

The Hand Bones of the Jōmon Remains from the Ebishima (Kaitori) Shell Mound in Hanaizumi, Iwate Prefecture

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Abstract Four major carpal bones, five metacarpal bones, and two phalanges of the thumb of the Jōmon skeletal remains from the Ebishima site in the Tōhoku district were measured and compared with those of recent Ainu and Japanese series. The metacarpals and the phalanges of the thumb of the Ebishima series were significantly longer and relatively slenderer than those of the Japanese, and the Ainu were intermediate in the metacarpal and phalangeal lengths between the Jōmon and the Japanese series.

The hand bones of 28 adult human skeletons (12 males and 16 females) of the Late to the Latest phases of the Jōmon period, excavated at the Ebishima (alias Kaitori) shell mound, Hanaizumi, Iwate Prefecture, were measured according to the MARTIN's osteometric system (BRÄUER, 1988) and compared with those of the Ainu and the Japanese. Outlines of the site and excavations were described elsewhere (YAMAGUCHI, 1983).

Materials and Methods

The male skeletal materials comprise the Ebishima 6, 24, 26, 29(1), 29(2), 44, 45, 51, 52, 56, 60, and 63, and the female materials are the Ebishima 5(2), 7, 9, 10, 13, 14, 16, 27, 30, 42, 43, 47, 48, 57, 58, and 64. Measurements of major limb bones of these skeletons were already published by the present author (YAMAGUCHI, 1983).

Only those measurements that are least ambiguous in definitions were taken for the four major carpals, the five metacarpals, and the two phalanges of the thumb. The methods of main measurements taken after the MARTIN's system (BRÄUER, 1988) are as follows.

Maximum length of the scaphoid (MARTIN's #1): the maximum distance of the most projecting point of the edge between the proximal and ulnar joint surfaces from the farthest point of the radial surface, projected on the longitudinal axis of the bone.

Maximum height of the lunate (MARTIN's #3): the distance between the utmost points of the dorsal and the palmar surfaces, measured projectively. One puts the utmost points of the semilunar notch to the ruler and touches the metric landmarks with the caliper arms.

Table 1. Measurements of the Ebishima hand bones.

	Sex	Right			Left			Average of R & L*		
		N	M	s	N	M	s	N	M	s
Dimension of the Carpal Bones:										
Scaphoid Length	M	(4)	27.48	1.24	(4)	25.80	0.90	(7)	26.62	1.45
	F	(5)	25.66	1.68	(6)	24.68	2.20	(7)	25.09	2.03
Lunate Height	M	(4)	17.73	1.35	(3)	17.93	0.91	(5)	17.68	1.09
	F	(7)	16.69	0.63	(3)	16.47	0.42	(8)	16.63	0.60
Capitate Length	M	(5)	22.02	1.13	(6)	21.80	1.48	(9)	21.86	1.36
	F	(7)	20.79	0.88	(3)	20.53	1.10	(8)	20.59	0.93
Hamate Length	M	(4)	21.13	0.60	(5)	22.04	1.27	(6)	21.97	0.96
	F	(4)	19.93	1.87	(3)	21.03	1.19	(5)	20.14	1.76
Length of the Metacarpal Bones:										
Metacarpal I	M	(6)	46.17	2.48	(9)	45.44	2.51	(10)	45.85	2.55
	F	(9)	43.56	1.13	(7)	42.43	2.15	(11)	42.77	1.77
Metacarpal II	M	(5)	65.80	3.77	(9)	67.44	3.97	(9)	67.33	4.02
	F	(8)	65.25	3.11	(10)	63.80	3.49	(12)	64.33	3.46
Metacarpal III	M	(6)	62.17	3.55	(9)	64.00	3.67	(11)	63.45	3.67
	F	(8)	64.13	1.96	(9)	60.78	3.83	(13)	61.88	3.79
Metacarpal IV	M	(8)	57.38	2.33	(8)	58.38	3.38	(11)	58.18	2.93
	F	(10)	55.60	4.22	(7)	55.71	3.86	(13)	55.77	3.65
Metacarpal V	M	(4)	54.50	1.73	(8)	54.75	2.25	(9)	54.50	2.32
	F	(6)	51.83	3.97	(6)	52.50	2.07	(9)	51.61	3.17
Midshaft Breadth of the Metacarpal Bones:										
Metacarpal I	M	(6)	11.67	1.60	(9)	11.39	0.96	(10)	11.60	1.13
	F	(9)	11.00	1.30	(7)	10.64	0.85	(11)	10.66	1.13
Metacarpal II	M	(5)	9.00	0.79	(9)	8.67	0.66	(9)	8.67	0.60
	F	(11)	7.95	0.42	(10)	7.85	0.47	(13)	7.90	0.43
Metacarpal III	M	(6)	8.08	0.58	(8)	8.00	0.71	(10)	7.95	0.57
	F	(8)	7.44	0.42	(9)	7.06	0.46	(13)	7.25	0.51
Metacarpal IV	M	(8)	7.06	0.62	(8)	7.19	0.46	(11)	7.00	0.54
	F	(10)	6.35	0.41	(8)	6.25	0.60	(13)	6.33	0.44
Metacarpal V	M	(4)	8.63	0.85	(8)	8.25	0.85	(9)	8.31	0.85
	F	(6)	7.83	0.93	(7)	7.43	0.61	(10)	7.53	0.63
I Proximal Phalanx:										
Length	M							(9)	29.44	2.11
	F							(9)	28.83	1.03
Midshaft breadth	M							(9)	9.53	0.51
	F							(9)	8.86	0.56
Midshaft thickness	M							(9)	6.78	0.44
	F							(9)	6.19	0.50
I Distal Phalanx:										
Length	M							(6)	23.13	1.09
	F							(5)	22.25	1.54

* When one side was not available, the measurement of the other side was used for the average.

Maximum length of the capitate (MARTIN's #1): the projective distance of the most towering point of the distal surface from the utmost point of the caput. One puts the dorsal and palmar ends of the distal surface to one of the caliper arms and touches the top of the caput with another arm, keeping the ulnar surface parallel to the flank of the arms.

Maximum length of the hamate (MARTIN's #1): the projective distance of the proximal apex from the utmost point of the dorsal edge of the distal surface. The dorsal surface is put against the ruler.

Length of the metacarpal (MARTIN's #2): the rectilinear distance of the center of the basal surface from the vertex of the head.

Length of the phalanx (MARTIN's #3): the rectilinear distance of the proximal and the distal surfaces, measured on the axis of the bone.

Carpal measurements were taken to the nearest 0.1 mm, and all other measurements were to the nearest 0.5 mm.

Results

The sample sizes (N), means (M), and standard deviations (s) of the measurements are given in Table 1 for the right side, left side, and the average of both sides. When one side was missing, the measurement of the other side was used for the average. Only the statistics of the averages are given for the phalanges of the thumb, since the side of the phalanges could not always be determined precisely.

Table 2. Individual sets of the lengths of metacarpal I through V.

Skeleton No.	Sex	I	II	III	IV	V
Ebishima 6	M	43(l)	63(l)	60(l)	55(l)	51(l)
24	M	48(l)	71(l)	67(l)	59(l)	55(l)
29(1)	M	49(l)	73(l)	68(l)	63(l)	58(l)
29(2)	M	44(l)	70(l)	68(l)	62(l)	56(l)
51	M	48(l)	70(l)	66(l)	60(l)	55(l)
52	M	44(r)	66(r)	59(r)	58(r)	55(r)
56	M	47(l)	68(l)	66(l)	59(l)	56(l)
(N=7) Mean	M	46.14	68.71	64.86	59.43	55.14
(s)		(2.41)	(3.35)	(3.76)	(2.64)	(2.12)
Ebishima 7	F	44(r)	64(r)	63(r)	59(r)	55(r)
42	F	44(l)	63(l)	61(l)	55(l)	47(r)
43	F	41(l)	65(l)	63(l)	58(l)	50(l)
48	F	45(r)	68(r)	66(r)	63(r)	56(r)
57	F	45(r)	68(r)	66(r)	60(r)	52(r)
64	F	43(l)	67(l)	64(l)	58(r)	55(l)
(N=6) Mean	F	43.67	65.83	63.83	58.83	52.50
(s)		(1.51)	(2.14)	(1.94)	(2.64)	(3.51)

(l): left bone; (r): right bone.

A set of metacarpal I through V, irrespective of side, is preserved in 7 male and 6 female Ebishima skeletons. Table 2 gives the individual data of the lengths of those full sets of the five metacarpals.

Since the sample sizes are small, comparison was made only for the statistics based on the averages of both sides or either side available.

Comparison

The means and standard deviations of the average measurements in the Ebishima series are compared with those of the right hand skeletons of the Ainu from Hokkaido (SIOTA, 1941), the Japanese (1) (SIOTA, 1941), and the Japanese (2) (KATO, 1953) in Tables 3 through 5. The values marked with * and ** are significantly different from those in the Ebishima series at the levels of 0.05 and 0.01.

Table 3 shows that there is no statistically significant difference between the Ebishima Jōmon series and the Ainu in the carpal measurements. In comparison with the Japanese, however, the capitate of the Ebishima is significantly shorter in the male, and the hamate is significantly longer in both sexes.

All the metacarpal bones of the Ebishima series are significantly longer than those of the Japanese as shown in Table 4. The Ainu is intermediate between them and the differences from the Ebishima are significant only in metacarpals I, IV, and V. On the other hand, little differences are seen in the midshaft breadth of the metacarpals between the Ebishima and the Japanese. This means that the Ebishima met-

Table 3. Comparison of carpal bone measurements.

	Series	Male			Female		
		N	M	s	N	M	s
Scaphoid Length	Ebishima	(7)	26.62	1.45	(7)	25.09	2.03
	Ainu	(16)	27.79	2.15	(4)	22.93	
	Japanese(1)	(46)	27.43	2.07	(15)	24.84	1.68
	Japanese(2)	(71)	27.31	2.31	(41)	24.13	1.81
Lunate Height	Ebishima	(5)	17.68	1.09	(8)	16.63	0.60
	Ainu	(17)	17.90	2.18	(4)	15.33	
	Japanese(1)	(46)	18.46	1.24	(15)	16.47	0.65
	Japanese(2)	(67)	18.03	1.20	(49)	16.21	1.21
Capitate Length	Ebishima	(9)	21.86	1.36	(8)	20.59	0.93
	Ainu	(17)	21.88	1.31	(4)	18.40	
	Japanese(1)	(44)	23.35**	1.27	(14)	20.39	0.82
	Japanese(2)	(70)	23.38*	1.90	(46)	21.30	1.21
Hamate Length	Ebishima	(6)	21.97	0.96	(5)	20.14	1.76
	Aninu	(16)	21.11	1.83	(4)	17.85	
	Japanese(1)	(45)	20.50*	1.34	(14)	18.76	1.51
	Japanese(2)	(69)	19.86**	1.71	(48)	17.88*	1.80

*, **: significantly different from the Ebishima at the level of 0.05 or 0.01.

Table 4. Comparison of metacarpal bone measurements.

	Series	Male			Female		
		N	M	s	N	M	s
Length:							
Metacarpal I	Ebishima	(10)	45.85	2.55	(11)	42.77	1.77
	Ainu	(14)	43.15**	1.94	(4)	38.83	
	Japanese(1)	(48)	43.07**	2.76	(15)	39.78**	2.36
	Japanese(2)	(64)	41.80**	2.52	(45)	39.45**	2.40
Metacarpal II	Ebishima	(9)	67.33	4.02	(12)	64.33	3.46
	Ainu	(16)	64.61	1.61**	(3)	60.11	
	Japanese(1)	(46)	61.49**	3.25	(15)	58.93**	2.67
	Japanese(2)	(64)	61.43**	2.30*	(45)	58.17**	2.30
Metacarpal III	Ebishima	(11)	63.45	3.67	(13)	61.88	3.79
	Ainu	(16)	62.66	1.75*	(3)	58.19	
	Japanese(1)	(48)	59.48**	3.75	(14)	57.10**	2.56
	Japanese(2)	(64)	59.36**	2.20	(45)	57.12**	2.12**
Metacarpal IV	Ebishima	(11)	58.18	2.93	(13)	55.77	3.65
	Ainu	(16)	56.25*	1.63	(4)	50.48	
	Japanese(1)	(47)	54.10**	2.53	(15)	51.53**	2.67
	Japanese(2)	(64)	53.24**	2.69	(45)	50.71**	2.64
Metacarpal V	Ebishima	(9)	54.50	2.32	(9)	51.61	3.17
	Ainu	(16)	52.35*	1.88	(3)	46.39	
	Japanese(1)	(48)	49.76**	3.50	(15)	47.61**	2.55
	Japanese(2)	(64)	49.45**	2.23	(45)	47.98**	2.11
Midshaft Breadth:							
Metacarpal I	Ebishima	(10)	11.60	1.13	(11)	10.66	1.13
	Japanese(2)	(64)	10.99	1.10	(45)	10.92	0.93
Metacarpal II	Ebishima	(9)	8.67	0.60	(13)	7.90	0.43
	Japanese(2)	(64)	8.05	0.92	(45)	7.71	0.65
Metacarpal III	Ebishima	(10)	7.95	0.57	(13)	7.25	0.51
	Japanese(2)	(64)	8.35*	0.51	(45)	7.81**	0.48
Metacarpal IV	Ebishima	(11)	7.00	0.54	(13)	6.33	0.44
	Japanese(2)	(64)	6.87	0.66	(45)	6.34	0.64
Metacarpal V	Ebishima	(9)	8.31	0.85	(10)	7.53	0.63
	Japanese(2)	(64)	7.79	0.82	(45)	7.21	0.71

*: $p < 0.05$; **: $p < 0.01$.

acarpals are relatively thinner or slenderer than the Japanese. The only significant difference is seen in the 3rd metacarpal, with the Ebishima being even absolutely thinner than the Japanese.

Table 5 reveals that the phalanges of the thumb of the Ebishima series are also significantly longer than those of the Japanese. Though the differences from the Ainu can not be tested because no standard deviations are given for the phalangeal measurements of the Ainu, all the mean values of the Ainu series are intermediate

Table 5. Comparison of thumb bone measurements.

Series	Male			Female			
	N	M	s	N	M	s	
I Proximal Phalanx:							
Length	Ebishima	(9)	29.44	2.11	(9)	28.83	1.03
	Ainu		28.8			27.1	
	Japanese(2)	(36)	27.72*	1.84	(20)	26.85**	1.70
Midshaft breadth	Ebishima	(9)	9.53	0.51	(9)	8.86	0.56
	Japanese(2)	(36)	9.70	0.74	(20)	8.85	0.90
Midshaft thickness	Ebishima	(9)	6.78	0.44	(9)	6.19	0.50
	Japanese(2)	(36)	6.67	0.73	(20)	5.70*	0.45
Breadth-thickness index	Ebishima	(9)	71.26	5.02	(9)	70.03	4.63
	Japanese(2)	(36)	68.00	5.00	(20)	66.35	4.35
I Distal Phalanx:							
Length	Ebishima	(6)	23.13	1.09	(5)	22.25	1.54
	Ainu		22.45			20.75	
	Japanese(2)	(36)	20.34**	2.30	(20)	19.45*	0.78*

*: <0.05; **: p<0.01.

Table 6. Inter-bone length indices of the Ebishima hand bones.

	Male			Female		
	N	M	s	N	M	s
Capitate length/metacarpal III length	(8)	34.81	1.31	(8)	33.18	1.46
Metacarpal I length/metacarpal III length	(10)	71.77	2.75	(10)	68.76	2.41
I proximal phalanx length/metacarpal I length	(8)	63.59	2.90	(7)	66.79	1.54
I distal phalanx length/metacarpal I length	(6)	49.52	1.99	(5)	51.10	2.34
I distal phalanx length/I proximal phalanx length	(6)	77.90	4.32	(5)	76.12	3.32

between those of the Ebishima and the Japanese. Little difference is seen in the midshaft diameters and index of the proximal phalanx of the thumb.

Several inter-bone length indices are given in Table 6. Full statistics of these indices have not yet been reported for the Ainu and the Japanese, but the mean capitate/metacarpal III length index of the right hand is given as 34.7 for the males and 32.4 for the females of the Ainu, and the mean metacarpal I/metacarpal III length index of both sexes is given as 67.95 for the Ainu and 70.45 for the Japanese by SIOTA (1941). So far as the Ebishima indices are compared with these mean values, there seems little peculiarity in the proportion of the Ebishima hand bones.

Table 7 gives mean proportional lengths for 7 male sets and 6 female sets of the five metacarpals listed in Table 2. The base length of 100 is metacarpal III. Met-

Table 7. Comparison of metacarpal length proportion (III = 100).

		(N)	I	II	III	IV	V
Ebishima	M	(7)	71.1	105.9	100	91.6	85.0
	F	(6)	68.4	103.1	100	92.2	82.2
Japanese(2)	M	(64)	70.4	103.5	100	89.7	83.3
	F	(45)	69.1	101.8	100	88.8	84.0

acarpals I, II, IV, and V of the Ebishima male series seem to be relatively longer than those of the Japanese (KATO, 1953), but no such difference pattern is seen in the female series.

Discussion and Conclusion

That the metacarpals and phalanges of the Jōmon people are rather longer than those of the modern Japanese has been known since the early studies of Jōmon skeletal remains by HASEBE (1920), KIYONO and HIRAI (1928), OHBA (1935), and others. Although the size of the Jōmon sample from the Ebishima site is rather small, the differences in the lengths of the hand and finger bones between the Jōmon and the Japanese have been confirmed to be statistically significant. No such distinct differences have been found in the size of the carpal bones and the midshft diameters of the metacarpals and the phalanges of the thumb. It has also been disclosed that the Ainu occupy an intermediate place in the length of the hand bones between the Jōmon and the modern Japanese, just as they do in many other osteological features.

Thus the Jōmon remains are characterized not only by the relatively long forearm bones, as indicated by the greater brachial or humero-radial index (YAMAGUCHI, 1989), but also by the absolutely long and slender metacarpals and phalanges. They are definitely closer to the Ainu than to the modern Japanese in these respects. Such a resemblance in the proportion of the upper limb skeleton furnishes another evidence for a close genetic proximity of the modern Ainu to the prehistoric Jōmon population.

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