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An Anthropometric Study of the Face and Dentition of the Papago Indian at the Stewart Indian School, Carson City, Nevada

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AN ANTHROPOMETRIC STUDY OF THE FACE AND DENTITION OF THE PAPAGO INDIAN AT STEWART INDIAN SCHOOL, CARSON CITY, NEVADA

by

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Each person whose signature appears below certifies that he has read this thesis and that in his opinion it is adequate, in scope and quality, as a thesis for the degree of Master of Science.

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CHAPTER I

INTRODUCTION AND PURPOSE OF THE STUDY

History

Paleontologists and physical anthropologists have been largely dependent upon fossilized remains in their quest to "find out man." Prominent among these remains have been the densely calcified tissues of teeth and bones of cranium and mandible. In addition, fossilized teeth, jaw and cranial bones possess detailed morphologic characteristics which lend themselves to descriptive taxonomic functions. These traits, in the case of teeth, are genetically sensitive and are relatively insensitive to most environmental influences during development. The morphology of individual cranial bones also is predominantly genetically determined, while the spacial relationship of these bones within the craniofacial complex is the result of interplay of genetic and environmental forces of yet unweighed proportions.

Relationship of American Indians to Mongoloids

The morphologic traits of teeth and bones have been among the characteristics employed in many different ways to organize man into various groupings. Based on physical characteristics the people of eastern Asia and the American Indians have much in common. This has led many people to assume that the American Indian and the people of eastern Asia are basically of the same stock, the Mongoloids.

A master pattern of the Mongoloid dentition has been proposed by Moorrees (1957). It is reasoned that if this pattern is valid for the Mongoloid group it should penetrate to some degree in all of the subgroups. The degree of expression of the pattern would naturally be expected to vary but not be absent in the subgroups. The morphology of the craniofacial bones would also be expected to vary within subgroups but tend to follow a pattern.

The Papago Indian

The Papago is one of several North American Indian tribes which are being studied at Loma Linda University. The tribe is located in southwestern Arizona and Sonora, Mexico. In 1921 they numbered 6,100 in Arizona and less than 1,000 in Sonora. They speak a dialect of the same language as the Pima to whom they are closely related. Their language is of the Uto-Aztecan language stock. The Mayo of Sonora, Mexico is a more distantly related member of the same language group. The Papago, like the Pima, are excellent farmers but differ in their semi-nomad traditions. In the past they raised their maize and beans in one area and moved to another for the winter and did not establish permanent villages.

The young Papago boys were taught to be brave and suffer in silence as they prepared for the frequent battles with their quarrelsome neighbors, the Apaches. Even though the Apache lives in the same area as the Papago and Pima they have a different language. Their language stock is the Athapascan which relates them more closely to the Navajo and other tribes in North America (Collier 1960).

Purposes of the Study

The major purposes of this study are two-fold. The first is to apply the criterion described as the master pattern of the Mongoloid dentition to the Papago Indians of the southwestern United States and contingent areas of Mexico. The second is to compare some of the features of the dentition and skeletal features of the face of the Papago with other contemporary North American Indian tribes to see whether or not one group can be distinguished from another on the basis of the features chosen.

CHAPTER II

REVIEW OF THE LITERATURE

Mongoloid Master Pattern

Variation in tooth morphology from one group to another has long been recognized. With the accumulation of studies, patterns of characteristics for groups have been found. The master pattern of the Mongoloid dentition as described by Moorrees (1957) is a pattern of characteristics that are thought to hold true for related subgroups of Mongoloid stock. The following four traits are thought to characterize the Mongoloid dentition: (1) shovel shaped incisors, (2) low incidence of cusp of Carabelli, (3) small mesiodistal width difference between the maxillary central and lateral incisors, and (4) high incidence of torus mandibularis. Although torus mandibularis is not specifically a trait of the dentition it is included in this paper to conform to previous usage.

Shovel shaped incisors. The term shovel shaped incisor is given to incisor teeth in which the lingual surface is deeply concave and marked by prominent mesial and distal marginal ridges. Hrdlicka (1920) suggested that frequency and expression of the trait might be useful in comparing groups of people. He reviewed his own studies on a number of American Indian tribes and concluded that the shovel shaped incisor is a trait of the American Indian. His studies demonstrated the frequency of the trait in other groups. He found the Chinese and Japanese have a high frequency.

The American white and American Negro were shown to have a very low frequency. The Polynesians of Hawaii were in between. Subsequent workers have substantiated Hrdlicka's observations (Dahlberg 1949) (Carbonell 1963).

Kraus and Jordan (1965) found the trait in feti even before calcification of the teeth had begun. The frequency was 66% Japanese, 90% American Indian and 23% American whites. Carbonell (1963) found a high correlation between the shovel shape of the central and lateral incisors. She implies that this occurs because of a common genetic factor being responsible for this morphology in both teeth. This common genetic factor and the mode of inheritance is not known.

Mesiodistal width differences of the maxillary incisors. Moorrees (1957) believes that a relatively small difference between the mesiodistal widths of the maxillary central and lateral incisors is characteristic of the Mongol dentition. The advantages of this type of observation are great in that there is a standardized method of measuring and the statistical treatment of the data is enhanced.

Carabelli's cusp. The accessory cusp that appears on the lingual aspect of the maxillary molars is variously termed Carabelli's cusp, Carabelli's anomally, or tuberculum impar. Carabelli's cusp may range from a pronounced cusp to a faint pit or groove. It was found in a high percentage of American soldiers of European extraction (Dietz 1944). The percentage found in eastern Asians and American Indians is relatively low (Dahlberg 1963a). This trait has been extensively studied and its genetic mode of inheritance more completely developed than any other trait of the human dentition (Kraus 1951) (Kraus and Jordan 1965).

Torus mandibularis. Torus mandibularis is described by Moorrees (1957) as an exostosis which appears on the lingual side of the mandible near the roots of the premolars and canines above the mylohyoid line. The expression is usually bilateral and may appear in a variety of shapes and sizes. The role that function and genetics play in its development has been debated at length. Moorrees (1957) feels that the lack of correlation between tooth wear and torus development and the strong familial tendencies towards high incidence points toward a genetic basis. He also feels that a high incidence is a characteristic of the Mongol.

Other Measurements of the Dentition

In searching for objective measurements of the dentition that may be accurate and valid in distinguishing one group from another additional characteristics were chosen.

Arch length, width, and palatal height. The dimensions of the dental arches have not been shown to be of value in comparative studies of man. They are included here because differences have been noted (Moorrees 1957). If significant group differences can be shown, this type of measurement should be especially valuable. In comparing subgroups, having an objective measurement for a continuous variable is preferable to a subjective evaluation of a characteristic. Intergroup comparisons are more difficult to make with subjective evaluations than with objective measurements.

Maxillary premolar and molar diameter ratio. Dahlberg (1963b) reports that there are differences among different groups in the ratio obtained by dividing the buccolingual diameter of the maxillary second premolar by the buccolingual diameter of the maxillary first molar. Among contemporary European groups the premolar diameter may vary from 80% to 90% of the diameter of the molar. Dahlberg feels that those whose ancestral history stems from the eastern Mediterranean areas have maxillary first premolars that are attenuated in size when compared to those from northwest African areas. Other trends might appear if data from more groups were available.

Cephalometric Measurements

Radiographic cephalometry has been a relatively recent development in the science of craniometry. Anthropologists were limited to studies on dry skulls in making accurate measurements until Pacini (1922) applied radiographic technics to craniometry. With radiographic technics it became possible to make accurate measurements on living subjects utilizing landmarks inaccessable to mechanical measuring devices.

The early application of radiographic cephalometry to orthodontic research provided information which was immediately useful to researchers and clinicians who were interested in the growth and development of the head and face. Broadbent (1931) developed the cephalometer with which the head could be oriented and later reoriented relative to the source of X rays and the film. This technic led to a longitudinal study of growth patterns of the human head by Brodie (1941) using the data from the study started by Broadbent (1931). Other researchers accepted Broadbent's concepts utilizing a standardized position for the X ray source, head position, and film position. They investigated the use of the many landmarks available for establishing planes and points for angular and linear measurements. The work of Bjórk (1947) on prognathism among Swedish conscripts was outstanding in the field of research on growth and craniofacial complexes. It demonstrated some of the many relationships possible and some of the graphic methods of presenting the information gathered.

The majority of the work done in radiographic cephalometry has been in the area of clinical diagnosis and treatment planning. Some of the many contributions in this area include the work of Downs (1948) and Riedel (1952). The planes and points utilized in the cephalometric analyses of these two men have been widely accepted. The cephalometric measurements utilized in this study are taken from these two analyses. The measurements and the anthropometric points and planes from which they are derived are defined in the glossary of this paper. These measurements are intended to provide data for assessing the relative position of the various component parts of the craniofacial complex to one another.

The use of radiographic cepholometrics has not found wide use for comparisons of one ethnic group to another. However, good studies are beginning to accumulate. Bjork (1951) has studied the Bantu of South Africa. Cotton, Takano, and Wong (1951) studied the American groups of Negro, Japanese, and Chinese respectively. Craven (1958) studied the central Australian aborgine. The American Negro was studied by Altemus (1960). Cole (1964), Bunker (1965) and Webster (1965) have studied modern American Indian tribes.

CHAPTER III

METHODS AND PROCEDURES

Sample

This study is one of three being done concurrently at Loma Linda University based on material gathered at the Stewart Indian Boarding School near Carson City, Nevada. Stewart Indian School is designed to provide a high school education for capable American Indian children from reservations in the western United States. The facilities of the U. S. Public Health Service Dental Clinic were used for the study.

The individuals considered for the study were students recorded on the school records as being full-blooded Papago Indians between 13 and 20 years of age. Individuals were accepted for the study if they had no more than one contiguous tooth missing and no malocclusion or cranio-facial deformities present which would interfere with the jaws assuming a normal relationship. This sample, 13 males and 18 females, can be considered representative of the Papago population at the school. Any inference as to the Papago tribe must be tested against a random sample from that tribe.

Records

The individuals selected were examined for mandibular tori by palpation and the findings recorded as described in the next section. Casts of dental stone were obtained of the maxillary and mandibular dental arches from impressions of irreversible hydrocolloid. A beeswax record of each patient's bite was kept for later articulation of the casts. A standard lateral cephalometric roentgenogram was taken (Broadbent 1931). A 65 k. v. Ritter machine was used with a 60 inch target to film distance. Par speed intensifying screens with Ansco film were used. No grid was used to control secondary radiation.

Tooth Morphology

The dental casts were carefully measured using the instruments pictured in Figure 1.

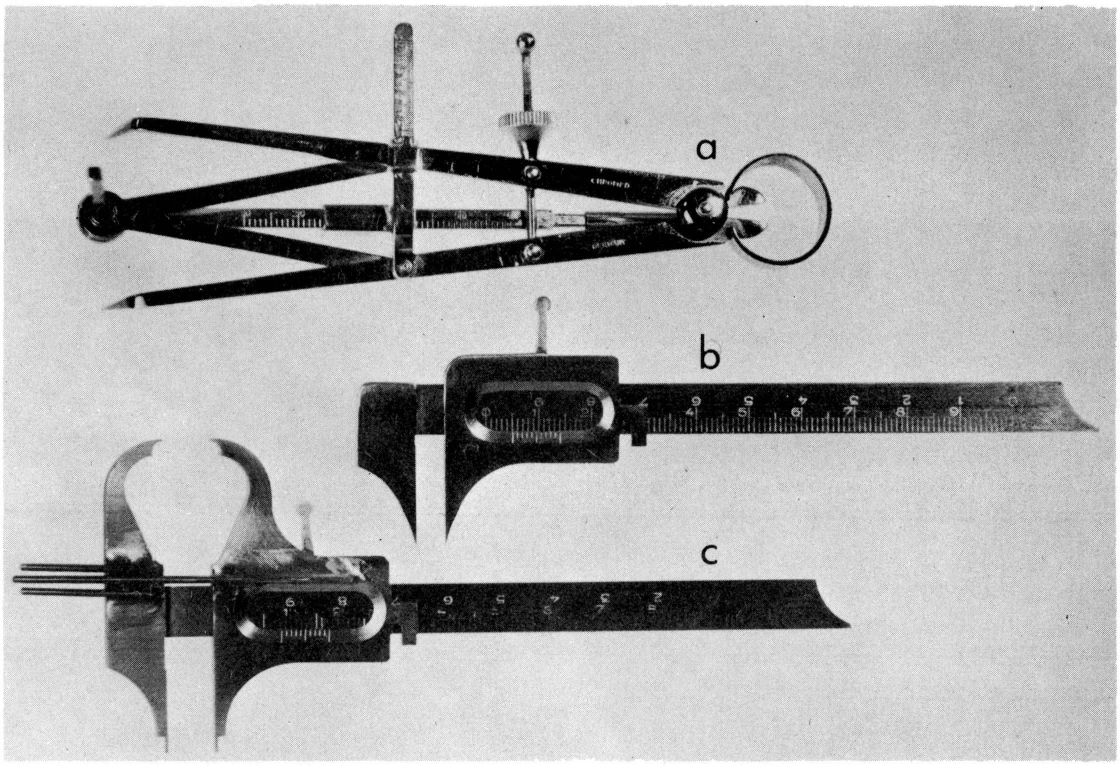


FIGURE 1

MEASURING INSTRUMENTS

Shovel shaped incisors. The degree of shoveling was measured using a modified Boley guage (Dahlberg 1957) (Figure 1c). The measurement made was the maximum rim-fossa depth of the lingual fossa of the maxillary central incisors. This measurement was recorded and also converted to the subjective scale shown in Figure 2 (Hrdlicka 1920). This was done as follows:

0	Non-shovel	0 mm.
1	Trace shovel	Less than 1 mm. depth
2	Moderate shovel	1 mm. depth
3	Shovel	More than 1 mm. depth

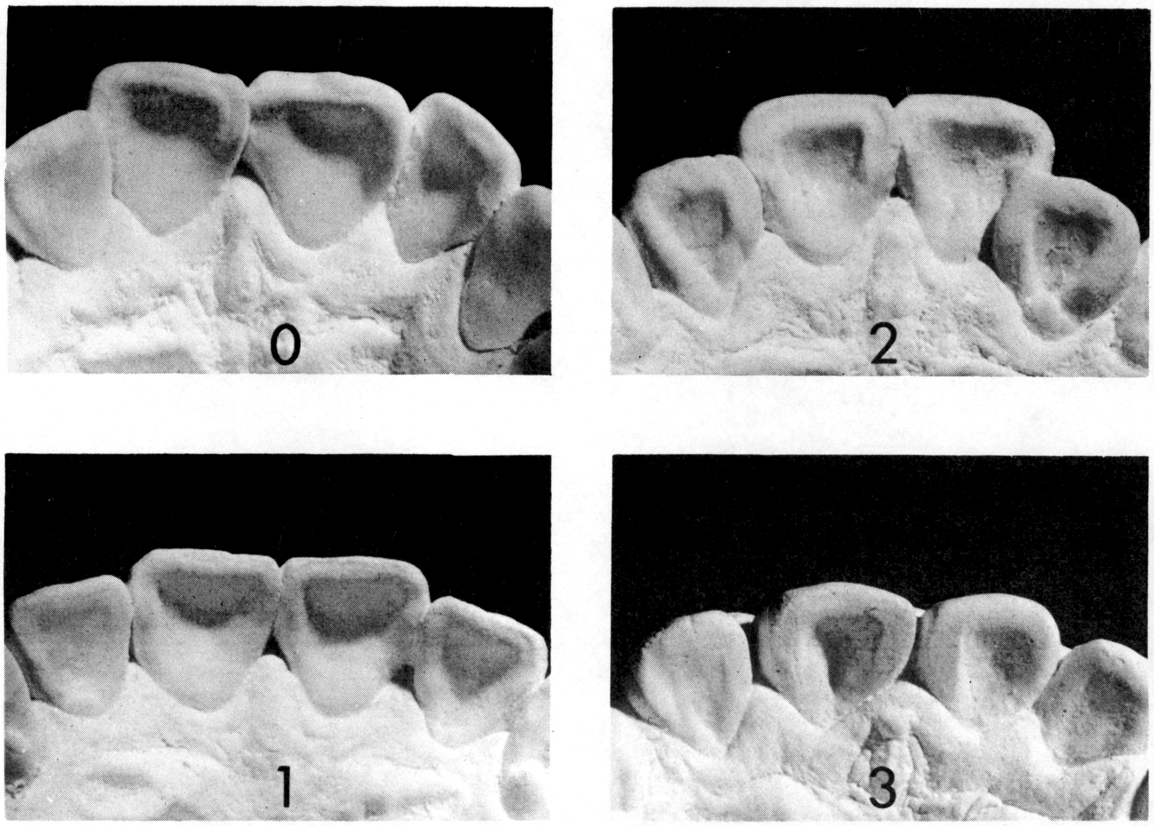


FIGURE 2

DEGREES OF SHOVELING OF MAXILLARY CENTRAL INCISORS

(Illustrations are from the Mayo sample, Artress 1965)

Incisor width differences. The greatest mesiodistal width parallel to the labial surface and incisal edge of each maxillary incisor was measured using a ground tip Boley gauge (Moorrees 1957) (Figure 1b). The average for the two central incisors and the average for the two lateral incisors was recorded. The difference between the average widths was determined for each individual.

Carabelli's cusp. Dahlberg's plaques (1957) were used to standardize observations. The following system (Kraus 1951) illustrated in Figure 3 was used for recording Carabelli's cusp:

0 Complete absence
1 Pit or groove
2 Slight tubercle
3 Pronounced tubercle

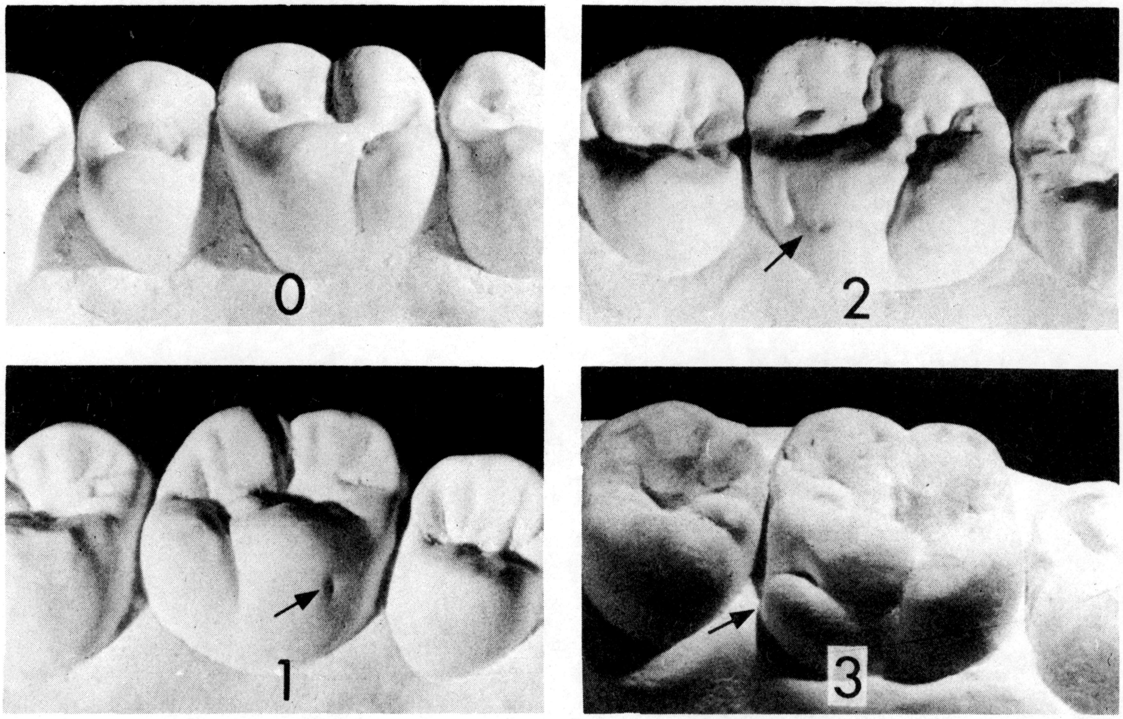


FIGURE 3

CLASSIFICATION OF CARABELLI'S CUSP (ANOMALY)

Torus mandibularis. The presence or absence of tori was determined by palpation on the initial examination. This was recorded as follows (Moorrees 1957):

0 Absent
1 Trace
2 Slight
3 Marked
4 Extreme

Maxillary premolar and molar ratio. For each subject the right and left maxillary second premolar buccolingual diameter was divided by the average buccolingual diameter of the maxillary first molar (Dahlberg 1963b). This may be multiplied by 100 to express it as a per cent.

Mandibular and maxillary arch length, width, and palatal height. The Korkhaus intraoral caliper (Figure 1a) was used following the method described by Korkhaus to obtain measurements (Korkhaus 1939). Arch width was measured from normally occluding points on the first molars. Arch length for both arches is the distance between a tangent to the labial surfaces of the central incisors and a plane through the arch width line, perpendicular to the occlusal surface. Palatal height was taken from the arch width line to the depth of the palate.

Cephalometric Data

Each of the roentgenograms was traced using conventional landmarks. The tracings were checked by other observers to standardize the results. Data for the following relationships which are defined in the glossary were obtained:

1. The facial plane angle
2. The angle of convexity
3. The A-B plane angle
4. Mandibular plane angle
5. Y axis
6. Cant of the occlusal plane
7. Inter-incisal angle
8. Mandibular incisor to occlusal plane
9. Mandibular incisor to mandibular plane
10. Maxillary incisor to point B
11. S-Na-A
12. S-Na-B
13. A-Na-B
14. S-Na to Go-Gn
15. Maxillary central to S-Na
16. Maxillary central to Na-P

Method of Data Analysis

Mongoloid master pattern. Comparisons of the four traits of the master pattern were made using the most appropriate statistical tests with the available data. Material from other studies is in varied format. This with its inherent subjectivity and the lack of individual values makes statistical comparisons limited.

An analysis of variance and t-tests were performed for the shovel shaped incisor trait and the incisor width differences comparing the Apache, Pima and Papago tribes. For these same tribes a chi-square test was performed to test the significance of differences in expression of the cusp of Carabelli trait. More general comparisons were made with groups other than the Papago, Pima and Apache due to the subjectivity of observations and varying methods of recording and summarizing data.

Analysis for discrimination. A stepwise discriminant analysis was performed using available data at Loma Linda University for the Papago, Pima, Apache, Mayo and Chamula Indians. The analysis was performed at the Health Sciences Computing Facility of the University of California, Los Angeles, California, using Bio-Med program 07M (Dixon 1965). Various combinations of variables and groups were run. This analysis was chosen because group comparisons may be made and the degree of discrimination determined. It would be neither possible nor appropriate to attempt to reach these objectives with a simple test such as the t-test.

The program used performs a multiple discriminant analysis in a stepwise manner. At each step one variable is entered into the set of discriminating variables. The most significant variable is entered in the first step. This is the variable which the program has found to be best for separating the groups based on within group and between group comparisons. In preparation for the second step the variables are all, except the one entered in the first step, reconsidered and the second most discriminating variable is chosen and entered. A list of significance is obtained.

At each point in the succession of steps the degree of discrimination can be determined for the group or the individuals of the group. For each group a composite mean of all the variables entered up to that point is determined. These means are then tested for equality between each pair of groups and reported as an F-statistic in an F-matrix. For individuals the degree of discrimination is determined by computing the probability of each individual fitting into a group based on the variables used up to that point. This may be presented graphically in the form of a classification matrix which shows how the individuals would be grouped according to the data from the variables used. This in turn may be expressed in a percentage as a sensitivity score.

Another way of presenting the data is as a type of scatter-gram. The individuals are plotted to give an optimal two-dimensional picture of the dispersion. The X and Y coordinates of the diagram represent canonical variables which are a composite of the variables analyzed. The diagram is the two dimensional presentation of three dimensional position of each individual with respect to the variables used.

CHAPTER IV

FINDINGS

Mongoloid Master Pattern Traits

Shovel shaped incisor. The Papago has a high frequency of shoveling. The mean depth of the fossa is 1.26 mm. for females, 1.16 mm. for males and 1.22 mm. combined. The frequency when the objective measurement of fossa depth is converted to the subjective measurement of fossa depth is converted to the subjective scale is shown in Table I. Comparisons with other groups are shown in Figure 4. The analysis of variance and t-test showed no significant differences between the Papago, Pima and Apache Indians.

TABLE I

DEGREE OF SHOVEL SHAPE OF MAXILLARY CENTRAL INCISOR

Subjective scale	Measured depth	Female	Male	Both
Non-shovel	0 mm.	0	0	0
Trace	Less than 1 mm.	3	5	8
Moderate shovel	1 mm.	2	3	5
Shovel	More than 1 mm.	13	5	18

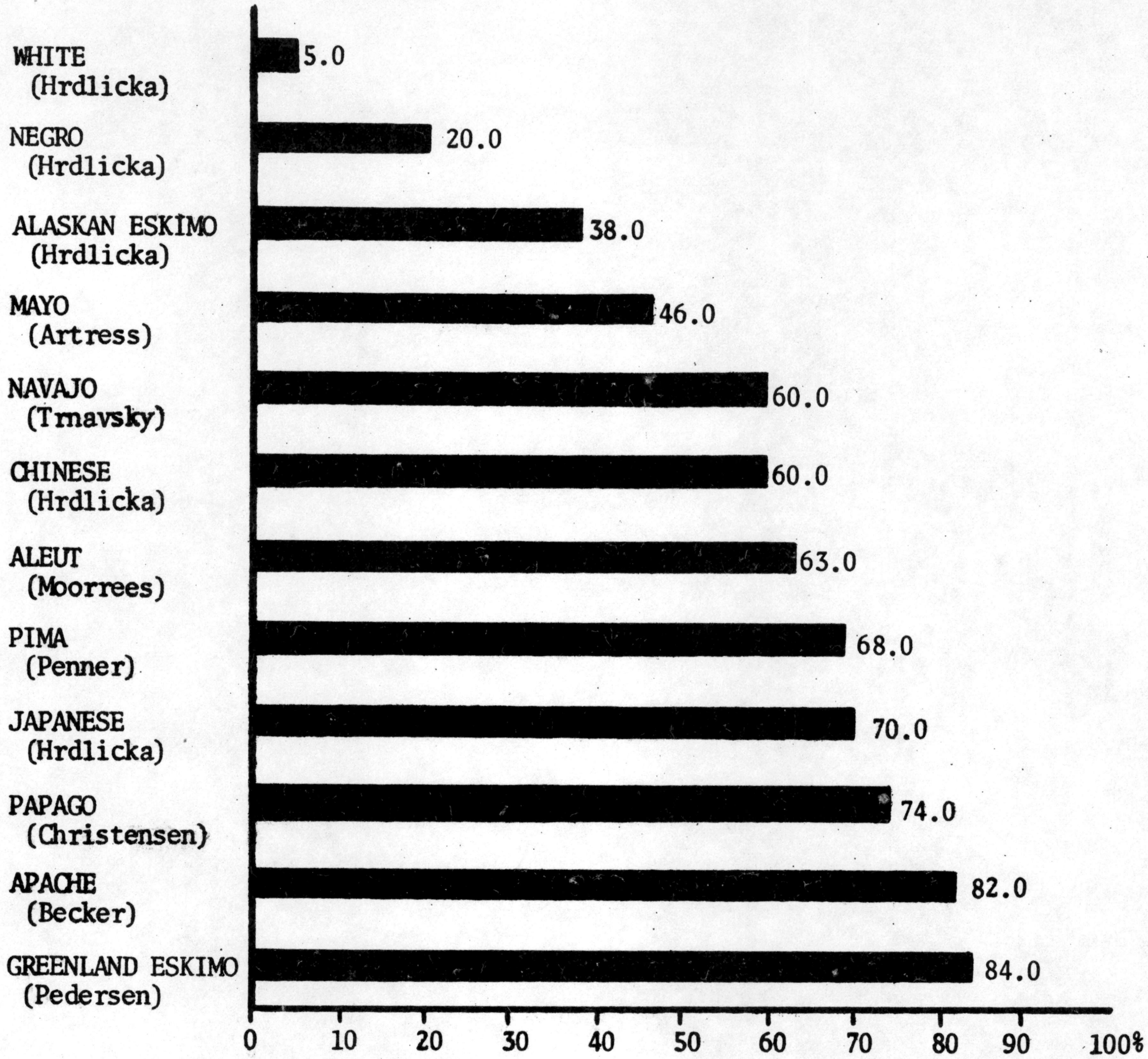


FIGURE 4

FREQUENCY OF SHOVEL-SHAPED INCISORS

Incisal width difference. The mean width difference for the Papago is 1.36 mm. The t-tests and analysis of variance revealed no significant differences among the Papago, Pima or Apache groups. Group comparisons showing the central and lateral incisor widths, the width differences and the ratio for the lateral width divided by the central width is shown in Table II. Group comparisons of the lateral width difference is also shown in Figure 5.

TABLE II

MAXILLARY CENTRAL AND LATERAL INCISOR WIDTHS, WIDTH DIFFERENCES, AND LATERAL OVER CENTRAL WIDTH RATIO FOR VARIOUS GROUPS

Lateral incisor width in mm.	Central incisor width in mm.	Diff erence in width of central and lateral in mm.	Ratio of lateral divided by central width in per cent.
7.58 Pima	9.00 Pima	1.10 Aleut	84.7 Aleut
7.45 Papago	8.88 Mayo	1.29 Navajo	82.7 Navajo
7.45 Mayo	8.82 Papago	1.36 Papago	81.6 Papago
7.44 Navajo	8.76 Apache	1.36 Apache	81.6 Apache
7.40 Apache	8.73 Navajo	1.40 Japanese	81.3 Pima
7.20 Aleuts	8.73 Swedes	1.42 Pima	81.3 Mayo
7.06 Pecos	8.70 Tristanites	1.45 Mayo	80.0 Japanese
7.00 Japanese	8.67 Pecos	1.58 Javanese	77.2 Javanese
6.93 Javanese	8.59 Am. White	1.58 Lapps	76.5 Lapps
6.73 Lapps	8.51 Javanese	1.61 Pecos	75.1 Pecos
6.72 Swedes	8.40 Japanese	1.99 Tristanites	70.5 Tristanites
6.71 Tristanites	8.31 Lapps	2.01 Swedes	70.1 Swedes
6. 56 Am. White	8.30 Aleut	2.03 Am. White	69.1 Am. Whites

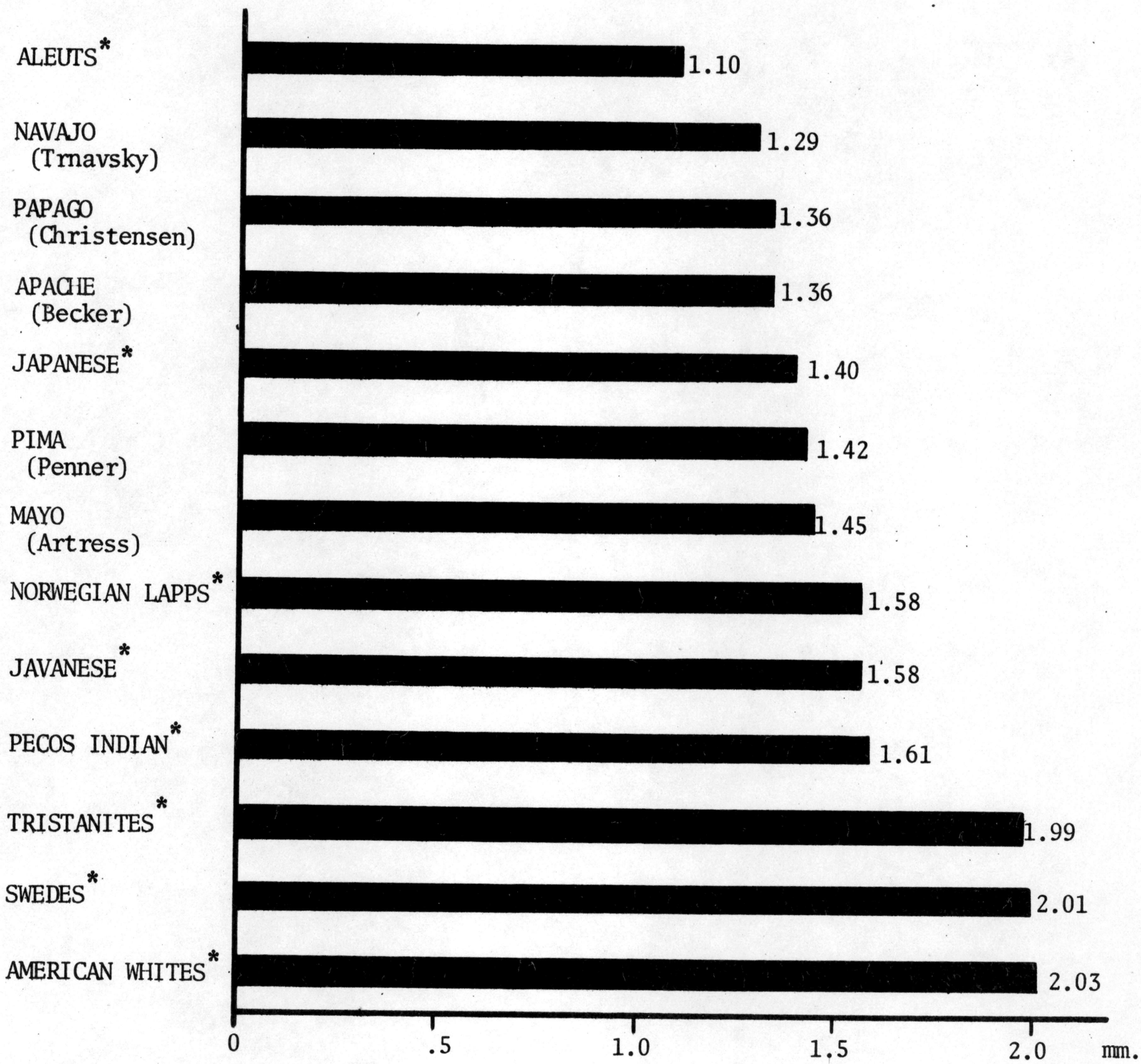


FIGURE 5

MEAN MESIODISTAL WIDTH DIFFERENCES IN MAXILLARY CENTRAL AND LATERAL INCISORS

*From data cited by Moorrees (1957)

Carabelli's cusp. The tabulation of Carabelli's cusp appears in Table III. Combining the first and second categories, 24% of the maxillary first molars express the trait as a cusp. Figure 6 is a graphic representation of group comparisons.

TABLE III

FREQUENCY OF CARABELLI'S CUSP ON MAXILLARY FIRST MOLARS

	Expression of trait	Frequency
0	Complete absence	16 (26%)
1	Pit or groove	31 (50%)
2	Slight tubercle	11 (17%)
3	Pronounced tubercle	4 (7%)

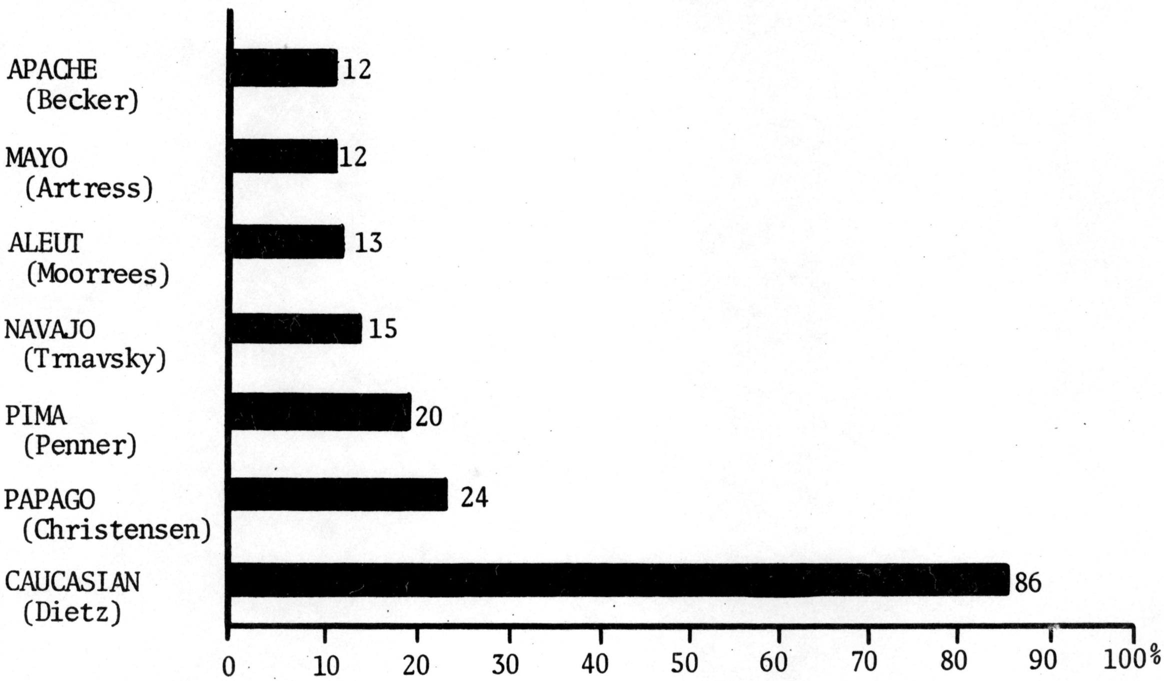


FIGURE 6

INCIDENCE OF CARABELLI'S CUSP

Mandibular torus. Three individuals or 8% were found to have slight mandibular tori. Two cases were female and one male. In all cases occurrence was bilateral. Group comparisons are shown in Figure 7.

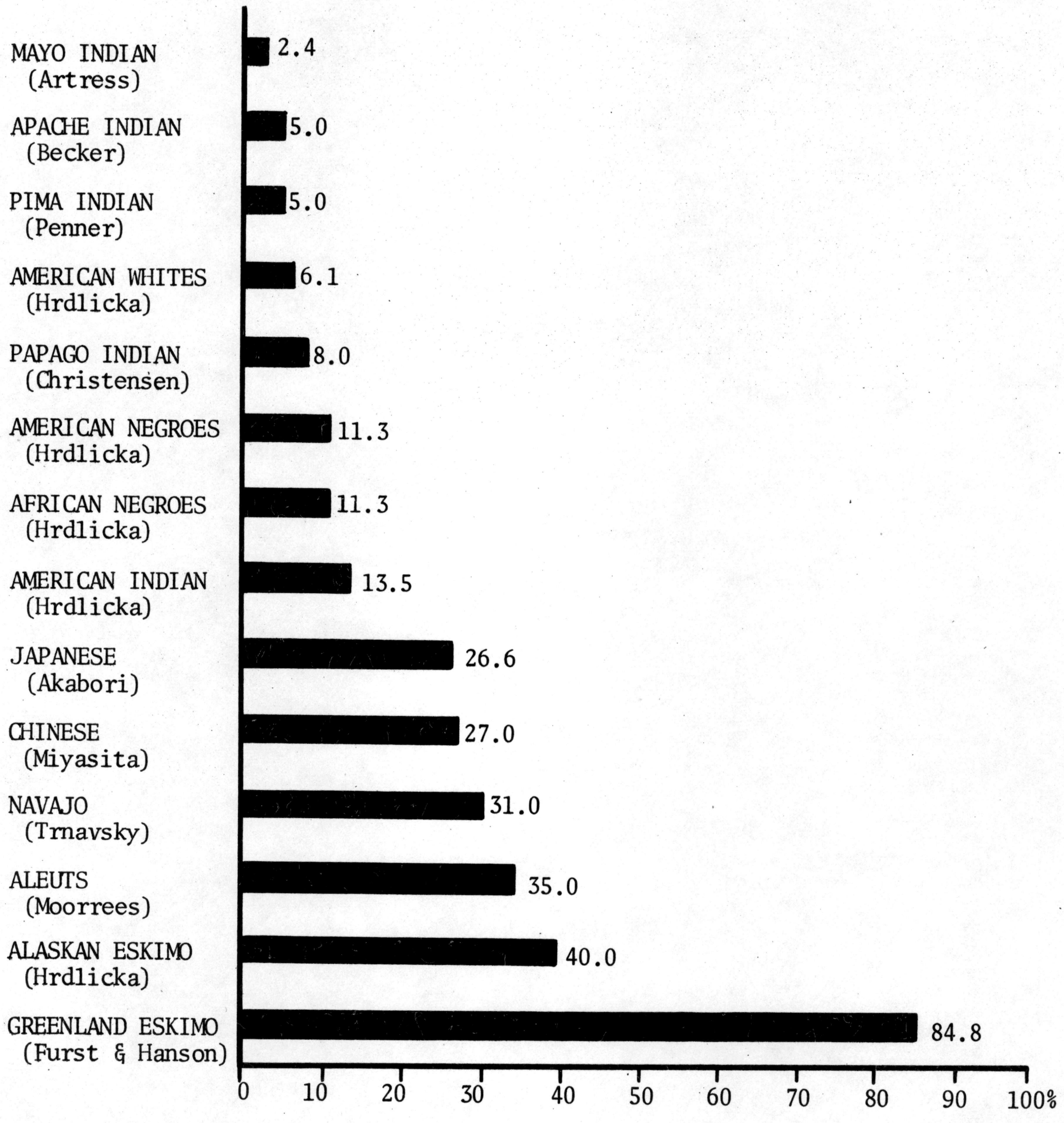


FIGURE 7

INCIDENCE OF MANDIBULAR TORI

Data For Traits Used in the Discriminant Analysis

The variables used in the stepwise discriminant analysis may be divided as follows: (1) morphologic variables of the dentition, (2) cephalometric skeletal pattern variables, and (3) cephalometric dental pattern variables. The means, standard deviations and ranges for these variables appear in Table IV.

Findings of Discriminant Analysis

The information obtained from the stepwise discrimination analysis is organized into tables for reader accessibility.

Table V describes the variables used. Table VI describes the individuals and variables included in each run. Table VII lists for each run the variables in the order they were chosen for discriminating among tribes. It also lists the final significance of the variables.

Table VIII presents the final F-matrices for each run. By taking one group of a pair in the vertical columns and the other one in the horizontal columns the F-statistic for the pair may be located at the intersection of the appropriate columns. Table IX summarizes the significance of the differences between each pair of tribes.

Figure 8 uses run number 1 to describe how the computed classification and the true classification are presented as a classification matrix and how the classifications are compared to obtain a sensitivity score. The matrices for the remaining runs appear in Table X.

Figure 9 a and b are scattergrams of runs 1 and run 13. They represent the dispersion of the individuals of each group about the mean.

TABLE IV

VARIABLES USED IN DISCRIMINANT ANALYSIS

Variables*	Mean	S. D.	Low	High
Morphologic Variables				
Maxillary central incisor width	8.82	0.52	7.9	9.9
Maxillary lateral incisor width	7.45	0.54	6.3	8.9
Mandibular arch length	28.65	1.94	25.0	32.0
Mandibular arch width	50.48	2.94	44.0	55.0
Maxillary arch length	33.32	2.07	29.0	37.0
Maxillary arch width	49.74	3.05	44.0	56.0
Palatal height	17.58	1.59	13.0	21.0
Shoveled incisor-fossa depth	1.22	0.47	0.3	2.2
Maxillary premolar to molar	83.1	3.0	75.8	93.8
Skeletal Pattern Variables				
Facial plane angle	87.1	4.6	78	96
Mandibular plane angle	29.3	5.6	35	39
Y axis	64.6	4.5	56	74
Angle of convexity	7.6	4.6	-2	15
A-B plane angle	5.8	2.8	1	11
S-Na-A	84.3	3.8	74	90
S-Na-B	80.3	4.8	67	90
A-Na-B	4.0	2.3	-1	7
S-Na to Go-Gn	35.4	6.1	23	46
Dental Pattern Variables				
Cant of occlusal plane	10.0	4.8	1	20
Interincisal angle	118.8	7.1	104	131
Mandibular incisor to occlusal	25.4	5.8	17	38
Mandibular incisor to Go-Gn	96.4	5.6	84	110
Maxillary incisor to A-P plane	9.3	2.7	3	14
Maxillary incisor to S-Na	110.1	7.6	93	124
Maxillary incisor to Na-P	11.3	4.1	14	17

*Morphologic variables are in mm. except for maxillary premolar to molar ratio which is in per cent. All skeletal and dental pattern variables are in degrees except maxillary incisor to Na-P which is in mm.

TABLE V

NUMBERED VARIABLES USED IN DISCRIMINANT ANALYSIS

Number and variable	Number and variable
1. Max. central incisor width	16. Interincisal angle
2. Max. lateral incisor width	17. Mand. incisor to Go-Gn
3. Mand. arch length	18. S-Na to Go-Gn
4. Mand. arch width	19. Angle of convexity
5. Max. arch length	20. Sex
6. Max. arch width	21. Facial plane angle
7. Palatal height	22. Mandibular plane angle
8. Sex	23. Y axis
9. Shovel depth central incisor	24. Na-A-Pog
10. Premolar to molar ratio	25. A-B plane angle
11. S-Na-A	26. Cant of occlusal plane
12. S-Na-B	27. Interincisal angle
13. A-Na-B	28. Mand. incisor to occlusal
14. Max. incisor S-Na	29. Mand. incisor to Go-Mn
15. Max. incisor to Na-P	30. Max. incisor to A-Pog

TABLE VI

DESCRIPTION OF NUMBERED RUNS IN DISCRIMINANT ANALYSIS

Run No.	SEX	TRIBES INCLUDED	VARIABLES
1	Female	Apache, Pima, Papago	1 through 30
2	Male	Apache, Pima, Papago	1 through 30
3	Both	Apache, Pima, Papago	1 through 30
4	Both	Apache, Pima, Papago, Mayo	1 through 30
5	Female	Apache, Pima, Papago	1 through 10
6	Male	Apache, Pima, Papago	1 through 10
7	Both	Apache, Pima, Papago	1 through 10
8	Both	Apache, Pima, Papago, Mayo	1 through 10
9	Female	Apache, Pima, Papago	11 through 30
10	Male	Apache, Pima, Papago	11 through 30
11	Both	Apache, Pima, Papago	11 through 30
12	Both	Apache, Pima, Papago, Mayo	11 through 30
13	Both	Apache, Pima, Papago, Mayo, Chamula	21 through 30

TABLE VII

ORDER AND SIGNIFICANCE OF VARIABLES CHOSEN FOR EACH RUN

Run 1* V*	Run 1* F*	Run 2 V	Run 2 F	Run 3 V	Run 3 F	Run 4 V	Run 4 F
27	9.7	25	4.5	27	11.0	25	19.6
10	6.1	28	2.7	10	5.1	7	11.6
9	3.1	18	3.0	25	3.5	27	5.8
5	2.5	21	1.8	28	4.5	18	5.5
2	1.9	23	1.5	18	3.8	10	4.2
3	1.2	6	1.5	6	2.1	17	2.5
18	1.1	14	0.8	21	1.6	4	2.6
22	3.2	29	1.1	5	1.3	23	2.3
12	1.8	15	0.7	13	0.8	14	1.3
17	2.2	30	1.1	15	0.6	28	1.3
4	1.9	24	1.1	7	0.6	21	1.2
25	1.6	2	0.8	23	0.6	5	0.7
7	1.9	10	0.8	26	0.6	1	0.7
26	1.3	9	0.8	14	0.5	30	0.6
11	1.1	27	0.3	22	0.9	15	1.2
21	1.3	5	0.3	2	0.7	24	0.8
28	0.6	7	0.3	4	0.4	26	0.4
30	0.8	4	0.2	9	0.4	13	0.5
14	0.5	1	0.2	3	0.4	29	0.3
6	0.3	3	0.3	1	0.3	12	0.3
24	0.2	26	0.2	17	0.3	22	0.4
1	0.0	11	0.5	12	0.2	6	0.2
		22	0.1	30	0.1	2	0.3
				24	0.1	3	0.2

Run 5 V	Run 5 F	Run 6 V	Run 6 F	Run 7 V	Run 7 F	Run 8 V	Run 8 F	Run 9 V	Run 9 F	Run 10 V	Run 10 F	Run 11 V	Run 11 F	Run 12 V	Run 12 F	Run 13 V	Run 13 F
5	7.6	4	2.7	5	6.1	7	6.9	27	9.7	25	4.5	27	11.0	25	19.6	24	15.6
10	8.2	3	0.9	10	5.5	10	6.2	18	1.3	28	2.7	25	3.8	23	9.7	23	8.6
9	2.8	5	1.5	4	3.0	5	2.8	21	3.0	18	3.0	28	4.8	27	6.6	22	7.0
2	2.0	1	1.0	1	1.7	4	3.0	11	1.6	21	1.8	18	3.8	18	3.2	30	4.7
3	1.3	9	0.7	3	1.0	3	2.0	22	2.4	23	1.5	21	2.0	17	3.7	28	7.2
7	1.0	10	0.5	7	0.7	1	1.2	13	0.9	15	0.8	24	0.9	22	2.0	21	2.4
4	0.4	7	0.4	9	0.6	6	0.2	29	3.2	30	0.9	15	0.8	11	1.9	27	1.4
1	0.1	6	0.3	6	0.5	2	0.2	25	1.6	24	1.3	13	0.7	28	1.0	29	0.9
6	0.1	2	0.1	2	0.1			30	1.4	14	0.6	26	0.6	30	1.2	25	0.9
								23	0.9	11	1.1	23	1.3	15	1.3	26	0.3
								24	0.6	29	0.3	30	0.5	26	0.8		
								15	1.1	22	0.1	22	0.3	24	0.6		
								28	0.3	26	0.1	14	0.4	29	0.4		
								26	0.4	27	0.1	12	0.1	12	0.4		
								14	0.4	12	0.6	17	0.1	14	0.4		
														21	0.4		

*Runs and variables are described inTables V and VI
Underlined F-values indicate significance at the .05 level.

TABLE VIII
F-MATRICES
SIGNIFICANT DIFFERENCES BETWEEN GROUPS

Run 1

	A	X
X	2.5**	
P	1.8	1.9*

Run 2

	A	X
X	0.9	
P	0.9	0.7

Run 3

	A	X
X	2.0*	
P	1.7*	1.1

Run 4

	A	X	P
X	2.0**		
P	1.6	1.0	
M	4.7**	5.4**	3.2**

Run 5

	A	X
X	2.3*	
P	4.5**	1.4

Run 6

	A	X
X	1.0	
P	1.2	0.3

Run 7

	A	X
X	2.6*	
P	3.2**	0.8

Run 8

	A	X	P
X	3.0**		
P	3.4**	0.8	
M	3.9**	3.8**	2.1*

Run 9

	A	X
X	2.4*	
P	1.4	2.0*

Run 10

	A	X
X	1.1	
P	1.1	1.0

Run 11

	A	X
X	2.6**	
P	1.9*	1.6

Run 12

	A	X	P
X	2.5**		
P	1.6	1.2	
M	6.1**	6.6**	4.0**

Run 13

	A	X	P	M
X	2.7**			
P	1.8	0.8		
M	8.8**	6.1**	5.2**	
C	7.8**	7.1**	4.5**	7.7**

* Significant at .05 level.
** Significant at .01 level.
A = Apache; X = Pima; P = Papago; M = Mayo; C = Chamula.

TABLE IX

SUMMARY OF RUNS WITH SIGNIFICANT DIFFERENCES BETWEEN TRIBES

	At .05 level	At .01 level	Number of runs compared
Papago -Pima	2	0	13
Apache -Pima	4	6	13
Apache -Papago	2	3	13
Mayo -Pima	0	4	4
Mayo -Apache	0	4	4
Mayo -Papago	1	3	4
Chamula -Mayo	0	1	1
Chamula -Apache	0	1	1
Chamula -Pima	0	1	1
Chamula -Papago	0	1	1

COMPUTED CLASSIFICATION

ACTUAL CLASSIFICATION	A (Apache)	X (Pima)	P (Papago)
A (20 Apaches)	18	0	2
X (18 Pimas)	1	16	1
P (18 Papagos)	1	0	17

56 Total individuals

51 Correctly classified

Correct/Total = Sensitivity = S = 51/56 = 91%

FIGURE 8

CLASSIFICATION MATRIX OF RUN 1 AND COMPUTATION OF SENSITIVITY SCORE

TABLE X
CLASSIFICATION MATRICES

Run 2

	A	X	P
A	15	2	2
X	3	17	1
P	2	3	9

S = 77%

Run 3

	A	X	P
A	30	3	6
X	5	27	7
P	9	5	17

S = 79%

Run 4

	A	X	P	M
A	28	5	6	0
X	6	27	5	1
P	8	5	18	0
M	1	0	4	20

S = 69%

Run 5

	A	X	P
A	17	1	2
X	3	12	3
P	3	4	11

S = 71%

Run 6

	A	X	P
A	12	4	3
X	4	9	8
P	4	2	7

S = 53%

Run 7

	A	X	P
A	26	7	6
X	9	20	10
P	9	6	16

S = 57%

Run 8

	A	X	P	M
A	21	6	4	8
X	7	18	9	5
P	7	5	13	6
M	6	1	4	14

S = 49%

Run 9

	A	X	P
A	17	1	2
X	0	14	4
P	2	1	15

S = 82%

Run 10

	A	X	P
A	14	2	3
X	5	13	3
P	2	2	9

S = 68%

Run 11

	A	X	P
A	24	6	9
X	9	25	5
P	4	8	19

S = 62%

Run 12

	A	X	P	M
A	26	6	7	0
X	7	24	6	2
P	8	6	25	2
M	1	1	3	20

S = 63%

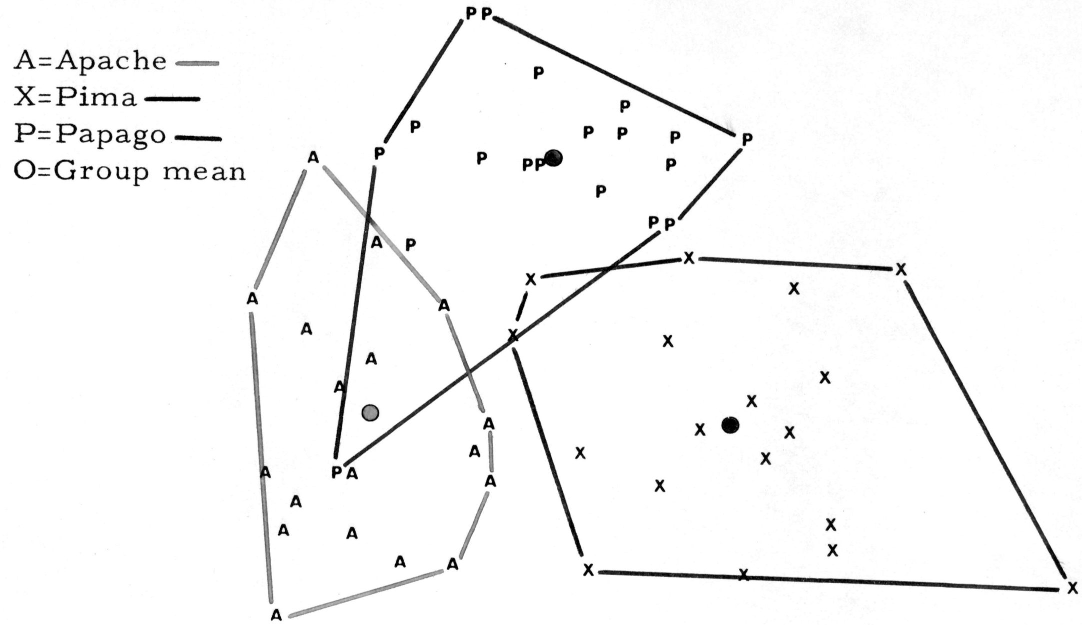
Run 13

	A	X	P	M	C
A	27	5	5	0	2
X	6	20	6	1	6
P	6	8	10	3	4
M	2	0	3	19	1
C	2	4	3	3	18

S = 57%

A = Apache; X = Pima; P = Papago; M = Mayo; C = Chamula
Vertical columns = computed classification
Horizontal columns = actual classification
S = sensitivity

a. Run 1. All individuals included.



b. Run 13. Only peripheral individuals of each group included.

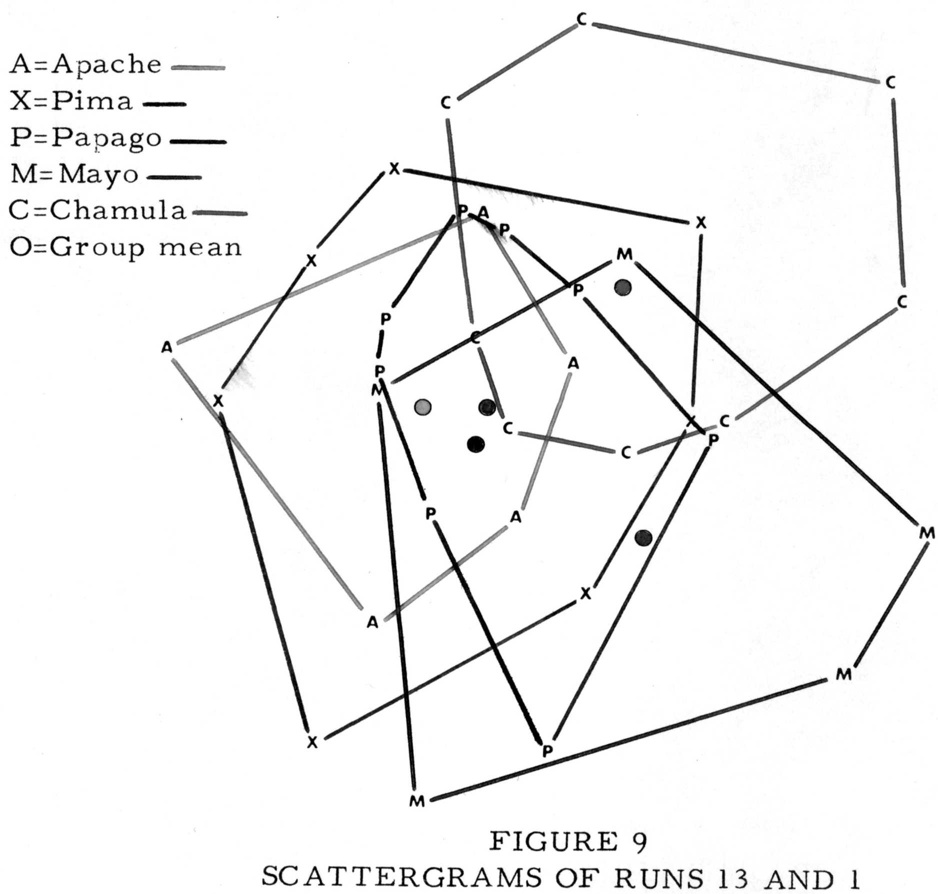


FIGURE 9
SCATTERGRAMS OF RUNS 13 AND 1

CHAPTER V

DISCUSSION

Mongoloid Master Pattern

When comparing the per cent of Papago with shovel shaped incisors to other groups, there is little doubt that the frequency is high. With such a variety of observers and ways of reporting frequency and intensity of shoveling, the actual comparisons may very well be slightly different than that shown in Figure 4. Even allowing for these differences the American Indian and the eastern Asians would still be grouped together as relatively high. It is recognized that the expression of the trait involves morphology of the tooth and not just the depth of the concavity. A subjective classification can take this into consideration. On the other hand the objective measurement method used in this study has distinct advantages over other methods when it comes to making accurate statistical comparisons. Something is lost from either method when one attempts to convert one to another. Perhaps a method combining the two would be useful.

A frequency of 23% of the Papagos with Carabelli's cusp is slightly higher than that reported for other Indian groups and Oriental groups. It is still well within the low ranges reported for the Mongoloid subgroups. By combining those with a slight tubercle and those with a pronounced cusp it is possible that some individuals in this study reported to have the trait would not have been reported in other studies. Frequencies for Caucasian and Negro groups are expressed in less definite terms but still appear to be much higher. Another factor is that of Caucasian mixtures in the recent generations. Kraus (1951) demonstrated a dominent genetic tendency for the trait. With the small population of the tribe it would take very little cross breeding over the years to have an increase in the incidence of the trait.

Mandibular tori in the Papago were considerably less frequent than among the Oriental groups reported. The frequency among the Negro and Caucasian groups were higher than the Papago. With the small sample it is possible that the frequency of 8% reported here is in the same range as the American Indian reported at 13.5% by Hrdlicka (1920). The grouping shown on the graph (Figure 7) tends to include other Indians, the Caucasian and Negroes but not the Orientals. Part of the low frequency of torus may be due to the differences in the ages of individuals in the different groups and to different methods of reporting. Also, examinations on living subjects are not apt to be as accurate as observations would be in studying dried skulls as was the case in some of the groups reported.

The mean incisor width difference of 1.36 mm. is relatively low (Table II). Only the Navajo and Aleut have a lower mean difference. The Indians and the Oriental groups all seem to be lower than the Caucasian groups. This seems to be a valid criteria for the dentition of Mongoloids.

In searching for better criteria of the Mongoloid dentition two ideas may be considered that involve the same data as the incisor width difference. From Table II it may be noted that in the groups compared, the central incisor width varies a great deal. The largest and the smallest widths are from the Pima and Aleut respectively. These are both subgroups of the American Indian. When the lateral incisor width is compared it is noted that all of the Asian and American Indian groups, with the one exception of the Pecos Indian, have larger lateral incisors than the other groups. The following question is then raised: Is the large lateral width a more consistent characteristic of the Mongoloid dentition than the width difference of the central and lateral incisor?

The second idea is to use a ratio to express the relative difference in size between the two incisors rather than the absolute width difference. Differences in absolute tooth sizes may tend to obscure relative width differences. This ratio was worked out for the groups compared (Table II). The order changed only slightly but the distribution of the groups has changed more. They now appear to be more distinctly concentrated in separate groups.

Discussion of the Stepwise Discriminant Analysis

The stepwise discriminant analysis as used for this study has the advantage of providing a great deal of information from which to draw conclusions. This in turn calls for care in assessing the true significance of the results to avoid unwarranted assumptions.

The problem of investigator bias is real and impossible to avoid unless one investigator were to make all the observations. In this study the data for the Papago, Pima and Apache tribes was cross checked by the three investigators involved in similar studies. This has helped to reduce investigator bias to a level below what might be expected for completely independent studies. When the groups are compared by sex it is noted that there are greater group differences among the females than among the males. This would tend to substantiate that the differences are real and not due to different investigators because no sex distinction was made until the over all data was tabulated.

A precise determination of the discrimination of one group from another is gained from the F-statistics of the F-matrices (Table VIII). The degree of significance for each pair of groups may be determined. In Table VIII the pairs with differences at the .05 level are marked by one asterisk and at the .01 level or lower by two asterisks. A summary of the pairwise differences by runs appears in Table IX. By noting the F-statistic for each pair for all of the runs we can see that there is little difference between the Pima and Papago. The only differences, significant at the .05 level, are in runs number 1 and 9 which are of females only. The difference is somewhat greater between the Papago and Apache. There are significant differences in five out of thirteen runs. Three of these reach significance at the .01 level. The difference is still greater between the Pima and Apache where the difference is significant in ten out of thirteen of the runs. In six of these the significance reaches the .01 level. With the Mayo compared to other groups, the least significant difference is in the Mayo-Papago comparison with the tooth morphology variables significant at the .05 level. The greatest differences are between the Chamula and all the other groups.

The scatter-grams (Figure 9) give a more graphic but less precise picture of the group differences pin-pointed by the F-matrices. For example, in run 1, (Figure 9) all three tribes appear to be very well separated from one another. The sensitivity score gives the same impression. However, the F-matrix indicates that even though the groups appear to be neatly separated they are not widely separated. In run 13, one can see from the scattergram the groups are not so neatly separated as in run 1. But the F-matrix indicates that the means of both the Mayo and the Chamula are widely separated from each of the others. The scatter-gram nicely demonstrates the overlap of one group on another. It also demonstrates the wide variation of the individuals among the Chamula and Mayo. The variation among the individuals of the Papago, Pima and Apache is relatively small.

The degree of success in classifying individuals, as indicated by the sensitivity scores and the classification matrices (Table X) varies from one run to another. In general the higher scores were obtained with more variables and fewer groups. When the Papago, Pima and Apaches were compared one sex at a time the score was considerably greater than when they were combined. The decrease in sensitivity noted when the Mayo and Chamula were added must be viewed with two factors in mind. First, with the addition of more groups into which an individual may be classified, the probability of an incorrect classification increases. For example with three tribes the probability of getting a correct classification by chance is .33. But with five groups the probability goes down to .20. The second factor to observe is that the number of variables had decreased. There are fewer points of comparison making it more difficult to properly classify the individuals. Thus, the low sensitivity score of run 13 is relatively good. The F-matrix for the run bears this out. As discussed in the preceeding paragraph greater group differences were noted in run 13 than in any other run.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The dentition and craniofacial complex of the Papago was studied and compared to other groups. The individuals in the sample, 13 males and 18 females, were between 13 and 20 years of age and were from reservations in the Western United States. They were studied at the Stewart Indian Boarding School near Carson City, Nevada. The first objective of the study was to test the conformance of the Papago to the master pattern of the Mongoloid dentition as proposed by Moorrees. The second objective was to test whether or not the Papago and other related ethnic groups can be distinguished from one another on the basis of their tooth morphology and features of the craniofacial complex.

The Papago in this sample conforms in part to the proposed master pattern of the Mongoloid dentition. A low frequency of mandibular torus was found which is not in conformance to the proposed master pattern. The Papago in this sample was found to have the following characteristics which are in conformance with the proposed master pattern:

1. A high incidence of shovel shaped incisors.
2. A low incidence of cusp of Carabelli.
3. A relatively small width difference between the maxillary lateral and central incisors.

The pairwise discriminant comparisons of tribes revealed the smallest differences between the Papago and Pima. Significant differences at the .05 level were found in only 15% of the runs. The Papago-Apache comparisons revealed significant differences in 38% of the runs. Approximately half of the 38% were significant at the .01 level and half at the .05 level. The Pima-Apache differences were greater than the Papago-Apache. There were significant differences in 77% of the runs. The differences were significant at the .01 level in over one half of the 77% and significant at the .05 level in the remainder of the 77%. The Mayo when compared to each of the other tribes had differences significant at the .01 level in all of the runs involved. The same was true of the Chamula as of the Mayo.

The following conclusions may be made from this study:

1. The Papago Indian in this sample conforms in part to the master pattern of the Mongoloid dentition as described by Moorrees.
2. The Papago, Pima and Apache in this sample cannot be clearly distinguished from one another on the basis of the variables and tests utilized.
3. The Mayo and Chamula of the sample used are clearly distinguished from each other and from the other tribes with the variables and tests utilized.

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APPENDIX A

GLOSSARY

A (Subspinale): The deepest midline point on the premaxilla between the anterior nasal spine and prosthion.

A-B Plane Angle: The angle formed by the intersection of a line between nasion and pogonion and a line between point A and point B extended if necessary. The acute angle is read. If point B is posterior to point A relative to the nasion pogonion line the angle is recorded as negative.

A-Na-B: The difference between S-Na-A and S-Na-B.

Angle of Convexity: The angle formed by the intersection of a line between nasion and point A with the extension of the Pogonion-point A line. If the latter line is anterior to the Nasion- point A line the angle is considered positive.

B (Supramentale): The deepest midline point on the mandible between infradentale and pogonion.

Cant of the Occlusal Plane: The angle established by extending the occlusal plane to intersect with Frankfort Horizontal.

Facial Plane: A line from nasion to pogonion.

Facial Plane Angle: The angle established by the intersection of the facial plane with Frankfort horizontal.

Frankfort Horizontal: (Cephalometric) a horizontal plane running through the right and left cephalometric porion and the left orbitale.

Gn (Gnathion): A point on the chin determined by bisecting the angle formed by the facial and mandibular planes.

Go (Gonion): The point which, on the jaw angle, is the most inferior, posterior, and outwardly directed.

Inter-incisal Angle: The angle formed by the intersection of the long axes of the maxillary and mandibular central incisors which pass through the incisal tip and the apex of the root. As the crowns tip labially the angle gets smaller.

Mandibular incisor to Mandibular Plane: The angle formed by the intersection of the mandibular plane and the long axis of the mandibular central incisor. The angle is positive when the incisor crown is tipped labially.

Mandibular Incisor to Occlusal Plane: The angle formed by the intersection of the long axis of the lower central incisor with the occlusal plane. The inferior inside angle is read as a plus or minus deviation from a right angle. The positive values increase as the incisor is inclined labially.

Mandibular Plane: A line at the lower border of the mandible tangent to the gonial angle and the profile image of the symphysis.

Mandibular Plane Angle: The angle formed by the intersection of the Frankfort plane with the extension of the mandibular plane.

Maxillary Central to S-Na: This is the intersection of the long axis of the maxillary central incisor with the sella nasion line.

Maxillary Incisor to Na-Pog (1 - NP): A linear measurement from the incisal edge of the maxillary central incisor to the nasion-pogonion line.

Maxillary Incisor to Point B: A linear measurement from the incisal edge of the maxillary central incisor to a line connecting point A with pogonion.

Na (Nasion): The suture between the frontal and nasal bones.

Occlusal Plane: A line bisecting the occlusion of the first molars and central incisors. Should either incisor lack full eruption or be in supra- or infraclusion, the general occlusion as determined by the premolars is used.

O (Orbitale): The lowest point on the infraorbital margin.

Por (Porion): (Cephalometric) the highest point on the superior surface of the soft tissue of the external auditory meati as recorded by the ear rod.

Pog (Pogonion): The most anterior point on the mandible in the midline.

S (Sella tursica): The midpoint of sella tursica determined by inspection of the profile image of the fossa.

S-Na-A: The angle formed by sella to nasion line and nasion to point A line.

S-Na-B: The angle formed by sella to nasion line and nasion to point B.

Y Axis: This is the acute angle formed by the intersection of the line from sella tursica to gnathion with Frankfort plane.

APPENDIX B

TABLE XI

MEANS OF VARIABLES

VARIABLE	APACHE Female	APACHE Male	APACHE Both Sexes	PIMA Female	PIMA Male	PIMA Both Sexes	PAPAGO Female	PAPAGO Male	PAPAGO Both Sexes	MAYO Both Sex.	CHAMULA Both Sexes
1	8.57	8.96	8.76	8.91	9.08	9.00	8.71	8.97	8.82	8.89	
2	7.17	7.65	7.40	7.58	7.58	7.58	7.33	7.62	7.45	7.44	
3	27.15	29.58	28.33	28.72	29.33	29.05	28.72	28.54	28.65	27.91	
4	51.40	53.32	52.33	49.56	51.48	50.59	49.67	51.62	50.48	51.92	
5	30.55	32.84	31.67	32.78	33.52	33.18	33.06	33.69	33.32	32.61	
6	50.00	52.79	51.36	49.28	50.95	50.18	48.94	50.85	49.74	50.74	
7	15.70	18.00	16.82	17.83	18.19	18.03	17.56	17.62	17.58	15.66	
9	0.98	1.29	1.13	1.07	1.24	1.16	1.26	1.16	1.22	0.00	
10	0.81	0.80	0.80	0.83	0.81	0.82	0.85	0.81	0.83	0.83	
11	82.80	83.42	83.10	84.11	82.05	83.00	84.72	83.62	84.26	86.88	
12	80.85	80.53	80.69	80.44	78.43	79.36	81.22	79.00	80.29	81.16	
13	1.95	2.89	2.41	3.67	3.62	3.64	3.50	4.62	3.97	5.72	
14	106.70	108.42	107.54	110.06	108.62	109.28	111.17	108.62	110.10	108.52	
15	7.90	9.79	8.82	11.50	11.48	11.49	10.78	12.08	11.32	12.00	
16	125.45	122.42	123.97	116.06	117.33	116.74	117.61	119.77	118.52	120.40	
17	93.50	97.00	95.21	97.78	98.05	97.92	96.00	96.92	96.39	97.84	
18	35.10	32.79	33.97	37.89	37.29	37.56	34.72	36.46	35.45	33.64	
19	3.70	4.42	4.05	7.83	6.57	7.15	6.89	8.62	7.61	11.76	
21	88.30	86.21	87.28	88.72	86.43	87.49	87.56	86.46	87.10	88.28	86.07
22	28.10	28.37	28.23	29.17	29.86	29.54	29.11	29.54	29.29	28.00	26.80
23	62.75	64.68	63.69	63.50	65.24	64.44	63.94	65.46	64.58	61.28	64.40
24	3.80	4.47	4.13	7.83	6.57	7.15	6.94	8.54	7.61	12.04	12.17
25	3.65	4.11	3.87	4.67	4.76	4.72	5.00	6.92	5.81	9.12	8.10
26	9.90	10.74	10.31	8.44	10.33	9.46	9.11	11.16	9.97	8.44	9.57
27	125.90	122.42	124.21	116.06	117.33	116.74	118.17	119.77	118.84	119.20	120.37
28	21.40	24.11	22.72	28.17	27.90	28.03	25.56	25.23	25.42	27.36	26.37
29	3.50	7.00	5.21	7.78	8.05	7.92	6.00	6.92	6.39	7.96	10.30
30	7.10	8.37	7.72	9.44	10.10	9.79	9.17	9.54	9.32	8.32	10.87

TABLE XII

STANDARD DEVIATIONS OF VARIABLES

VARIABLE	APACHE Female	APACHE Male	APACHE Both Sexes	PIMA Female	PIMA Male	PIMA Both Sexes	PAPAGO Female	PAPAGO Male	PAPAGO Both Sexes	MAYO Both Sex.	CHAMULA Both Sexes
1	0.49	0.67	0.61	0.57	0.53	0.55	0.52	0.48	0.52	0.57	
2	0.47	0.53	0.55	0.51	0.66	0.58	0.63	0.33	0.54	0.53	
3	1.69	1.64	2.02	1.81	2.20	2.03	1.93	2.03	1.94	1.64	
4	2.01	2.21	2.21	3.05	2.75	3.02	2.54	3.18	2.94	2.33	
5	2.24	2.63	2.67	1.99	1.89	1.94	2.34	1.65	2.97	2.51	
6	2.58	2.88	3.04	1.71	3.13	2.68	1.98	3.93	3.05	3.04	
7	2.52	2.11	2.57	1.92	1.78	1.83	1.34	1.94	1.59	2.46	
9	0.33	0.29	0.35	0.45	0.35	0.41	0.47	0.48	0.47	0.00	
10	0.04	0.06	0.07	0.02	0.03	0.03	0.04	0.03	0.04	0.03	
11	3.04	3.24	3.11	3.56	3.17	3.47	3.61	4.09	3.79	4.04	
12	3.38	3.64	3.47	3.54	3.16	3.44	4.37	5.13	4.76	3.60	
13	1.43	1.56	1.55	2.11	2.25	2.16	2.38	2.02	2.27	2.57	
14	6.70	7.54	7.08	5.63	5.81	5.70	7.22	8.16	7.60	5.21	
15	3.11	3.34	3.32	3.93	3.40	3.60	4.48	3.59	4.12	3.88	
16	6.47	7.59	7.11	7.46	6.76	7.03	8.25	7.10	7.74	6.58	
17	5.06	5.50	5.50	5.08	4.97	4.96	5.20	6.21	5.57	4.56	
18	5.37	5.55	5.51	4.47	6.10	5.35	5.91	6.44	6.09	4.30	
19	3.77	4.02	3.86	5.08	4.48	4.74	4.86	4.21	4.61	5.97	
21	3.20	2.82	3.16	3.64	3.87	3.89	4.49	4.77	4.56	2.26	2.63
22	5.67	4.54	5.09	4.37	6.59	5.61	5.31	6.20	5.60	4.40	4.63
23	4.17	2.21	3.46	3.68	4.86	4.39	4.68	4.24	4.49	2.69	3.09
24	3.66	3.94	3.76	5.08	4.48	4.74	4.92	4.16	4.61	5.94	6.01
25	1.66	2.18	1.92	2.83	2.90	2.83	2.50	2.99	2.83	3.68	6.61
26	4.42	3.33	3.91	2.94	4.93	4.19	4.73	4.93	4.84	3.33	5.08
27	7.15	7.59	7.49	7.46	6.76	7.03	7.27	7.10	7.12	6.96	11.17
28	4.31	6.59	5.63	5.64	3.69	4.63	5.92	5.90	5.82	4.32	6.41
29	5.06	5.50	5.53	5.08	4.97	4.96	5.20	6.21	5.57	4.52	5.34
30	2.57	2.54	2.61	2.68	2.39	2.52	2.92	2.54	2.73	2.29	2.40

LOMA LINDA UNIVERSITY

Graduate School

AN ANTHROPOMETRIC STUDY OF THE FACE AND DENTITION OF THE PAPAGO INDIAN AT STEWART INDIAN SCHOOL, CARSON CITY, NEVADA

by

Stephen J. Christensen

An Abstract of a Thesis

in Partial Fulfillment of the Requirements

for the Degree of Master of Science

in the Field of Orthodontics

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ABSTRACT

The dentition and craniofacial complex of the Papago Indian was studied and compared to other groups. Casts of plaster and lateral cephalometric roentgenograms were obtained from 31 Papago Indians who were from southwestern Arizona and were attending high school at the Stewart Indian Boarding School, Carson City, Nevada. The individuals were between the ages of 13 and 20 years and had normal jaw relationships with no contiguous missing teeth. Data was obtained for the following variables from an oral examination, dental casts and tracings of the roentgenograms:

1. Degree of shovel shape of the maxillary centrals.
2. Frequency of cusp of Carabelli.
3. Mesiodistal crown widths of the Maxillary central and lateral incisors.
4. Occurance of mandibular tori.
5. Maxillary second premolar to first molar buccolingual diameter ratio.
6. Palatal height and maxillary and mandifular arch width and length.
7. The facial plane angle.
8. The angle of convexity.
9. The A-B plane angle.

10. Mandibular plane angle.

11. Y axis.

12. Cant of the occlusal plane.

13. Inter-incisal angle.

14. Mandibular incisor to occlusal plane.

15. Mandibular incisor to mandibular plane.

16. Maxillary incisor to point B.

17. S-Na-A.

18. S-Na-B.

19. A-Na-B.

20. S-N to Go-Gn.

21. Maxillary central to S-Na.

22. Maxillary central to N-P.

Comparisons were made with various groups to see to what degree the Papago conforms to the master pattern of the Mongoloid dentition as proposed by Moorrees (1957).

A stepwise discriminant analysis was performed comparing the Papago, Pima, Apache, Mayo and Chamula Indians. This was done to determine the degree of discrimination possible between closely related groups of people.

The Papago in this sample was found to have the following characteristics which are in conformance with the proposed master pattern:

1. A high incidence of shovel shaped incisors.

2. A low incidence of cusp of Carabelli.

3. A relatively small width difference between the maxillary lateral and central incisors.

Not in conformance with the proposed master pattern was the finding of a low frequency of torus mandibularis.

On the basis of the discriminant analysis it is concluded that:

1. The Papago, Pima and Apache of this sample cannot be clearly distinguished from one another on the basis of the variables and tests utilized.
2. The Mayo and Chamula of the sample used are clearly distinguished from each other and from the other tribes with the variables and tests utilized.