Affinities of the Philippine Negritos as Viewed from Dental Characters: A Preliminary Report

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Abstract Dental characteristics of Aeta, one of the Negrito tribes in westcentral Luzon, the Philippines, were compared with those of Japanese, Ainu, Pima-Indians, Australian Aborigines, Filipinos, American Caucasoids and American Blacks. The overall tooth size of Negritos is smallest among the populations compared and closest to Ainu. As regards the shape factor of the dental measurements, they are closely related to Mongoloid populations as revealed by Q-mode correlation coefficients. These findings are almost parallel to the results obtained by principal component analysis. On the other hand, B-square distances based on seven non-metric crown characters show close affinity between Negritos and Ainu. The frequency distribution of the crown characters in both populations well corresponds to the "Sundadont" pattern defined by TURNER (1987).

The results obtained from the present study, together with TURNER's (1978, 1979, 1987, 1989) dental anthropological model of the late Pleistocene population history in southeast Asia, support the hypothesis proposed by OMOTO (1984, 1986) who suggested that Negritos might have shared an ancestral stock with Semang of Malaysia and evolved in the upper Pleistocene times under the environment of tropical rain-forest in Sundaland.

Keywords Negritos, Dental characters, Sundaland, Proto-Mongoloid, Southeast Asia

Introduction

The Negritos, inhabiting the remote areas of the Philippines, southeast Asia and Andaman Islands, have such phenotypic characteristics as short stature, dark skin color and frizzly hair.

The origin and microevolution of Negritos

have been the subject of controversy in the field of physical anthropology (SCHEBESTA, 1957; OMOTO, *et al.*, 1978; OMOTO, 1984). Concerning Negritos of the Little Andaman Island, KUMAR and MUKHERJEE (1983) showed marked divergence of this population from the other Negrids, especially from those in Africa, and indicated a

possible migration from Malayan Archipelago based on the blood genetic studies. The same suggestion was also advanced by CIPRIANI (1966), REYNOLDS (1976) and CADELINA (1984) who carried out ethnographical studies on the Philippine Negritos.

During 1976–1982 period, OMOTO organized a research project under the title “Population Genetic Survey of the Negritos” and a number of papers on human genetic studies were published (OMOTO, *et al.*, 1978, 1981; OMOTO, 1979, 1980, 1981, 1984; MATSUMOTO, *et al.*, 1979; HORAI, *et al.*, 1981; HARIHARA, *et al.*, 1988). In the first year of this survey, plaster casts of the permanent dentition of Aeta (Negrito in *sensu stricto* living in Luzon) were made by SAKAI who was a dentist and one of the project members.

These excellent studies revealed that Negritos were genetically more closely related to Asian-Pacific population groups than to African groups (OMOTO, 1981, 1984; HARIHARA, *et al.*, 1988). It was also elucidated that there were genetically two distinct groups in the so-called Philippine Negritos, one having been Aeta including some other groups of Luzon and another Mamanwa of Mindanao. The former group is said to show close affinity to southeast Asian populations and the latter to be derived from the ancestral Proto-Malay of Late Pleistocene Sundaland (OMOTO, 1984). OMOTO (1984, 1986, 1987) goes further to suggest a close relationship between Aeta and Proto-Mongoloid populations.

In regard to morphology, on the other hand, no reliable studies of Negritos have so far been reported. Although importance of the anatomical characteristics of this population has been emphasized by some authorities (e. g. HOWELLS, 1970, 1976, 1977),

few papers based on concrete data have been published.

Dental morphology provides one of the most important grounds for studies on evolution and affinities of different populations. Interpopulation differences in tooth structure enable us to reconstruct the history and evolution of modern human populations (TURNER, 1989). In this concern, the present study was focused to obtain additional informations for discussing affinities of Negritos on the basis of metric and nonmetric dental traits.

Materials and Methods

The Negrito samples in the present study consist of 25 individuals (21 males and 4 females) from Aeta of west-central Luzon, the Philippines. The control populations for comparison are Japanese, Ainu, and Filipinos living in the Marcos village. All the materials are plaster casts of the permanent dentition housed at Department of Anthropology and Prehistory, the University Museum, the University of Tokyo. The data of Pima-Indians, Australian Aborigines, American Caucasoids and American Blacks reported by K. HANIHARA (1976) were used for comparison (Table 1). In the following text, Pima-Indians, American Caucasoids and American Blacks are simply referred to as Pimas, Caucasoids and Blacks, respectively.

As regards metric traits, mesiodistal crown diameters of all the teeth except for the upper and lower third molars were measured. The usefulness of this measure in comparative studies was discussed in the previous paper (T. HANIHARA, 1989b). The nonmetric crown characters recorded are shovel shape in the upper central incisors; CARABELLI's cusp in the upper first molars; 6th cusp, 7th cusp, deflecting wrinkle and

Table 1. Numbers of samples used in metric analyses (male)

Population	N	Author
Negrito	21	Present study
Japanese	50	Present study
Ainu	20	Present study
Filipino	14	Present study
Pima-Indian	60	HANIHARA (1976)
Australian Aborigine	95	HANIHARA (1976)
American White	40	HANIHARA (1976)
American Black	47	HANIHARA (1976)

protostylid in the lower first molars; and +4 pattern in the lower second molars. Both metric and nonmetric data were obtained from the right side teeth. When a particular tooth is missing or badly damaged on the right side, the corresponding left side tooth was measured and/or observed.

In analyzing the metric traits, the measurements for males were used. In the non-metric crown characters, male and female samples were combined because between-sex differences in frequencies were insignificant in most of the populations observed.

Statistical methods applied for the dental measurements were PENROSE's size distance, principal co-ordinate analysis, Q-mode correlation coefficients, cluster analysis and principal component analysis. Those for frequencies of nonmetric crown traits were BALAKRISHNAN and SANGHVI's B-square

distances (1968), cluster analysis and principal co-ordinate analysis. The B-squares are computed in mathematically more sophisticated way than any other distances. This method has advantages in using dispersion matrix which warrants 'decorrelation' of the elements of frequency vectors and in providing the contribution rates of each trait to the distance coefficient.

All the above calculations were performed with NEC personal computer model 9801-Vm2 and statistical analysis programs coded by K. HANIHARA.

Analysis of the Mesiodistal Crown Diameters

Fig. 1 gives one-dimensional expression of the group constellation resulted from principal co-ordinate analysis of PENROSE's size distances. The populations are arranged, from left to right, in the ascending order of overall tooth size. It is easily recognized that Negritos are smallest in overall tooth size, and Ainu comes next. Filipinos show intermediate size among the populations compared. The original tooth size of Filipinos, however, may have changed through hybridization with Caucasians, especially with Spanish. Detailed descriptions on the other populations were already given by K. HANIHARA (1976, 1979) and T. HANIHARA (1989a, 1989b).

In comparing dental measurements, shape

Fig. 1. One dimensional expression of the eight populations based on the PENROSE's size distances.

Fig. 2. Dendrogram drawn from the distance matrix transformed from Q-mode correlation coefficients among the eight populations.

factor represents affinities among different populations much better than size factor. Fig. 2 demonstrates clustering of the eight populations. The dendrogram was drawn by the group average method based on the distance matrix transformed from Q-mode correlation matrix which represent similarity between populations. It is quite likely that Negritos have closer affinities to the Mongoloid populations than to Caucasians, Blacks, Australian Aborigines and Filipinos.

For the purpose of obtaining more detailed and concrete informations, the principal component analysis was performed. The correlation matrix used in the analysis was calculated from a pooled covariance matrix obtained from mesiodistal crown diameters of all the populations. Table 2 gives eigenvectors for the first three principal components. The first two components have eigenvalues greater than 1.0, but their cumulative proportion of total variance is only 0.66. If the third component is included, the cumulative proportion increases

to 0.73. The first three principal components are, therefore, worth considering in morphological analysis.

On the basis of eigenvectors, each principal component can be explained as follows: the 1st principal component represents overall tooth size; the 2nd component is a shape factor which contrasts the anterior tooth size (incisors and canines) to the posterior tooth size (premolars and molars); and the 3rd one is another shape factor contrasting the size of canine and premolar to that of other teeth (incisors and molars).

Table 3 shows the mean principal component scores of different populations and Fig. 3 was drawn on the basis of the first principal component scores. The populations are scattered in the order of tooth size, Negritos being the smallest and Pimas the largest. The result obtained is in full agreement with that from the PENROSE's size distance.

On the other hand, populations in Fig. 4 are plotted according to the second and

Table 2. Eigenvalues and eigenvectors of the correlation matrix used in the principal component analysis

Tooth	1st PC	2nd PC	3rd PC
U I 1	0.26987	-0.17650	0.27266
U I 2	0.22986	-0.39165	0.16093
U C	0.26827	-0.29267	-0.24888
U P 3	0.29692	0.07823	-0.36138
U P 4	0.28228	0.10939	-0.33328
U M1	0.27371	0.25357	0.23231
U M2	0.24058	0.36245	0.38507
L I 1	0.25656	-0.25773	0.25470
L I 2	0.28365	-0.34514	0.11779
L C	0.28256	-0.30041	-0.16819
L P 3	0.25580	0.19969	-0.36653
L P 4	0.22720	0.29828	-0.23258
L M1	0.25116	0.19229	0.13009
L M2	0.26505	0.27238	0.28550
Eigenvalue	7.84040	1.40377	0.98057
Proportion	0.56003	0.10027	0.07004
Cumulative Prop.	0.56003	0.66030	0.73034

Table 3. Mean principal component scores in each population

Population	Principal component No.		
	1	2	3
Negrto	-3.054	0.234	-0.638
Japanese	-1.070	-0.283	-0.475
Ainu	-2.860	-0.827	-0.009
Filipino	-0.291	1.137	0.167
Pima-Indian	2.128	-0.665	-0.270
Australian Aborigine	1.171	0.298	0.833
Am-White	-2.192	0.910	0.337
Am-Black	0.426	1.110	-0.219

third principal component scores which represent shape factors of the dental measurements. The eight populations are roughly divided into three clusters: 1) cluster of Caucasoids, Blacks and Filipinos; 2) cluster of Australian Aborigines; and 3) cluster of Negritos, Japanese, Pimas and Ainu.

The second principal component scores contrasting the anterior and posterior tooth sizes are larger in Caucasoids, Blacks and Filipinos. The scores obtained, therefore, show that these populations are characterized by relatively large posterior teeth and small anterior teeth. The Mongoloid populations such as Japanese, Pimas and Ainu, on the other hand, show the reverse type. These results are fully consistent with those obtained by K. HANIHARA (1974) who proposed the term 'molar type' for the former group and 'incisor type' for the latter. Negritos and Australian Aborigines represent intermediate scores between the two types.

In more detail, Negritos and Australian Aborigines have close affinity to each other in the shape factor as represented by the second principal component, while they are different in the third principal component

Fig. 3. One dimensional expression of the scores of the first principal component.

Fig. 4. Diagram drawn from the second and third principal component scores.

scores showing that the canine-premolar group is relatively large in Negritos but the molar group is relatively large in Australian Aborigines.

Analysis of Nonmetric Crown Characters

Since the sample size for Filipino is so small (14 males and 3 females) that this population is excluded from the following

analysis. The nonmetric crown traits recorded and their frequencies were listed in Table 4. For Australian Aborigines, Pimas, Caucasoids and Blacks, the data given by K. HANIHARA (1976) were used for comparison. Table 5 gives a matrix of BALAKRISHNAN and SANGHVI's B-square distances calculated from the frequencies of crown characters.

Fig. 5 illustrates the contribution rates of each character to the distances between

Table 4. Frequency distributions of tooth crown traits (in %)

Population	Shovel (UI1)	CARA- BELLI'S (UM1)	6th Cusp (LM1)	7th Cusp (LM1)	Defl. Wrinkle (LM1)	Protostylid (LM1)	+4 pattern (LM2)
Negrito	66.7(21)	25.0(20)	17.7(17)	11.8(17)	17.7(17)	5.9(17)	58.8(17)
Japanese	95.1(492)	6.5(444)	42.6(342)	4.3(342)	30.7(342)	6.4(485)	26.0(96)
Ainu	72.9(70)	10.2(98)	23.8(84)	2.4(84)	28.6(84)	12.2(82)	60.3(63)
Pima-Ind.	99.1(222)	6.9(216)	26.6(207)	8.2(208)	39.5(205)	19.4(217)	28.0(89)
Aust. Abor.	89.8(166)	1.7(159)	52.5(162)	6.5(155)	41.1(163)	6.1(165)	52.0(12)
Am-White	27.7(83)	35.0(59)	5.2(58)	5.1(59)	3.6(56)	0.0(81)	84.1(57)
Am-Black	37.2(78)	16.39(80)	6.5(77)	43.6(78)	16.3(80)	0.0(78)	49.0(218)

Table 5. BALAKRISHNAN'S square distance between populations based on non-metric crown characters

	Negrito	JPN	Ainu	P-Ind.	Aust. Abor.	Am-W	Am-B
Negrito	—						
Japanese	1.250	—					
Ainu	0.482	0.834	—				
Pima-Ind.	2.136	0.722	1.244	—			
Aust. Abor.	1.458	0.483	0.860	0.981	—		
Am-White	2.029	5.614	3.385	7.998	6.043	—	
Am-Black	2.421	4.929	4.051	6.291	5.738	3.319	—

Negritos and the other populations compared. It is quite evident that the frequency of shovel shape plays an important role for distinguishing the populations, and the lower frequency of this trait in Negritos attracts our special attention in this regard.

Among other crown characters, frequencies of the 6th cusp and deflecting wrinkle in the mandibular first molar are lower in Negritos than in Japanese, Pimas, and Australian Aborigines but higher than in Caucasoids and Blacks with a few exceptions. On the other hand, those of the +4 pattern in the mandibular second molar is higher in Negritos than in the former group but lower than in the latter group. In general, the frequencies of dental traits in Negritos agree with the characteristics of 'Sundadonty' defined by TURNER (1987, 1989), and the

closest morphological affinity is found between Negritos and Ainu.

Fig. 6 illustrates a dendrogram based on the distance matrix given in Table 5 and drawn by the group average method. Negritos and Ainu are again closely related to each other, and they show closer affinity to Japanese, Pimas and Australian Aborigines than to Caucasoids and Blacks. Fig. 7 shows a two-dimensional scattergram drawn by principal co-ordinate analysis of the B-square distances. Perhaps the most notable finding in this figure is that a cluster of Negritos and Ainu is more closely related to Australian Aborigines than to Japanese and Pimas. As regards the affinity between Japanese and Australian Aborigines in the nonmetric crown characters, the detailed discussion has been already made

Fig. 5. Contribution rates of total variance for B-squares.

by K. HANIHARA (1976).

Discussion

Among several ethnological and anthropological investigations on the Philippine Negritos, the studies undertaken by OMOTO and his colleagues (1978, 1984, 1986, 1987) have been focused to their origins and affinities which were the subject of controversy.

As regards the genetic origin and the microevolution of Negritos, OMOTO (1984) proposed the hypothesis that large part of Negritos including Aeta might be more closely related to the southeast Asian populations than to Australian Aborigines. On the other hand, BIRDSSELL (1949, 1977), COON (1962), JACOB (1967) and HOWELLS (1970, 1976, 1977) stressed that there existed basically Austro-Melanesian characters in Negritos (Old Melanesians in HOWELLS' terminology). They provided, however, no satisfactory explanations to cover all the available evidence.

The present study revealed that the overall tooth size of Negritos was smaller than that of Ainu who had been reported to carry the smallest teeth in Asia (BRACE and NAGAI,

Fig. 6. Dendrogram drawn from the B-square distance matrix.

Fig. 7. Two dimensional expression by principal co-ordinate analysis based on the B-square distance matrix.

1982). Viewed from the shape factor of dental measurements, Negritos are likely included in the Mongoloid population cluster and, at the same time, they share some similar characteristics with Australian Aborigines as shown by the principal component analysis.

In the nonmetric crown characters, it is of quite interest to note that Negritos are closest to Ainu than to any other populations compared and, as shown in Fig. 7, both populations are located more closely to Australian Aborigines than to Japanese and Pimas. However, the result does not necessarily mean a close affinity between the Ainu-Negrito group and Australian Aborigines as suggested by YAMAGUCHI (1967),

OMOTO (1972), K. HANIHARA (1976) and others since several problems concerning the relationship between Negritos and Australian Aborigines are still remained unanswered.

As shown in this study, Negritos are largely similar to Mongoloid populations in dental morphology, less to Australian Aborigines and quite different from Caucasoids and Blacks. BIRDSELL (1949, 1977) regarded Negritos as direct ancestors of Australian Aborigines. According to OMOTO's hypothesis (1984, 1986, 1987), Negritos are related to modern Australian Aborigines only through their common ancestral type "Proto-Australoid". The dental evidence presented here supports this hypothesis and clearly indicates

that Negritos derived from the ancestral stock of Asian populations, not from Africans.

Aeta is said to be the true Negrito or Negrito in *sensu stricto* (OMOTO, 1981, 1984). OMOTO (1984) suggested that this population might have shared an ancestral stock with the Semang of Malaysia and evolved in the Upper Pleistocene times, probably during 20,000 to 30,000 years B.P., in the tropical rain-forest of Sundaland and they are called Proto-Malays (GLINKA, 1981; OMOTO, 1984, 1986). OMOTO (1984) goes further to say that the direct descendants of the Proto-Malays may be Mamanwa of Mindanao. On the other hand, Aeta of Luzon might have been influenced by the Proto-Mongoloid agriculturists intruding from the Asian mainland, culturally as well as physically, some 10,000-20,000 years B.P. (HOWELLS, 1976; KENNEDY, 1979; OMOTO, 1984). It is quite possible, from this viewpoint, that there might have been genetic interrelationship between Negritos (Aeta) and Proto-Mongoloid population in the past (OMOTO, 1986, 1987).

Based on the frequencies of nonmetric dental characters, another hypothesis has been proposed: in the late Pleistocene now-flooded Sundaland could have been occupied by a population ancestral to the Proto-Mongoloid and those who extended to most northern Pacific might become the Neolithic Jomon population and modern Ainu (TURNER and SWINDLER, 1978; TURNER, 1976, 1979, 1987, 1989). TURNER (1978, 1979, 1987, 1989) referred to their tooth pattern as 'Sundadont'. Applying TURNER's terminology, the pattern of nonmetric crown traits in Negritos is evidently classified into the "Sundadont".

Taking the dental evidence presented in this study as well as hypothesis proposed by OMOTO and that by TURNER into account,

it is highly probable that Negritos (Aeta) are closely related to the southeast Asian Proto-Mongoloid population and they still maintain some ancestral dental characteristics. The issue in the future is to obtain additional dental data from the other Pacific populations which allow more detailed discussions on the origins and divergence of Mongoloids including modern Japanese.

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抄 録

歯冠形質からみたネグリの系統

植 原 恒 彦

ネグリトはフィリピン、マレー半島、アンダマン諸島に分布する採集狩猟民で低身長、暗褐色の皮膚、縮毛、等の外観的特徴を示すが、その人種の起源と分化に関しては長い間、人類学における論争の的であった。最近の人類遺伝学的研究によれば、ネグリトは東南アジアを起源とする集団で、その身体的特徴は熱帯

降雨林という環境によってもたらされた適応の結果であるとされている (OMOTO, 1984; 尾本, 1986, 1987)。

本研究では、文部省科学研究費 (海外学術調査) 「ネグリの集団遺伝学的研究」 (研究代表者, 尾本恵市東京大学教授) によって, 歯科医師酒井賢一郎博士により収集, 作製されたルソン島中西部に分布するネグリティ (アエタ) の全額石膏模型を使用, 比較資料として現代日本人, アイヌ, フィリピン人, オーストラリア原住民, ピマーインディアン, アメリカ白人, アメリカ黒人のデータを用いた。

歯冠計測値 (第三大臼歯を除く歯冠近遠心径) に基づく分析の結果, 歯全体の大きさに関してはネグリティは上記7集団中最も小さく, この点でアイヌとの類似性が認められた。一方, Qモード相関係数に基づく形態距離からネグリティはモンゴロイド人種のクラスターに含まれることが明かとなった。同様の結果は主成分分析によっても示され, さらに前歯 (切歯, 犬歯) と後歯 (小臼歯, 大臼歯) の相対的な大きさに関してはネグリティはオーストラリア原住民と同様の特徴を示すことが明らかにされた。しかし, アメリカ白人, アメリカ黒人との間には何ら類似性は認められなかった。

非計測的歯冠形質についてはネグリティはアイヌと共にスンダ歯型を示し, B² 距離 (BALAKRISHNAN and SANGHVI, 1968) においても両者は強い類似性を示した。ここでもやはり, アメリカ白人, アメリカ黒人との類似性は認められなかった。

以上の結果は, ネグリティが人種的にアジア起源であるという可能性を強く示唆しているものと思われる。TURNER (1979, 1983, 1987, 1989) は縄文人, アイヌが後期更新世のプロトモンゴロイドに由来し, スンダランドがその放散中心であったと考えている。一方, OMOTO (1984), 尾本 (1986, 1987) は後期更新世にスンダランドを舞台としてプロトオーストラロイドから進化したプロトマレーコソがネグリティの直接の祖先であるとし, さらに彼らとプロトモンゴロイドとの密接な関係を指摘している。これらの仮説を考慮すると今回の分析結果はネグリティとプロトモンゴロイドとの関係についてある程度の示唆を与え得るものと思われる。しかし, 両者の関係はさらに, 縄文時代人, 太平洋民族等を含めた詳細な分析, 検討が必要である。この意味において本研究がその一資料となれば幸いである。

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