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Geographical and Temporal Variation in Dental Metrics of the Jomon People from the Mainland Japan

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Abstract The permanent teeth of the skeletal remains from 18 sites in the mainland Japan in the early to late Jomon period were collected. On these permanent teeth, mesio-distal diameter and the bucco-lingual diameter were measured. The site being a basic unit for the analysis, the statistical features were examined differently according to sex. The t-test was carried out to compare the differences in the mesio-distal and bucco-lingual diameters among the sites. The Mahalanobis generalized distance was performed to determine the morphological distances between the sites as well as for creating the dendrogram. In general, a larger morphological distance was observed in male samples compared to the female samples. In males, larger differences were shown in the mesio-distal diameters of the mandibular teeth and in the bucco-lingual diameters of the posterior maxillary teeth, whereas in the female, notable differences were found in the mesio-distal and bucco-lingual diameters of the upper canine and upper first premolar. Many of the dental traits of the earlier part of the Jomon period were observed to be greater than one standard deviation of the "Jomon people", indicating greater variation existed. The Mahalanobis generalized distance showed no significant distance among the sites in both males and females. In the dendrogram, clusters tended to be formed by the sites that are geographically close to each other. The univariate analysis showed that the temporal difference could lead to morphological differences. Mahalanobis' generalized distance in, contrast, suggested that geographical variations in dental metrical traits were very low. As a conclusion, when the multivariate analysis is utilised for the inter-site variations of dental metric traits, the individual site (or personal) information tend to be deleted or disappeared. Therefore, there would not be any problem when an issue concerns the "Jomon period". However, the univariate approach allows more detailed analyses (e.g. determination of kinship within a site).

Key words Neolithic, Crown size, Dentition, Migration

Introduction

No archaeological evidence of immigration from overseas has been discovered during the Jomon period although it occurred in the pre-Jomon period and during the latest Jomon to the early Yayoi period. Therefore, in comparative anthropological studies based on skeletal remains researchers have not considered geographic and temporal variations within the "Jomon people" when comparing remains from other periods or from overseas populations, despite the fact that the Jomon period lasted for about 10,000 years (from 13,000 BP to 2,300 BP).

In contrast, several studies reported variations in skeletal remains during the Jomon

period. Ogata (1981) showed differences in the cranium between the skeletal remains from the earlier stage (i.e. the earliest Jomon and the early Jomon) with gracile crania, and the later stage (i.e. the middle Jomon, the late Jomon and the latest Jomon) with robust crania. He ascribed the difference to diet, that is the people in the later stage Jomon period had more constant food resources than in the early stage Jomon period. Furthermore, metrical or non-metrical studies of the cranium or dentition of the late or the latest Jomon populations showed considerable variations between sites (i.e. Mouri 1986; Hashimoto & Baba 1998, 2000). Kondo (1993, 1994) reported that the inter-regional variations of the cranial metrical traits were almost the same as intra-regional variations in the Kanto region during the middle to the late Jomon.

The kinship of human remains was investigated from dental measurements. Hanihara *et al.* (1983) determined the kinship among the remains from Uwasato in the early to the middle Jomon period using Q-mode correlation coefficients of mesio-distal tooth diameter. Comparative study of dental measurements between different ritual tooth ablation type groups within a site showed that uxorilocal marriage was the common conjugal system, and the place from where the husband came from was limited on Tsukumo in the late Jomon period (Hashimoto & Baba 2000).

The dental measurements of remains from the Jomon period were studied in comparison with remains from other periods or from overseas populations with no consideration of geographic and temporal variations within the "Jomon people". Even though dental measurements can help determine kinship among the remains. In this study inter-site variations of dental measurements are investigated using the earliest to the latest Jomon skeletal remains from mainland Japan. The biological problems of ignoring any geographic and temporal variations within the "Jomon people" are discussed in detail. In this study a site is the basic unit for analysis, and the region's name is for the place where a site situates.

Materials and Methods

Materials

In this study dental remains of 542 individuals from nine of the earliest to the latest Jomon sites in mainland Japan were investigated (Fig. 1, Table 1). Five sites are in the Tohoku region (i.e. Obora, Nakazawahama, Hosoura, Sanganji and Ebishima), six sites in the Kanto region (i.e. Nakazuma, Kasori, Ubayama, Horinouchi, Yoyama and Kuroya), five sites in the Tokai region (i.e. Yoshigo, Inariyama, Ikawazu, Hobi and Karekinomiya) and two sites in San'yo region (i.e. Tsukumo) (Fig. 1).

Methods

The mesio-distal and bucco-lingual diameters of the permanent dentition were measured in accordance with the criteria established by Fujita. (1949). Available left side teeth were measured individually, but if a left side tooth was missing, its antimere was measured, as there has been found no significant differences between sides for the same kind of tooth (Doi *et al.* 1986). Teeth from medial incisor to the second molar were measured, omitting the third molars, because of large variations in their size. All the measurements

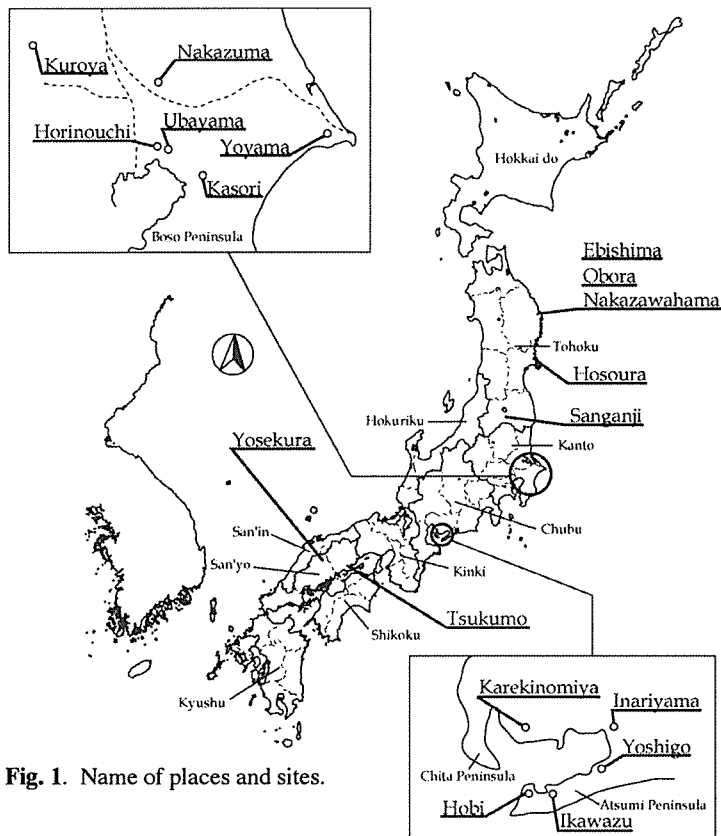


Fig. 1. Name of places and sites.

Table 1. Chronological table of Jomon Period by pottery.

BC	Phase	Site
10500	Incipient	
8000	Earliest	- Yosekura
4000	Early	- Nakazawahama Kuroya
3000	Middle	- Ebishima
2000	Late	- Nakazuma
		- Horinouchi
		- Kasori
		- Ubayama
1000	Latest	- Obora Hosoura Sanganji Yoyama
		- Hobi Yoshigo Ikawazu Inariyama Karekinomiya Tsukumo

were taken with a digital sliding caliper (calibrated to 0.01 mm).

A site being a basic unit for the analysis, the statistical analysis was done separately were examined for each sex. The t-test was carried out to compare the differences in the measurements of mesio-distal diameter and bucco-lingual diameter among the sites. When no significant difference of variance between two sites was shown, the Student's t test was applied. And when a significant difference of variance was shown, Welch's t test was applied. For determining intra-site variations, z-scores were calculated based on the average data of the "Jomon people" shown by Matsumura (1995).

For determining inter-site variations, the Maharanobis generalized distances were calculated. The mesio-distal diameter of P1, P2 and M1 for males and the bucco-lingual diameter of P1, P2 and M1 for females were selected for the calculation of the Maharanobis generalized distance, and as many sites as possible were analysed. Therefore, all anterior teeth (i.e. upper and lower I1, I2 and C) were omitted, since ritual tooth ablation was a very common custom during the latest Jomon and usually anterior teeth were extracted (Harunari 1986). Not so many mandibles remained at the sites, so mandibular teeth were excluded. Furthermore, Doi (1986) showed that correlation between M1 and M2 was very high, so that M2 was also excluded.

Using the Maharanobis generalized distances, the dendrogram was made by the mean group method of the cluster analysis.

Results

Z-score of male samples compared with the average data of the "Jomon people" (Matsumura 1995) is shown in Figs. 2 and 3. Hosoura (in the Tohoku region in the early Jomon period) most of the mesio-distal and bucco-lingual diameters of the entire dentition were smaller at one standard deviations or over than the average data of the "Jomon people". In Yoyama from the Kanto region in the late to the latest Jomon period, most of the bucco-lingual diameters of maxillary dentition were smaller at one standard deviation than the average data of the "Jomon people". In Horinouchi from the Kanto region in the middle to the late Jomon period, most of the mesio-distal diameters of maxillary dentition were larger at one standard deviation than the average data of the "Jomon people". In Tsukumo from the San'yo region in the late Jomon period, the mesio-distal and bucco-lingual diameters of the anterior teeth were larger, and those of posterior teeth were smaller at one standard deviation than the average data of the "Jomon people". In Yoshigo from the Tokai region in the latest Jomon period, the mesio-distal and bucco-lingual diameters of the entire dentition were smaller than the average of the "Jomon people", especially the measurements of anterior teeth were at one standard deviation. Many of the dental traits of the earlier part of the Jomon period were observed to be greater at more than one standard deviation than the "Jomon people", indicating that considerable variations existed in size of teeth before the middle Jomon period.

Z-score of female samples compared with the average data of the "Jomon people" (Matsumura 1995) is shown in Figs. 4 and 5. Most of the mesio-distal and bucco-lingual diameters of the entire dentition were smaller at one standard deviation than the average

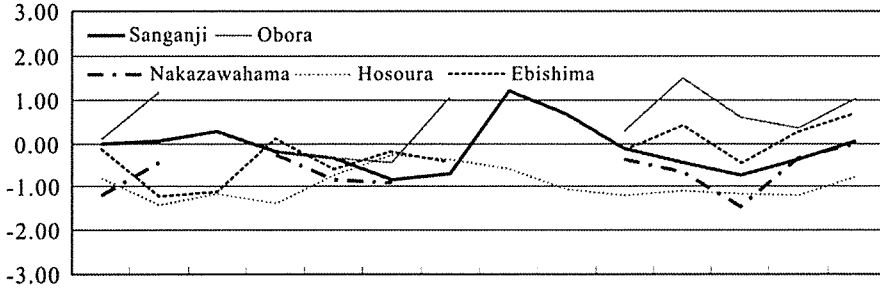
of the “Jomon people” in Yoshigo, Yosekura (in the San’yo region in the earliest Jomon period), Nakazawahama (in the Tohoku region in the early Jomon period) and Ebishima (in the Tohoku region in the middle Jomon period). In Tsukumo the mesio-distal and bucco-lingual diameters of the anterior teeth were larger, and those of posterior teeth were smaller at one standard deviation than the average data of the “Jomon people”, thus the same tendency is found as the male samples. Many of the dental traits of the earlier part of the Jomon period were observed to be greater at more than one standard deviation than the “Jomon people”, indicating that greater variations existed in the size of teeth before the middle Jomon period.

Larger morphological variations were observed in the male sample when compared with to the female samples (Tables 2 and 3). In males, larger differences were shown in the mesio-distal diameters of the mandibular teeth and in the bucco-lingual diameters of the maxillary posterior teeth among the sites, whereas in the females, notable differences were found in the mesio-distal and bucco-lingual diameters of the upper canine and upper first premolars. A significant inter-site difference was observed, always the two sites in different regions and periods both for males and females. In other words, when comparing sites in the same regions and periods, it was very rare to observe significant difference in tooth size.

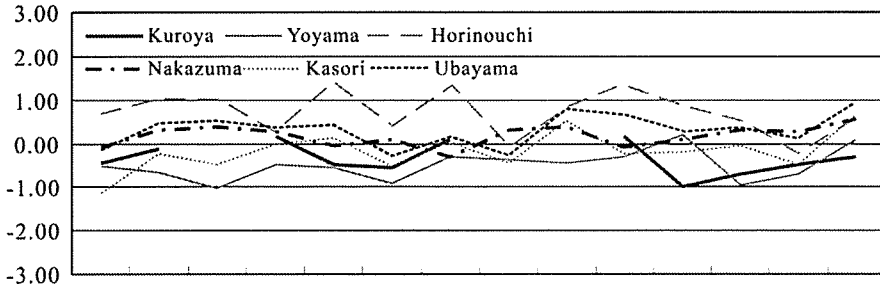
The Mahalanobis generalized distances calculated with the mesio-distal diameters of upper P1, P2 and M1 among the sites in male samples (Table 4). Significant differences were observed between Tsukumo and the other sites, between Ubayama and Hosoura, Ubayama and Yoshigo, and Yoshigo and Nakazuma. In addition, the Mahalanobis generalized distances were calculated with the bucco-lingual diameters upper P1, P2 and M1 among the sites in female samples (Table 5). Significant differences were observed only between Ubayama and Ebishima, and Ubayama and Sanganji.

The dendrogram of male samples based on the Mahalanobis generalized distance applied to the mesio-distal diameters of upper P1, P2 and M1 is shown in Fig. 6. A cluster was formed by sites in the Tohoku and Kanto region (i.e. the Tohoku region: Nakazawahama, Ebishima, Sanganji and Obora; the Kanto region: Nakazuma, Ubayama, Kasori, Kuroya and Yoyama). Four sites in the Tokai region (Hobi, Ikawazu, Yoshigo and Inariyama) were connected to the Tohoku and Kanto cluster. Hosoura (the Tohoku region, the early Jomon) and Horinouchi (the Kanto region, the middle to the late Jomon) were connected to the cluster. At last Tsukumo from the San’yo region in the late Jomon connected to the cluster. The dendrogram of female samples based on the Mahalanobis generalized distance applying to the bucco-lingual diameters of upper P1, P2 and M1 is shown in Fig. 7. A cluster was formed by sites in the Tohoku region (i.e. Nakazawahama, Ebishima, Sanganji and Obora). The Kanto, Tokai and San’yo sites (i.e. the Kanto region: Nakazuma, Ubayama, Kasori and Kuroya; the Tokai region: Hobi, Ikawazu, Yoshigo and Inariyama; the San’yo region: Tsukumo) formed another big cluster. Only Yoyama from the Kanto region in the late to the latest Jomon was distant from the other sites. In the Kanto, Tokai and San’yo cluster, the Tokai sites were close together. However the Kanto sites were separated out to two clusters, one was formed by Ubayama and Nakazuma, and Horinouchi went together with the San’yo site.

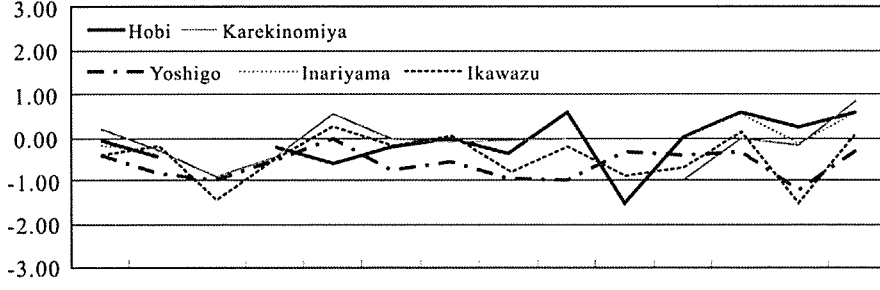
Tohoku



Kanto



Tokai



Sanyo

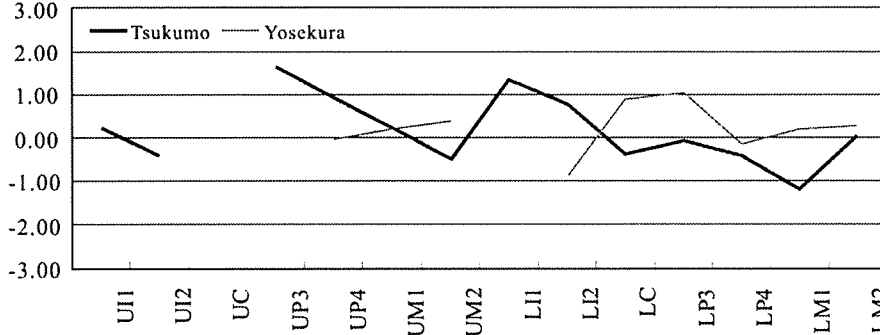
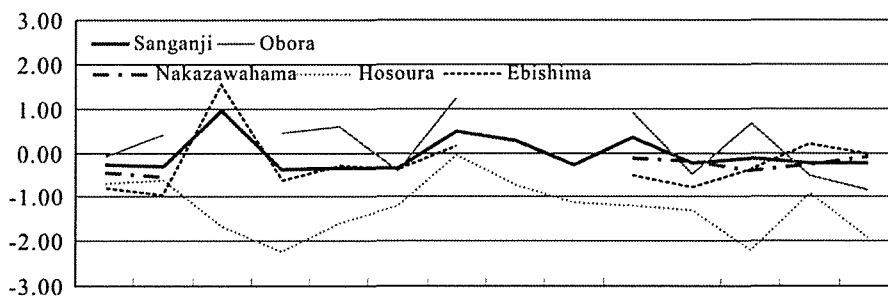
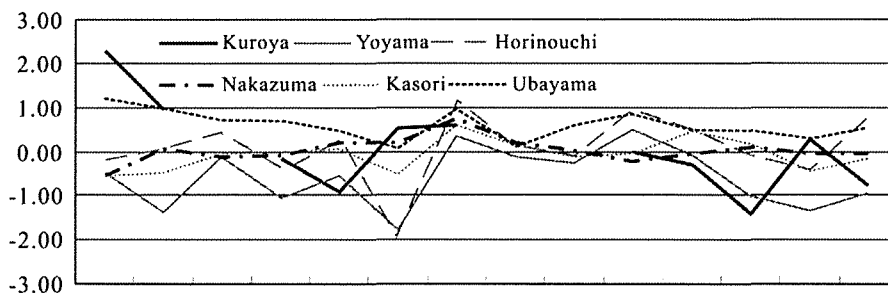


Fig. 2. Deviation diagrams showing mesio-distal diameter of male samples percentage differences from the average of Jomon samples (Matsumura 1995).

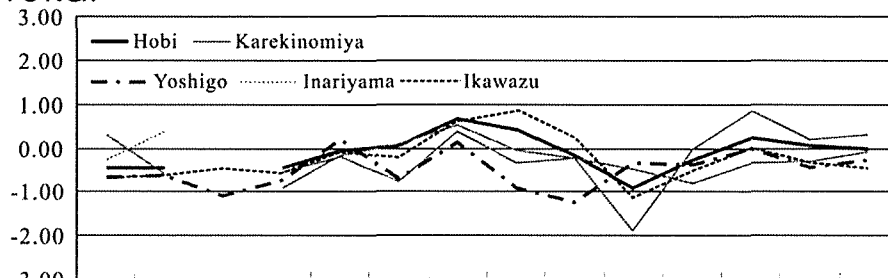
Tohoku



Kanto



Tokai



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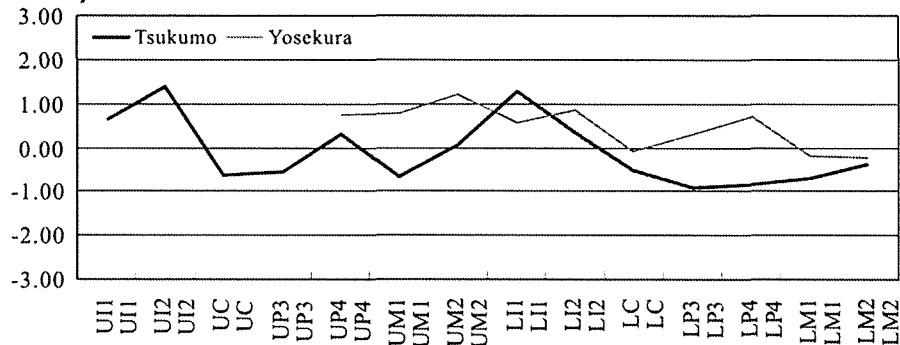
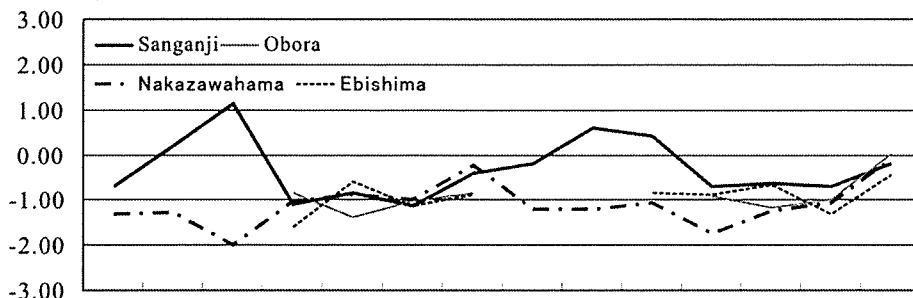
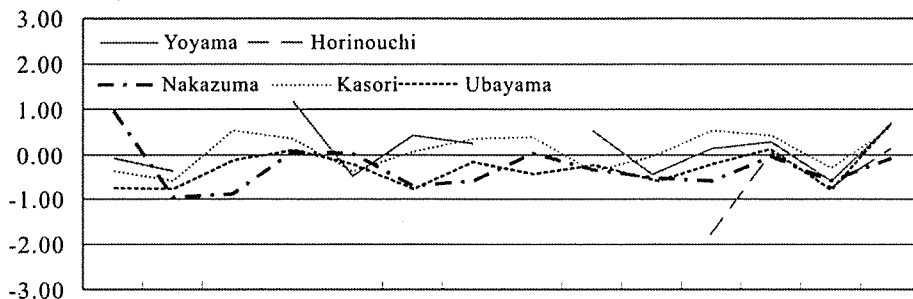


Fig. 3. Deviation diagrams showing bucco-lingual diameter of male samples percentage differences from the average of Jomon samples (Matsumura 1995).

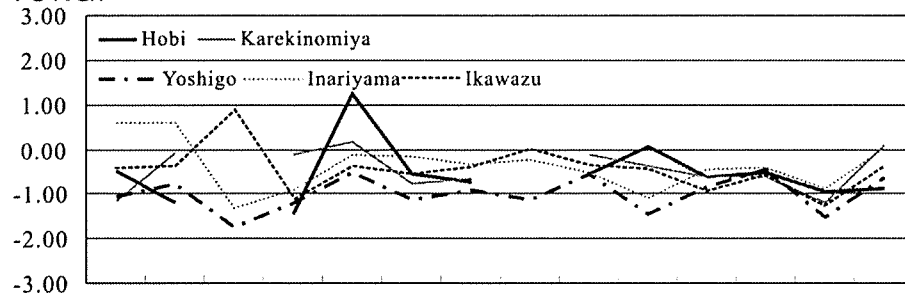
Tohoku



Kanto



Tokai



Sanyo

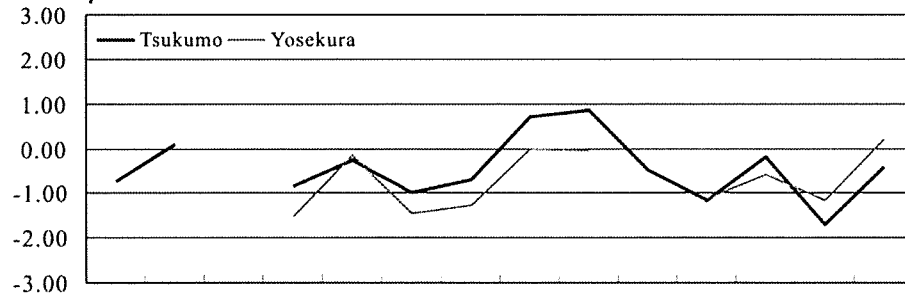
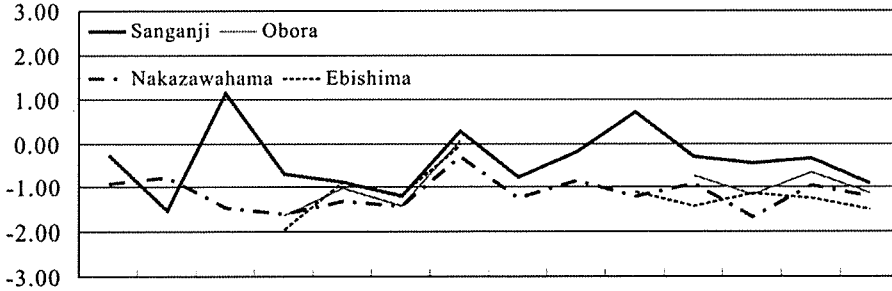
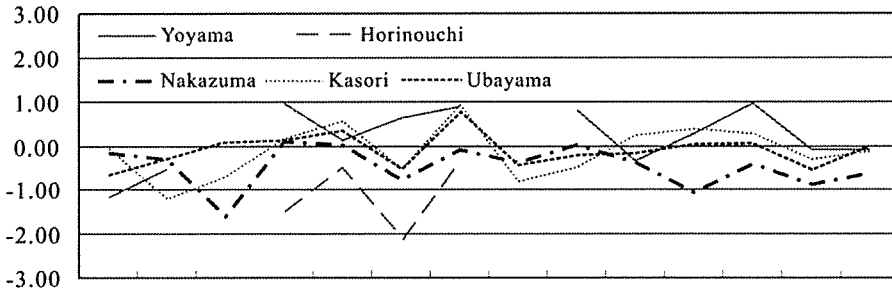


Fig. 4. Deviation diagrams showing mesio-distal diameter of female samples percentage differences from the average of Jomon samples (Matsumura 1995).

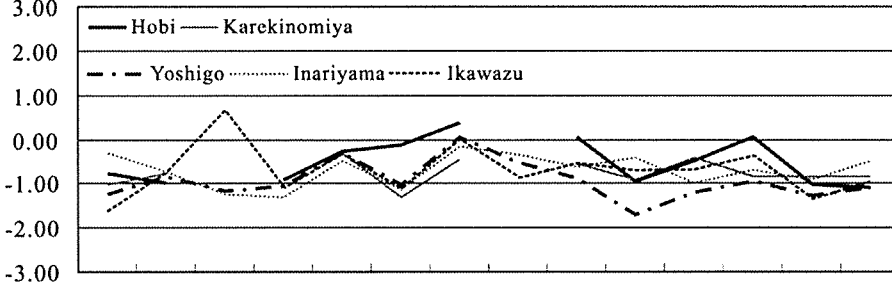
Tohoku



Kanto



Tokai



Sanyo

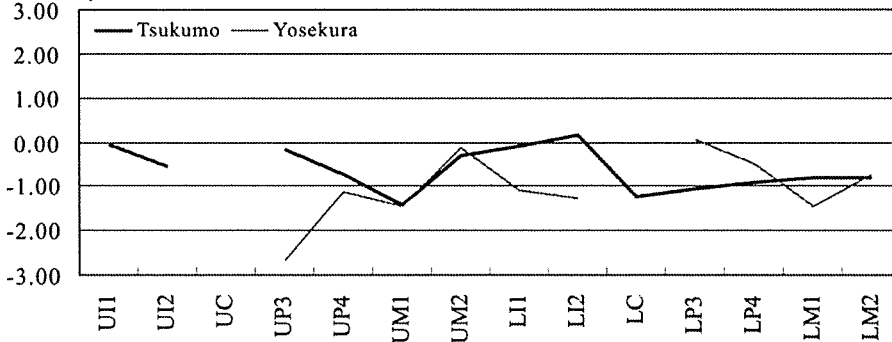


Fig. 5. Deviation diagrams showing bucco-lingual diameter of female samples percentage differences from the average of Jomon samples (Matsumura 1995).

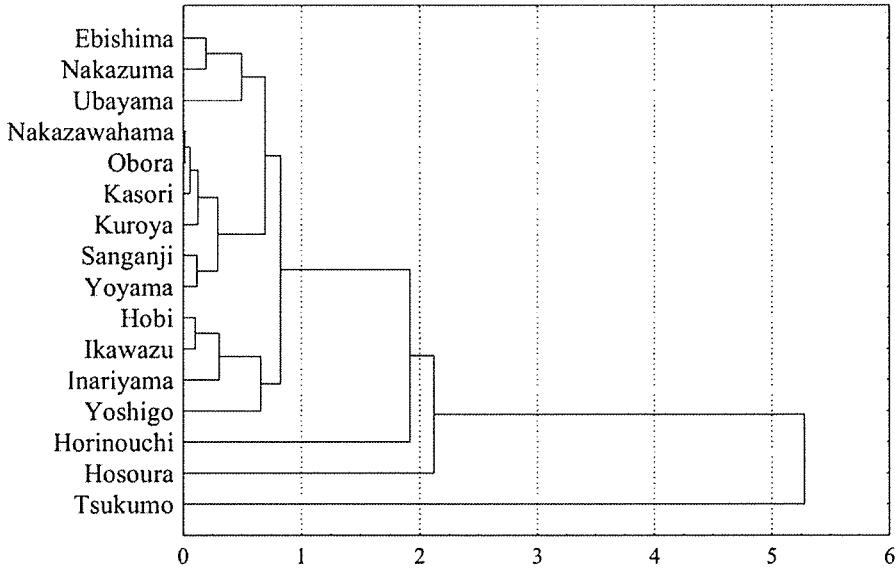


Fig. 6. Cluster analysis of the Mahalanobis distance using male samples. The Mahalanobis distance matrix is based on mesio-distal diameter of upper first premolar, upper second premolar and upper first molar.

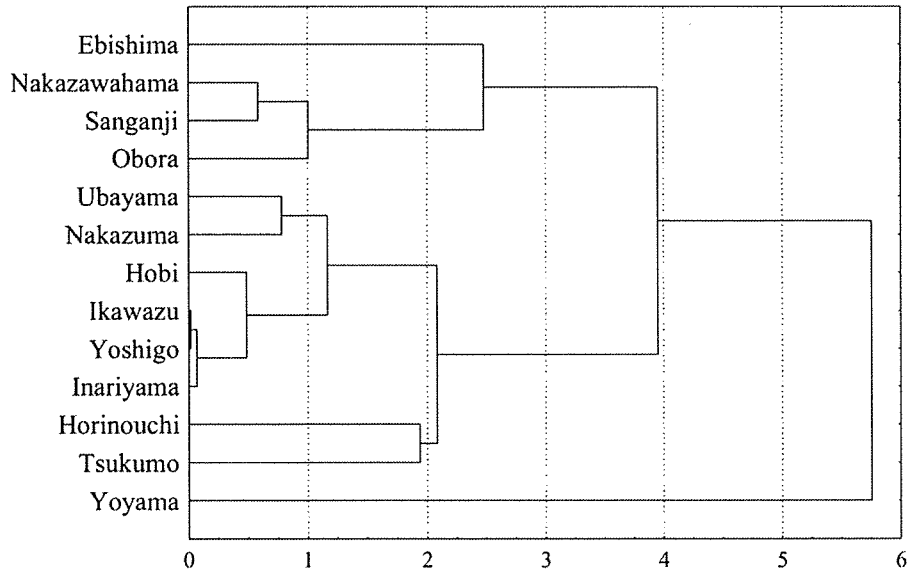


Fig. 7. Cluster analysis of the Mahalanobis distance using female samples. The Mahalanobis distance matrix is based on bucco-lingual diameter of upper first premolar, second premolar and first molar.

Table 2. Inter-site differences in male samples using t-test. When no significant difference of variance between two sites was shown, the Student's t test was applied. And when a significant difference of variance was shown, the Welch's t test was applied. Lower part is bucco-lingual diameter and upper part is mesio-distal diameter. Bold literature indicate significance at the 5% level. Abbreviations indicate following site names: EB: Ebishima, HS: Hosoura, NKH: Nakazawahama, OB: Obora, SG: Sanganji, NKZ: Nakazuma, UB: Ubayama, KS: Kasori, HR: Horinouchi, YY: Yoyama, KU: Kuroya, TS: Tsukumo, HB: Hobi, IK: Ikawazu, KRK: Karekinomiya, YS: Yoshigo, and IN: Inariyama.

Upper First Incisor

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	TS	HB	IK	KRK	YS	IN
EB		0.15	0.41	0.51	0.59	0.29	1.74	0.39	0.48	0.24	2.00	1.58	0.41	0.14	1.15	0.17	0.61
HS	0.80		0.46	0.67	0.89	0.28	3.82	0.28	0.79	0.25	2.83	2.63	0.62	0.01	2.47	0.03	1.09
NKH	0.94	0.66		0.28	0.47	0.18	3.13	0.17	0.85	0.05	1.26	2.75	0.05	0.44	2.78	0.48	0.64
OB	0.22	1.43	2.31		0.24	0.66	1.73	0.59	0.12	0.29	1.31	0.84	0.26	0.82	0.27	0.44	0.13
SG	0.17	1.48	1.95	0.17		0.66	3.34	0.62	0.11	0.34	1.12	2.13	0.51	0.97	1.69	0.85	0.01
NKZ	0.08	1.06	1.18	0.21	0.15		5.17	0.01	0.52	0.09	1.10	2.43	0.32	0.41	2.97	0.26	0.75
UB	0.02	1.30	1.58	0.40	0.31	0.16		4.39	2.18	2.43	0.59	1.16	4.61	5.17	2.15	4.08	3.76
KS	1.03	0.37	0.06	1.05	1.32	1.59	1.70		0.52	0.08	3.32	2.37	0.29	0.36	2.01	0.24	0.72
HR	1.06	3.36	9.71	0.85	1.57	1.93	3.03	3.11		0.32	1.76	1.85	0.52	0.74	1.78	0.34	0.14
YY	0.24	0.14	0.39	0.35	0.43	0.40	0.17	0.45	0.59		1.68	1.60	0.09	0.29	0.67	0.13	0.22
KU	0.26	0.50	0.98	0.64	0.61	0.39	0.43	0.56	1.17	0.03		0.86	1.11	1.16	0.94	2.18	1.09
TS	0.49	2.34	3.64	0.25	0.51	0.48	0.84	2.21	1.15	0.36	1.20		2.92	2.70	1.02	2.56	2.64
HB	0.11	1.63	2.05	0.33	0.17	0.01	0.21	1.66	2.81	0.21	0.62	0.77		0.71	2.46	0.53	0.61
IK	0.35	0.63	0.91	0.59	0.63	0.61	0.56	1.11	2.86	0.11	0.05	1.05	0.70		2.34	0.07	1.11
KRK	0.46	2.05	2.53	0.13	0.39	0.45	0.77	1.74	1.43	0.34	0.99	0.11	0.66	1.05		2.33	2.15
YS	0.38	0.62	0.88	0.59	0.64	0.70	0.60	1.28	3.91	0.11	0.05	1.03	0.72	0.01	1.05		0.96
IN	0.05	1.09	1.38	0.39	0.31	0.17	0.05	1.29	2.06	0.31	0.34	0.79	0.23	0.40	0.72	0.42	

Upper Second Incisor

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	TS	HB	IK	KRK	YS	IN
EB		0.29	0.49	1.64	0.75	1.08	2.79	0.72	0.83	0.50	1.52	2.13	0.67	0.49	0.43	0.46	1.85
HS	0.26		0.31	6.04	0.83	1.12	1.98	0.22	1.26	4.93	2.23	1.51	0.23	0.00	0.06	0.01	1.54
NKH	1.24	1.67		6.04	0.81	1.25	4.63	0.14	1.49	5.78	1.38	2.45	0.27	0.20	0.06	0.22	1.79
OB	3.69	4.24	2.68		2.12	0.64	1.73	1.45	0.72	18.8	0.64	1.29	1.18	1.46	1.72	3.58	0.10
SG	2.14	2.18	0.76	1.60		1.12	2.23	0.36	0.80	3.75	2.31	2.11	0.25	0.59	0.59	0.46	1.45
NKZ	2.16	1.74	0.75	0.88	0.39		2.52	1.52	0.02	6.41	1.43	1.59	1.24	1.86	1.39	1.88	0.84
UB	2.79	2.30	1.10	0.90	0.55	0.27		3.31	1.11	7.23	0.02	0.65	2.83	3.60	2.60	3.64	1.24
KS	1.81	1.60	0.28	1.92	0.49	1.05	1.41		0.82	2.96	2.10	2.15	0.07	0.33	0.20	0.30	1.97
HR	3.19	3.18	1.93	0.18	1.25	0.74	0.72	1.69		1.58	1.04	0.98	0.66	0.92	0.96	0.72	0.46
YY	0.71	0.69	0.19	1.65	0.76	1.11	1.42	0.57	1.45		1.75	3.33	2.30	2.33	1.77	2.51	4.74
KU	1.75	2.21	0.57	2.11	0.27	0.42	0.69	0.17	1.49	0.49		0.33	1.74	2.07	2.12	1.65	0.82
TS	1.07	0.94	0.04	1.47	0.53	1.08	1.32	0.27	1.32	0.25	0.27		2.34	2.94	2.05	3.06	1.35
HB	1.60	1.62	0.02	2.73	0.96	1.28	1.77	0.46	2.34	0.28	0.58	0.08		0.35	0.23	0.32	1.64
IK	1.69	1.47	0.27	1.74	0.43	1.04	1.36	0.02	1.54	0.56	0.14	0.29	0.45		0.07	0.01	2.15
KRK	1.50	1.46	0.17	1.97	0.56	0.85	1.21	0.13	1.67	0.38	0.27	0.11	0.26	0.14		0.06	1.82
YS	0.58	0.59	0.41	2.08	1.13	2.45	2.49	1.20	1.92	0.23	0.75	0.68	0.67	1.24	0.74		1.87
IN	1.27	1.14	0.07	1.70	0.57	1.08	1.39	0.25	1.51	0.31	0.29	0.04	0.14	0.26	0.08	0.75	

Table 2. Continued.

Upper Canine

	EB	HS	SG	NKZ	UB	KS	HR	YY	IK	KRK	YS
EB		1.42	0.40	2.14	0.48	0.83	0.71	1.09	1.26	1.25	1.65
HS	0.04		5.17	3.15	5.76	5.54	5.58	2.43	2.73	1.72	0.72
SG	1.09	0.94		1.51	0.40	2.51	0.92	1.08	2.86	1.27	1.37
NKZ	2.12	3.15	0.07		2.74	0.16	0.79	0.03	0.78	0.49	1.18
UB	2.16	3.18	0.28	0.35		2.83	0.49	1.39	2.40	1.90	2.04
KS	0.89	1.37	1.03	2.33	2.56		1.40	0.06	1.62	0.33	1.27
HR	2.67	6.04	0.65	0.92	0.69	2.24		0.58	13.4	0.77	1.98
YY	0.15	0.42	1.17	2.03	2.06	0.76	4.66		0.53	0.27	0.64
IK	0.35	0.64	1.41	2.62	2.62	1.38	3.45	0.66		0.16	0.59
KRK	0.17	0.18	0.76	1.71	1.77	0.52	1.60	0.09	0.43		0.41
YS	0.16	0.29	1.28	2.84	2.98	0.94	2.32	0.03	0.54	0.08	

Upper First Premolar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	TS	HB	IK	KRK	YS	IN
EB		3.18	0.04	1.83	0.55	1.07	2.59	1.40	0.29	0.78	0.67	0.02	0.22	0.01	0.61	0.18	0.05
HS	2.10		1.74	4.56	4.51	4.60	5.92	5.34	2.71	1.86	3.20	1.77	2.91	3.07	2.29	2.06	2.89
NKH	0.59	1.65		0.84	0.28	0.56	1.26	0.65	0.17	0.40	0.35	0.06	0.23	0.04	0.24	0.13	0.09
OB	0.37	1.42	0.15		1.74	0.87	0.33	0.93	1.22	2.10	1.03	0.78	1.10	1.46	3.80	1.15	1.30
SG	0.39	1.61	0.12	0.01		0.76	2.79	1.09	0.05	1.44	0.39	0.31	0.19	0.56	1.21	1.00	0.44
NKZ	0.31	3.01	0.90	0.62	1.01		2.94	0.25	0.46	1.81	0.12	0.74	1.02	1.62	1.31	1.96	1.39
UB	0.56	3.47	1.20	0.86	1.30	0.39		2.03	1.58	3.07	1.25	1.85	2.99	3.83	2.41	4.16	3.44
KS	0.24	2.63	0.51	0.28	0.33	0.78	1.14		0.70	2.17	0.29	0.86	1.03	1.55	1.83	2.02	1.35
HR	0.21	1.90	0.84	0.55	0.48	0.00	0.16	0.46		0.81	0.28	0.13	0.07	0.27	0.81	0.32	0.21
YY	0.94	1.35	0.47	0.54	0.40	1.26	1.59	0.95	1.21		1.14	0.46	0.86	0.76	0.20	0.41	0.75
KU	0.13	2.65	1.22	0.59	0.74	0.53	1.07	0.70	0.14	1.68		0.30	0.34	0.58	1.36	0.54	0.50
TS	1.17	2.28	2.23	0.99	1.97	1.58	1.47	1.92	0.74	2.50	1.84		0.17	0.04	0.27	0.27	0.01
HB	0.72	2.34	0.08	0.08	0.11	1.44	1.87	0.63	0.87	0.54	1.72	2.16		0.32	0.58	0.54	0.23
IK	1.44	2.03	0.54	0.61	0.61	2.48	3.03	1.56	1.48	0.04	3.56	2.41	0.90		0.46	0.29	0.08
KRK	0.56	0.96	0.18	0.21	0.24	0.92	1.17	0.60	0.59	0.07	0.52	1.11	0.30	0.13		0.20	0.47
YS	1.07	1.42	0.39	0.42	0.71	2.73	3.02	1.26	0.99	0.06	3.16	2.36	0.76	0.10	0.12		0.34
IN	0.86	1.37	0.27	0.32	0.48	1.88	2.22	0.97	0.84	0.03	1.71	2.33	0.52	0.09	0.04	0.16	

Upper Second Premolar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN
EB		2.16	0.41	1.32	0.03	1.23	1.42	0.88	0.78	0.24	0.73	1.72	0.97	0.52	0.51	0.30	0.86	0.24
HS	0.27		7.47	2.79	4.47	4.58	3.95	4.84	6.19	0.93	0.84	8.04	4.74	4.88	3.23	2.95	2.90	4.69
NKH	0.28	0.13		0.98	0.71	0.41	0.66	0.17	0.70	0.63	1.46	1.90	0.40	0.02	0.06	0.15	0.29	0.26
OB	0.38	0.69	0.48		2.03	0.83	0.22	1.21	0.48	1.32	1.98	0.26	0.38	1.07	1.17	1.11	0.50	1.38
SG	0.48	0.89	0.45	0.07		1.54	1.77	1.17	1.33	0.41	1.25	2.83	1.47	0.67	0.61	0.40	1.73	0.28
NKZ	1.14	1.50	0.68	0.51	0.85		0.98	0.55	0.12	1.28	1.97	1.19	0.34	0.78	1.06	0.86	0.10	1.35
UB	1.86	2.19	1.90	1.21	1.91	1.73		1.20	0.26	1.31	1.84	0.47	0.36	1.31	1.76	1.19	0.73	1.81
KS	0.56	1.07	0.65	0.31	0.62	0.24	0.39		0.43	1.08	1.88	1.68	0.63	0.26	0.38	0.47	0.60	0.75
HR	2.63	3.45	1.71	2.13	3.18	2.39	1.36	0.73		0.91	1.68	0.99	0.06	0.44	0.49	0.55	0.04	0.69
YY	0.04	0.33	0.23	0.32	0.39	0.81	1.34	0.39	2.87		0.38	1.81	0.95	0.69	0.68	0.50	0.85	0.48
KU	0.12	0.45	0.34	0.26	0.30	0.73	1.28	0.86	3.10	0.16		2.84	1.40	1.25	1.24	1.03	1.28	1.05
YSR	0.66	0.94	0.66	0.30	0.51	0.00	0.76	0.12	1.44	0.53	0.48		0.61	1.39	1.47	1.48	0.71	1.71
TS	1.40	1.58	0.97	0.71	1.24	0.96	0.52	0.70	0.20	0.68	1.44	0.56		0.76	0.99	0.75	0.20	1.14
HB	0.00	0.32	0.39	0.47	0.60	1.65	2.75	0.91	3.16	0.04	0.13	0.88	1.43		0.08	0.19	0.62	0.40
IK	0.87	1.03	0.97	0.52	1.27	0.69	0.39	0.16	0.89	0.60	1.83	0.27	0.65	1.73		0.14	0.94	0.38
KRK	2.41	3.23	1.19	1.77	2.54	1.57	0.30	0.57	1.67	2.57	2.64	1.01	0.39	2.82	0.68		0.62	0.13
YS	0.49	1.32	0.63	0.22	0.68	0.02	1.10	0.23	0.96	0.33	1.19	0.01	1.16	1.17	0.52	1.37		1.05
IN	1.89	2.48	0.88	1.15	1.75	0.84	0.68	0.08	2.49	1.61	1.54	0.49	0.74	2.39	0.12	1.16	0.57	

Table 2 . Continued.

Upper First Molar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN	
EB		1.29	0.18	0.01	0.10	1.46	0.89	0.15	1.35	1.61	0.97	1.53	0.46	0.88	0.21	0.64	0.43	0.63	
HS	0.10		2.49	1.57	3.46	3.62	2.51	1.18	0.43	0.95	3.40	3.45	1.03	2.96	2.59	4.34	1.57	1.03	
NKH	1.05	1.10		0.23	0.32	0.78	0.40	0.30	1.17	1.69	0.97	1.19	0.57	0.47	0.02	0.75	0.43	0.64	
OB	0.32	0.31	0.62		0.18	1.09	0.64	0.09	0.99	1.37	1.00	1.31	0.33	0.74	0.16	0.85	0.27	0.43	
SG	1.48	1.41	0.18	0.74		2.62	1.56	0.38	0.77	1.50	2.22	1.64	0.92	1.36	0.27	1.49	1.28	1.21	
NKZ	0.77	0.89	2.18	0.98	3.39		0.56	2.08	0.91	4.10	0.60	1.35	2.77	0.49	1.33	0.29	3.12	2.47	
UB	0.15	0.02	1.07	0.24	1.62	1.44		1.37	2.60	3.00	0.66	1.34	1.89	0.01	0.83	0.03	2.32	2.21	
KS	0.68	0.56	0.55	0.16	0.70	2.15	0.78		1.49	1.69	1.15	1.87	0.35	1.23	0.47	0.80	0.40	0.60	
HR	0.80	1.14	1.76	1.35	2.35	0.55	0.93	1.30		0.13	1.58	2.30	1.47	0.91	1.62	1.01	1.16	1.19	
YY	0.99	1.00	0.01	0.55	0.16	2.12	1.05	0.53	1.55		2.30	3.01	1.65	3.18	1.81	2.63	1.23	1.29	
KU	0.39	0.36	0.39	0.09	0.49	1.10	0.36	0.03	0.90	0.35		0.27	1.54	0.75	0.77	0.81	1.14	1.47	
YSR	0.61	0.75	1.49	0.78	2.22	0.25	0.88	1.30	0.24	1.40	0.76		2.37	1.38	1.39	1.07	1.91	2.32	
TS	0.84	0.97	1.92	0.99	2.93	0.44	1.31	1.83	0.24	1.85	1.03	0.05		1.76	0.83	1.20	0.07	0.28	
HB	0.10	0.02	1.15	0.29	1.66	1.18	0.06	0.76	0.98	1.11	0.40	0.84	1.19		0.78	0.03	2.10	1.92	
IK	0.02	0.13	1.21	0.35	1.86	1.12	0.27	0.99	0.82	1.19	0.47	0.73	1.11	0.16		0.39	1.14	1.14	
KRK	0.23	0.36	1.17	0.52	1.64	0.28	0.39	0.82	0.57	1.07	0.50	0.32	0.45	0.36	0.25			0.88	1.21
YS	0.87	0.71	0.18	0.32	0.19	3.06	1.55	0.43	1.15	0.17	0.23	1.33	2.01	1.10	1.81	0.87		0.21	
IN	0.84	0.87	1.58	0.82	2.77	0.61	1.55	1.83	0.07	1.55	0.89	0.19	0.21	1.23	1.35	0.47	2.46		

Upper Second Molar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN
EB		0.47	0.65	2.04	1.18	1.84	1.88	1.62	1.90	0.32	0.76	2.18	0.15	1.28	1.07	0.60	0.03	0.51
HS	0.11		0.54	4.59	2.40	2.66	2.41	2.69	4.49	0.82	1.63	3.26	0.21	2.10	1.62	0.96	0.35	0.97
NKH				3.00	2.22	2.34	2.04	2.32	2.94	0.80	1.26	2.47	0.43	1.84	1.49	0.90	0.55	1.00
OB	1.44	5.15			2.48	1.29	0.53	1.48	0.33	1.41	1.18	0.04	1.72	1.29	1.19	0.87	1.67	1.42
SG	0.31	0.94		3.59		1.03	2.00	0.88	2.22	0.32	0.28	2.34	1.29	0.58	0.35	0.04	1.74	0.44
NKZ	0.31	0.35		2.06	1.15		0.97	0.13	1.07	1.08	0.30	1.56	1.88	0.29	0.58	0.33	2.84	1.36
UB	0.95	1.87		1.18	1.99	1.30		0.81	0.38	1.25	0.58	0.66	2.68	0.88	1.29	0.91	3.34	1.89
KS	0.67	1.00		1.45	1.67	0.73	0.30		1.26	0.92	0.23	1.53	1.74	0.15	0.36	0.38	1.67	0.97
HR	1.63	5.53		0.44	3.98	2.37	1.44	1.72		1.29	1.05	0.13	1.60	1.11	1.04	0.77	1.54	1.28
YY	0.16	0.12		1.79	0.79	0.03	0.65	0.45	2.03		0.37	1.53	0.44	0.70	0.53	0.26	0.37	0.09
KU	0.53	1.46		1.77	1.60	0.60	0.02	0.15	2.06	0.52		1.02	0.77	0.10	0.02	0.08	0.71	0.36
YSR	1.08	1.86		1.07	2.60	1.40	0.47	0.71	1.39	1.06	0.45		2.22	1.42	1.50	1.08	2.27	1.81
TS	0.03	0.21		1.52	0.39	0.43	1.27	0.81	1.72	0.21	0.58	1.18		1.46	1.49	0.80	0.18	0.81
HB	0.59	1.19		2.37	2.17	0.77	0.31	0.00	2.79	0.62	0.24	0.98	0.89		0.19	0.25	1.43	0.76
IK	0.72	1.18		1.24	1.64	0.87	0.26	0.07	1.49	0.47	0.10	0.60	0.93	0.07		0.13	1.60	0.66
KRK	0.44	0.73		2.26	1.46	0.35	0.44	0.22	2.61	0.30	0.42	1.02	0.49	0.30	0.25		0.81	0.29
YS	0.13	0.88		2.78	0.44	1.06	2.55	1.64	3.13	0.51	1.14	2.22	0.14	1.70	1.90	1.03		0.80
IN	0.37	0.46		1.64	1.13	0.19	0.86	0.45	1.90	0.13	0.41	1.05	0.48	0.48	0.54	0.17	1.09	

Lower First Incisor

	HS	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YS	IN
HS		2.06	1.67	1.45	2.73	1.63	1.38	2.06	3.23	3.01	1.92	1.14	0.27	0.94
SG	2.52		0.20	0.22	0.49	0.36	0.93	0.43	1.45	0.35	0.59	0.50	0.97	1.40
NKZ	1.92	1.56		0.11	0.16	0.11	0.51	0.51	1.65	0.44	0.96	0.40	1.50	1.15
UB	0.77	3.09	1.69		0.01	0.04	0.39	0.52	1.60	0.48	0.99	0.30	1.42	0.97
KS	0.29	3.15	1.95	0.55		0.13	1.08	0.53	1.50	1.30	0.86	0.34	1.56	1.56
HR	0.56	1.04	0.55	0.14	0.52		0.63	0.68	1.52	0.96	0.65	0.20	0.68	0.92
YY	0.27	1.40	1.08	0.11	0.12	0.22		1.20	2.22	1.75	1.06	0.12	1.15	0.53
YSR									0.78	0.32	0.22	0.74	0.98	1.63
TS	3.00	0.28	1.95	3.77	3.90	1.26	1.62			1.60	0.43	1.73	1.74	3.01
HB	0.32	2.20	1.18	0.22	0.16	0.24	0.00		3.14		0.53	0.87	1.94	2.11
IK	0.33	2.56	2.26	1.19	0.68	0.74	0.49		2.97	0.56		0.99	1.54	1.34
KRK	0.70	1.26	0.61	0.40	0.65	0.02	0.30		1.53	0.33	0.93		0.80	0.57
YS	0.51	2.08	2.32	1.30	0.80	0.81	0.65		2.27	0.59	0.23	1.01		0.82
IN	1.49	1.64	0.33	1.19	1.48	0.32	0.77		2.03	0.88	1.80	0.34	1.82	

Table 2. Continued.

Lower Second Incisor

	HS	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YS	IN
HS		1.50	1.60	3.85	1.98	1.45	0.99	3.50	2.52	2.45	2.16	1.90	0.14	1.74
SG	2.94		0.53	2.02	0.27	0.21	0.00	1.92	1.06	0.28	0.82	0.03	1.16	0.07
NKZ	3.41	0.59		1.26	0.29	0.14	0.28	1.00	0.44	0.43	0.30	0.47	1.93	0.43
UB	2.47	0.16	0.88		1.98	1.16	1.32	0.57	0.50	2.23	0.79	2.29	2.59	2.13
KS	1.60	0.11	0.15	0.30		0.04	0.18	1.92	0.96	0.06	0.70	0.29	1.67	0.22
HR	3.93	0.19	0.74	0.02	0.16		0.13	1.70	0.66	0.10	0.42	0.26	0.86	0.19
YY	1.07	1.33	1.40	1.16	0.53	2.02		1.30	0.70	0.09	0.53	0.01	0.73	0.04
YSR	0.24	1.69	2.20	1.82	0.91	1.56	0.38		0.89	2.79	0.95	2.53	1.93	2.09
TS	3.25	0.14	0.75	0.02	0.16	0.06	1.52	1.69		1.27	0.19	1.31	1.68	1.12
HB	3.35	0.14	0.43	0.28	0.05	0.39	1.50	1.76	0.30		0.87	0.31	1.71	0.21
IK	1.59	1.53	1.58	1.53	0.79	1.70	0.25	0.78	1.66	1.57		0.96	1.69	0.85
KRK	2.53	1.25	1.03	1.19	0.55	1.72	0.76	1.22	1.48	1.28	0.55		1.53	0.06
YS	0.16	2.73	3.61	3.19	1.47	2.41	0.70	0.14	2.67	2.75	1.34	1.94		1.52
IN	1.91	0.55	0.30	0.79	0.25	0.59	0.70	1.21	0.63	0.46	0.78	0.42	2.10	

Lower Canine

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN
EB		1.22	0.61	1.87	1.91	0.72	3.30	1.06	1.93	1.76	0.73	0.54	0.05	0.46	0.95	1.44	0.24	0.08
HS	1.88		1.63	4.98	4.99	2.35	5.60	3.07	5.71	6.14	3.50	1.14	1.45	0.51	0.02	0.71	2.05	1.61
NKH	0.34	2.43		1.12	0.83	0.28	2.07	0.09	1.14	0.85	0.10	0.02	0.53	1.02	1.56	1.80	0.25	0.43
OB	0.82	5.80	2.04		1.28	2.00	0.23	1.82	0.01	0.93	1.53	0.90	1.97	1.99	2.55	2.39	0.99	1.88
SG	0.13	2.94	0.65	1.32		1.64	1.53	1.18	1.35	0.46	0.83	0.45	1.93	2.33	3.13	1.80	1.57	1.77
NKZ	0.22	3.18	0.80	2.12	0.07		4.01	0.55	2.01	1.56	0.39	0.28	0.59	1.50	2.42	2.96	0.25	0.45
UB	2.00	5.25	2.82	2.30	2.39	3.16		2.93	0.22	0.78	1.64	0.89	3.01	4.06	5.32	1.85	2.77	2.53
KS	0.20	2.29	0.22	2.00	0.45	0.66	3.08		1.87	1.32	0.09	0.02	0.97	1.66	2.45	1.52	0.64	0.81
HR	1.88	7.53	3.66	2.11	2.74	2.85	1.26	2.78		1.08	1.83	0.92	2.09	2.58	2.44	0.98	2.10	
YY	0.17	3.30	0.25	2.21	0.41	0.49	2.35	0.00	4.74		1.45	0.68	1.94	1.95	2.56	2.69	1.94	2.06
KU	0.37	2.42	0.83	0.11	0.43	0.47	0.96	0.70	1.36	0.68		0.06	0.77	0.99	1.44	1.65	0.25	0.77
YSR	1.28	2.17	1.91	0.86	1.66	2.10	0.43	1.99	0.46	1.65	0.69		0.47	0.89	1.37	1.52	0.24	0.37
TS	0.18	0.75	0.01	0.59	0.23	0.25	0.86	0.07	1.28	0.08	0.37	1.04		0.48	0.93	1.37	0.18	0.04
HB	1.88	0.55	1.89	3.29	2.65	3.65	5.32	2.43	3.41	1.86	1.83	2.94	1.19		0.43	1.04	0.67	0.44
IK	1.37	0.73	1.22	3.87	2.01	2.64	4.89	1.62	3.90	1.35	1.64	2.97	0.48	1.16		0.85	1.18	0.82
KRK																	1.43	1.17
YS	0.31	1.72	0.06	2.76	0.55	0.92	3.40	0.16	2.34	0.11	0.69	2.01	0.03	2.37	1.39			0.12
IN																		

Lower First Premolar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN
EB		0.83	0.89	0.30	1.01	1.65	3.03	2.11	1.51	0.98	0.59	1.77	0.21	1.01	0.43	1.19	0.73	0.02
HS	1.94		1.95	1.01	2.30	2.58	4.12	2.91	3.84	2.52	2.05	3.04	0.71	2.00	1.44	2.14	1.40	1.09
NKH	1.34	0.71		0.32	0.09	0.28	1.42	0.97	0.88	0.13	0.14	0.78	1.21	0.14	0.70	0.26	0.31	1.21
OB	1.16	3.85	3.13		0.35	0.64	1.52	1.04	0.90	0.43	0.19	0.92	0.48	0.30	0.09	0.51	0.12	0.42
SG	1.11	0.87	0.26	1.98		0.46	1.86	1.28	1.20	0.26	0.10	1.06	1.38	0.06	0.75	0.42	0.28	1.36
NKZ	0.56	2.36	1.47	2.09	0.97		1.78	1.20	0.76	0.10	0.37	0.74	2.35	0.60	1.47	0.08	1.05	2.23
UB	0.17	2.48	1.66	1.64	1.48	0.57		0.07	0.00	1.15	1.30	0.40	3.99	2.15	3.12	1.08	3.10	4.05
KS	1.01	1.70	0.84	2.63	0.46	0.81	1.20		0.03	0.78	0.89	0.24	2.80	1.48	2.17	0.72	1.79	2.85
HR	0.52	2.85	2.17	2.01	1.34	1.16	0.80	1.65		1.13	2.23	0.24	1.80	1.03	1.53	0.58	0.93	2.05
YY	0.21	2.11	1.35	2.71	0.78	0.17	0.15	0.70	1.33		0.36	0.66	1.26	0.27	0.82	0.14	0.38	1.33
KU	1.37	0.14	0.48	5.91	0.55	1.62	1.70	1.21	3.80	2.11		0.86	0.80	0.04	0.41	0.35	0.10	0.81
YSR	0.54	1.51	1.19	0.39	1.28	0.72	0.58	0.94	0.07	0.52	1.01		2.23	1.10	1.74	0.48	1.16	2.38
TS	0.74	1.64	0.91	1.96	0.63	0.47	0.87	0.26	1.18	0.40	1.12	0.84		1.47	0.77	1.60	1.24	0.26
HB	0.67	2.13	1.25	2.34	0.86	0.27	0.72	0.51	1.36	0.34	1.54	0.79	0.20		0.74	0.48	0.29	1.37
IK	1.97	0.73	0.14	3.55	0.50	2.25	2.52	1.29	2.53	1.69	0.43	1.30	1.41	1.84		1.07	0.43	0.59
KRK	1.70	0.15	0.48	2.99	0.69	2.08	2.21	1.40	2.20	1.63	0.01	1.41	1.40	1.80	0.48		0.64	1.62
YS	1.19	0.90	0.31	1.77	0.07	1.58	2.02	0.40	1.19	0.68	0.55	1.05	0.64	1.12	0.84	0.75		1.01
IN	0.67	2.47	1.48	2.65	1.00	0.19	0.68	0.65	1.51	0.32	1.83	0.77	0.29	0.09	2.12	2.08	1.34	

Table 2. Continued.

Lower Second Premolar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN
EB		3.06	0.01	1.42	0.64	0.79	2.25	1.27	0.44	0.76	1.44	2.01	0.62	1.67	0.84	1.71	0.86	0.16
HS	0.95		2.07	2.98	3.96	2.97	5.66	4.61	2.45	1.11	0.88	4.29	1.64	5.23	3.84	3.33	2.43	3.85
NKH	1.81	0.32		0.90	0.47	0.63	1.71	0.91	0.27	0.53	0.89	1.43	0.48	0.81	0.65	1.28	0.42	0.12
OB	1.39	1.38	2.37		1.16	0.53	0.32	0.89	0.70	1.14	1.78	0.03	1.28	0.71	0.87	0.15	0.55	1.58
SG	0.48	0.60	1.13	1.47		0.56	1.85	0.67	0.04	0.74	1.95	1.75	1.29	1.09	0.32	1.33	0.29	0.60
NKZ	1.91	2.73	3.67	0.47	2.75		1.00	0.02	0.19	1.22	1.41	0.93	1.67	0.36	0.25	1.11	0.28	1.13
UB	1.89	2.64	3.53	0.37	2.71	0.16		1.16	0.93	1.11	3.04	0.57	2.42	0.77	1.53	0.56	1.50	2.71
KS	0.84	1.14	2.99	1.24	1.37	1.41	1.45		0.36	0.91	2.50	1.32	1.76	0.41	0.30	1.03	0.36	1.36
HR	1.50	1.43	2.86	0.09	1.44	0.33	0.25	1.24		0.67	1.41	0.96	0.63	0.61	0.13	0.78	0.06	0.39
YY	0.82	0.22	0.77	1.63	0.32	2.33	2.26	1.71	2.09		0.27	1.88	0.20	0.99	1.43	1.61	0.96	0.58
KU	0.37	0.41	1.16	1.31	0.03	1.58	1.54	1.09	2.49	0.39		2.47	0.51	2.88	1.84	1.82	1.11	1.76
YSR	0.50	1.11	1.80	0.74	0.89	0.98	1.01	0.03	0.72	0.99	0.60		2.15	1.08	1.44	0.21	0.98	2.37
TS	0.18	1.23	1.97	1.31	0.76	2.09	2.10	0.67	1.26	0.94	0.45	0.42		2.02	1.66	2.13	1.39	0.93
HB	2.76	1.77	4.69	0.04	3.19	0.95	0.75	2.40	0.14	3.23	2.45	1.57	2.76		0.69	0.87	0.76	1.84
IK	1.39	2.24	3.22	0.75	2.07	0.66	0.77	0.77	0.64	1.95	1.28	0.54	1.40	1.52		1.52	0.04	0.93
KRK	0.68	1.23	1.82	0.55	1.10	0.69	0.73	0.20	0.50	1.05	0.65	0.18	0.66	0.96	0.25		1.17	1.58
YS	0.35	0.92	1.24	0.71	0.69	1.85	1.90	0.49	0.64	0.61	0.30	0.19	0.19	2.59	1.19	0.38		0.91
IN	2.74	1.71	4.81	0.15	2.90	0.77	0.58	2.30	0.03	3.28	2.48	1.52	2.71	0.23	1.39	0.86	2.51	

Lower First Molar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN
EB		1.28	0.66	0.55	0.60	0.46	0.17	0.81	0.53	1.49	0.04	0.59	1.21	0.20	0.90	0.02	1.13	0.72
HS	1.63		1.35	0.43	1.80	1.44	2.08	1.05	0.79	0.60	1.26	1.29	0.28	2.13	0.99	2.09	0.75	0.92
NKH	0.64	1.27		0.18	0.14	0.36	1.00	0.27	0.41	1.87	0.37	0.13	0.59	0.77	0.10	1.51	0.26	0.03
OB	0.10	2.09	0.90		0.21	0.54	0.97	0.17	0.08	0.71	0.48	0.38	0.17	0.85	0.22	0.48	0.09	0.23
SG	1.04	1.55	0.10	1.16		0.57	1.68	0.53	0.46	2.47	0.33	0.06	1.03	0.95	0.33	2.01	0.81	0.17
NKZ	0.06	2.57	1.05	0.11	1.72		1.03	0.84	0.45	1.84	0.36	0.33	1.46	0.31	0.77	0.51	1.25	0.57
UB	0.19	2.29	0.79	0.29	1.32	0.42		1.73	0.92	2.41	0.05	1.12	2.18	0.66	1.70	0.41	2.21	1.38
KS	1.17	1.28	0.27	1.21	0.25	1.94	1.54		0.06	1.61	0.87	0.45	0.61	1.29	0.15	1.99	0.10	0.21
HR	0.41	1.27	0.11	1.19	0.22	0.67	0.49	0.34		1.21	0.59	0.32	0.27	0.84	0.12	3.65	0.01	0.15
YY	0.93	0.69	0.49	1.40	0.53	1.48	1.25	0.34	0.59		1.40	1.74	0.71	2.61	1.45	1.80	1.20	1.31
KU	0.60	0.78	0.19	0.93	0.17	0.98	0.79	0.03	0.27	0.20		0.55	0.87	0.29	0.68	0.05	0.75	0.55
YSR	0.07	2.77	1.03	0.28	1.50	0.19	0.15	1.66	0.76	1.63	1.07		0.87	0.67	0.28	1.10	0.50	0.17
TS	2.19	0.02	1.39	1.97	1.86	3.63	3.16	1.57	1.19	0.72	0.82	3.11		1.56	0.79	2.00	0.62	0.74
HB	0.00	3.55	1.40	0.25	2.00	0.10	0.36	2.19	1.05	2.14	1.42	0.16	3.54		1.04	0.53	1.65	0.82
IK	1.35	0.38	1.31	0.86	1.38	2.12	1.97	1.25	0.58	0.47	0.47	2.06	0.42	2.14		1.82	0.31	0.08
KRK	0.53	1.38	0.19	0.58	0.38	0.91	0.62	0.55	0.06	0.62	0.32	0.72	1.72	0.77	1.45		3.02	1.27
YS	2.43	0.00	1.27	1.63	1.84	4.64	3.84	1.60	1.00	0.64	0.72	2.86	0.03	5.14	0.42	1.76		0.35
IN	0.71	1.99	0.31	0.80	0.59	1.22	0.81	0.82	0.12	0.92	0.48	0.95	2.47	1.32	1.64	0.04	2.53	

Lower Second Molar

	EB	HS	NKH	OB	SG	NKZ	UB	KS	HR	YY	KU	YSR	TS	HB	IK	KRK	YS	IN
EB		3.25	0.11	0.63	0.39	0.06	1.04	0.13	0.76	1.12	0.57	0.34	0.63	0.02	0.79	0.55	0.53	0.11
HS	2.62		2.63	0.44	3.86	6.41	4.86	5.26	1.68	1.34	0.46	3.66	4.18	4.44	4.08	5.28	5.25	4.32
NKH	1.76	1.63		0.51	0.22	0.09	1.08	0.02	0.89	1.06	0.46	0.21	0.44	0.18	0.58	0.70	0.31	0.05
OB	0.42	2.19	0.82		0.25	0.31	0.50	0.30	0.74	0.07	0.02	0.25	0.19	0.33	0.14	0.46	0.23	0.31
SG	1.52	1.78	0.24	1.51		0.46	2.00	0.38	1.42	1.29	0.22	0.05	0.40	0.59	0.64	1.26	0.16	0.42
NKZ	0.31	2.59	2.55	0.66	1.47		1.68	0.14	1.01	1.40	0.28	0.41	0.85	0.11	1.17	0.78	0.80	0.07
UB	0.57	3.80	4.41	0.19	2.78	1.28		1.69	0.34	2.39	0.47	1.65	2.25	1.46	2.60	0.40	2.62	1.70
KS	0.05	3.23	2.77	0.50	1.94	0.45	0.65		1.52	1.81	0.27	0.36	0.75	0.25	1.06	1.12	0.70	0.06
HR	0.18	2.07	2.17	0.47	0.89	0.01	0.59	0.26		1.78	0.70	1.13	1.31	1.14	1.33	0.60	1.28	1.25
YY	1.08	1.60	0.34	1.24	0.06	0.84	1.73	1.36	1.08		0.11	0.98	0.80	1.71	0.61	2.07	1.05	1.61
KU	1.31	0.62	0.32	1.13	0.56	1.21	1.99	1.66	1.05	0.57		0.22	0.16	0.30	0.11	0.43	0.20	0.28
YSR	0.99	2.64	1.06	1.31	0.71	0.69	1.88	1.26	0.63	0.59	1.16		0.28	0.52	0.47	1.03	0.08	0.39
TS	1.49	2.64	0.33	0.73	0.05	2.07	3.76	2.45	1.48	0.05	0.38	0.99		0.93	0.23	1.35	0.30	0.79
HB	0.28	2.36	1.83	0.60	1.29	0.01	1.10	0.41	0.02	0.78	1.10	0.63	1.51		1.16	0.79	0.78	0.19
IK	1.48	1.46	0.08	1.36	0.11	1.71	2.96	1.92	0.78	0.12	0.42	0.71	0.19	1.42		1.47	0.65	1.04
KRK	0.38	4.20	3.75	0.16	2.31	1.09	0.19	0.40	0.78	2.47	2.44	2.03	3.60	0.86	2.74		1.27	0.95
YS	2.33	0.93	1.58	1.85	1.05	3.40	4.71	3.04	1.23	0.65	0.00	1.54	1.81	2.64	1.04	4.07		0.62
IN	0.34	3.31	2.74	0.82	1.71	0.03	1.28	0.49	0.00	1.17	1.60	0.92	2.12	0.03	1.73	0.93	2.96	

Table 3. Inter-site differences in female samples using t-test. When no significant difference of variance between two sites was shown, the Student's t test was applied. And when a significant difference of variance was shown, the Welch's t test was applied. Lower part is bucco-lingual diameter and upper part is mesio-distal diameter. Bold literature indicate significance at the 5% level. See Table 2 for abbreviation.

Upper First Incisor

	NKH	SG	NKZ	UB	KS	YY	TS	HB	IK	KRK	YSG	IN
NKH		1.00	0.10	0.37	1.68	0.17	1.33	0.17	1.09	0.06	0.22	0.83
SG	0.56		0.63	0.67	0.39	0.88	0.44	0.63	2.70	0.75	0.92	0.03
NKZ	0.06	0.13		0.62	0.58	0.02	1.11	0.22	0.61	0.06	0.12	0.68
UB	0.62	0.13	0.16		0.82	0.63	1.40	0.17	2.53	0.50	1.09	0.67
KS	0.92	0.34	0.19	0.53		0.83	0.03	0.76	2.47	0.73	0.82	0.36
YY	0.99	0.56	0.27	0.84	0.30		1.35	0.30	0.61	0.09	0.05	0.86
TS	0.56	0.05	0.19	0.10	0.36	0.62		1.09	3.86	1.26	2.10	0.47
HB	0.77	0.23	0.20	0.44	0.11	0.37	0.30		1.40	0.20	0.39	0.59
IK	0.96	0.31	0.37	0.63	0.10	0.42	0.47	0.03		0.88	0.72	2.72
KRK	0.12	0.42	0.02	0.47	0.67	0.83	0.45	0.62	0.86		0.19	0.76
YSG	0.24	0.48	0.01	0.54	0.74	1.02	0.60	0.75	1.19	0.09		1.00
IN	2.68	1.94	0.66	2.45	1.86	1.01	1.88	1.64	1.74	2.18	2.48	

Upper Second Incisor

	NKH	SG	NKZ	UB	KS	YY	TS	HB	IK	KRK	YSG	IN
NKH		0.81	0.06	0.86	1.03	0.65	0.41	0.59	0.01	0.00	0.15	0.12
SG	5.05		0.68	1.21	0.22	0.68	1.15	0.57	0.78	0.48	0.81	0.67
NKZ	0.20	2.04		0.86	0.31	0.24	0.37	0.20	0.08	0.03	0.03	0.11
UB	0.77	1.50	1.06		1.18	0.29	0.52	1.25	1.22	0.57	1.07	0.63
KS	1.70	2.46	0.83	0.22		1.53	0.87	0.41	0.61	0.36	0.33	0.72
YY	1.21	0.79	1.00	0.47	0.23		0.03	0.99	0.35	0.22	0.29	0.29
TS	2.16	0.21	2.26	1.49	0.86	0.50		0.81	0.49	0.26	0.46	0.24
HB	0.18	2.59	0.34	0.65	0.85	0.94	2.02		0.43	0.27	0.20	0.53
IK	2.01	1.35	2.27	0.98	0.38	0.04	1.13	1.83		0.00	0.14	0.10
KRK	1.60	0.30	1.24	0.76	0.51	0.20	0.21	1.26	0.46		0.06	0.06
YSG	0.79	1.58	1.18	0.03	0.25	0.52	1.66	0.68	1.11	0.83		0.14
IN	1.40	0.31	1.44	1.51	0.80	0.59	0.53	1.65	0.73	0.44	1.72	

Upper Canine

	NKH	SG	NKZ	UB	KS	IK	YSG	IN
NKH		4.40	0.61	3.13	1.49	2.82	0.20	0.28
SG	3.00		4.65	2.15	3.23	0.63	1.68	2.75
NKZ	0.75	2.58		4.94	1.48	3.08	0.69	0.85
UB	3.20	2.40	2.20		1.33	0.95	1.22	2.37
KS	2.21	0.62	1.60	1.13		1.82	0.53	0.57
IK	2.77	0.35	1.96	1.76	0.49		1.06	1.70
YSG	0.16	2.08	0.53	1.67	1.35	1.57		0.03
IN	0.43	1.57	0.05	0.69	0.97	1.19	0.29	

Table 3 . Continued.

Upper First Premolar

	EB	NKH	OB	SG	NKZ	UB	KS	YY	YSR	TS	HB	IK	KRK	YSG	IN
EB		0.50	0.46	1.71	2.53	3.27	2.24	0.23	2.81	0.68	2.63	1.47	1.23	1.08	0.58
NKH	0.61		0.10	1.38	2.22	2.85	4.53	0.04	4.37	1.41	2.55	1.18	0.76	0.65	0.26
OB	0.79	0.41		1.44	2.28	2.92	4.85	0.06	4.53	1.38	2.63	1.25	0.81	0.69	0.29
SG	0.51	0.07	0.28		1.06	1.85	1.09	0.38	2.05	2.65	1.08	0.38	0.72	0.70	0.85
NKZ	2.45	2.03	1.68	2.09		0.61	0.40	0.60	1.39	3.58	0.02	1.40	1.94	1.85	1.45
UB	2.40	1.75	1.47	2.39	0.03		0.10	0.66	1.23	4.37	0.54	2.17	3.11	3.01	1.71
KS	1.71	3.70	2.92	1.39	0.42	0.34		0.82	1.18	2.98	0.45	1.51	1.41	1.27	1.17
YY	2.06	2.74	2.46	2.03	1.46	1.32	0.84		1.38	0.75	0.61	0.57	0.47	0.41	0.12
YSR	0.05	1.31	1.61	0.42	2.51	2.08	11.7	2.81		3.48	1.55	2.49	2.33	2.09	1.77
TS	0.92	0.29	0.02	0.39	1.90	1.97	1.53	2.27	0.88		3.64	2.43	2.17	1.92	1.21
HB	0.12	0.38	0.54	0.41	2.21	1.74	1.33	1.83	0.06	0.75		1.48	1.80	1.67	1.59
IK	0.70	0.08	0.34	0.02	2.69	3.17	1.78	2.66	0.56	0.49	0.58		0.28	0.29	0.53
KRK	1.28	2.38	1.73	0.92	0.32	0.29	3.48	1.35	8.28	0.91	0.97	1.18		0.05	0.43
YSG	0.49	0.26	0.51	0.23	2.87	3.50	1.81	2.65	0.37	0.72	0.36	0.33	1.25		0.37
IN	0.41	0.08	0.07	0.15	0.85	0.84	1.14	1.10	0.32	0.08	0.40	0.13	0.72	0.24	

Upper Second Premolar

	EB	NKH	OB	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YSG	IN
EB		0.44	0.17	0.04	0.69	1.64	1.79	0.41	0.90	0.26	0.27	1.04	0.88	0.66	1.03	0.66
NKH	0.33		0.38	0.73	1.12	3.70	2.83	0.85	1.34	0.16	0.92	1.69	1.37	1.24	1.46	1.37
OB	0.69	0.44		0.29	0.88	3.42	4.44	0.64	1.48	0.12	0.54	1.44	1.00	1.25	1.09	1.07
SG	0.40	0.06	0.66		1.09	4.42	2.72	0.42	1.41	0.46	0.37	1.56	1.34	1.00	1.57	0.97
NKZ	1.29	1.61	1.34	2.39		2.03	1.32	0.16	0.52	0.87	0.72	0.23	0.03	0.10	0.16	0.24
UB	0.84	1.30	0.94	1.91	1.42		0.63	0.86	0.42	1.55	3.68	1.98	2.55	1.52	2.34	2.87
KS	0.26	0.98	0.95	0.71	0.97	0.36		1.19	0.66	2.03	2.43	1.63	1.53	1.68	1.35	2.27
HR									0.58	0.53	0.31	0.38	0.16	0.27	0.26	0.02
YY	0.09	0.37	0.55	0.41	0.84	0.43	0.11			1.02	1.17	0.52	0.63	0.46	0.51	0.91
YSR	0.33	0.54	0.68	0.74	0.26	0.02	0.12		0.16		0.64	1.34	1.20	0.87	1.33	1.01
TS	0.57	1.17	0.89	1.37	1.39	0.30	0.19	0.28	0.06			1.14	0.86	0.74	1.07	0.58
HB	1.33	1.24	1.46	1.85	0.77	1.30	1.52		0.80	0.63	1.40		0.31	0.08	0.11	0.60
IK	0.26	0.57	1.08	0.94	1.55	0.65	0.06		0.06	0.25	0.35	1.48		0.14	0.26	0.26
KRK	1.05	2.25	1.27	1.77	0.31	0.77	1.39		0.78	0.16	1.05	1.01	0.84		0.00	0.37
YSG	0.12	0.56	1.20	0.85	1.89	1.17	0.26		0.06	0.18	0.68	1.58	0.31	1.30		0.46
IN	0.66	1.08	1.39	1.40	0.86	0.13	0.36		0.37	0.02	0.34	1.23	0.51	0.51	0.89	

Upper First Molar

	EB	NKH	OB	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YSG	IN
EB		1.51	0.69	0.02	0.26	1.28	1.19	1.98	3.30	0.42	0.48	2.12	0.16	0.20	0.27	0.09
NKH	0.27		0.03	0.67	1.16	4.22	1.69	1.40	4.63	0.11	0.08	2.57	1.47	0.13	1.79	0.64
OB	0.12	0.11		0.40	0.67	1.98	1.68	1.55	3.43	0.05	0.07	1.85	0.65	0.16	0.76	0.45
SG	0.01	0.34	0.12		0.41	1.85	1.03	1.80	2.11	0.54	0.53	1.90	0.28	0.18	0.46	0.09
NKZ	0.70	0.59	0.64	0.99		1.23	0.66	2.14	1.75	0.89	0.97	1.47	0.25	0.42	0.07	0.27
UB	0.61	0.45	0.53	0.95	0.25		0.01	2.14	1.81	2.46	2.89	0.93	1.92	1.43	1.66	1.52
KS	1.64	2.04	1.73	1.79	1.31	1.61		2.93	1.47	1.46	1.90	0.54	1.02	1.02	0.86	0.89
HR									3.65	0.79	1.26	2.03	1.40	0.87	1.45	1.10
YY	1.21	1.53	1.35	1.58	1.30	1.56	0.32			2.44	3.41	0.77	2.31	1.93	2.14	1.93
YSR	0.63	1.19	0.88	0.70	1.82	1.77	3.01		2.31		0.14	2.26	0.92	0.18	1.07	0.57
TS	0.14	0.01	0.06	0.23	0.57	0.43	1.23		1.12	0.88		2.74	0.95	0.14	1.14	0.60
HB	0.65	0.81	0.63	0.99	0.24	0.48	0.79		0.83	1.55	0.63		2.12	1.37	1.94	1.61
IK	0.67	1.18	0.66	1.20	0.27	0.58	0.83		0.90	1.61	0.82	0.00		0.38	0.24	0.13
KRK	0.35	0.26	0.30	0.47	0.16	0.03	0.97		0.86	1.05	0.23	0.26	0.29		0.48	0.23
YSG	0.01	0.41	0.12	0.02	0.98	1.02	1.60		1.44	0.60	0.27	1.00	1.38	0.45		0.29
IN	1.27	1.34	1.32	1.78	1.06	1.43	0.34		0.57	2.54	1.24	0.60	0.68	0.80	1.72	

Table 3 . Continued.

Upper Second Premolar

	EB	NKH	OB	SG	NKZ	UB	KS	YY	YSR	TS	HB	IK	KRK	YSG	IN	
EB		0.74	0.18	0.69	0.61	2.27	2.51	0.48	1.73	0.15	0.76	0.81	0.05	1.19	0.25	0.33
NKH	1.44		0.59	1.11	0.15	2.69	3.12	0.11	2.00	0.25	0.02	1.15	0.57	0.43	0.80	0.28
OB	0.13	1.92		0.39	0.64	1.59	1.23	0.54	0.98	0.24	0.79	0.48	0.24	0.86	0.01	0.44
SG	0.86	0.28	0.68		1.56	1.58	1.08	0.81	0.94	0.80	1.81	0.23	1.16	1.42	0.75	1.24
NKZ	0.33	0.94	0.19	0.76		3.24	1.63	0.04	1.51	0.45	0.24	1.33	1.05	0.08	1.42	0.52
UB	1.55	0.09	1.29	0.58	1.55		0.48	1.12	0.33	1.46	4.12	0.95	3.43	3.11	2.89	3.20
KS	2.23	2.66	3.42	1.00	1.69	0.90		1.80	0.08	1.28	2.59	0.79	1.94	3.56	1.63	2.02
								1.46	0.28	0.13	0.99	0.60	0.16	0.78	0.35	
YY	1.75	1.03	2.02	0.83	1.45	0.69	0.20			1.14	2.30	0.65	1.77	2.28	1.48	1.79
YSR	0.71	2.12	0.86	1.52	1.09	2.36	2.69	2.21		0.42	0.79	0.19	0.48	0.47	0.09	
TS	0.34	0.84	0.20	0.71	0.04	1.48	1.51	1.31	1.06		1.72	0.99	0.37	1.41	0.44	
HB	0.19	0.81	0.10	0.55	0.03	1.11	1.74	0.94	0.70	0.06		1.16	1.42	0.84	1.22	
IK	0.85	0.27	0.65	0.00	0.81	0.63	0.95	0.80	1.51	0.78	0.60		0.95	0.53	0.41	
KRK	0.45	1.09	0.36	0.48	0.11	1.09	2.11	1.56	1.18	0.07	0.10	0.47		1.16	0.62	
YSG	0.02	1.13	0.13	1.31	0.48	2.26	1.71	1.54	0.70	0.54	0.30	1.59	0.44		0.80	
IN	0.81	0.14	0.64	0.12	0.78	0.34	0.74	0.61	1.35	0.74	0.56	0.14	0.49	1.30		

Lower First Incisor

	NKH	SG	NKZ	UB	KS	YSR	TS	IK	YSG	IN
NKH		1.07	0.72	2.71	0.59	0.57	2.09	0.69	1.72	4.53
SG	1.42		0.87	0.62	0.03	0.55	1.12	0.18	0.42	0.71
NKZ	0.32	0.65		1.60	0.61	0.52	0.99	1.00	1.09	0.74
UB	0.98	0.33	1.19		0.50	1.01	0.63	0.86	0.17	0.18
KS	1.39	0.42	0.83	0.96		0.49	0.94	0.11	0.36	0.70
YSR	3.37	0.21	0.71	0.56	0.34		1.71	0.25	0.89	2.83
TS	3.29	1.15	1.17	1.76	0.32	1.17		1.07	0.73	0.40
IK	1.78	0.24	1.24	0.86	0.45	0.02	1.16		0.58	0.65
YSG	0.06	0.84	0.58	1.07	1.26	1.03	2.02	1.63		0.31
IN	0.64	0.02	0.62	0.24	0.32	0.13	0.73	0.23	0.70	

Lower Second Incisor

	NKH	SG	NKZ	UB	KS	YY	YSR	TS	HB	IK	KRK	YSG	IN
NKH		1.34	0.38	1.18	0.52	1.92	0.82	2.50	1.54	0.75	0.61	0.06	0.29
SG	3.48		0.86	0.07	0.52	1.42	2.01	0.87	0.44	1.14	0.68	1.04	0.67
NKZ	0.24	1.04		1.40	0.42	0.89	0.15	0.82	0.62	0.62	0.41	0.56	0.38
UB	1.47	1.39	1.61		0.44	1.57	1.72	0.79	0.44	1.04	0.52	1.03	0.62
KS	0.70	0.90	0.58	0.16		1.16	1.09	1.35	0.74	0.15	0.07	0.27	0.13
YY	2.76	0.17	1.00	1.26	0.80		1.98	0.85	0.72	2.59	1.36	1.15	1.18
YSR	2.28	3.46	0.74	0.35	0.31	1.44		3.72	2.16	1.79	1.62	0.27	0.79
TS	3.42	0.53	1.42	2.13	1.33	0.59	1.87		0.30	2.33	2.59	1.69	1.33
HB	1.04	3.01	0.51	0.49	0.17	2.09	1.40	2.61		1.49	1.20	0.64	0.77
IK	1.32	1.60	0.97	0.20	0.03	1.41	0.51	2.24	0.36		0.06	0.53	0.12
KRK	1.66	1.66	0.70	0.21	0.22	1.17	0.19	1.74	0.81	0.35		0.25	0.11
YSG	0.56	0.98	1.07	0.54	0.14	0.92	0.42	1.46	0.02	0.25	0.35		0.19
IN	0.81	1.63	0.52	0.41	0.12	1.36	0.70	2.00	0.05	0.26	0.50	0.01	

Table 3. Continued.

Lower Canine

	EB	NKH	SG	NKZ	UB	KS	YY	TS	HB	IK	KRK	YSG	IN
EB		0.19	2.20	0.53	1.84	4.71	1.69	0.17	0.46	0.56	0.38	0.48	0.72
NKH	2.88		2.27	0.63	2.00	3.39	1.67	0.07	0.52	0.67	0.47	0.41	0.79
SG	1.95	1.21		2.60	1.89	0.57	1.55	3.12	2.04	2.51	1.92	3.40	1.41
NKZ	1.48	1.02	1.24		1.41	1.24	0.54	0.95	0.35	0.01	0.27	1.75	0.40
UB	1.59	0.97	1.37	0.48		0.96	0.33	1.81	1.56	1.38	1.40	2.99	0.22
KS	13.2	10.7	0.72	0.51	0.92		1.43	1.71	5.97	1.27	2.45	1.56	0.68
YY	1.32	2.06	0.85	0.09	0.24	1.27		1.24	1.47	0.55	1.06	1.33	0.07
TS	1.64	1.39	1.28	0.19	0.26	0.96	0.08		0.33	0.95	0.39	0.58	1.01
HB	4.19	5.12	0.56	0.79	1.33	0.43	1.69	1.41		0.37	0.12	0.59	0.59
IK	1.65	1.48	1.25	0.13	0.30	0.94	0.02	0.07	1.38		0.29	1.45	0.39
KRK	1.15	2.22	0.64	0.01	0.30	1.09	0.15	0.19	1.39	0.14		0.64	0.50
YSG	2.04	0.48	3.07	2.44	2.72	1.80	1.58	2.24	2.34	2.14	1.36		1.24
IN	0.13	0.02	1.05	0.32	0.25	0.51	0.48	0.29	0.52	0.30	0.40	0.15	

Lower First Premolar

	EB	NKH	OB	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YSG	IN
EB		0.49	0.66	1.52	0.35	2.64	2.16		1.47	1.77	0.47	1.02	1.08	0.87	0.30	0.61
NKH	1.15		0.21	0.85	0.23	1.76	1.63		1.08	1.29	0.21	0.57	0.35	0.47	0.41	0.11
OB	0.07	1.58		0.50	0.40	1.22	1.32		0.83	1.34	0.42	0.56	0.04	0.31	0.59	0.36
SG	0.27	1.91	0.36		1.47	0.96	1.24		0.80	0.59	1.63	0.40	0.86	0.13	2.17	1.50
NKZ	0.45	1.71	0.48	0.39		2.20	2.22		1.56	1.48	0.08	1.33	0.92	0.69	0.22	0.23
UB	1.00	2.60	0.98	1.22	0.61		0.85		0.46	0.08	3.14	1.41	2.22	0.72	3.99	2.97
KS	2.06	5.12	2.99	2.50	1.60	1.50			0.12	0.50	2.50	1.83	1.98	0.93	2.89	2.50
HR	0.57	0.00	0.57	0.62	0.73	0.80	1.17									
YY	0.96	2.26	1.04	1.28	0.77	0.58	0.55	1.39		0.24	1.77	1.19	1.37	0.56	2.08	1.76
YSR	0.38	1.51	0.40	0.88	0.96	1.73	4.19	0.42	1.76		1.65	1.52	1.14	0.69	1.84	1.69
TS	0.39	1.58	0.56	1.58	1.49	3.35	5.18	0.36	2.80	0.18		1.63	0.99	0.76	0.37	0.18
HB	0.15	0.97	0.15	0.07	0.11	0.32	0.97	0.54	0.44	0.43	0.48		0.66	0.10	2.54	1.18
IK	0.10	0.83	0.02	0.57	0.75	1.65	1.78	0.66	1.10	0.35	0.54	0.28		0.32	1.63	0.78
KRK	0.19	1.09	0.23	0.08	0.15	0.60	1.32	0.72	0.62	0.45	0.49	0.01	0.32		0.93	0.72
YSG	0.01	0.80	0.06	0.35	0.51	1.50	2.83	0.64	0.85	0.62	0.88	0.25	0.21	0.18		0.55
IN	0.46	1.50	0.46	0.49	0.11	0.44	1.25	1.15	0.61	0.89	1.60	0.15	0.91	0.21	0.67	

Lower Second Premolar

	EB	NKH	OB	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YSG	IN
EB		0.66	0.04	1.32	1.01	1.81	1.82		1.91	1.04	0.37	1.83	0.72	0.35	0.25	0.73
NKH	1.01		0.57	2.17	1.63	2.34	2.44		2.34	1.95	1.14	2.52	1.07	1.14	0.89	1.44
OB	0.57	0.15		1.10	0.81	1.38	1.58		1.60	1.03	0.33	1.54	0.54	0.49	0.22	0.60
SG	0.06	0.90	0.60		0.03	1.27	1.38		1.92	0.12	1.28	1.16	0.12	0.62	1.36	0.67
NKZ	1.03	2.92	1.19	1.47		1.00	1.02		1.42	0.11	1.04	0.86	0.07	0.46	1.14	0.56
UB	1.36	2.25	1.65	1.86	0.20		0.37		0.99	0.94	2.34	0.02	0.79	1.02	2.76	1.83
KS	1.99	3.98	2.41	1.84	0.32	0.68			0.60	1.26	1.99	0.35	0.63	1.35	1.80	1.58
HR	0.82	1.38	1.16	0.75	0.19	0.08	0.50									
YY	1.25	5.24	1.71	1.02	0.07	0.23	0.30	0.36		1.74	2.23	0.99	0.88	1.54	1.95	1.91
YSR	0.09	1.17	0.52	0.06	1.07	1.36	1.46	0.57	0.80		0.82	1.02	0.20	0.61	0.77	0.37
TS	0.85	1.87	1.32	1.02	0.75	0.82	1.33	0.32	0.67	0.73		2.01	1.00	0.10	0.12	0.56
HB	0.21	1.07	0.69	0.19	0.98	1.24	1.60	0.61	0.91	0.10	0.64		0.73	1.20	1.91	1.52
IK	0.04	1.33	0.38	0.01	1.13	1.41	1.93	0.45	0.62	0.04	0.82	0.12		0.32	1.15	0.58
KRK	0.02	0.58	0.37	0.02	0.82	1.07	1.30	0.50	0.72	0.05	0.64	0.14	0.02		0.13	0.19
YSG	0.32	1.13	0.80	0.43	1.40	1.68	1.58	0.56	0.83	0.25	0.69	0.11	0.33	0.25		0.71
IN	0.51	1.78	1.21	0.53	1.16	1.64	2.17	0.77	1.21	0.27	0.70	0.21	0.40	0.20	0.11	

Table 3. Continued.

Lower First Molar

	EB	NKH	OB	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YSG	IN
EB		0.49	1.00	1.69	0.40	1.69	1.58		1.21	0.37	0.87	0.36	0.10	0.49	0.06	0.56
NKH	0.29		0.41	0.91	0.10	0.80	0.86		0.68	0.69	0.24	0.11	0.39	0.10	0.47	0.06
OB	0.27	0.06		0.42	0.44	0.24	0.44		0.39	0.94	0.18	0.43	0.58	0.15	0.73	0.27
SG	1.06	0.60	0.40		1.64	0.56	0.07		0.29	2.48	1.20	1.45	2.11	0.70	2.79	1.35
NKZ	0.52	0.22	0.13	0.23		1.43	1.32		1.13	0.89	0.53	0.01	0.56	0.23	0.65	0.25
UB	0.80	0.36	0.22	0.32	0.03		0.51		0.65	2.47	0.86	1.29	1.88	0.55	2.53	1.07
KS	1.45	1.24	0.89	0.98	0.76	1.11			0.19	1.97	0.98	1.20	1.49	0.61	1.95	1.04
HR	0.39	0.22	0.17	0.02	0.06	0.05	0.32			1.55	0.92	1.01	1.23	0.51	1.63	0.94
YY	0.59	0.39	0.26	0.20	0.24	0.33	0.32	0.10			1.46	0.78	0.25	0.75	0.44	1.09
YSR	0.17	0.21	0.23	1.27	0.63	0.94	1.76	0.51	0.76			0.49	1.07	0.06	1.35	0.25
TS	0.53	0.78	0.68	2.25	1.49	2.10	2.26	0.90	1.20	1.07			0.46	0.22	0.54	0.23
HB	0.47	0.13	0.04	0.56	0.18	0.29	1.20	0.22	0.41	0.45	1.25			0.49	0.11	0.79
IK	0.09	0.26	0.27	1.42	0.79	1.12	1.76	0.53	0.81	0.12	1.04	0.54			0.60	0.08
KRK	0.12	0.17	0.19	0.89	0.41	0.63	1.35	0.38	0.52	0.01	0.67	0.34	0.06			0.99
YSG	0.39	0.70	0.63	2.47	1.64	2.23	2.41	0.90	1.28	0.93	0.42	1.20	0.90	0.56		
IN	0.62	0.23	0.12	0.50	0.12	0.20	1.17	0.17	0.40	0.69	1.75	0.12	0.84	0.47	1.81	

Lower Second Molar

	EB	NKH	OB	SG	NKZ	UB	KS	HR	YY	YSR	TS	HB	IK	KRK	YSG	IN
EB		0.50	0.59	1.13	0.51	3.58	2.44		1.65	1.17	1.38	0.65	0.85	1.10	0.72	1.78
NKH	1.04		0.12	0.51	0.17	2.52	1.70		1.13	0.63	0.70	0.17	0.33	0.54	0.20	1.12
OB	0.96	0.32		0.30	0.07	1.96	1.36		0.85	0.43	0.45	0.03	0.16	0.36	0.05	0.82
SG	0.70	0.27	0.46		0.24	2.96	1.47		1.24	0.37	0.27	0.41	0.21	0.11	0.53	1.08
NKZ	0.07	0.40	0.45	0.54		1.68	1.00		0.86	0.43	0.41	0.08	0.09	0.19	0.10	0.90
UB	2.40	1.43	0.95	3.09	2.51		0.24		0.11	1.94	2.74	2.81	2.98	1.71	4.13	1.37
KS	3.22	3.12	1.49	2.25	1.48	0.09			0.05	0.94	1.36	1.51	1.42	1.07	1.66	0.61
HR	0.69	0.26	0.09	0.37	0.60	0.62	0.62			0.79	1.15	1.20	1.22	0.74	1.46	0.53
YY	2.07	1.44	0.85	1.94	1.31	0.04	0.14	0.70			0.17	0.61	0.51	0.13	0.81	0.53
YSR	1.63	0.67	0.29	1.41	1.27	1.38	1.08	0.16	0.96			0.63	0.47	0.04	0.82	0.88
TS	0.12	0.71	0.79	0.82	0.00	3.65	2.58	0.90	2.21	2.01			0.21	0.35	0.03	1.20
HB	0.77	1.98	1.21	1.92	0.78	3.76	2.88	1.27	2.35	2.62	1.22			0.21	0.29	1.19
IK	0.10	0.59	0.66	0.75	0.00	3.44	2.13	0.75	1.87	1.79	0.01	1.09			0.36	0.54
KRK	1.41	0.68	0.10	0.68	0.62	1.09	1.95	0.04	1.06	0.26	1.08	1.60	0.90			1.60
YSG	0.36	1.03	1.03	1.71	0.61	4.92	2.71	1.13	2.42	2.69	0.83	0.67	0.81	1.35		
IN	0.96	0.41	0.01	0.76	0.89	1.72	1.11	0.09	1.00	0.41	1.34	1.95	1.25	0.07	2.14	

Table 4. Mahalanobis generalized distance matrix of male samples based on the six dental measurements (i.e. mesio-distal diameter of upper first premolar, upper second premolar and upper first molar). Lower part is generalized distances and upper part is F values. *: $p < .05$, **: $p < .01$ and ***: $p < .001$

	EB	HS	NKH	OB	SG	UB	KS	HR	YY	KU	TS	HB	IK	NKZ	YSG	IN
EB		1.05	0.10	0.08	0.85	0.62	0.31	0.49	0.27	0.12	2.67	0.14	0.34	0.16	1.24	0.52
HS	2.15		0.43	0.40	1.93	2.70	1.53	0.84	0.51	0.70	7.10	0.88	0.53	2.52	0.98	0.85
NKH	0.41	1.74		0.00	0.11	0.24	0.02	0.40	0.03	0.02	1.40	0.05	0.14	0.17	0.19	0.31
OB	0.32	1.64	0.01		0.13	0.21	0.02	0.36	0.04	0.03	1.38	0.03	0.11	0.14	0.18	0.25
SG	1.38	3.15	0.39	0.48		1.17	0.29	0.85	0.03	0.07	3.76	1.00	1.59	1.43	1.13	2.20
UB	0.75	3.30	0.79	0.69	0.96		0.78	0.25	0.32	0.16	3.24	1.18	1.92	0.64	3.11	1.52
KS	0.44	2.15	0.06	0.05	0.29	0.46		0.59	0.06	0.02	4.31	0.32	0.81	0.66	1.15	1.34
HR	1.98	3.40	2.45	2.18	3.11	0.83	2.02		0.47	0.40	1.22	0.48	0.46	0.44	0.54	0.21
YY	1.11	2.08	0.19	0.25	0.12	1.03	0.19	2.87		0.05	1.53	0.18	0.28	0.33	0.14	0.47
KU	0.49	2.83	0.14	0.17	0.26	0.53	0.06	2.44	0.30		1.01	0.13	0.28	0.11	0.31	0.42
TS	4.35	11.6	5.15	5.06	4.59	2.64	4.28	4.47	5.63	3.70		5.42	6.91	3.76	9.16	6.07
HB	0.20	1.23	0.19	0.11	1.00	0.69	0.24	1.66	0.61	0.46	5.38		0.14	0.73	1.15	0.52
IK	0.46	0.72	0.48	0.37	1.51	1.04	0.59	1.56	0.94	0.95	6.57	0.10		1.56	1.14	0.29
NKZ	0.19	2.98	0.53	0.44	1.10	1.24	0.36	1.40	1.07	0.35	2.90	0.40	0.78		4.66	1.54
YSG	1.43	1.13	0.62	0.58	0.85	1.07	0.60	1.73	0.45	1.00	6.87	0.60	0.55	1.40		1.58
IN	0.73	1.19	1.06	0.87	2.18	0.89	1.02	0.72	1.62	1.46	6.03	0.40	0.21	0.84	0.83	

Table 5. Mahalanobis generalized distance matrix of female samples based on the six dental measurements (i.e. bucco-lingual diameter of upper first premolar, second premolar and first molar). Lower part is generalized distances and upper part is F values. *: $p < .05$, **: $p < .01$ and ***: $p < .001$

	EB	NKH	OB	SG	UB	HR	YY	TS	HB	IK	NKZ	YSG	IN
EB		0.25	0.55	0.90	3.39	1.40	1.81	2.66	1.87	1.93	1.98	2.12	1.46
NKH	1.54		0.17	0.16	1.68	0.58	1.17	0.99	0.99	0.74	0.84	0.84	0.51
OB	2.54	0.78		0.57	1.89	0.55	1.30	1.69	0.58	0.51	0.96	0.65	0.28
SG	3.35	0.58	1.23		4.41	1.01	1.11	1.67	2.32	2.29	1.04	2.64	1.27
UB	11.2	5.53	3.31	3.63		0.87	0.99	2.26	1.01	2.12	0.80	1.91	1.42
HR	8.65	3.59	2.55	3.75	2.88		1.64	0.52	0.68	0.35	0.99	0.32	0.26
YY	11.2	7.20	6.00	4.11	3.26	10.1		1.45	1.17	1.51	0.40	1.56	1.45
TS	9.87	3.67	3.66	2.07	1.86	1.94	5.39		2.57	2.10	1.15	2.04	1.40
HB	7.23	3.81	1.34	3.22	0.99	2.62	4.51	3.57		0.42	0.94	0.45	0.38
IK	6.42	2.45	0.91	1.96	0.94	1.16	5.01	1.80	0.42		1.12	0.03	0.04
NKZ	7.63	3.25	2.21	1.44	0.78	3.81	1.53	1.59	1.45	1.13		1.20	0.92
YSG	7.02	2.78	1.15	2.21	0.81	1.06	5.15	1.71	0.45	0.02	1.19		0.09
IN	5.62	1.98	0.64	1.77	1.39	1.01	5.59	1.94	0.59	0.05	1.42	0.09	

Discussion

The purpose of this study is to describe the inter-period and inter area variations among Jomon sites using dental measurements. In comparative osteological studies between skeletal remains in the Jomon period and remains from other periods or from overseas populations, researchers have not considered geographic and temporal variations within the “Jomon people” generally. However, there were large temporal and geographical variations in the skeletal remains from the Jomon period have been found in the present paper. The biological problem as to any geographic and temporal variations within the “Jomon people” is examined in detail.

In comparison with the average data of “Jomon people” (Matsumura 1995), many of the dental measurements of earlier Jomon periods were observed to be greater than one standard deviation than the “Jomon people”, but not so many dental measurements in later Jomon periods exceeded the one standard deviation of the “Jomon people”, indicating that greater variation existed. Especially in the sites from the early to the middle Jomon, there was a tendency for tooth to be size small. In a word, tooth size gradually enlarged from the early to the latest Jomon.

Inter-site differences in the average values of measurement were observed when the two sites occurred in different areas and periods. The differences in the average values of measurement could not determine whether geographical distance was the cause of the differences, or whether temporal one was. In males, however, larger differences were shown in the mesio-distal diameters of the mandibular teeth and in the bucco-lingual diameters of the posterior maxilla teeth among the sites. Whereas in the females, the notable differences were found in the mesio-distal and bucco-lingual diameters of the upper canine and upper first premolar. Matsumura (2000) reported that great inter-population variations were observed in the mesio-distal and bucco-lingual diameters of upper premolars in the late to the latest Jomon. The results of t-test between sites showed that this tendency was not limited to the late to the latest Jomon but was common to the entire Jomon period.

Although univariate analysis of the t-test indicated significant differences in some combinations of sites, a very few significant differences are observed in the Maharanobis generalized distances in both males and females. When the multi-variate analysis is utilised for inter-site variations of dental metrical traits, the individual site (or personal) information tend to be deleted or disappear. Doi *et al.* (1986) indicated based on the dental materials including some relations groups that determination of kinship becomes difficult depending on the combinations of dental metrical traits.

The results of the cluster analysis based on the Maharanobis generalized distances showed that the clusters were formed by the sites clustered in the same area. Although there is no significant distance, the Maharanobis generalized distances are reliable indicators for determination of geographical variation.

The dental measurements of skeletal remains in the earliest to the latest Jomon sites were examined. The following a tendency was determined in comparison with the average values of the “Jomon people”, the inter-site variation in the dental measurements was

much greater in earlier periods than that of later periods of Jomon, and the tooth size increased through the ages. On the other hand, the cluster analysis based on the Maharanobis generalized distances showed geographical variations. Univariate analysis of the differences in tooth size among the sites indicated both geographical and temporal variations. These results indicated that the dental metrical traits are very unstable and changed easily, although the direction of change the tooth size is stable temporally and geographically. Therefore, dental measurements are suitable for inter-individual analysis (e.g. determination of kinship in a population using Q-mode correlation coefficients). However, the inter-site variations in dental metrics among the Jomon populations is so large that it does not make sense to compare remains from the pooled Jomon period with remains from other periods or from overseas populations.

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