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Osteometric Studies on the Femur of the Japanese of Middle to Late Edo Period from Fukagawa, Tokyo*

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Introduction

The secular changes in the morphological features of Japanese skeletons were investigated by several authors. Suzuki (1969) described the changes in skull, Hojo (1970) in scapula, Terazawa (1971, 1975) in tibia, and Hiramoto (1972) in femur. A number of authors also contributed to the studies on the femora of both modern and prehistoric Japanese populations. The researches on the modern Japanese femora were carried out by Hirai *et al.* (1928), Sunada (1931), Ohba (1950), Abe (1955), Kiyozumi *et al.* (1960), and Takahashi (1975). The descriptions on the prehistoric Japanese femora were given by Okamoto (1926), Kiyono *et al.* (1928), Ishizawa (1931), Imamichi (1934), Yorimitsu (1935), Jo (1938), Ushijima (1954), Zaitsu (1956) and others. In comparison with these works, the studies on the femora of historic populations in Japan were small in number. Kohara (1956) described the femora of the mediaeval Kamakura period, and Kato (1960), those of Edo period. There was also a study on the skeletal remains of Tokugawa Shoguns and their families as compared with those of the Middle to Late Edo population by Endo *et al.* (1971).

The purpose of the present study is to examine the femora of Middle to Late Edo Japanese, and to compare them with those of modern population in Kanto district which were previously reported by Ohba.

Materials

The skeletal materials described here are from the collections at the Museum of University of Tokyo and the National Science Museum, Tokyo. They were found and collected at the old cemeteries of Unkoin and Joshinji temples in Fukagawa, Tokyo, in 1955. Unkoin temple was, according to Nihei *et al.* (1957) and Naito (1966), removed from the midst of Edo (old name of Tokyo) city to Fukagawa in 1682 (the second year of Tenna in Japanese calendar), and Joshinji temple likewise in 1658 (the first year of Manji). Since the cemeteries were probably used after these dates, the skeletons collected would be those of the citizens of Edo who died in the Middle

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and Late Edo periods. Thus, the date of the skeletons is set at the late seventeenth to mid-nineteenth centuries.

In the present study, only the adult femora were examined. These femora are the same bones as used by both ENDO *et al.* (1971) and HIRAMOTO (1972). All the materials were newly measured by the present author. They show no pathological changes. The femora studied belong to a mixture of bones of different individuals of unknown sex, becasue they have been indiscriminatdly collected in course of speedy construction works. In identifying the sex of these Edo femora, therefore, the author used HANIHARA's discriminant functions (1958) based on the following four measurements of modern Japanese femora: the oblique length, the minimum transverse diameter of shaft, the vertical diameter of head and the epicondylar breadth. The discriminant functions are shown in Table 1. As the minimum transverse diameter of shaft of the Unkoin femora was not measured, it was estimated from the transverse diameter of mid-shaft by using the regression equation which was set up based on the data of the Joshinji materials. The regression equations are given in Table 2. It was found according to these methods of sexing that eighty-seven femora (44 right and 43 left) were of males and twenty-nine (19 right and 10 left) of females.

Table 1. The discriminant function of modern Japanese femora by HANIHARA (1958).

Side	Discriminant formula	Dividing point for discriminant value	Probability of misclassification
Right	$Y=X_1+9.8542X_2+11.9880X_3+4.1270X_4$	Female<1431.8164<Male	0.0384
Left	$Y=X_1+9.3511X_2+8.3691X_3+3.5747X_4$	Female<1277.8337<Male	0.0409

Y: Discriminant value. X_1: Oblique length. X_2: Vertical diameter of head. X_3: Minimum transverse diameter of shaft. X_4: Epicondylar breadth.

Table 2. The regression equation for estimating the minimum transverse diameter of shaft from the transverse diameter of mid-shaft in the Unkoin femora, based on the data of the Joshinji materials.

Side	Regression equation	N	Correlation coefficient	S. D. of correlation
Right	$M=0.8789T-2.7003$	35	0.9756	0.0408
Left	$M=0.8799T-2.7049$	36	0.9703	0.0415

M: Minimum transverse diameter of shaft. T: Ttansverse diameter of mid-shaft

Methods

Most of the measurements presented here were taken by the same method of osteometry as used by MARTIN (1928), each of which is indicated by a letter "M" in this paper. Several measurements were, however, made by the special methods devised by the present author. Such measurements are marked with an asterisk in this study. The linear measurements are recorded in millimeter, while the angles are given in degree. The significance of the difference between the mean values was determined by a t-test.

The items of the measurements and indices of the femur are classified and tabulated below.

(I) Measurements

(A) Lengths

M1.	Maximum length
M2.	Oblique length
M3.	Maximum trochanteric length
M4.	Oblique trochanteric length
M5.	Diaphyseal length
M5a.	Diaphyseal length

(B) Dimensions of shaft

M6.	Sagittal diameter of mid-shaft
M7.	Transverse diameter of mid-shaft
M8.	Circumference of mid-shaft
*1.	Subtrochanteric transverse diameter The maximum transverse diameter of subtrochanteric region is measured.
*2.	Subtrochanteric sagittal diameter The measurement is taken at a right angle to the subtrochanteric transverse diameter.
M11.	Supracondylar sagittal diameter
M12.	Supracondylar transverse diameter
*3.	Diaphyseal chord The straight-line distance, or chord, between the upper and lower points of inflection on the mid-line of the anterior surface of the shaft is measured with a large coordinate caliper.
*4.	Diaphyseal subtence The distance between the line of the diaphyseal chord and the most anterior point on the anterior surface of the shaft is measured using the movable third arm of a large coordinate caliper.

(C) Dimensions of upper epiphysis

M13.	Upper epiphyseal length
M15.	Vertical diameter of neck
M16.	Sagittal diameter of neck
M17.	Circumference of neck
M18.	Vertical diameter of head
M19.	Transverse diameter of head
M20.	Circumference of head

(D) Dimensions of lower epiphysis	
M21.	Epicondylar breadth
M22.	Length of lateral condyle
M23.	Maximum length of lateral condyle
M24b.	Length of medial condyle
M24.	Maximum length of medial condyle
(E) Angles	
*5.	Angle of torsion The posterior aspect of the femur is rested on the horizontal board of an osteometric table (as in measuring the oblique length). The angle is measured between the axis of the neck and the horizontal board of the osteometric table, viewing the femur from the proximal end.
*6.	Collo-diaphyseal angle The angle is determined on the horizontal of the osteometric table, setting the axes of both neck and shaft parallel to this board.
M30.	Condylo-diaphyseal angle
(II) Indices	
M8/M2.	Length-thickness index
M8/M5.	Length-thickness index
M8/M5a.	Length-thickness index
M6/M7.	Pilasteric index
(M6+M7)/M2.	Robusticity index
*1/*2.	Subtrochanteric cross-sectional index
M11/M14.	Popliteal index
M16/M15.	Cross-sectional index of neck
M19/M18.	Cross-sectional index of head
(M18+M19)/M2.	Robusticity index of head
M22/M21.	Condylar index
M7/M21.	Epicondylar breadth—transverse diameter of mid-shaft index
M21/M5a.	Diaphyseal length—epicondylar breadth index
M23/M24.	Condylar length index
*4/*3.	Index of curvature

Results

The measurements and indices of the Middle to Late Edo femora are shown in Table 3. For comparison, Table 3 also gives OHBA's data of the modern Japanese femora from Kanto district, in which the diaphyseal chrod, the diaphyseal subtence, the angle of torsion, the collo-diaphyseal angle, the subtrochanteric transverse diameter and the subtrochanteric sagittal diameter are not included.

1. Side difference. In both sexes the measurements are larger on the right side

than on the left side. But no differences between sides in the measurements are significant.

The indices also show no statistically significant difference, with the only exception of the popliteal index in females which is significantly larger on the right side than on the left side ($P<0.01$).

2. Sex difference. Most of the linear measurements are significantly larger in males than in females. But the angle of torsion is significantly larger in females than in males on the right side ($P<0.01$).

The three length-thickness indices (each $P<0.01$), the robusticity index ($P<0.01$), the robsticity index of head ($P<0.05$) and the epicondylar breadth—transverse diameter of mid-shaft index ($P<0.05$) on the right side, and the robusticity index ($P<0.05$) and the popliteal index ($P<0.05$) on the left side are significantly larger in males than in females.

3. Comparison of the Middle to Late Edo series with the modern Kanto Japanese of OHBA.

3a. Right femora in males. The Edo series is significantly larger than the modern Kanto in several measurements, such as the transverse diameter of mid-shaft ($P<0.05$), the subtrochanteric transverse diameter ($P<0.05$), the upper epiphyseal lenght ($P<0.05$) and the condylo-diaphyseal angle ($P<0.05$). The other measurements of the Edo series are generally smaller, though insignificantly, than those of the modern Kanto.

The Edo series are significantly larger than the modern Kanto in several indices, such as the length-thickness index ($P<0.05$), the robusticity index of head ($P<0.01$) and the condylar index ($P<0.01$). The pilasteric index of the Edo series is, however, significantly smaller than the modern Kanto ($P<0.01$).

3b. Left femora in males. The Edo series is significantly smaller than the modern Kanto in several measurements, such as the subtrochanteric transverse diameter ($P<0.01$), the subtrochanteric sagittal diameter ($P<0.05$), the supracondylar sagittal diameter ($P<0.01$), the vertical diameter of neck ($P<0.01$), the sagittal diameter of neck ($P<0.05$), the transverse diameter of head ($P<0.05$), the epicondylar breadth ($P<0.01$) and the maximum length of lateral condyle ($P<0.05$). The other measurements of the Late Edo series are insignificantly smaller than those of the modern Kanto. Only the condylo-diaphyseal angle of the Edo series is larger than that of the modern Kanto ($P<0.01$).

The Edo series is significantly larger than the modern Kanto in several indices, such as the condylar index ($P<0.01$) and the epicondylar breadth—transverse diameter of mid-shaft index ($P<0.01$). The poplitial index of the Edo series is, however, significantly smaller than that of the modern Kanto ($P<0.01$).

3c. Right femora in females. The Late Edo series is significantly smaller than the modern Kanto in several measurements, such as the maximum length ($P<0.05$), the oblique length ($P<0.05$), the two diaphyseal lenghts ($P<0.05$ and $P<0.01$), the sagittal diameter of mid-shaft ($P<0.01$), the subtrochanteric transverse diameter

Table 3. The measurements and indices of the Middle to Late Edo femora with comparative data of modern Kanto Japanese (OHBA, 1950).

Item		Side	Middle to Late Edo (HIRAMOTO)						Modern Kanto (OHBA)	
			Male			Female			Male	Female
			N.	Mean	S.D.	N.	Mean	S.D.	Mean	Mean
M1.	Maximum length	R	44	412.2	16.1	19	371.9	17.4	412.07	381.80
		L	43	409.1	16.9	10	365.5	18.4	412.25	382.56
M2.	Oblique length	R	44	408.2	15.9	19	368.6	17.4	408.42	377.67
		L	43	405.6	16.7	10	362.8	18.7	408.01	378.35
M3.	Maximum trochanteric	R	40	401.3	14.7	16	360.3	18.0	399.11	364.43
	length	L	38	395.8	17.6	10	353.1	16.1	399.10	364.32
M4.	Oblique trochanteric	R	40	388.0	14.5	16	350.2	17.5	388.13	358.29
	length	L	38	384.2	16.9	10	342.9	17.0	387.85	358.35
M5.	Diaphyseal length	R	43	326.3	13.0	19	295.6	16.7	324.60	305.45
		L	43	324.0	14.8	10	291.3	15.0	325.65	306.14
M5a.	Diaphyseal length	R	43	341.9	13.7	19	309.8	16.4	346.08	323.52
		L	43	341.6	14.6	10	308.2	15.5	346.65	323.69
M6.	Sagittal diameter of	R	44	27.2	1.7	19	23.3	2.4	27.60	24.51
	mid-shaf	L	43	27.0	2.0	10	22.9	1.4	27.52	24.42
M7.	Transverse diameter of	R	44	27.4	2.4	19	23.1	1.8	26.28	23.01
	mid-shaft	L	43	26.5	2.2	10	23.0	1.9	26.66	23.31
M8.	Circumference of	R	44	85.0	4.5	19	72.6	5.7	83.74	73.82
	mid-shaft	L	43	83.8	5.0	10	72.5	4.4	83.70	73.68
*1.	Subtrochanteric transverse	R	44	31.9	2.8	19	27.7	2.2	32.06	28.65
	diameter	L	43	30.9	2.1	10	27.3	2.5	32.14	28.64
*2.	Subtrochanteric sagittal	R	43	24.5	1.4	19	21.1	2.3	24.86	21.88
	diameter	L	43	24.2	1.5	10	21.0	1.5	24.90	21.94
M11.	Supracondylar sagittal	R	44	27.3	1.9	19	22.9	2.6	26.57	23.69
	diameter	L	43	26.5	2.2	10	21.5	1.8	27.71	24.55
M12.	Supracondylar transverse	R	44	38.3	3.4	19	32.2	2.6	36.95	33.94
	diameter	L	43	38.1	3.6	10	32.9	2.0	37.05	34.03
*3.	Diaphyseal chrod	R	44	298.6	13.9	19	270.8	14.8	—	—
		L	43	299.8	15.1	10	272.6	16.1	—	—
*4.	Diaphyseal subtence	R	44	11.0	2.9	19	10.4	2.4	—	—
		L	43	10.9	3.3	10	10.6	2.4	—	—
M13.	Upper epiphyseal length	R	43	96.1	5.6	19	84.5	4.3	93.79	83.45
		L	43	94.0	6.0	10	82.9	4.7	94.28	84.39
M15.	Vertical diameter of neck	R	44	33.3	3.2	18	27.6	2.4	33.64	28.11
		L	43	32.3	2.3	10	26.7	2.5	33.83	27.95
M16.	Sagittal diameter of neck	R	44	27.0	2.5	18	23.4	1.9	27.40	23.05
		L	43	26.6	1.9	10	22.2	2.1	27.34	23.19
M17.	Circumference of neck	R	44	95.6	6.5	18	81.3	5.9	97.27	81.91
		L	43	94.6	5.5	10	79.3	6.8	97.50	81.98
M18.	Vertical diameter of head	R	44	46.3	2.0	19	40.6	2.5	46.43	40.20
		L	43	45.5	2.4	10	39.8	2.3	46.35	39.75
M19.	Transverse diameter of	R	44	45.8	1.9	19	40.2	2.3	46.13	40.09
	head	L	43	45.0	2.3	10	39.0	2.3	45.98	39.75

M20.	Circumference of head	R	44	145.5	5.9	19	127.5	7.4	146.43	126.84
		L	43	143.9	7.0	10	125.1	7.3	145.96	125.86
M21.	Epicondylar breadth	R	44	78.5	3.4	19	69.7	3.9	80.19	69.88
		L	43	78.1	3.5	10	68.5	4.3	80.09	69.53
M22.	Length of lateral condyle	R	42	60.4	2.7	19	53.6	3.2	60.26	54.16
		L	40	59.9	3.2	10	53.1	4.3	59.94	53.90
M23.	Maximum length of lateral	R	42	60.6	2.7	19	53.6	3.2	60.98	54.53
	condyle	L	40	60.0	3.2	10	53.4	4.1	61.02	54.58
M24b.	Length of medial condyle	R	38	57.4	2.6	19	50.5	3.2	57.28	51.45
		L	41	57.0	3.1	10	49.5	3.4	57.28	51.35
M24.	Maximum length of	R	38	61.5	2.8	19	53.9	3.4	61.56	54.66
	medial condyle	L	41	60.8	3.1	10	52.7	2.9	61.59	54.53
*5.	Angle of torsion	R	42	10.5°	9.2	19	23.2°	7.1	—	—
		L	42	8.5°	6.8	10	12.4°	14.2	—	—
*6.	Collo-diaphyseal angle	R	44	126.1°	4.6	19	126.7°	3.8	—	—
		L	43	126.9°	4.0	10	126.0°	5.3	—	—
M30.	Condylo-diaphyseal angle	R	44	99.7°	1.7	19	99.5°	1.9	**81.18°	**80.22°
		L	43	100.2°	2.6	10	100.4°	1.3	**80.86°	**79.82°
M8/M2	Length-thickness index	R	44	20.85	1.03	19	19.71	1.25	20.44	19.55
		L	43	20.67	1.02	10	20.29	2.00	20.44	19.57
M8/M5	Length-thickness index	R	43	26.07	1.29	19	24.59	1.73	25.66	24.26
		L	43	25.87	1.37	10	25.29	2.59	25.68	24.21
M8/M5a	Length-thickness index	R	43	24.79	1.44	19	23.44	1.61	24.08	22.81
		L	43	24.53	1.29	10	23.90	2.51	24.19	22.88
M6/M7	Pilasteric index	R	44	100.03	10.26	19	101.09	9.09	105.40	107.32
		L	43	102.63	11.05	10	99.87	6.05	103.66	105.45
(M6+M7)/M2	Robusticity index	R	44	13.39	0.69	19	12.59	0.82	13.06	12.48
		L	43	13.21	0.69	10	12.68	0.92	13.11	12.51
*1/*2	Subtrochanteric cross-	R	43	77.64	7.71	19	76.24	8.03	77.69	77.70
	sectional index	L	43	78.97	6.20	10	77.22	5.56	77.64	76.49
M11/M14	Popliteal index	R	44	71.55	5.56	19	71.34	6.56	71.81	69.68
		L	43	69.80	5.78	10	65.35	3.49	74.63	72.07
M16/M15	Cross-sectional index	R	44	81.38	7.30	18	84.87	5.08	81.22	82.04
	of neck	L	43	82.42	5.80	10	83.29	5.77	80.86	82.84
M19/M18	Cross-sectional index	R	44	98.85	1.82	19	98.99	1.49	99.46	99.86
	of head	L	43	98.94	1.51	10	98.52	2.38	99.45	99.99
(M18+M19)/M2	Robusticity	R	44	22.59	1.03	19	21.64	1.95	22.69	21.27
	index of head	L	43	22.33	1.09	10	21.81	1.50	22.47	20.99
M22/M21	Condylar index	R	41	77.46	4.11	19	77.09	2.78	75.43	77.62
		L	40	76.67	2.95	10	77.72	4.93	75.14	77.50
M7/M21	Epicondylar breadth-transverse diameter of	R	44	35.03	3.02	19	33.15	2.36	32.75	32.78
	mid-shaft index	L	43	34.08	2.93	10	33.62	2.65	33.07	33.45
M21/M5a	Diaphyseal length-epi-	R	43	22.94	1.31	19	22.56	1.47	24.75	22.95
	condylar breadth index	L	43	22.89	1.09	10	22.30	1.84	24.63	22.79
M23/M24	Condylar length index	R	38	99.11	3.45	19	99.50	3.38	99.45	99.93
		L	39	99.37	3.59	10	101.06	4.02	99.44	100.16
*4/*3	Index of curvature	R	44	3.67	0.94	19	4.02	1.00	—	—
		L	43	3.63	1.10	10	3.89	0.79	—	—

*: The author's method of measurement. **: Angle on the lateral side.

($P<0.05$), the subrtochanteric sagittal diameter ($P<0.05$) and the supracondylar transverse diameter ($P<0.05$). The other measurements of the Edo series are insignificantly smaller than those of the modern Kanto.

The Edo series is significantly smaller than the modern Kanto in several indices, such as the pilasteric index ($P<0.01$), subtrochanteric cross-sectional index ($P<0.01$) and the cross-sectional index of neck ($P<0.05$). The popliteal index of the Edo series is, however, larger than that of the modern Kanto ($P<0.05$).

3d. Left femora in females. The Edo series is significantly smaller than the modern Kanto in several measurements, such as the maximum length ($P<0.01$), the oblique lenght ($P<0.05$), the maximum trochanteric length ($P<0.01$), the oblique trochanteric length ($P<0.01$), the two diaphyseal lengths (each $P<0.01$), the sagittal diameter of mid-shaft ($P<0.01$), the subtrochanteric transverse diameter ($P<0.05$), the supracondylar sagittal diameter ($P<0.01$), the vertical diameter of neck ($P<0.05$), the length of medial condyle ($P<0.05$) and the maximum length of medial condyle ($P<0.05$). The other measurements of the Edo series are insignificantly smaller than those of the modern Kanto.

The Edo series is significantly larger than the modern Kanto in several indices, such as the three length-thickness indices (each $P<0.05$) and the robusticity index of head ($P<0.05$). The popliteal index and the cross-sectional index of the Edo series are, however, significantly smaller than those of the modern Kanto (each $P<0.01$).

Discussion

The secular changes in the morphological features of Japanese skeletons have been reported by SUZUKI (1969), HOJO (1970), TERAZAWA (1971, 1975) and HIRAMOTO (1972). Of these authors only HIRAMOTO has studied the changes in the femoral length. It is the author's belief that secular changes in the femur of the Japanese from Kanto district including Tokyo may be due to the qualitative changes in cultural environment from the Edo period to the modern times. As shown in Table 3, there are secular changer in several morphological characters of both male and female femora. In most of the measurements, the right femora of the Middle to Late Edo males are in general smaller than those of the modern Kanto, though the transverse diameter of mid-shaft, the supracondylar transverse diameter, the upper epiphyseal length and the condylo-diaphyseal angle of the Edo series are significantly larger than those of the modern Kanto. The left femora of the Edo males are generally smaller than those of the modern Kanto. In particular, three dimensions of the shaft, four dimensions of the upper epiphysis and two dimensions of the lower epiphysis of the Edo series are significantly smaller than those of the modern Kanto. The condylo-diaphyseal angle is, however, significantly larger in the Edo series than in the modern Kanto. It is thus clearly proved that the secular changes in Japanese males have occurred both in the shaft and in the epiphysis of the femur. In females, the Middle to Late Edo series is generally smaller than the modern Kanto. The right femora of the Edo females are significantly smaller than those of the modern Kanto in four femoral lengths and four dimensions of the shaft. As to the left femora in females, the same tendency is seen in six femoral lengths, three dimensions of the shaft, one of the dimensions of the upper epiphysis and two dimensions of the lower epiphysis.

For statistical comparison of the Middle to Late Edo series with several modern local populations in Japan the shape distances of PENROSE (1954) have been calculated. They are based upon the nine measurements of the right femora of modern Japanese of Kanto district reported by OHBA (1950), of Kinai district by HIRAI *et al.* (1928) and of Kyushu district by ABE (1955). The nine measurements are the oblique length, the sagittal diameter of mid-shaft, the transverse diameter of mid-shaft, the subtrochanteric transverse diameter, the sagittal diameter of neck, the transverse diameter of neck, the vertical diameter of head, and the epicondylar breadth. All of the mean values are shown in Table 4. The standard deviations are cited from the data of the modern Kanto series by OHAB (1950). The results of distance analysis are shown in Table 5.

Table 4. The means of the nine measurements of the Middle to Late Edo and modern Japanese femora used for PENROSE's shape distance analysis.

Sex	Item	Middle to Late Edo	Modern			S.D. for Kanto[1]
			Kanto[1]	Kinai[2]	Kyushu[3]	
Male	Oblique length	408.2	408.42	410.1	402.53	20.00
	Sagittal diameter of mid-shaft	27.2	27.60	27.3	26.50	2.29
	Transverse diameter of mid-shaft	27.4	26.28	25.2	25.22	2.24
	Subtrochanteric transverse diameter	31.9	32.06	30.2	29.89	2.18
	Subtrochanteric sagittal diameter	24.5	24.86	23.6	23.08	1.81
	Vertical diameter of neck	33.3	33.64	32.7	31.84	2.45
	Sagittal diameter of neck	27.0	27.40	25.4	26.03	2.21
	Vertical diameter of head	46.3	46.43	45.6	45.32	2.60
	Epicondylar breadth	78.5	80.19	78.6	78.76	4.03
Female	Oblique length	368.6	377.67	377.4	375.91	17.60
	Sagittal diameter of mid-shaft	23.3	24.51	23.5	23.58	1.70
	Transverse diameter of mid-shaft	23.1	23.01	23.2	23.26	1.69
	Subtrochanteric transverse diameter	27.7	28.65	27.9	27.92	1.42
	Subtrochanteric sagittal diameter	21.1	21.88	20.8	20.15	1.85
	Vertical diameter of neck	27.6	28.11	28.4	28.23	1.69
	Sagittal diameter of neck	23.4	23.05	23.0	21.77	1.76
	Vertical diameter of head	40.6	40.20	41.2	39.96	1.86
	Epicondylar breadth	69.7	69.88	69.6	69.46	2.44

1) Modern Kanto Japanese series (OHBA, 1950) consists of 81 male and 88 female femora. 2) Modern Kinai Japanese series (HIRAI *et al.*, 1928) consists of 30 male and 20 female femora. 3) Modern Kyushu Japanese series (ABE, 1955) consists of 62 made and 13 female femora.

Table 5. The shape distance analysis of PENROSE (1954) of the Middle to Late Edo and modern Japanese femora.

Female \ Male	Middle to Late Edo	Modern		
		Kanto[1)]	Kinai[2)]	Kyushu[3)]
Middle to Late Edo	—	0.062	0.157	0.114
Modern Kanto	0.129	—	0.105	0.067
Modern Kinai	0.067	0.150	—	0.050
Modern Kyushu	0.196	0.139	0.087	—

The results of analysis in males are shown at the upper right part in the table, and those in females at the lower left. For explanation of the markings 1) 2) and 3), see the marginal notes in Table 4.

In males, the shape distances show that the Edo series is close to the modern Kanto, but distant from the modern Kyushu and Kinai. The distance between the Edo and the modern Kanto series is larger than the distance between the modern Kinai and the modern Kyushu, but smaller than the distance between the modern Kanto and the modern Kyushu. In females, on the other hand, the Edo series is close to the modern Kinai, but distant from the modern Kanto and Kyushu. It is to be noted here that the distance between the Edo and the modern Kanto series is relatively small in males, but considerably large in females. The shape distance between the Middle to Late Edo and the modern Kanto series is within the range of variation of the distances of the various modern Japanese local populations, though the distribution of shape distances in males is somewhat different from that in females. It is of interest that the condylo-diaphyseal angle of the Middle to Edo series is significantly larger than that of the modern Kanto in males, whereas in females, there is little secular change in this angle. In order to confirm the sex difference in the distribution of shape distances, it is desirable that the available number of female femora is substantially increased.

It is possible, however, that the sex difference in the morphological changes of Japanese femora is a reflection of the differences in the mode of life between males and females.

Summary and Conclusion

The materials used in this osteometric study were 87 male and 29 female adult femora of the Japanese of Middle to Late Edo period (the late seventeenth to mid-nineteenth century) from Fukagawa, Tokyo. The measurements and indices of those femora are shown in Table 3. Side differences in the measurements and indices were not significant in both sexes, except in the popliteal index of females. Most of the linear measurements were significantly larger in males than in females. The secular changes in the femur were examined by comparing the Middle to Late Edo series with the modern Kanto Japanese studied by OHBA (1950). In males, the right femora of the Edo series were significantly larger than those of the modern Kanto in the transverse diameter of mid-shaft, the subtrochanteric transverse diameter, the upper epiphyseal length, and the condylo-diaphyseal angle. As to the left femora in males, the Edo series was generally smaller than the modern Kanto, with the exception of the condylo-diaphyseal angle, which was significantly larger in the Edo than in the modern Kanto. On either side in females, however, the femoral lengths and several dimentions of the shaft and the epiphysis of the Edo series were significantly smaller than those of the modern Kanto.

The PENROSE's distance between the Middle to Late Edo and the modern Kanto series was small in males, and was large in females. These distances fall within the range of variation of the distances among the various local populations of modern Japanese.

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