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Metrical Analysis of the Dentition of Perak Man from Gua Gunung Runtuh in Malaysia

By

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Abstract Perak man is a nearly complete human skeleton dating from the early Holocene, which was excavated from Gua Gunung Runtuh, Malaysia. The metrical tooth traits of Perak man were statistically compared with those of early and modern samples from Australia, Southeast Asia, and Japan. The results showed a close affinity with the Australian samples in both the overall tooth size and proportion, suggesting dentally Australoid occupation of this region at the time of the early Holocene.

Introduction

An excavation in Gua Gunung Runtuh, a cave in the Bukit Kepala Gajah limestone massif in Lenggong Valley, resulted in the discovery of an almost complete human skeleton. He was named "Perak man" after the State of Perak in which the cave was located. Excavations revealed that the cave was used mainly as a habitation site and that the Perak man was its only burial.

Perak man was found in a primary burial accompanied with mortuary objects that revealed a Palaeolithic tradition, while a radiocarbon date of 10,120 ±110 B.P. (Beta 38394) indicates an early Holocene date for this burial. Hence, we refer epi-Paleolithic to his culture (ZURAINA, 1994a, 1994b). Perak man is, thus far, the most complete skeleton in Southeast Asia in its antiquity range of 10,000–11,000 years before present.

Morphological examinations of Perak man were first conducted by JACOB and SOEPRIYO (1994), LOH (1994) and JAMALUDIN (1994). They provided fine descriptions and measurements of the skeleton. According to these studies, Perak man displays Australo-Melanesoid characteristics in its cranial and forelimbs morphology, suggesting the possibility of the Australoid occupation of this region during the early Holocene.

In order to evaluate and confirm the Perak man's Australoid affinity, a statistical analysis comparing the skeletal and dental measurements of Perak man with those of the samples from other regions, is needed. This article reports on

the results of such an analysis. We, in fact, compared the metrical traits in the dentition of Perak man with those of the early and modern samples from Australia, Southeast Asia and Japan.

Materials and Methods

Perak man is kept at the Center for Archaeological Research Malaysia in the Universiti Sains Malaysia. Figure 1 shows the permanent dentition with its maxilla and mandible of Perak man. The preserved teech are shown in the following dental formula.

/	7	6	5	o	o	o	o	/	/	/	/	/	/	/	/
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

o: tooth missing but socket present, /: tooth and socket missing

Crown measurements were taken according to the system of tooth measurement described by FUJITA (1949). The degree of crown wear corresponds to BROCA's third stage or more. In particular, the lower first molars are heavily worn out, reaching the fourth stage. Consequently, the crown measurements were not taken for the lower first molars. Although both the mesiodistal and buccolingual crown diameters of the remaining teeth were measured, only the buccolingual crown diameters were used for the present statistical analysis, because the mesiodistal crown diameters were obviously reduced from the original size due to heavy attrition.

Using the buccolingual crown diameters available, distance analysis was performed to examine the affinity of Perak man to the early and modern

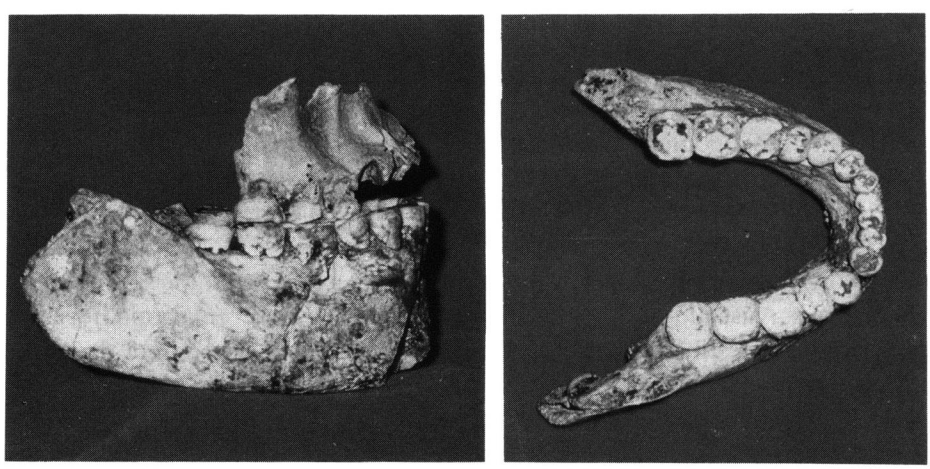


Fig. 1. Perak man's maxilla and mandible with teeth.

Australian Aborigines, Southeast Asians and some samples from Japan. The comparative data on recent populations were taken from the skeletal series of Indonesians, Australian Aborigines from the whole area of Australia (MATSUMURA, 1995b) and Australian Aborigines from Swanport (BROWN, 1989). The data on Neolithic populations were from Thai from the Ban-Kao, South Chinese from the Weidun and the Jomon series from Japan (MATSUMURA, 1994, 1995a). In addition, the late Pleistocene samples used are the Coobool Creek series from southern Australia (BROWN, 1989), Minatogawa man from the Island of Okinawa in Japan (data from the Minatogawa 1, HANIHARA & UEDA, 1982), and Wadjak man from Java (data from the cast of Wadjak II).

Results

The mesiodistal and buccolingual crown diameters measured in the dentition of Perak man are given in Table 1. Only the data from the right side teeth were used for the statistic analysis of crown dimensions in case the data from both the sides were given. The comparable buccolingual crown diameters were from nine teeth of the upper second premolar, first and second molars, and all the lower teeth except the first and third molars. Table 2 shows these buccolingual crown diameters of the male samples.

First, PENROSE's size distances (PENROSE, 1954) were calculated using the nine buccolingual crown diameters in order to compare the overall tooth size between the samples. The results are given in Table 3. Since the data of the nine items were not provided for Minatogawa man, this sample was not included for the comparison. Figure 2 represents a linear relation of the overall tooth size between the nine samples compared, which was depicted by applying the multidimensional scaling (MDS) (TORGERSON, 1958) to the size distances. The overall tooth size of all Australians is remarkably larger than those of the Neolithic and modern Southeast Asians, Neolithic Southern Chinese and Jomon Japanese. Among the Australian samples compared, those from the Coobool Creek possess the largest tooth size. The overall tooth size of Perak man is smaller than that of the Coobool Creek, and comparable to those of the other Australian

Table 1. Tooth crown measurements of Perak man.

	UP2	UM1	UM2	LI1	LI2	LC	LP1	LP2	LM1	LM2	LM3
Right											
MD	7.09	—	10.82	—	—	6.77	8.05	7.75	—	11.83	10.95
BL	9.51	12.31	12.95	6.11	7.09	8.52	9.51	—	—	—	11.20
Left											
MD	—	—	—	—	—	6.44	7.90	7.85	—	11.79	11.17
BL	—	—	—	6.03	6.96	8.62	9.35	9.94	—	11.61	11.90

Table 2. Buccolingual crown diameters of Perak man and nine comparative samples.

	UP2	UM1	UM2	LI1	LI2	LC	LP1	LP2	LM2
Perak man	10.00 (R)	12.31 (R)	12.95 (R)	6.03 (L)	6.96 (L)	8.72 (L)	9.35 (L)	9.94 (L)	11.61 (L)
Wadjak man	10.00	12.68	12.83	6.56	7.42	9.23	8.95	8.52	10.78
Neol. Southern Chinese	9.55	12.00	11.76	6.06	6.49	7.94	8.21	8.54	10.42
Neolithic Jomon	9.00	11.78	11.45	5.93	6.2	7.44	7.79	8.33	10.47
Neolithic Ban-Kao	9.28	12.04	11.56	5.79	6.18	7.73	8.11	8.47	10.52
Modern Indonesians	9.49	11.93	11.72	5.93	6.29	7.76	8.14	8.38	10.18
Coobool Creek[1)]	10.8	13.6	13.9	7.0	7.0	9.1	9.7	9.9	12.4
Swanport Aborigines[1)]	10.4	12.9	13.5	6.7	6.7	8.8	9.7	9.2	12.0
Whole Aborigine	9.99	12.64	12.81	6.31	6.43	8.32	8.73	9.03	11.41
Minatogawa man[2)]	9.8 (R)	12.8 (L)	13.4 (L)	—	—	8.0 (L)	8.4 (L)	8.8 (L)	11.5 (L)

R: Right side tooth; L: Left side tooth. [1)] BROWN, 1989. [2)] HANIHARA & UEDA, 1982.

Table 3. PENROSE's size distances based on the nine buccolingual crown diameters.

	Perak man	Wadjak man	Neol. Chinese	Neol. Jomon	Neol. Ban-Kao	Indo-nesians	Coobool Creek	Swanport
Wadjak man	0.028							
Neolithic S-Chinese	2.473	1.975						
Neolithic Jomon	4.693	3.996	0.353					
Neolithic Ban-Ko	3.569	2.964	0.100	0.077				
Modern Indonesians	3.451	2.857	0.081	0.095	0.001			
Coobool Creek	1.616	2.070	8.088	11.818	9.988	9.790		
Swanport Aborigines	0.201	0.379	4.085	6.838	5.465	5.318	0.677	
Whole Aborigine	0.278	0.129	1.093	2.688	1.855	1.771	3.234	0.952

samples and Wadjak man.

PENROSE's size distances were again calculated using the seven buccolingual crown diameters including those from Minatogawa man. Figure 3 is depicted by applying MDS to the distances computed. It is obvious that the overall tooth size of Perak man is somewhat larger than that of Minatogawa man.

In order to compare the proportion in tooth size, Q-mode correlation coefficients between the samples were calculated using the nine buccolingual diameters. The results are given in Table 4. Of the eight samples, Perak man shows the highest coefficient with the Coobool Creek Australians, and the next highest correlations were with the two modern Australian samples. In contrast with those, the other samples show relatively large inverse correlations with Perak man. Figures 4 and 5 represent the results of the two dimensional scaling and the cluster analysis of the correlation coefficients in Table 4. In both figures, all the Australian samples are close to one another, while the early and modern Southeast Asians and the others are distinctly separate. However, Perak man appears connected to the Australian cluster.

For comparing with Minatogawa man, Q-mode correlation coefficients were again calculated using the seven buccolingual crown diameters, as given in Table

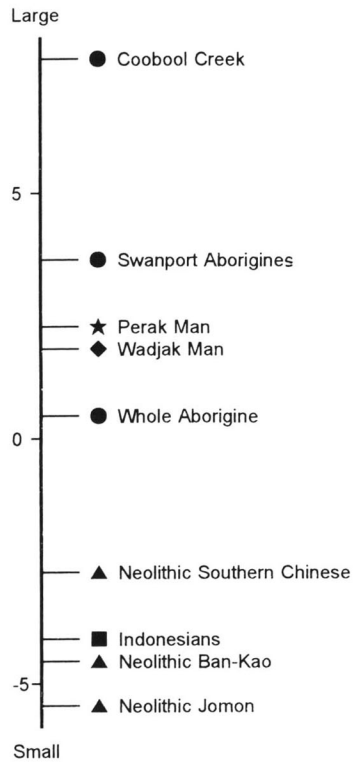


Fig. 2. One dimensional expression of MDS applied to the PENROSE's size distances based on the nine buccolingual crown diameters.

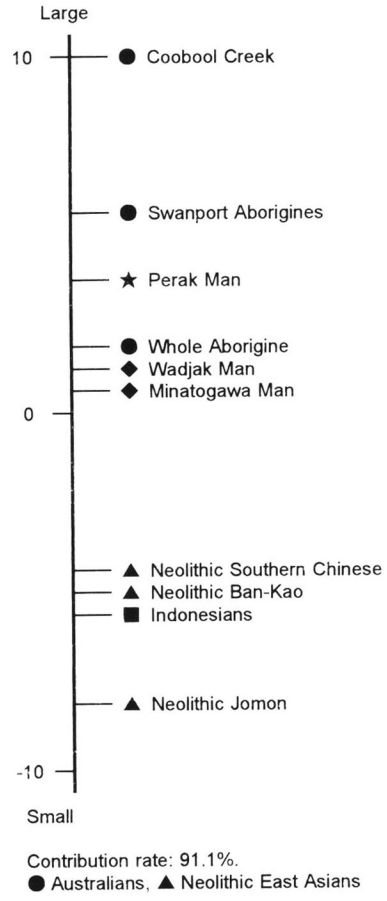
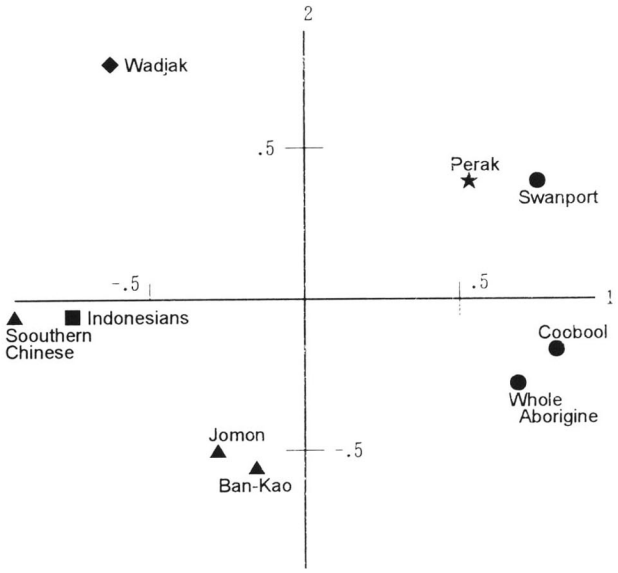


Fig. 3. One dimensional expression of MDS applied to the PENROSE's size distances based on the seven buccolingual crown diameters.

Table 4. Q-mode correlation coefficients based on the nine buccolingual crown diameters.

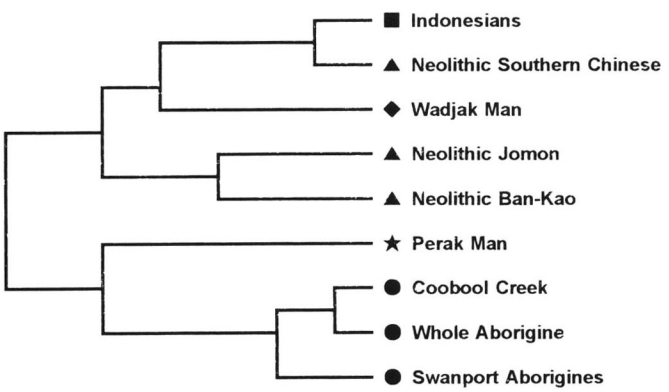
	Perak man	Wadjak man	Neol. Chinese	Neol. Jomon	Neol. Ban-Kao	Indo-nesians	Coobool Creek	Swanport
Wadjak man	−0.460							
Neolithic S-Chinese	−0.559	0.422						
Neolithic Jomon	−0.411	−0.213	0.486					
Neolithic Ban-Ko	−0.191	−0.363	0.264	0.519				
Modern Indonesians	−0.614	0.316	0.865	0.296	0.288			
Coobool Creek	0.097	−0.608	−0.730	0.019	0.058	−0.592		
Swanport Aborigines	0.010	−0.261	−0.736	−0.273	−0.310	−0.526	0.708	
Whole Aborigine	−0.039	−0.611	−0.631	0.119	0.175	−0.427	0.917	0.638



Contribution rate in the 1st axis: 67.5%, and 2nd axis: 24.5%.

● Australians, ▲ Neolithic East Asians

Fig. 4. Two dimensional expression applied to the Q-mode correlation coefficients based on the nine buccolingual crown diameters.



● Australians, ▲ Neolithic East Asians

Fig. 5. Dendrogram of cluster analysis applied to the Q-mode correlation coefficients based on the nine buccolingual crown diameters.

Table 5. Q-mode correlation coefficients based on the seven buccolingual crown diameters.

	Perak man
Wadjak man	−0.313
Neolithic S-Chinese	0.036
Neolithic Jomon	0.031
Neolithic Ban-Kao	−0.030
Modern Indonesians	−0.166
Coobool Creek	0.342
Swanport Aborigine	0.039
Whole Aborigine	−0.083
Minatogawa man	−0.572

5. The correlation coefficient between Perak man and Minatogawa man is a minus value, suggesting dissimilarity in tooth size proportion between the two specimens.

Discussion

Human remains from the preceramic levels associated with similar tools as Perak man have been excavated from other cave sites in the State of Perak, Malaysia. In Gua Kajang, a cave also located in the Lenggong district, EVANS (1918) found a fragment of female jaw with some teeth. Further, EVANS, GORDON and CALLENFELS collected some fragmentary parts of the human bones from Gua Kerbau in Gunong Pondok (CALLENFELS, 1936). DUCKWORTH (1934) found Australo-Melanesian affinities in his examination of these samples. From Gua Kepah, a shell midden site in mainland Penang, MIJSBERG (1940) unearthed some human jaws, and regarded these specimens as Palaeo-Melanesians. According to these reports, the skeletal morphology of these samples can be interpreted as comparable to Australo-Melanesians, as seen in the dolichocephalic crania, massive jaws with relatively large teeth, alveolar prognathism, and slender limbs. As stated by JACOB and SOEPRIYO (1994), Perak man from Gua Gunung Runtuh also has characteristics similar to these samples. The present comparison of tooth size revalued a close affinity of Perak man with the Australian samples including those from the late Pleistocene Coobool Creek.

Features similar to those of the Australo-Melanesians are manifested in the skeletal morphology of other late Pleistocene and early Holocene fossil records from Southeast Asia. BROTHWELL (1960) studied the late Pleistocene human skull excavated from Niah Cave in Borneo Island, and found that it bears the closest affinity to Tasmanians. JACOB (1975) described the Wadjak skull from Java as possessing Australoid characteristics. Recently, WU (1992) also demonstrated that Wadjak man has a close similarity to late Pleistocene Keilor man

from Australia, and suggested the possibility of an Australoid occupation of early Java. The Tabon specimens from Palawan Island have also been considered close to the Australoids by MACINTOSH (1978). In Vietnam, CUONG (1986) examined two nearly complete skulls belonging to the early Hoabinhian cultural stage, and also found the features similar to those of the Australoids as well as some Mongoloid characteristics.

Thus, it has been generally accepted that Southeast Asia was occupied by the Australo-Melanesoid lineage before the expansion of "classic" Mongoloid populations from the north to this area. So far, the present-day Southeast Asian populations have been considered to have originated from the hybrids formed between the indigenous Australo-Melanesian stock and the Mongoloid lineage migrated from East Asia (CALLENFELS, 1936; MIJESBERG, 1940; VON KOEINIGSWALD, 1952; COON, 1962; JACOB, 1975; BELLWOOD, 1987).

On the contrary, some recent cranial and dental studies have advocated somewhat different views. According to TURNER's dental studies (TURNER, 1989, 1990, 1992), both the early and modern Southeast Asians are characterized by the Sundadont dental complex which links up well with Australian aboriginal teeth, suggesting that the Australian Aborigines and Southeast Asians originated from a common stock which had probably occupied the Sundaland as the ultimate homeland during the late Pleistocene. On the other hand, the craniofacial studies by HANIHARA (1993, 1994) advocated that the Proto-Malays like present-day Dayak had widely inhabited Southeast Asia during the late Pleistocene. He regards the Proto-Malays as an original source for the present-day Southeast Asians including the Jomon people. These researchers consider that the present-day Southeast Asians have evolved by local adaptation without any admixture of the "classic" Mongoloid populations from East Asia. In addition, HANIHARA's assessment does not favor the hypothesis of the Australoid occupation of early Southeast Asia.

The present study is not concerned with the population history of the present-day Southeast Asia, but focuses on the problem of the early inhabitants of Southeast Asia. The archaeological evidence for the occupation of Australia suggests that the first inhabitants came into Australia approximately 50,000 years ago (BOWDLER, 1992). The Australian teeth, which are most like those of early Southeast Asians (TURNER, 1992; MATSUMURA, 1995b), prove the Sundaland origin of the Australian Aborigines. Until the end of the last glacial stage, lowered sea level reduced the water barrier between Australia and Southeast Asia. Under such a geographic background during the late Pleistocene, genetic separation between the inhabitants of Australia and Southeast Asian is considered still incomplete. The fossil records of Tabon, Wadjak, Niah, Vietnam and Malay suggest that some morphological characteristics shared with Australoids had been retained in such regional inhabitants of Southeast Asia until the early Holocene.

The present metrical analysis of the dentition of Perak man from Gua Gunung Runtuh, at least, proves that this region was occupied by dentally Australoids at the time of the early Holocene.

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