

A Study on the Facial Flatness of the Jōmon Crania

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Transverse facial flatness measurements taken on the cranial series of the Ainu from Hokkaido and of the recent Japanese from northeastern Honshū (YAMAGUCHI, 1973) revealed that the Japanese crania were, on the average, flatter in the frontal and nasal regions and more protruding in the zygomaxillary region than the Ainu crania. In comparison with various cranial series of northern Eurasian populations, the Ainu crania were intermediate in the measure of facial flatness between those of the Caucasoid and the Mongoloid populations, whereas the recent Japanese crania were closer to those of the Mongoloid populations, though slightly deviated from the latter cluster with striking transverse prognathism (*ibid.*).

In this paper is presented the result of a preliminary study on the facial flatness of the crania of Jōmon period from northeastern Honshū as compared with those of the recent Japanese, the Ainu, and other adjacent populations.

Materials

Fifty-three adult or nearly adult crania, 30 male and 23 female, of Middle to Latest Jōmon periods (III to I millennia B.C.) from various sites in the Kantō and the Tōhoku districts have been measured. Their provenances and identification numbers or marks are as follows:

Shōsenzuka (Kanagawa Pref.)

Ubayama (Chiba Pref.) 4, 5, 11, 21, A, F, K, L, N, T

Horinouchi (Chiba Pref.) 1, (Koiwa-) 1, *NN*

Sanganji (Fukushima Pref.) 22, 25, B3, B7, II-3

Miyatojima (Miyagi Pref.) 15

*Satohama (Miyagi Pref.) 5, 6, 13, 14, 15, 17

*Maehama (Miyagi Pref.)

*Minamisaichi (Miyagi Pref.) 3

*Aoshima (Miyagi Pref.) 1

Ebishima (Iwate Pref.) 2, 13, 14, 24, 27, 29, 42, 43, 44, 45, 47, 51, 52, 54, 57, 58, 60, 62, 63, 64, *NN*

Miyano (Iwate Pref.) 102, 104, 105

The materials from the sites marked with asterisks were measured by Dr. Y. DODO of Sapporo Medical College (DODO, 1979, 1980a, 1980b). The rest of the

materials are kept in the National Science Museum, Tokyo. Dr. H. SUZUKI is gratefully acknowledged for making his collection available to this study.

Because of incomplete state of preservation of the facial skeletons, only small parts of the materials have been available for taking the measurements of the nasal and zygomaxillary regions.

Methods

The same definitions of measurements and indices of facial flatness as described in detail on an earlier occasion (YAMAGUCHI, 1973) have been followed. A summary is given below.

- 1) Frontal index of flatness is the percentage of the *nasion* subtense to the chord between the *frontomalaria orbitalia* (WOO & MORANT, 1934).
- 2) Simotic index is the percentage of the minimum subtense of the median ridge of the nasalia to the simotic chord, *i.e.* the minimum horizontal breadth of the nasalia (*ibid.*).
- 3) Zygomaxillary index of flatness is the percentage of the *subspinale* subtense to the chord between the *zygomaxillaria anteriora* (ALEKSEEV & DEBETS, 1964).

In practice, the subtense and index have been obtained by calculation from the three sides of triangle measured to the nearest 0.1 mm with a pair of vernier calipers.

Results of Measurements

Sample sizes (n), means ($\bar{x}$), and unbiased estimates of variances (s^2) of the flatness measurements and indices of the Jōmon crania are given in Tables 1–3, together with those of the recent Japanese and Ainu crania published before. Significance of the difference between the Jōmon series and the two comparative series is shown by asterisks in those tables. The obelisk denotes the significance of sex difference in the Jōmon cranial series.

The female crania are generally smaller than the male in absolute measurements as well as in indices. Significant differences are observed in the subtenses and indices of the frontal and nasal regions. Lack of significant sex difference in the zygomaxillary region is probably due to insufficient sample sizes of both sexes.

Compared with the recent Japanese and Ainu crania, the Jōmon crania are characterized by absolutely broader chords in three regions, extremely high simotic subtense, and rather low subtenses in the frontal and zygomaxillary regions. Consequently, the simotic index of the Jōmon crania is as high as in the Ainu, but the frontal and zygomaxillary indices are lower than in either of the comparative series. The difference of the frontal index from the Ainu and that of the zygomaxillary index from the Japanese are significant in the female.

Thus the Jōmon crania are closer to the Ainu in protrusion of the nasal bones and flatness of the zygomaxillary region, while they are closer to the recent Japanese than

Table 1. Frontal measurements and index of flatness.

		Male			Female		
		(n)	$\bar{x}$	s^2	(n)	$\bar{x}$	s^2
Chord	Jōmon	(28)	99.6	10.564	(21)	97.6	14.321
	Japanese	(86)	97.8*	18.44	(51)	92.6**	12.30
	Ainu	(68)	99.5	13.26	(48)	94.7**	13.88
Subtense	Jōmon	(28)	16.4	5.793	(21)	14.4†	1.812†
	Japanese	(86)	16.3	4.31	(51)	14.3	4.98*
	Ainu	(68)	16.9	4.53	(48)	15.5*	7.46**
Index	Jōmon	(28)	16.5	5.800	(21)	14.8†	2.502
	Japanese	(86)	16.7	3.53	(51)	15.4	4.65
	Ainu	(68)	17.0	3.63	(48)	16.4**	7.74**

†, ‡ Significantly different from the Jōmon male at the level of 0.05 or 0.01.

*, ** Significantly different from the Jōmon at the level of 0.05 or 0.01.

Table 2. Simotic measurements and index of flatness.

		Male			Female		
		(n)	$\bar{x}$	s^2	(n)	$\bar{x}$	s^2
Chord	Jōmon	(16)	10.2	3.554	(8)	9.3	5.317
	Japanese	(86)	7.2**	3.65	(50)	7.4	1.97*
	Ainu	(69)	8.7**	2.82	(49)	8.4	3.58
Subtense	Jōmon	(16)	4.6	0.585	(8)	3.2†	1.263
	Japanese	(86)	2.7**	0.95	(50)	2.2**	0.59
	Ainu	(69)	3.7**	0.84	(49)	3.0	0.78
Index	Jōmon	(16)	45.5	67.338	(8)	33.6†	37.327
	Japanese	(86)	38.7*	163.38	(50)	30.6	102.84
	Ainu	(69)	43.3	156.70	(49)	37.1	147.99

†, * See the footnotes of Table 1.

Table 3. Zygomaxillary measurements and index of flatness.

		Male			Female		
		(n)	$\bar{x}$	s^2	(n)	$\bar{x}$	s^2
Chord	Jōmon	(11)	102.8	35.793	(6)	101.0	16.482
	Japanese	(83)	97.9**	26.92	(49)	93.6**	25.08
	Ainu	(51)	101.4	30.67	(21)	95.6*	29.65
Subtense	Jōmon	(11)	22.9	10.383	(6)	21.8	6.744
	Japanese	(83)	23.6	8.37	(49)	22.3	5.18
	Ainu	(51)	22.7	4.07*	(21)	22.2	7.53
Index	Jōmon	(11)	22.2	8.395	(6)	21.6	6.864
	Japanese	(83)	24.1	8.97	(49)	23.8*	5.81
	Ainu	(51)	22.5	3.60*	(21)	23.2	6.72

* See the footnotes of Table 1.

to the Ainu in flatness of the frontal region. In other words, the average Jōmon facial skeleton is rather flat in the frontal and zygomaxillary regions and is protruding only in the nasal regions. The protrusion of the nasalia is so characteristic of the Jōmon facial skeleton that a prominence index of nasal root (chord mf—mf: arc mf—mf) was devised and successfully used as an efficient discriminator of the Jōmon crania from those of later periods (SUZUKI, 1954, 1969).

Comparison with Eurasian Populations

Average indices of flatness in the three facial regions of various groups in Eurasia were compiled from different sources, and positions of the recent Japanese and the Ainu were shown graphically by the present author (Table 6, Figs. 1 and 2 in YAMAGUCHI, 1973). Plotting the average index values of the male Jōmon crania into the three-dimensional diagram, it can be observed that the position of the Jōmon is closer to those of the Ainu from Hokkaido and from Sakhalin than to any other group represented there, and is roughly intermediate between the Mongoloid and the Caucasoid groups (Fig. 1).

Geographical Cline of the Nasomalar Angle

Of the three indices of facial flatness, the frontal index is almost equivalent to and approximately convertible into the nasomalar angle, *i.e.* the angle formed by the two lines drawn from *nasion* (n) to the right and left *frontomalarior orbitalia* (fmo). Since this angle was included in the list of standard cranial measurements of MARTIN (1928) as no. 77 (Querprofilwinkel des Obergesichtes), a fairly large quantity of comparative data have been accumulated from craniological materials in Japan and adjacent areas in Eastern Asia.

Table 4 gives means and standard deviations of the nasomalar angle in various prehistoric and recent cranial series published by different authors. A geographical cline is observed in three Jōmon series from the east (Kantō and Tōhoku), the centre (Yoshiko), and the west (Tsukumo) of Honshū, and a similar cline, from northeast to southwest, also exists in recent cranial series from Hokkaidō, Kantō and Tōhoku, Hokuriku, Kinai, and Kyūshū. The gradient from the smallest in Hokkaidō to the largest in Kyūshū can be extended westward to the Korean Peninsula rather than to the Southwestern Islands.

In the mainland of Eastern Asia, the average angle is the largest in the north and gradually decreases toward the south. Apparently, the centre of frontal flatness is in northeastern Asia, and those of frontal protrusion are in southeastern Asia and in Hokkaido.

Northeast to southwest gradients across the Japanese Archipelago have been observed also in some somatometric characters, ABO gene frequencies, and incidences of finger print patterns (KOHAMA, 1960; TANAKA, 1959; MITSUHASHI, 1967). These

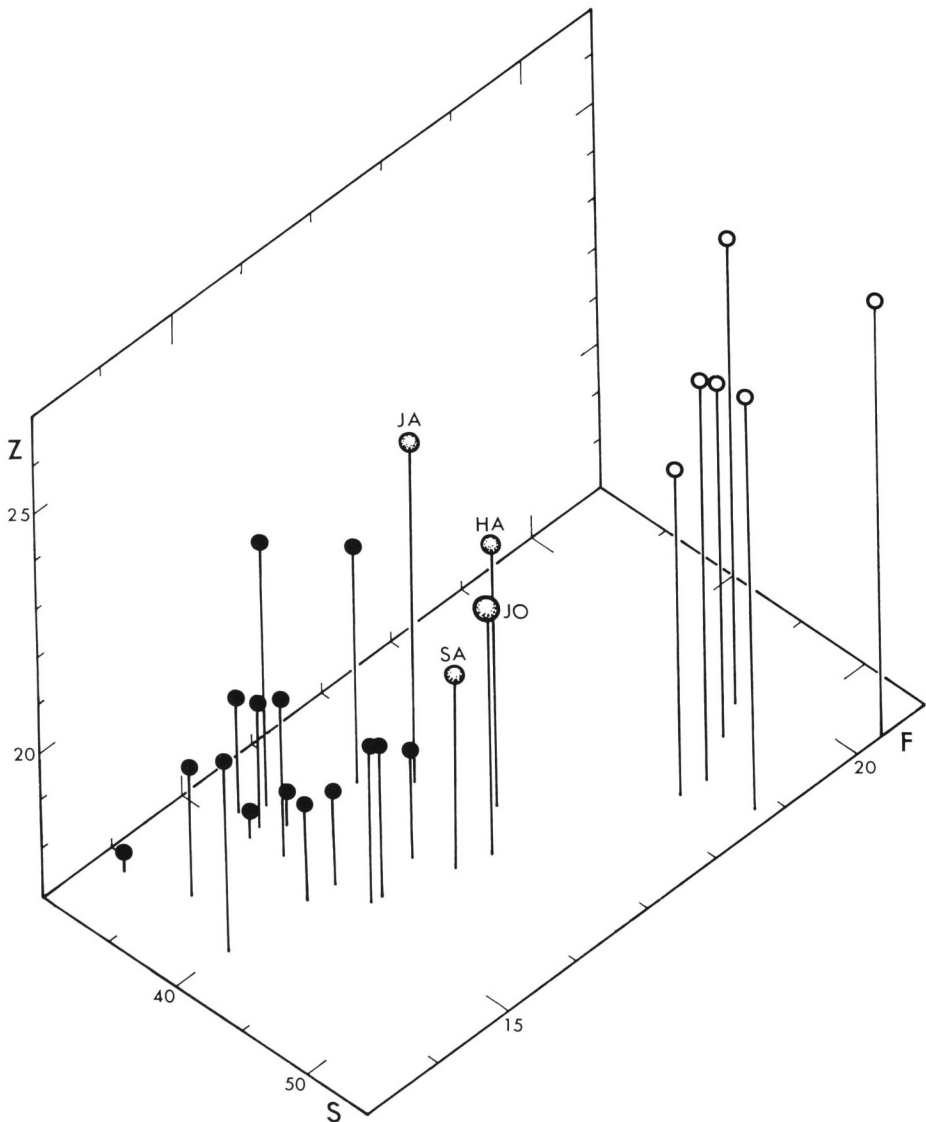


Fig. 1. Stereogram showing positions of the Jōmon (JO), recent Japanese (JA), Hokkaido Ainu (HA), and Sakhalin Ainu (SA) among various Eurasian Mongoloid (●) and Caucasoid (○) series in the frontal (F), simotic (S), and zygomaxillary (Z) indices of flatness. See YAMAGUCHI (1973, Table 6) for numerical data of each comparative series.

have been explained by some authors as the results of hybridization between the aboriginal Jōmon population and hypothetical immigrant populations from the Korean Peninsula in Yayoi and Kofun periods (e.g. KOHAMA, 1960; KANASEKI, 1976). Existence of a similar gradient in the nasomalar angle of the cranial series from Jōmon period,

Table 4. Nasomalar angle (fmo-n-fmo).

	Male			Female		
	(n)	Mean	S.D.	(n)	Mean	S.D.
Japanese Archipelago, recent						
Ainu, Sakhalin ¹⁾	(21)	144.5	6.78	(14)	142.8	3.44
Ainu, Hokkaido ²⁾	(68)	142.5	3.91	(48)	143.8	5.80
Japanese, Kantō-Tōhoku ²⁾	(86)	143.2	3.86	(27)	145.7	3.97
Japanese, Hokuriku ³⁾	(30)	144.0	4.52	(20)	145.5	3.07
Japanese, Kinai ⁴⁾	(30)	145.4	4.81	(20)	147.9	3.87
Japanese, Kyūshū ⁵⁾	(108)	146.2	3.83	—	—	—
Japanese, Amami ⁶⁾	(37)	144.8	4.17	(42)	145.9	3.74
Japanese Archipelago, prehistoric						
Jōmon, Kantō-Tōhoku ⁷⁾	(28)	143.6	4.93	(21)	147.0	3.41
Jōmon, Yoshiko ⁸⁾	(24)	145.5	3.91	(15)	147.7	3.53
Jōmon, Tsukumo ⁹⁾	(12)	146.3	1.91	(12)	148.7	4.28
Yayoi, Doigahama ¹⁰⁾	(42)	148.0	2.70	(25)	148.4	2.70
Mainland of Eastern Asia, recent						
Tungus ¹¹⁾	(28)	149.1	4.7	(27)	149.9	3.2
Mongol ¹²⁾	(104)	146.6	4.47	(50)	146.0	4.62
Ul'chi ¹¹⁾	(30)	146.2	4.8	(25)	147.7	4.3
Korean ¹²⁾	(178)	146.5	4.74	(50)	147.1	3.94
Northern Chinese ¹²⁾	(77)	145.6	4.66	(18)	144.6	4.78
Southern Chinese ¹³⁾	(136)	144.9	—	(17)	144.5	—
Burmese ¹³⁾	(84)	144.5	—	(38)	146.0	—
Thai ¹⁴⁾	(30)	143.3	3.54	(20)	147.2	5.13
Dayak ¹³⁾	(55)	143.5	—	(18)	142.4	—
Mainland of Eastern Asia, Neolithic and Aeneolithic						
Zabaikal ¹⁵⁾	(13)	149.3	6.2	(11)	149.8	4.2
North China ¹⁶⁾	(52)	146.5	—	—	—	—
South China ¹⁷⁾	(6)	144.3	—	(8)	143.7	—

1) HIRAI, 1927. 2) YAMAGUCHI, 1973. 3) OTSUKI, 1931. 4) MIYAMOTO, 1924. 5) HARADA, 1954. A few crania from Chūgoku and Shikoku districts are included. 6) OYAMA, 1956. 7) Present study. 8) KINTAKA, 1928. 9) KIYONO & MIYAMOTO, 1926. 10) KANASEKI, NAGAI, & SANO, 1960. 11) DEBETS, 1951. 12) SHIMA, 1955–56. 13) Converted from the index values given by WOO & MORANT, 1934. 14) SHIMA, 1942. 15) GOKHMAN, 1980. 16) HAN & PAN, 1979 and cited data. 17) HAN, CHANG, & TSĒNG, 1976 and ZHANG, WANG, & DONG, 1977.

however, suggests that the origins of geographical clines in the Japanese population are to be traced not only to Yayoi and Kofun periods but also to Jōmon and even earlier periods.

Summary and Conclusion

Three sets of transverse facial flatness measurements as defined by WOO & MORANT (1934) and ALEKSEEV & DEBETS (1964) (See YAMAGUCHI, 1973.) were taken on a series of crania of Middle to Latest Jōmon periods from the Kantō and the Tōhoku districts.

Results were compared with those of the recent Japanese and Ainu crania (Tables 1–3). The Jōmon crania were found to be flat in the frontal and zygomaxillary regions and considerably protruding in the nasal region. Comparison with the data of 24 Eurasian groups, compiled in YAMAGUCHI (1973), revealed that the Jōmon was closer to the Ainu than to any other group compared (Fig. 1).

Data of the nasomalar angle, that is equivalent to the frontal index of flatness, of various prehistoric and recent cranial series from Eastern Asia were compiled in Table 4. Interesting geographical gradients were observed in prehistoric as well as in recent cranial series from the Japanese Archipelago. Northeast to southwest gradients observable in various physical characters of the Japanese population seem to have remoter sources than hitherto assumed.

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