range of Subjects Tested



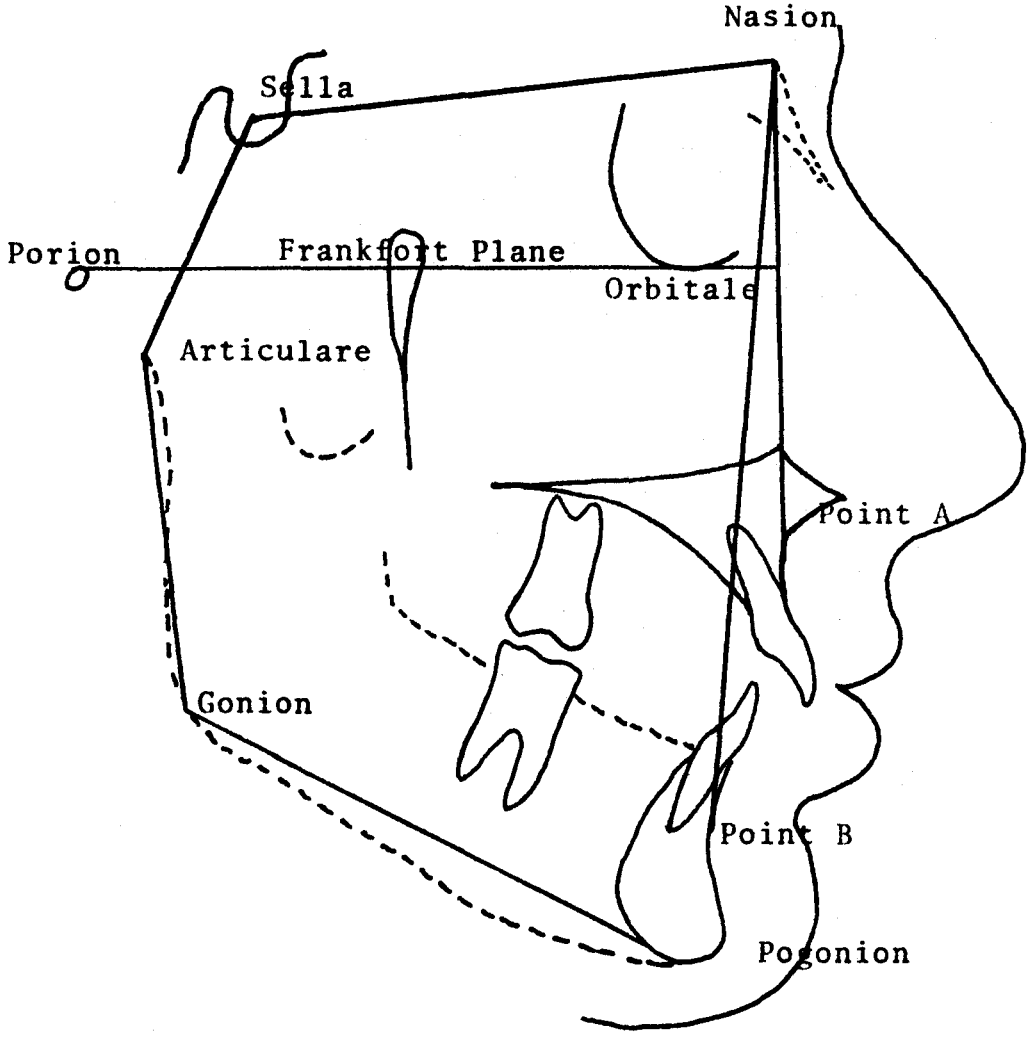


Figure 1 Skeletal Landmarks Used

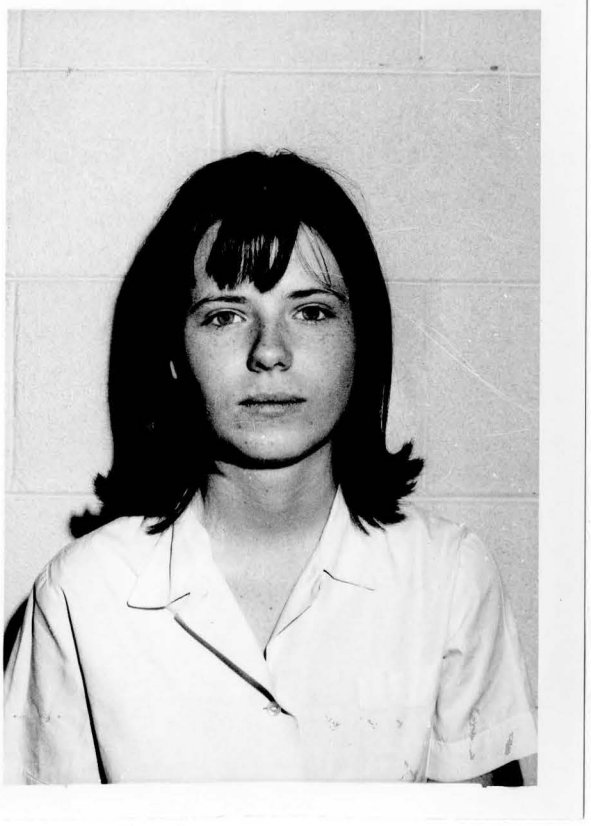


Figure 2 Frontal View of a Class I Control Subject

Figure 3 Profile View of a Class I Control Subject

Figure 4

Frontal View of a Skeletal Type, Class II, Division 1 Subject

Figure 5

Profile View of a Skeletal Type, Class II, Division 1, Subject

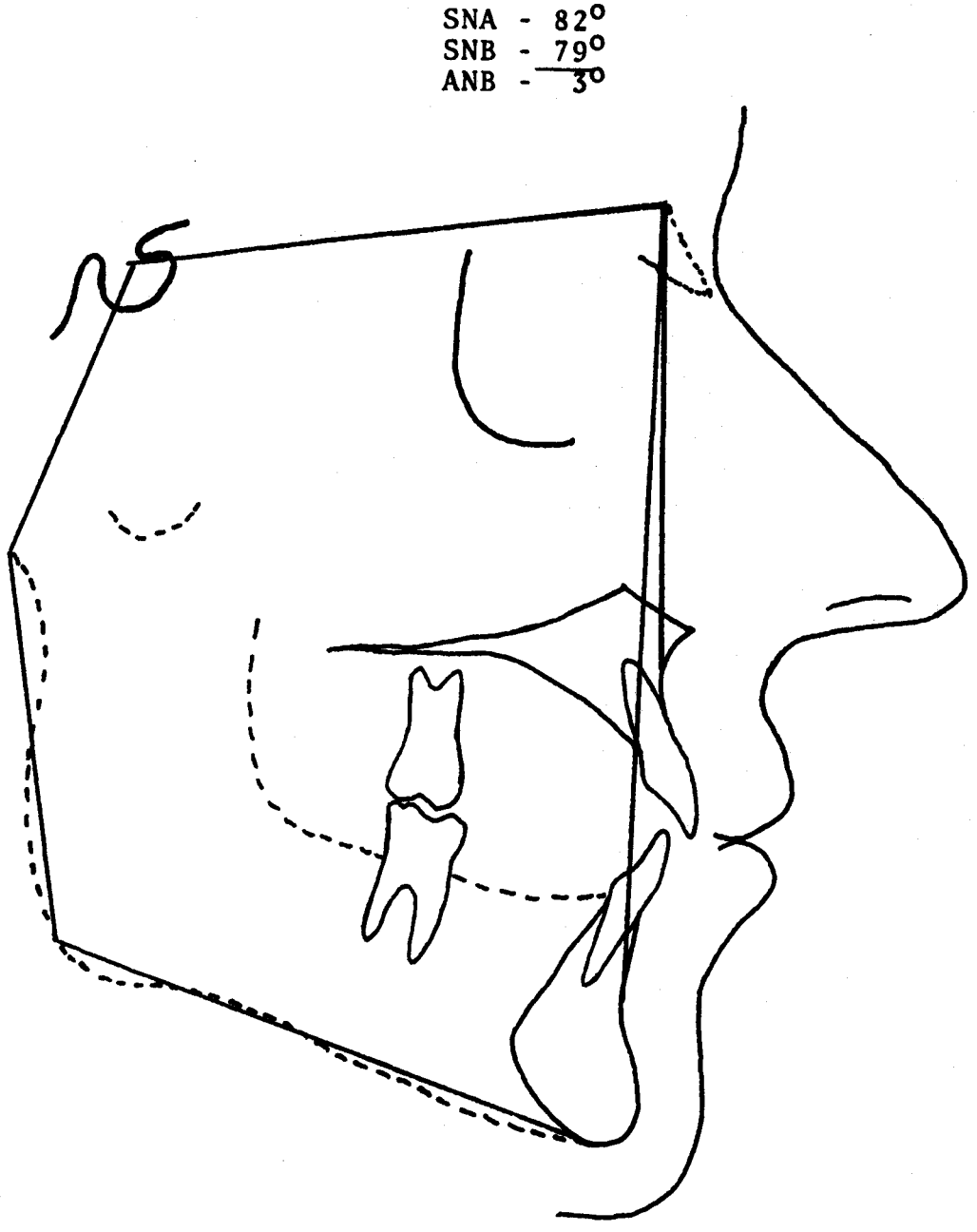


Figure 6

Lateral Headplate Tracing of a Class I Control Group Subject

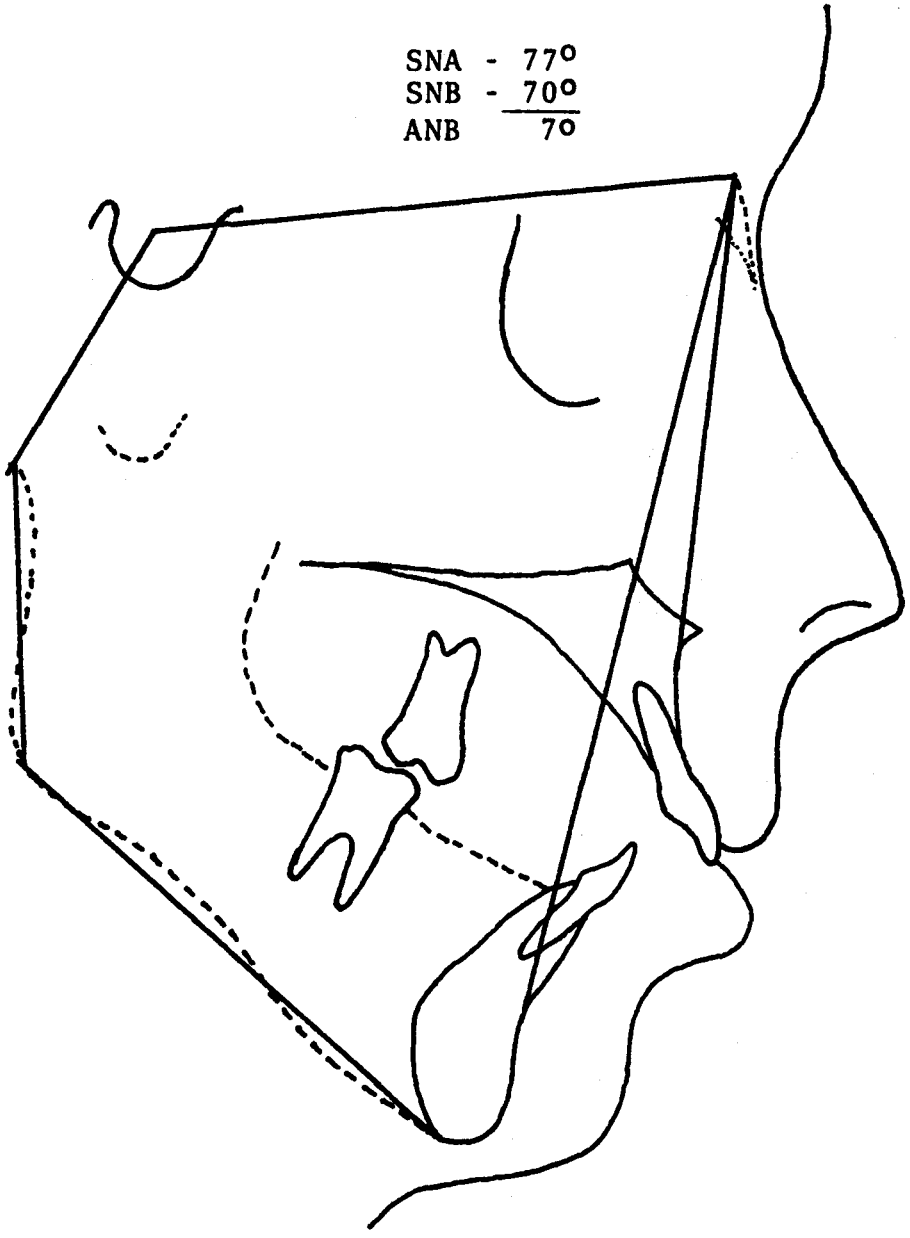


Figure 7

Lateral Headplate Tracing of a Skeletal Type, Class II, Division 1 Subject

CHAPTER III

FINDINGS

The graph in Table 1 and the statistics in Table 2 show that the skeletal test group falls on one side of the National Averages for Caucasions while the Class I control groups falls on the other side.

There were 10% more subjects with type O blood in the Class I control group than in the skeletal test group.

Type A blood subjects showed the greatest variation with only 34% showing up in the Class I control group while 48% were present in the skeletal test group.

No subjects with type AB blood showed up in the skeletal test group while 7% showed in the Class I control group.

Ten percent of the subjects in the skeletal group had type B blood and 7% had type B in the control Class I group.

Table 2

Class I Control Group

Blood Type	No. of Subj.	Rh+	Rh-	%Rh+	%Rh-	% of Total
O	52	41	11	41	11	52
A	34	25	9	25	9	34
B	7	6	1	6	1	7
AB	7	7	0	7	0	7

Class II Skeletal Group

Blood Type	No. of Subj.	Rh+	Rh-	%Rh+	%Rh-	% of Total
O	21	19	2	38	4	42
A	24	20	4	40	8	48
B	5	4	1	8	2	10
AB	0	0	0	0	0	0

National Averages - United States

Blood Type	% of Total		
O	45		
A	41	Rh+	85%
B	10	Rh-	15%
AB	4		

Table 3

Chi Square Table of Significance

	Group		Group	Chi^2
1.	Skeletal	vs.	Control	7.985**
2.	Skeletal	vs.	U.S. Average ***	2.666*
3.	Control	vs.	U.S. Average	5.436*
4.	Skeletal Rh-	vs.	Control Rh-	3.282*
5.	Skeletal Rh-	vs.	U.S. Average Rh-	.038*
6.	Control Rh-	vs.	U.S. Average Rh-	2.823*
7.	Skeletal O	vs.	Control non O	2.002*
8.	Skeletal A	vs.	Control non A	4.365**
9.	Skeletal B	vs.	Control non B	.690*
10.	Skeletal AB	vs.	Control non AB	3.763*
11.	Skeletal O	vs.	U.S. Average non O	.181*
12.	Skeletal A	vs.	U.S. Average non A	1.012*
13.	Skeletal B	vs.	U.S. Average non B	.000*
14.	Skeletal AB	vs.	U.S. Average non AB	2.833*
15.	Control O	vs.	U.S. Average non O	1.979*
16.	Control A	vs.	U.S. Average non A	1.618*
17.	Control B	vs.	U.S. Average non B	1.000*
18.	Control AB	vs.	U.S. Average non AB	2.343*

* Not Significant
** Significant to the .05 level
*** United States National Averages for Caucasians

Table 4

Incidence of Appearance By Random Selection

Class II Skeletal Group

1.	A	18.	O	35.	A-
2.	O	19.	O	36.	A
3.	O	20.	B-	37.	B
4.	A	21.	O	38.	O-
5.	A	22.	B	39.	O
6.	A-	23.	A	40.	A
7.	O-	24.	O	41.	O
8.	O	25.	A	42.	O
9.	A	26.	A	43.	A
10.	A	27.	O	44.	A
11.	A	28.	O	45.	O
12.	A-	29.	O	46.	A-
13.	A	30.	A	47.	A
14.	O	31.	O	48.	O
15.	A	32.	A	49.	B
16.	A	33.	B	50.	A
17.	O	34.	O		

Class I Control Group

1.	A	21.	A	41.	AB	61.	A-	81.	O
2.	O-	22.	O	42.	O	62.	O	82.	A
3.	O	23.	O	43.	O	63.	O	83.	AB
4.	AB	24.	A	44.	O	64.	A	84.	A
5.	O-	25.	A-	45.	B	65.	A	85.	O
6.	O-	26.	A	46.	A	66.	O	86.	O
7.	O-	27.	AB	47.	B	67.	B-	87.	O-
8.	A-	28.	B	48.	O	68.	O	88.	O
9.	A	29.	A	49.	O	69.	O	89.	A
10.	B	30.	O	50.	O	70.	O	90.	O-
11.	A	31.	O	51.	O	71.	A-	91.	A
12.	O	32.	A-	52.	A	72.	O	92.	A-
13.	A	33.	A	53.	O-	73.	O	93.	A
14.	AB	34.	A	54.	O	74.	O	94.	A-
15.	O	35.	O-	55.	O	75.	O	95.	O
16.	A	36.	A-	56.	O	76.	O	96.	O
17.	A	37.	O-	57.	B	77.	O	97.	O
18.	O-	38.	O-	58.	A	78.	O	98.	AB
19.	AB	39.	O	59.	A	79.	O	99.	A
20.	O	40.	B	60.	O	80.	A-	100.	A

CHAPTER IV

DISCUSSION

It is seen from the statistics in Table 1 and Table 2 that the skeletal, Class II, division 1, test group falls on one side of the United States National Averages for Caucasians while the control, Class I, arch length discrepancy group falls on the other side. When the individual blood groups of the test group and the control group are added together and averaged, it is seen that they fall exactly or very closely to the United States National Averages.

While the blood types O, B, and AB showed no significance when comparing the skeletal test group to the control group, type A did show significant results. The comparison of the skeletal group as a whole to control group also showed significant results. This, of course, is due to the fact that the A blood group subjects were included in the total for the skeletal group as a whole vs. the control group as a whole.

Why the skeletal type A blood group should show significant results while the other blood groups do not is difficult to answer since chemically there is not really a

great deal of difference between type A and type B for example. This is not to imply that there is a genetic link or direct influence between any of the blood groups and the skeletal pattern or malocclusion of the subjects tested. The results merely show that a higher number of subjects in the skeletal test group had type A blood than in the control group. The same could be said for the other groups tested. There was a higher percentage of subjects with type B blood in the skeletal group than in the control group, but there was a higher percentage of type O and AB in the control group than in the skeletal group.

The data obtained in a biological experiment are subject to variation, chance and random events which play a part in our daily lives. An example of this seen in this study is that there were no subjects in the skeletal test group which exhibited an AB blood type. The total in the test group studied was fifty subjects. Yet, if the total had been fifty-two subjects and the next two subjects had tested out as AB blood types, this would have brought the figures for type AB in the skeletal test group up to almost 4%, which is the United States National Average for Caucasians.

CHAPTER V

SUMMARY AND CONCLUSIONS

A. Summary

A research project was undertaken to investigate the possible existence of a relationship between the ABO human blood groups, the Rh factor and hereditary malocclusions of the skeletal type, Class II, division 1. Class I, arch length discrepancy subjects were used as a control group. There were fifty subjects in the test group which was chosen and 100 in the control group. The groups included both males and females of the Caucasian race.

Determination of the blood groups was carried out grossly using the direct method of testing fresh blood on a glass slide. Anti-A, anti-B and anti-D sera were used to determine the ABO blood type and the Rh factor involved.

The statistics obtained were examined using the Chi-square formula for comparison. It was seen that the skeletal test group fell on one side of the United States National Averages for Caucasians and the control group fell on the other side statistically. A significantly higher percentage of subjects were examined in the skeletal test group showing type A blood than in the control group. It was apparent that when

the skeletal test group and the control group were added together they made up the National Average.

B. Conclusions

The conclusions arrived at were the following: (1) The test group falls on one side of the National Averages for Caucasians while the control group falls on the other side. (2) The test group plus the control group make up the National Average or come very close to doing so. (3) There is a significantly higher number of subjects with type A blood in the skeletal test group than in the control group.

Statistics tells us that the number of subjects tested was sufficient to rule out errors in the size of the sample tested. In the future if the experiment was to be run again I would suggest a more sensitive type of blood testing to rule out any error in the exact typing of the subjects.

The natural laws of variation, natural selection and heredity play the determining roles just what the characteristics of an individual will be. Although variations are accidental and undirected, the accumulated variations that are preserved by natural selection and heredity are directed towards a better and better adaptation of the organism to the environment. With this in mind, while it appears from the investigation that there is no direct genetic link or influence of

the blood group antigens on the development of the skeletal pattern of the jaws, but there may be a possibility of parallel variation, natural selection and heredity at work.

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APPROVAL SHEET

The thesis submitted by Dr. Charles Louis Schnibben 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 24, 1968
Date

L. W. Rapp, Ph.D.
Signature of Advisor