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Human Skeletal Remains of Jomon Period from Minamitsubo Shell-Mound Site in Ibaraki Prefecture, East Japan

By

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Abstract Three adult male skeletons of Late Jomon period were excavated from Minamitsubo shell-mound site in Eastern Japan. Basic descriptions, measurements, and comparison to the recent Japanese skeletons were made on them. As a result, it was revealed that they have typical Jomon characters, i.e., low and wide face, projected supraorbital region, depressed nasal root, low and wide mandibular ramus with strong masticatory muscle attachments, edge-to-edge bite, evulsion of some anterior teeth, moderate stature with relatively longer distal segments, flattened bone shaft, marked muscle reliefs on the limb bones, wide squatting facets of talus, etc. These characters suggest that Jomon people were hunter-gatherers with powerful muscles, lived on the floor in squatting position, and ate tough foods by strong masticatory apparatus.

Introduction

Jomon people were ancient Japanese lived in most part of the Japanese Islands during Jomon age (ca. 11,000–300 B.C.) which is characterized by an extremely rich and stable hunter-gatherer adaptation including from very early times the use of ceramics and establishment of sedentary pithouse villages (AKAZAWA & AIKENS, 1986). Most of their skeletal remains were found in shell-mounds near the coast, as in the case of the present material.

There are many previous works on the description of Jomon skeletons. However, almost all of them were written in Japanese. So the authors at first introduce general morphological characters of the Jomon skeleton compared to those of the recent Japanese. The typical Jomon skull vault is lower, wider and longer than the recent ones (Fig. 1). The facial skeleton is also low and wide. The orbital opening is low and rectangular in marked contrast to the high and round orbit of recent Japanese. The glabellar and supraorbital region is prominent. The nasal root is depressed having a sharp notch, but the nasal bones are mostly wide and projecting forward. The alveolar processes of the jaws are well developed showing little alveolar prognathism.

The mandible is also low and wide. There is no preangular notch. The attachments of masticatory muscles are sharp, which fit to the fact that dental attrition is

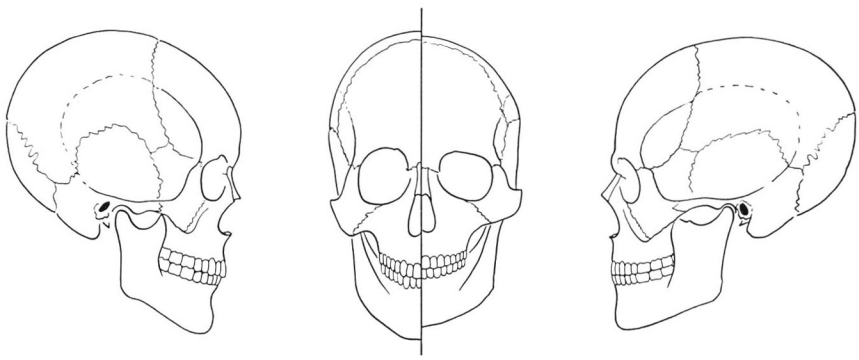

Fig. 1. Schematic comparison between recent Japanese (left) and Jomon (right) skulls (male). For explanation see in the text.

remarkable and the bite form is unexceptionally edge-to-edge. Artificial extraction of teeth is common in the Middle and Late Jomon age in both males and females.

The average stature of the Jomon males is estimated to be 159 cm from the femoral length. It is lower than that of the males of Yayoi Bronze age (163 cm), and the recent (170 cm), but higher than those of the Medieval and Early Modern males (156–158 cm: HIRAMOTO, 1972). The females also have the same situation as the males. Although the stature of Jomon people is modertate, their postcranial bones are generally stout; the bone shafts are often flattened and bowed, the cortical bones are thick, and the muscle reliefs are broad and marked.

They have relatively longer distal limb segments, suggesting an adaptation for hunting and gathering. They had well-developed squatting facets of talus, which reveal habitual squatting in their life. Taken all these features together, the Jomon skeletons are, in some degree, similar to those of the archaic Mongoloids such as Upper Cave Man in China and Minatogawa Man in Okinawa.

Materials and Methods

Present specimens were three human skeletons found in 1985 from Minamitsubo shell-mound site, Ogawa-machi, Ibaraki Prefecture, Eastern Japan (Figs. 2, 3). By the abandant archaeological findings, it is clear that the shell-mound was made in Late Jomon age and the human skeletons in question are presumed to belong to the same age. All the three were burried in an extended supine position. They were excavated and transported to the Department of Anatomy, Dokkyo University School of Medicine, former laboratory of the first author (H.B.). Then, cleaning, basic identification, photographing and measurement by MARTIN's (1928) method were carried out at the Department of Anatomy by Mr. Shuji ABE and the first author (H.B), except for tooth measurements which were taken at the National Science Museum, Tokyo by the second author (H.S.) according to the FUJITA's (1949) method.

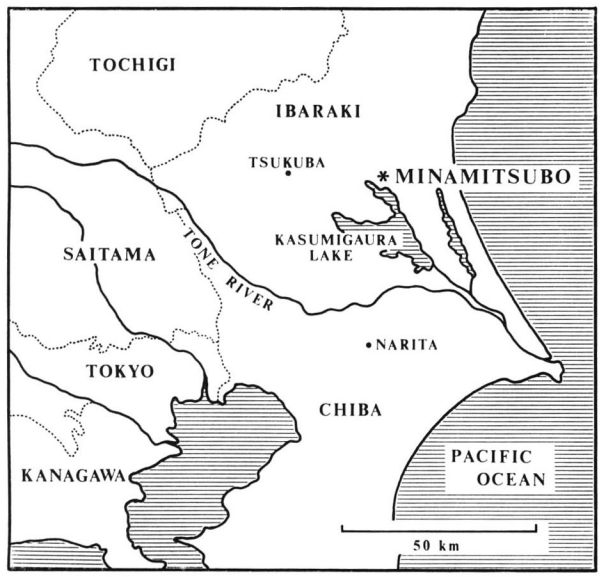

Fig. 2. Location map of the Minamitsubo shell mound site.

Descriptions and Measurements

No. 1 Skeleton

Preservation, sex and age

Most of the bones are preserved (Figs. 4–7). The degree of dental attrition is in grade 4–5 by MOLNER (1951). Main sutures of the cranial vault are fused in considerable degrees: 1–4 on the external table and 3–4 on the internal table according to the categories by BROCA (1861; after MARTIN, 1928).

The skull as a whole is large and stoutly built. The frontal and parietal tubers are not prominent. The supraorbital region is well developed. The mastoid process is large. The postcranial bones are long and thick. The muscle reliefs are marked. The greater sciatic notch is deep and narrow. All these characters suggest this individual is male. Degenerative changes around the articular area are moderate. The phase of the pubic symhysis is not clear by damage. The auricular surface of the coxa is smooth. Therefore, the No. 1 skeleton is of an individual about 30–40 years old.

Neurocranium

The vault as a whole is short, narrow and high for Jomon males. Superiorly, the vault outline is ovoid with slight projection of the parietal tuber. The cranial index is 77 (mesocephalic), which falls in the middle of Jomon and recent Japanese range of variation (Table 1). The skull has rather simple sutures, as is usual in Jomon

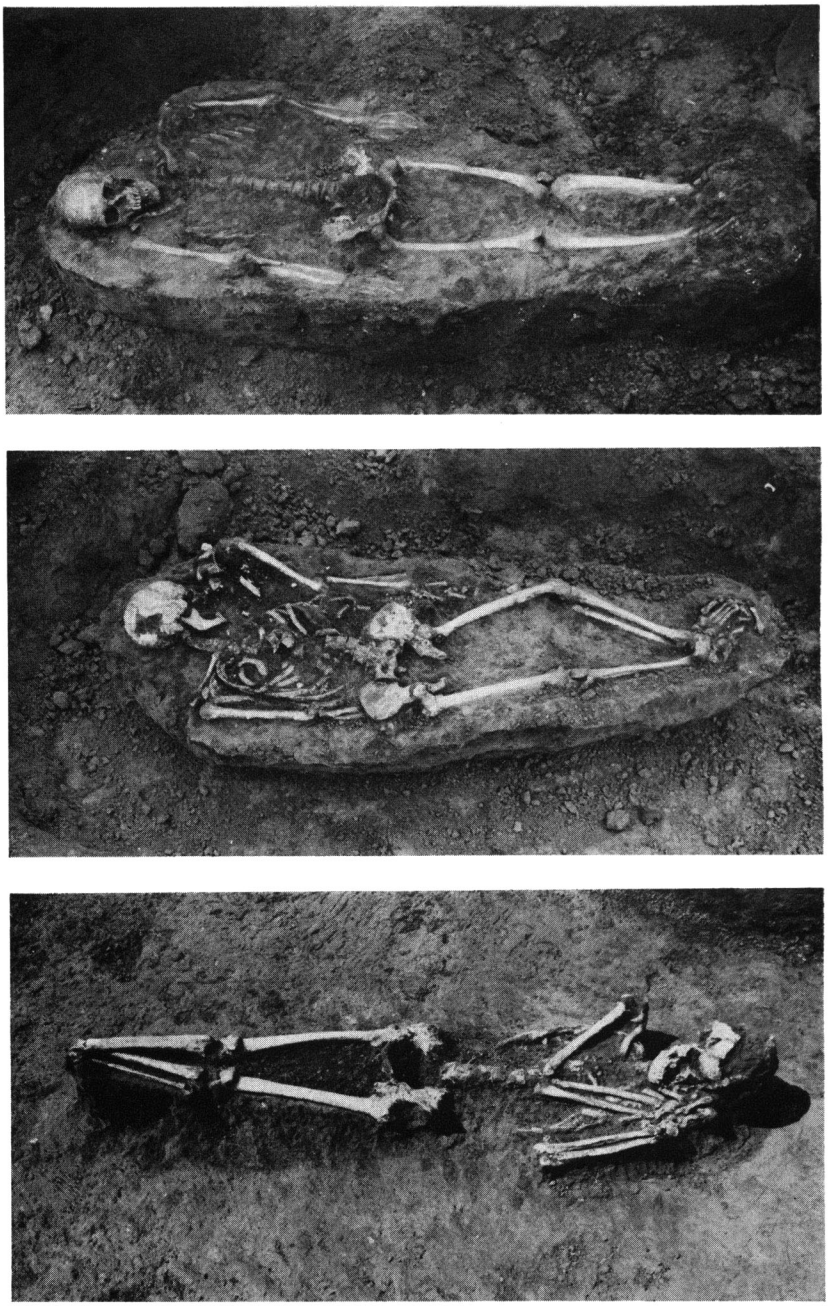

Fig. 3. Unearthed Minamitsubo skeletons in situ (Courtesy of Mr. M. ISHIDA).

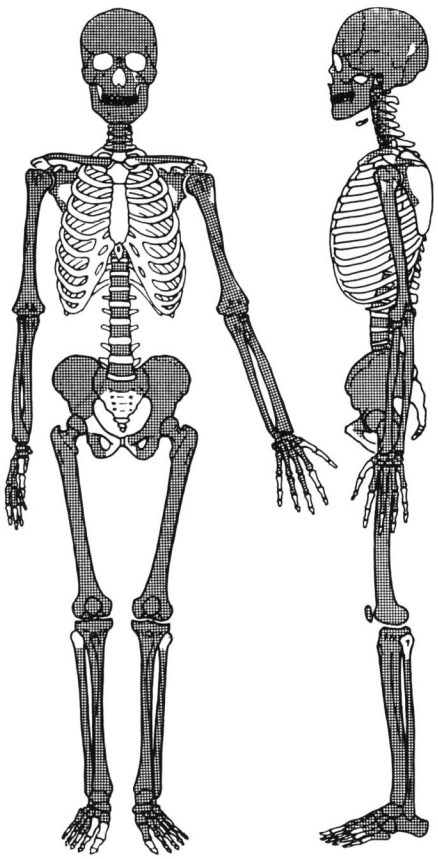

Fig. 4. Remaining parts of Minamitsubo No. 1 skeleton (shadowed).

skulls. The parietal foramen is present only in the left side. No extra-sutural bones are seen.

Posteriorly, the vault outline is house-formed. The height-width index is 101 (acrocranial), which lies above the Jomon mean, and slightly larger than the recent Japanese mean. The development of the external occipital protuberance is not clear due to damage of this area. But a transverse eminence is present, which might be the superior nuchal line.

Laterally, the eminence of the glabella is marked not only for the recent skulls but for the Jomon skulls, fitting the BROCA's categories V-VI. The skull vault is rather high, having a length-height index 78. The temporal ine is thick and rugged in frontal part, but is not clear in the parietal region because of the post-mortem damage of the bone surface. The supramastoid crest is thick and the supramastoid groove is well developed. The suture pattern of pterion is normal (H). The squamosal suture takes

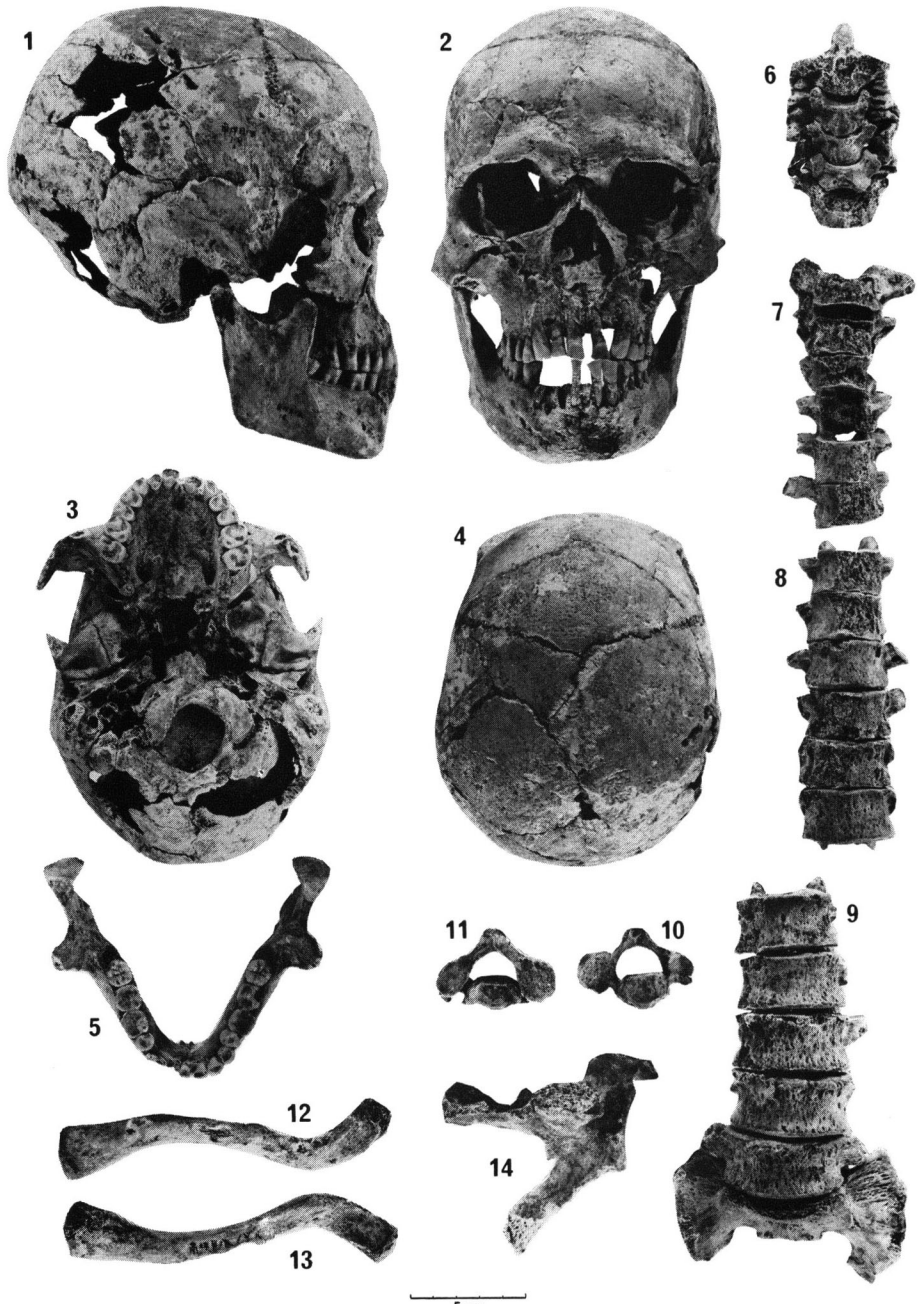

Fig. 5. Minamitsubo No. 1. 1–5, skull. 6–9, vertebrae C2–6, T1–12, and L1–S1, anterior views. 10–11, inferior and superior views of vertebrae C3 and C4, respectively. 12–13, superior and inferior views of right clavicle. 14, posterior view of right scapula.

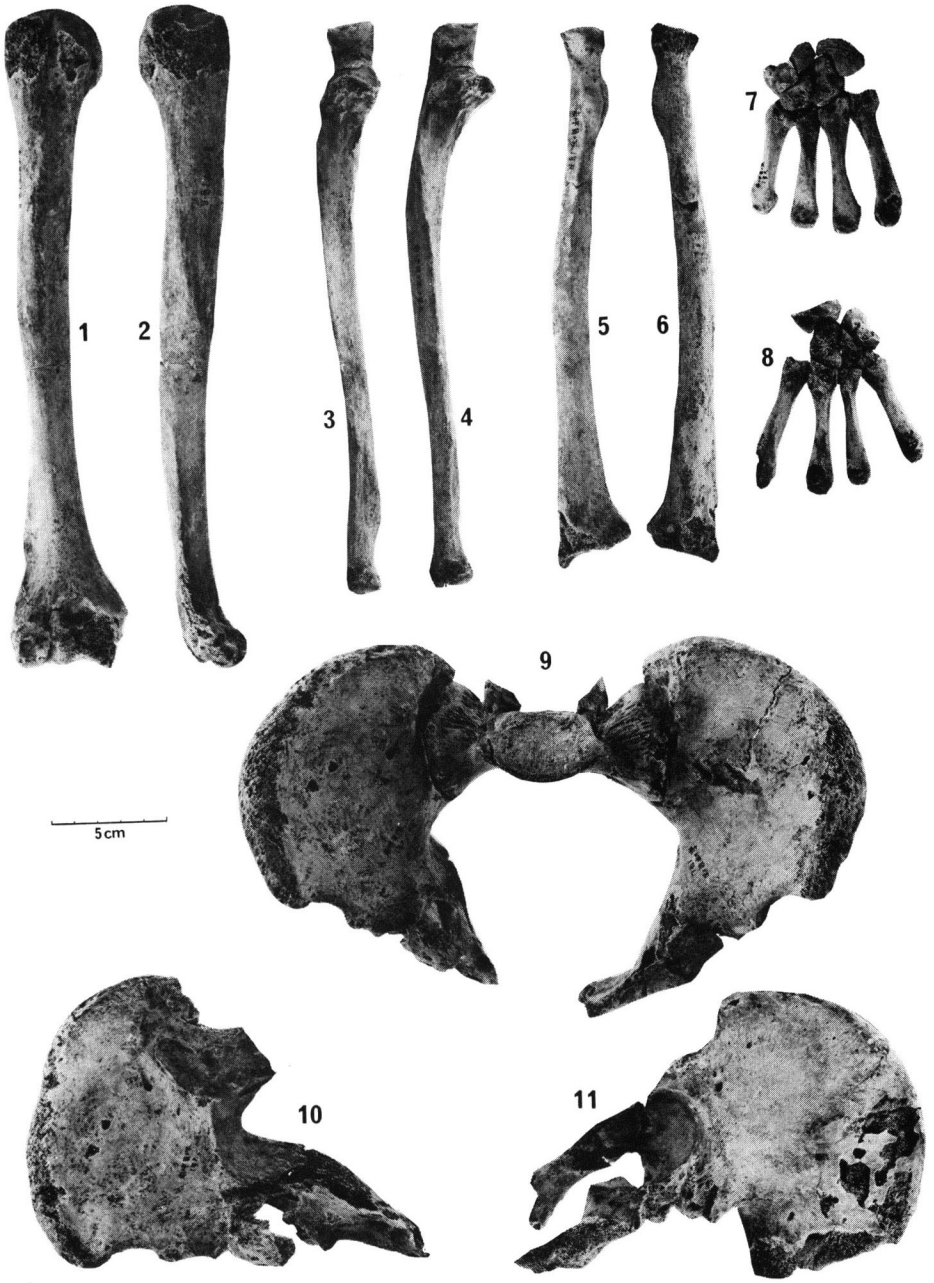

Fig. 6. Minamitsubo No. 1. 1–2, right humerus, anterior and lateral views. 3–4, right ulna, volar and lateral views. 5–6, right radius, volar and dorsal views. 7–8, right hand bones, dorsal and volar views. 9, pelvis, superior view. 10–11, right hip bone, internal and external views.

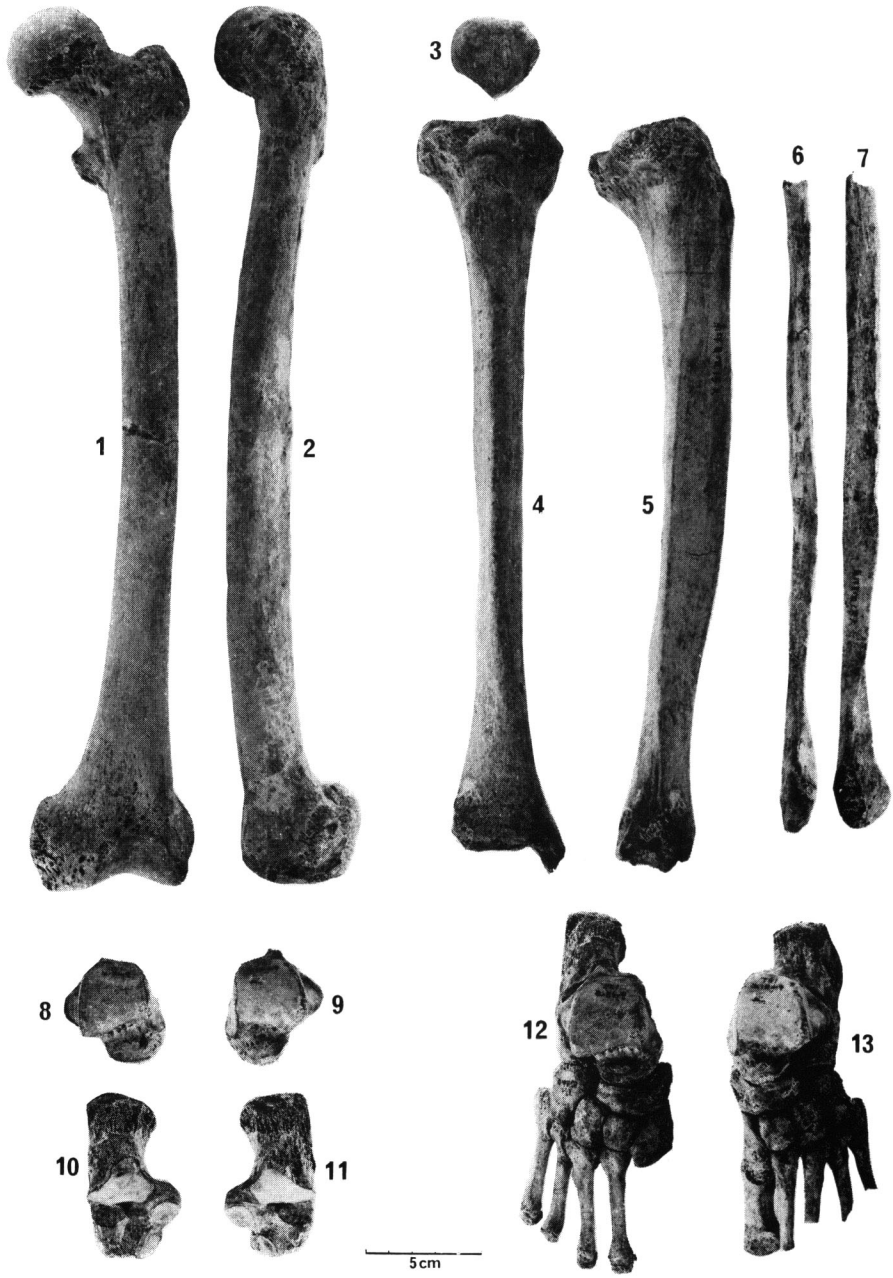

Fig. 7. Minamitsubo No. 1. 1–2, left femur, anterior and lateral views. 3, right patella, anterior view. 4–5, right tibia, anterior and lateral views. 6–7, right fibula, anterior and lateral views. 8–9, right and left tali, superior views. 10–11, right and left calcanei, superior views. 12–13, right and left foot bones, superior views.

Table 1. Comparisons of the measurements and indices of the male skulls.

	Measurements and Indices by MARTIN (1928)	Jomon Minamitsubo		Jomon Sanganji (HANIHARA & UCHIDA, 1988)			Recent Kanto (MORITA, 1950)		
		No. 1	No. 2	*N*	*M*	S.D.	*N*	*M*	S.D.
1	Max. cranial length	181	188	15	180.8	4.30	143	178.9	6.6
5	Cranial base length	105	110	3	104.3	2.31	144	100.7	4.3
8	Max. cranial breadth	139	136	16	145.8	5.39	143	140.3	5.2
9	Min. frontal breadth	97	103	14	100.0	4.10	143	93.2	4.7
10	Max. frontal breadth	118	119	14	120.1	4.69	143	115.9	5.1
11	Biauricular breadth	126	120	11	122.4	6.80	144	124.9	5.0
17	Basion-Bregma height	141	141	4	139.8	3.95	143	138.1	4.7
25	Sagittal arc	373	378	6	378.8	6.40	143	371.7	11.6
26	Sag. frontal arc	130	125	11	128.2	5.19	143	127.4	5.6
27	Sag. parietal arc	129	130	16	129.3	4.97	143	125.1	7.4
28	Sag. occipital arc	110	(123)	9	122.0	4.77	143	119.1	8.2
29	Sag. frontal chord	112	111	11	111.2	4.12	143	111.8	4.3
30	Sag. parietal chord	113	116	16	114.4	3.91	143	111.8	5.8
31	Sag. occipital chord	100	105	10	103.0	4.45	143	100.4	5.8
40	Facial length	102	(114)	3	103.7	4.73	144	97.6	5.5
43	Upper facial breadth	108	112	5	108.6	2.07	144	103.8	4.1
46	Middle facial breadth	104	(106)	5	102.6	5.86	143	98.6	5.2
48	Upper facial height	67	(64)	4	67.5	3.00	144	70.7	4.2
51	Orbital breadth	41	41	5	41.8	0.84	142	42.7	1.7
52	Orbital height	32	27	5	33.4	2.97	144	34.3	1.8
54	Nasal breadth	27	(30)	5	26.9	1.43	144	25.0	1.9
55	Nasal height	49	44	5	49.8	1.25	143	52.0	3.2
61	Upper alveolar breadth	67	—	3	67.5	3.00	144	65.8	4.0
	8:1	77	72	14	81.0	3.47	143	78.5	3.9
	17:1	78	75	4	76.1	1.35	143	77.3	3.3
	17:8	101	104	4	96.7	2.65	143	98.6	4.2
	9:8	70	76	13	68.2	3.21	143	66.4	3.4
	29:26	86	89	11	88.1	1.46	143	87.9	1.8
	30:27	88	89	16	88.5	2.26	143	89.3	1.9
	31:28	91	85	9	85.0	3.21	143	84.5	2.7
	26:25	35	33	6	33.9	0.78	143	34.3	1.2
	27:25	35	34	6	34.3	1.55	143	33.7	1.7
	28:25	29	33	6	31.8	1.16	143	32.0	1.9
	48:46	64	60	3	66.0	6.02	143	71.8	4.6
	52:51	78	66	8	78.5	2.84	142	80.4	4.6
	54:55	55	68	5	54.0	1.62	143	48.4	4.3
	(1+8+17)/3	154	155	4	157.1	3.84		108.1	

a low and flat course, as is usual in Jomon skulls and differs from a high and round course in recent Japanese. The mastoid foramina are seen just anterior to the occipito-mastoid suture on the right side, and in the suture on the left side. The external auditory meatus is large and ellipsoid with no exostosis.

Inferiorly, the relative position of the skull base and the palate is dislocated by

the post-mortem change. The mandibular fossa is deep without any degenerative change. The mastoid notch is wide and deep.

Facial skeleton

The overall size and shape of the face fit well to the typical features of the Jomon males; lower, wider and longer than those of the recent Japanese (Table 1). Viewed laterally, the facial projection is moderate having a profile angle of 83°.

In frontal aspect, the skull has well-developed supraorbital region; the glabellar swelling is strong, the medial part of the supercilliary arc is prominent, the superior border of the orbita is thick and round, and the supraorbital triangle is wide and projects laterally. Therefore, a continuous eminence traverses on the supraorbial region and a shallow groove exists between the frontal squama and this eminence. The supra-nasal vestige of metopic suture (ca. 1 cm) is present (Table 2). The supraorbital notches are seen on both sides. The right one is extremely wide (7 mm). The orbita is low and rectangular indicating sharp contrast to the high and round orbita of the recent Japanese.

The nasal bone is narrow, so-called a pinched nose, which is not common in Jomon skulls. But the nasal root (nasofrontal suture) is depressed, typical for Jomon skulls. The frontal process of the maxilla makes an angle of about 40° to the sagittal plane. The nasal aperture is low but not wide having a nasal index of 55. The anterior margin of the nasal sill and the spine are broken.

Table 2. Cranial nonmetric traits of Minamitsubo skeletons.

Cranial nonmetric traits	No. 1			No. 2			No. 3		
	R	M	L	R	M	L	R	M	L
Metopic suture		−			−			−	
Supra-nasal vestige of metopic suture*		+			+			+	
Supra-orbital foramen	−		−	−		−	?		?
Supra-orbital nerve groove	−		−	−		−	?		?
Lambdoid ossicle	−		−	−		−	?		?
Transverse occipital suture		−			+			−	
Ossicle at the asterion	−		−	+		+	?		?
Posterior condylar canal patent	+		−	+		−	?		+
Anterior condylar canal double	−		−	−		−	?		−
Posterior vestige of transverse zygomatic suture	+		+	?		+	?		?
Auditory exostosis	−		−	+		+	?		−
Foramen cinvinini	−		−	−		−	?		?
Mylohyoid canal	−		−	−		−	?		?
Palatine torus	−		−	−		−	−		−
Mandibular torus	−		−	+		+	−		−
Absence of third molar	−		−	−		−	−		−

R: Right. M: Middle. L: Left. +: Present. −: Absent. ?: Missing.

*: Length of 10 mm or more was counted as present.

The zygomatic bone faces anteriorly and projects laterally showing typical Mongoloid character. This bone and the adjacent zygomatic process of the maxilla are wide and thick, and carry the markings of strong masseter origins. The root of the zygomatic process (infrazygomatic crest) runs toward the alveolus of M1 forming a strong eminence. The so-called canine fossa is not present, but a shallow groove is seen between the canine root and the infrazygomatic crest.

The alveolar process is not reduced so that the alveolar prognathism is moderate, and the occlusion forms an edge-to-edge bite, as is usual in Jomon skulls. The tooth row shows no irregularity. The upper left I2 is lost by evulsion.

The mandible is moderate in size but it looks very strong in structure. The tooth row and the mandibular base are parabolic in shape. The extramolar groove is narrow due to relative wideness of dental arch to the mandibular body. The rami are low, wide and thick, having rounded coronoid processes, and well-developed masseteric fossae.

Laterally, the alveolar margin and the base are approximately paralell to each other; i.e., posterior reduction of height of the body is slight. There is no preangular notch. The mylohyoid bridging is not seen. The symphyseal area is rather small and not markedly devided into the mental and the lateral tubercles. This is partly because the alveolar region is not reduced.

Dentition

Status of the dentition:

1	c									x					1
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
				r	s	s		r						c	

In above formura, accompanied symbols denote as follows:

s=socket present but tooth missing
r=only root remaining
l=tooth lost ante-mortem, socket closed
x=as above but tooth artificially extracted
c=carious tooth

Most of the teeth were preserved. The crown diameters are generally larger than those of the recent Japanese (Table 3). The right and left upper M3s are lost and the root sockets are closed. The lower M3s show little attrition. The crown of the lower left I1 is missing, but the root is preserved in the soket, and the pulp cavity is filled up by secondary dentine. The adjacent left I1 and right I2 are inclined to this tooth. Therefore, it is clear that this tooth had been broken long before death. The upper left I2 is lost, its root socket is closed and the adjacent teeth are inclined. It is likely that this tooth was artificially extracted.

The dental attrition reaches the grade 4–5 by MOLNER (1963) except for the lower

Table 3. Mesio-distal and labio-/bucco-lingual diameters of Minamitsubo teeth compared with those of recent Japanese (in mm).

	Minamitsubo*						Recent Japanese (male)** (OZAKI *et al.*, 1987)		
	No. 1		No. 2		No. 3				
	R	L	R	L	R	L	*N*	*M*	S.D.
MDD									
Maxillary									
I1	(7.7)	(8.1)	—	(8.0)	—	—	497	8.49	0.54
I2	(7.0)	—	—	6.9	—	—	497	6.96	0.67
C	(8.5)	(7.7)	(8.0)	8.5	—	7.5	363	7.95	0.44
P1	(7.4)	(7.7)	(6.8)	7.0	7.3	(6.9)	569	7.29	0.44
P2	(6.8)	(7.3)	6.2	6.7	—	(6.5)	567	6.87	0.46
M1	(10.9)	(10.0)	—	(10.6)	10.1	(10.1)	490	10.45	0.59
M2	(10.4)	(10.3)	—	—	—	(9.1)	460	9.67	0.61
M3	—	—	—	—	—	8.5	275	8.80	0.89
Mandibular									
I1	(5.0)	—	—	—	—	—	414	5.51	0.38
I2	—	(6.5)	(5.7)	(5.3)	—	—	447	6.15	0.40
C	—	(7.3)	—	—	—	—	355	7.09	0.42
P1	—	(7.8)	(6.9)	(6.7)	7.1	6.7	544	7.12	0.42
P2	7.9	8.0	—	(6.9)	(6.2)	(6.9)	539	7.29	0.44
M1	(12.4)	(12.0)	—	(11.3)	(11.4)	(11.4)	303	11.54	0.59
M2	(12.1)	(11.5)	—	(10.6)	(10.8)	(10.6)	279	11.22	0.62
M3	11.9	11.9	—	9.3	10.3	9.7	208	10.67	0.93
LLD/BLD									
Maxillary									
I1	7.6	7.5	—	6.7	—	—	524	7.24	0.42
I2	6.8	—	—	6.7	—	—	524	6.49	0.54
C	8.7	8.7	7.8	8.0	—	7.6	366	8.59	0.55
P1	9.9	10.0	8.9	9.0	9.1	9.0	580	9.45	0.53
P2	9.8	10.1	8.6	8.4	—	9.5	578	9.33	0.60
M1	11.9	12.1	—	11.5	11.0	11.1	498	11.65	0.55
M2	13.0	12.6	—	—	—	—	467	11.78	0.68
M3	—	—	—	—	—	11.4	273	10.83	1.00
Mandibular									
I1	6.2	—	—	—	—	—	504	5.89	0.42
I2	—	6.8	5.7	5.8	—	—	521	6.41	0.41
C	—	8.6	—	—	—	—	361	8.13	0.49
P1	—	8.5	7.6	7.4	7.9	7.7	561	7.94	0.52
P2	9.0	9.4	—	7.5	8.4	8.3	558	8.36	0.53
M1	(11.7)	(11.7)	—	11.6	10.8	10.7	313	10.81	0.57
M2	11.7	—	—	10.2	10.1	10.2	290	10.43	0.55
M3	10.8	10.8	—	8.9	10.2	10.5	216	10.12	0.76

*: Measurements in parentheses are affected by attrition.

**: Both sides combined after SAKURA (1988).

M3 being in the grade 1. The caries is seen on mesial side of the neck of upper right M2 and on the buccal side of the neck of lower left M2.

Trunkal skeleton

Most of the vertebrae are preserved. The left joint between the third and fourth cervical vertebrae is extraordinary large (2 cm), and the articular surfaces are rugged and porous (cf. HIGUCHI, 1983). The lumbar vertebrae show slight hyperostotic lipping (of normal age change). Ribs are not well preserved, but they appear thick having strong muscle reliefs.

Upper limb skeleton

The clavicle is medium in size for Jomon standard but large for recent Japanese males (Table 4). Muscular and ligamentous reliefs such as impression for costo-clavicular ligament, tubercle for conoid ligament, and attachment for greater pectoral muscle are well developed. The articular surfaces have slight degenerative age change.

Scapulae are damaged and most part of the plate is lost. As HASEBE (1921) suggested, the acromio-glenoid distance is large (22 mm on the left) showing typical Jomon character. The axillary border exhibits no dorsal sulcus, which corresponds to the "sapiens" type.

The humerus has typical Jomon characters. It is short but stout with well-developed muscle attachments. The deltoid tuberosity is projected laterally, the antero-medial surface of the midshaft is flat and compressed having a cross-sectional index of 67 on the right (Fig. 15). Perforation of the conoid fossa is absent.

The radius also shows typical Jomon features. It is, contrary to the humerus, longer and thicker than those of recent Japanese. The oblique line for the flexor digitorum superficialis is well-developed to form a strong ridge. The tuberosity of radius is wide and rugged.

The ulna has similar features as the radius; long and thick with marked muscle reliefs. The tuberosity of ulna, the supinator crest, the pronator crest and the interosseous margin are well developed. Especially, the interosseous margin projects high, forming a strong crest (Fig. 15). By this the transverse diameter of the dorsal surface at the point where the crest is highest reaches 22 mm. The shaft is strongly bent to dorsal direction in its upper one third. The styloid process is thick and its tip faces medially and palmarly in a slight degree.

Most of the carpal and metacarpal bones are well preserved except for the first, but most digits are lost. No special feature is observed in the hand bones.

Lower limb skeleton

Both right and left coxae are preserved with some breakage. They are moderate in size but the muscle attachments are marked; the iliac tubercle is thick, the supra-acetabular fossa is strong, and the iliac groove is deep. The acetabulum is large. The greater sciatic notch is deep and narrow, showing a typically male character.

Table 4. Comparisons of the male upper limb bones.

Measurements and Indices by MARTIN (1928)	Jomon Minamitsubo			Jomon Sanganji (BABA, 1988)			Recent Kanto		
	No. 1	No. 2	No. 3	*N*	*M*	S.D.	*N*	*M*	S.D.
CLAVICLE							(TAKANO, 1958 b)		
1 Max. length	150	—	—	15	149.9	6.8	125	139.6	9.8
4 Vert. diam. mid.	10	10	10	16	10.6	0.8	125	10.0	1.4
5 Sagitt. diam mid.	14	15	15	16	12.7	1.1	125	12.2	1.7
4: 5	71.4	66.7	66.7	16	83.6	8.9	124	83.4	13.0
6 Circumf. mid.	40	42	45	16	38.0	2.5	125	38.2	4.1
6: 1	26.7	—	—	14	25.3	1.6	125	27.3	3.1
SCAPULA							(TAKANO, 1958 a)		
Acr-gl. distance	22	23	19	15	19.9	1.5	124	16.5	1.5
HUMERUS							(NISHIHARA, 1953)		
1 Max. length	293	300	—	18	291.2	10.1	70	295.9	16 9
2 Total length	291	294	—	19	289.1	11.2	70	290.4	16.1
5 Max. diam. of mid.	26	24	24	19	23.4	1.6	70	22.4	1.8
6 Min. diam. of mid.	18	17	17	19	17.2	1.3	70	17.7	1.6
6: 5	69.2	70.8	70.8	19	74.7	5.6	70	79.6	4.7
7 Least circumf.	67	65	66	19	62 6	4.7	70	62.3	4.3
7: 1	22.9	21.7	—	18	21.5	1.6	70	21.1	1.6
17 Head-shaft angle	47°	40°	—	19	41.1°	4.4	70	49.5°	4.8
18 Torsion angle	—	147°	—	18	144.4°	11.8	70	152.7°	5.2
RADIUS							(EBINA, 1951)		
1 Max. length	236	232	—	17	231.3	9.5	64	225.1	10.3
2 Functional length	220	219	—	17	216.2	9.8	64	208.2	10.2
4 Tr. diam. shaft	19	((15))	(16)	17	16.5	1.0	64	16.5	1.5
5 D-V diam. shaft	12	13	(14)	17	11.9	1.0	64	11.8	1.0
5: 4	63.2	((86.7))	((87.5))	17	72.4	5.6	64	71.8	6.7
ULNA							(EBINA, 1951)		
1 Max. length	250	—	—	11	250.5	6.9	64	241.5	10.3
4 Curv. index	5	3	—	12	2.1	0.8	64	1.5	0.7
11 D-V diam. shaft	15	13	15	12	14.1	1.2	64	13.2	1.1
12 Tr. diam. shaft	17	16	18	12	15.5	1.2	64	16.3	1.1
11: 12	88.2	81.3	83.3	12	91.2	9.2	64	80.9	7.3

There are slight degenerative changes on the iliac tuberosity, while the auricular surface is smooth.

Both the femora remains in good condition. They are rather short for Jomon as well as for recent males, but are rather thick for Jomon males (Table 5). The shaft bends anteriorly (in normal range) and medially (rather rare). The trochanter region is well developed. Anteriorly, the anterior femoral tubercle is prominent. Posteriorly, the lessor trochanter projects medially and the digital fossa exists between it and the medial surface of the shaft.

Table 5. Comparisons of the measurements and indices of the male lower limb bones.

Measurements and Indices by MARTIN (1928)	Jomon Minamitsubo			Jomon Sanganji (BABA, 1988)			Recent Kanto		
	No. 1	No. 2	No. 3	*N*	*M*	S.D.	*N*	*M*	S.D.
FEMUR							(OBA, 1950)		
1 Max. length	409	421	420	28	423.7	16.3	81	412.1	19.6
2 Total length	405	419	416	30	418.4	17.3	81	408.4	20.0
6 Sag. diam. mid.	31	28	27	30	29.6	2.6	81	27.6	2.3
7 Tr. diam. mid.	26	26	25	30	25.4	1.5	81	26.3	2.2
6:7	119.2	107.7	108.0	30	116.7	7.7	81	105.4	8.6
9a Max. diam. upp.	30	29	31	30	30.3	1.6	81	32.1	2.2
10a Max. diam. upp.	24	25	24	30	24.5	1.8	81	24.9	1.8
10a:9a	80.0	86.2	77.4	30	80.8	4.9	81	77.7	6.1
28 Torsion angle	25°	26°	29°	23	23.8°	8.5	81	12.5°	9.5
29 Co. sh. angle	130°	130°	134°	30	127.1°	6.2	82	128.9°	4.6
TIBIA							(SUZUKI, 1961)		
1 Total length	342	336	—	22	339.3	14.7	80	320.4	14.7
1a Max. length.	348	339	—	22	343.0	15.0	80	325.3	15.5
8 Sag. diam. mid.	30	29	29	22	31.1	2.3	80	28.7	2.1
9v Tr. diam. m. v.	22	19	20	22	21.0	1.8	80	22.8	1.7
9v:8	73.3	65.5	69.0	22	67.6	6.7	80	78.7	6.5
10b Least circumf.	75	75	—	22	75.5	5.3	80	72.3	4.1
10b:1	21.9	22.3	—	22	22.3	1.4	80	22.7	1.4
13 Inclin. angle	15°	14°	—	18	12.1°	3.6	80	10.7°	—
14 Torsion angle	26°	6°	—	18	21.3°	8.4	80	16.7°	—
FIBULA							(FUKUDA, 1961)		
1 Max. length	—	330	—	3	326.7	16.2	80	322.4	15.7
2 Max. diam. mid.	18	16	19	13	18.9	1.6	80	14.8	1.5
3 Min. diam. mid.	10	14	12	13	12.5	0.8	80	10.9	1.1
3:2	(55.6)	87.5	63.2	13	66.7	5.6	80	73.4	8.3

The proximal shaft is moderately flattened anteroposteriorly. On the posterior surface the gluteal tuberosity is sharp. The linea aspera is well developed, forming a pilaster with a pilasteric index of 119. This value is high not only for the recent but for the Jomon specimens. Indicative of squatting habits are presence of the cervical fossa of ALLEN and CHARLES' facet. The patella is rather narrow. It has a small vastus notch.

The tibiae of both sides are preserved well. They are medium in length. The shaft is not so flattened but bends strongly to the anterior. It appears so-called a boomerang tibia (LUSTIG, 1915). The anterior margin is round. The area for the attachment of the tibialis anterior is depressed showing strong muscle function, but this area does not expand to the medial surface across the anterior margin.

On the postrior surface, the soleal line is moderately developed and the vertical line, dividing the attachments of the tibialis posterior and the digitorum longus, is seen. There are medial and lateral squatting facets on the anterio-inferior part of

the distal epihysis. The abnormal hyperostotic eminence is seen on the lateral surface of the distal one fourth of the left tibia. It is 3.5 cm long, 1 cm wide and 2–3 mm high. Its surface is smooth and hard. It is regarded as healed periostitis (MITSUHASHI, 1984).

Foot bones are well preserved except digits. The talus has wide squatting facets such as medial maleolar facets, medial facets, lateral facets, and abnormal surface of the neck (BABA, 1970). On the inferior surface of the talus there is a facies accesorius corporis tali. In addition, the corresponding impression on the calcaneus is also seen.

The anterior and medial articular facets of the calcaneus are divided on the right side but fused on the left side. The grooves formed by the tendon of the flexor hallucis longs on the talus and the calcaneus are wider than those of the recent Japanese. indicating intensive use of this muscle.

No. 2 Skeleton

Preservation, sex and age

Most part of the skeleton except trunkal bones is preserved (Figs. 8–11). The dental attrition reaches the grade 4 by MOLNER. The principal cranial sutures are generally open, only the sutures of outer table near the lambda are partly fused. No degenerative change is seen on the articular surfaces. The pubic symphysis has smooth transverse grooves and eminences, corresponding to the phase at middle twenties.

The skull shows typical male characters: the mastoid process and the supraorbital region are well developed, the external tubercles of the chin is projected. The postcranial bones also indicate male features; the limb bones are generally large with strong muscle reliefs, and the greater sciatic notch is narrow and deep.

Neurocranium

Seen from above, the skull vault is longer and narrower than the ordinary Jomon skulls. The length-breadth index is 72. This value falls in the middle of the medieval Japanese range, which are the smallest (most dolichocephalic) among Japanese skulls of various historical ages (Table 1).

Posteriorly, the skull is house-form having a height-breadth index of 104, which is far above the mean of Jomon skulls and even higher than that of the recent ones. There are a small intersutural bone in the right lambdoid suture, and small asterion bones in both sides (Table 2). The transverse occipital suture is seen. The skull has a moderately developed external occipital protuberance and a low eminence between the supreme and superior nuchal lines.

In the lateral view, the glabella projects high, reaching 5th to 6th degree by BROCA's standard. The temporal line is clear on the frontal bone but obscure on the parietal bone. The supramastoid crest is discernible above the external auditory

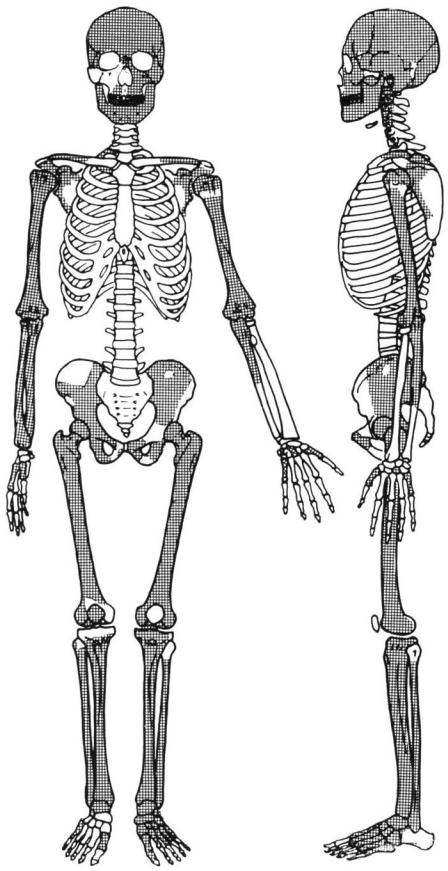

Fig. 8. Remaining parts of Minamitsubo No. 2 skeleton (shadowed).

meatus, and it becomes sharp above the mastoid process, forming the anterior superior mastoid tubercle (WALDEYER, 1909). The articulation of the pterion is of normal type (H). The squamosal suture runs drawing a high and round line. Marked exostosis is seen on both external auditory meati.

Seen from below, the mandibular fossa is deep and the mastoid incisura is wide. The tympanic deficiency is absent. The condylar canal is present only in the right side. The hypoglossal canal, foramen ovale and foramen spinosus are normal.

Facial Skeleton

The face is rather wide, very low and long not only for recent Japanese but for Jomon males (Table 1). The facial index of WIRCHOW is 104 and the prophile angle is 77°. The glabella and the supraciliary arch are projected. The supraorbital triangle is well-developed. The supraorbital groove is discernible only in the left

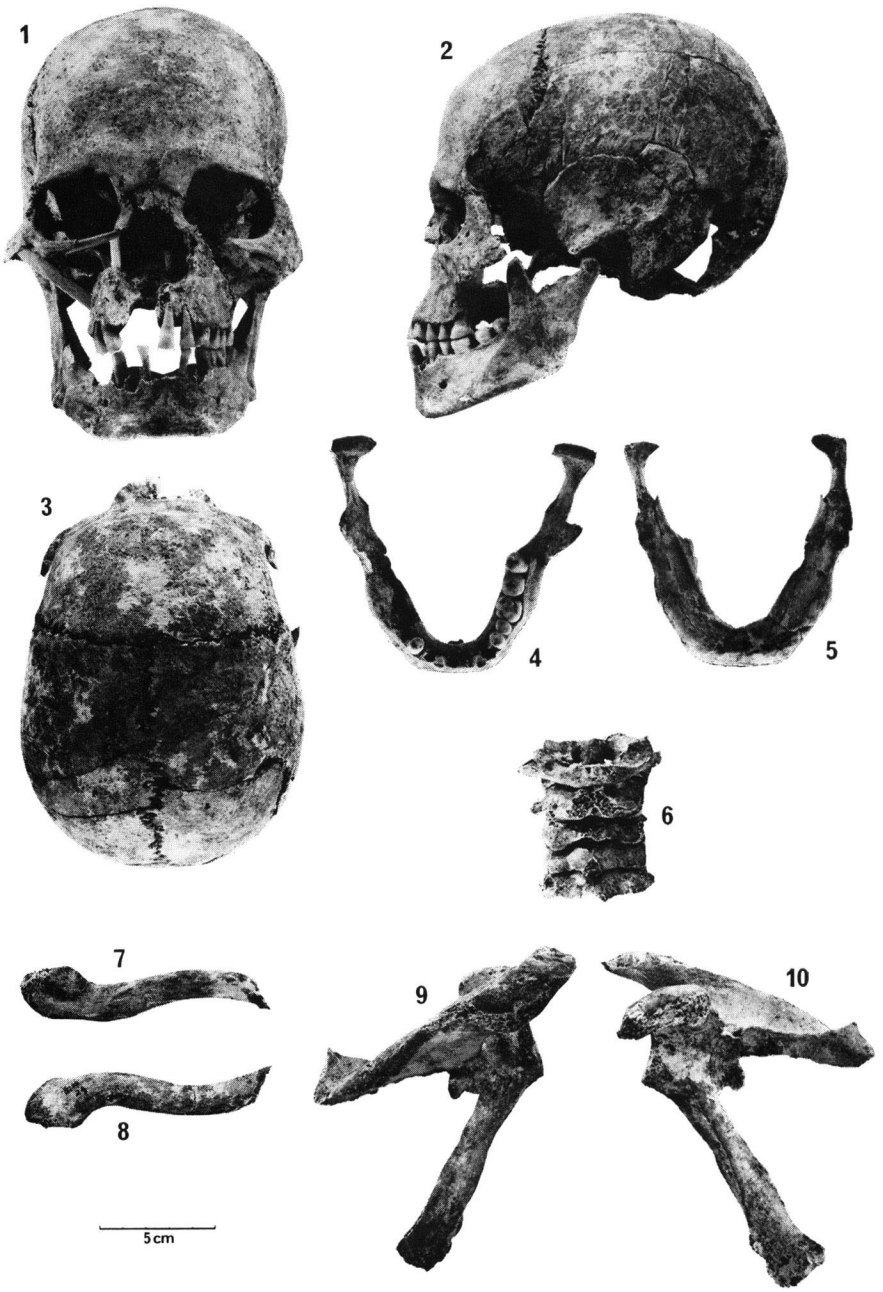

Fig. 9. Minamitsubo No. 2. 1–5, skull (note prominent external mandibular torus). 6, vertebrae C1–5, posterior view. 7–8, right clavicle, inferior and superior views. 9–10, right scapula, posterior and anterior views.

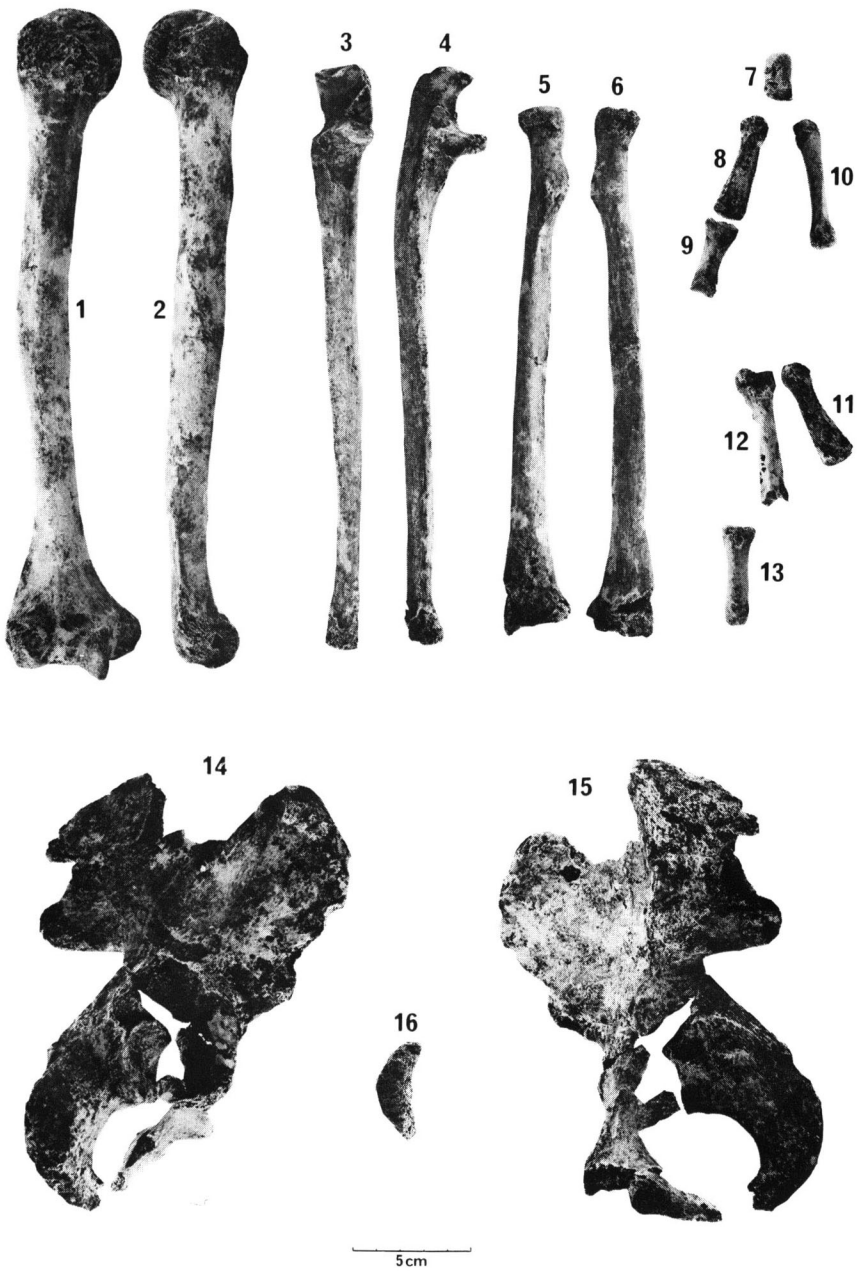

Fig. 10. Minamitsubo No. 2. 1–2, right humerus, anterior and lateral views. 3–4, right ulna, volar and lateral views. 5–6, right radius, volar and dorsal views. 7, left capitate, dorsal view. 8–9, left first metacarpal and proximal phalanx, dorsal views. 10, left fourth metacarpal, dorsal view. 11–12, right first and second metacarpals, dorsal views. 13, right third proximal phalanx, dorsal view (with sign of periostitis). 14–15, right hip bone, external and internal views. 16, left pubic bone, symphysial surface.

Fig. 11. Minamitsubo No. 2. 1–2, left femur, anterior and lateral views. 3, left patella, anterior view. 4–5, left tibia, anterior and lateral views. 6–7, right fibula, anterior and medial views. 8–9, right and left tali, superior views. 10, left foot bones, quasi-superior view (deformation in the distal end of the fourth proximal phalanx).

side. The supra-nasal vestige of metopic suture is present (1 cm). The supraorbital notches are present. The orbital openings are low and rectangular in shape, having an orbital index of 66. This is smaller by about 4 S.D. than the mean of the Jomon skulls. The nasal root is depressed with sharp flexion, but the nasal bone projects forward though its lower part is missing. As most Jomon skulls, the nasal bone is wide (minimum width is 14 mm). The horizontal section of the nasal bone and the frontal process of maxilla is not sharp as in the No. 1 skeleton but not so flat as in the Medieval or Early Modern skulls. The anterior nasal aperture is low and wide having the nasal index of 68, which is much smaller than the mean of other Jomon skulls.

The zygomatic bone is massive and wide, facing anteriorly and projecting laterally, which shows Mongoloid character. The marginal tubercle and the infrazygomatic tubercle of the zygomatic bone are well developed. The infrazygomatic crest is concave in the anterior view, but it forms a thick eminence above M1. There is a shallow fossa between it and the canine root. The palatine and mandibular tori are not present. The bite form is edge-to-edge as usual in Jomon skulls, but the alveolar prognathism is rather strong for Jomon skulls.

The mandible is moderate in size but looks stout because its ramus is low and the symphyseal region is wide. The dental arch is wide and elipsoid in the occlusal view, and the mandibular base is trapezoid in the inferior view. The prominentia mentalis is moderate but the tuberculum laterale is well developed to expand laterally. The wide fossa submentalis is present. While the digastric fossa is moderate.

Laterally, the prominentia lateralis projects high, forming the external mandibular torus (HRDLIČKA, 1940). The posterior reduction of height of the body is slight. The base is straight without preangular notch. The mental foramen is below P2–M1. The ascending ramus is low and the coronoid process is wide and thick. The angulus is flared laterally having deep masseteric fossa.

Dentition

Status of the dentition:

s	s	s				x									l	l
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
8			5	4	3	2	1		2	3	4	5	6	7	8	
s			s		s		s			s						

In above formula, blank tooth means the alveolar part missing together with the tooth.

Preservation of the teeth is not good, especially on the right side. The sizes of the teeth are generally smaller than those of the recent Japanese, except for the MDD of the upper canines and BLD of the lower M1 (Table 3). According to the wear pattern of the incisors, the bite form should have been edge-to-edge. But wear facets are observed also on the lingual surfaces of the upper first and second incisors and

canines of both sides, which are not formed by ordinary biting. The facets slant postero-anteriorly with some exposed dentine. On the corresponding labial surfaces of the lower teeth, no such wear facets are seen.

The upper left M2 and M3 are missing and the root sockets have been fused. The antagonistic lower M2 and M3 are slightly worn. Therefore, the upper M2 and M3 were lost before death. The upper right I2 is lost and the root socket is fused. No pathological change is seen in this region. Thus, this tooth is regarded as being artificially extracted.

Trunkal skeleton

Only parts of the cervical and lumber vertebrae are preserved. There is no degenerative change on its body. The ribs are also fragmentally, and are thick with sharp muscle reliefs. The sternum is almost lost.

Upper limb skeleton

Both the claviculae have lost sternal ends. They are thick; the sagittal diameters at the midshafts are much larger than the means for Jomon as well as recent Japanese (Table 4).

The scapulae have wide acromio-glenoid distance (23 mm right, 22 mm left). The axillary border is more developed in the left side than in the right. The axillary border exhibits only ventral sulcus (sapiens type).

Both the humeri are well preserved. They have common Jomon characters as described in No. 1 skeleton; moderate length, flat and laterally flexed shaft, and strong muscle attachments.

The preserved radius is of right side only. It is longer than the recent radii and matches the Jomon mean. Anteriorly, the oblique line is projected indicating strong grip. Laterally, the insersion of the pronator teres is sharp forming a shallow fossa.

The right ulna remains intact but the left one has lost its lower half. Their general features are of typical Jomon as that of No. 1 skeleton, although the interosseous margin is not so high as in the latter.

Preservation of the hand bones are poor. There are hyperostotic change on the dorsal surface of the distal shaft of right second proximal phalanx.

Lower limb skeleton

Both the innominate bones are incomplete, lacking some portions. Generally, the muscle reliefs are clear; the iliac tubercle is prominent, the supra-acetabular fossa is concave, the iliac sulcus is deep and long. The greater sciatic notch is narrow and deep showing a typical male character. There is no degenerative change on the iliac tuberosity and the auricular area is smooth. On the pubic symphysis surface, the parallel lines are seen and the dorsal margin is slightly projected, matching the grade 3 (23–24 yrs) to 4 (25–27 yrs) by HANIHARA (1952).

The femora remain intact except some part of the left bone. Their overall sizes

and proportions are of typical Jomon femora (Table 5). On the neck, there is a so-called anterior cervical fossa of ALLEN forming a small depression. The anterior femoral tubercle is prominent and the lesser trochanter projects medially, having the connecting bridge to the head. Posteriorly, the muscle markings such as gluteal tuberosity and pectineal line are well developed. The cross-section of the upper shaft is round (platymeric index, 86, right), which is true in most Jomon femora. The pilaster formation is moderate for Jomon femora (pilasteric index, 104, right).

Distally, the patellar groove of the anterior surface is deep and the intercondylar fossa is narrow, which are sometimes seen in Jomon specimens but rare in recent ones. On the upper posterior end of the medial condyle articular surface, a small CHARLES' facet is seen. The preserved right patella is high and naroow. The vastus notch is small.

The tibiae remain intact except the proximal end of the right bone. The shafts are moderately flattened (cross-section index at middle, 66, right), with slight anterior curvature. The anterior borders are sharp and deviate medially, indicative of the well-developed tibialis anterior muscle. Posteriorly, the sharp soleal line and the vertical line are seen.

The right fibula is well preserved, but the proximal part is lacking in the left one. They are not so flattened as in ordinary Jomon bones, though muscle reliefs are clear.

The foot bones remain well in the left side but poorly in the right side. The squatting facets of the talus, especially the lateral squatting facet, which is not seen in the reccent Japanese, are well developed indicating habitual squatting custom. The anterior and medial articular facets of the calcaneus are fused in the right bone and separated in the left. The tendon of the flexor hallucis longus made a wide groove on the talus and the calcaneus. There exists ante-mortem deformation of the left fourth proximal phalanx; the distal shaft is bent and the head faces medially.

No. 3 Skeleton

Preservation, sex and age

Generally, preservation of No. 3 skeleton is worse than in No. 1 and 2 skeletons, especially of its skull, trunkal bones and hand and foot bones are poor (Figs. 12–14). All the permanent teeth have erupted but the occlusal attrition is slight, in grade 1 or 2 by MOLNER's standard. Sutures of the skull vault are open. There is no degnerative change on the articular surfaces. Therefore, the age of this individual is estimated at early twenties.

The skull has a prominent glabella, large mastoid processes and a well-developed mental region. The limb bones are thick with considerable muscle markings. Taken these together, this individual should be male.

Neurocranium

Only some portions of the bones remain. The vault bones are thin. The glabella

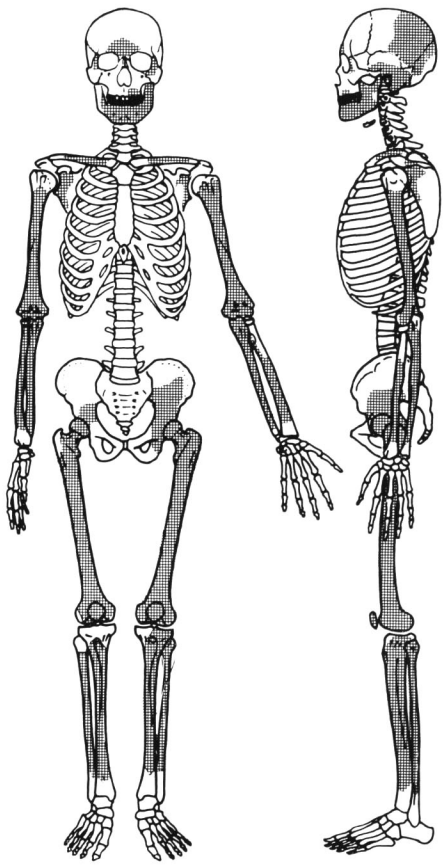

Fig. 12. Remaining parts of Minamitsubo No. 3 skeleton (shadowed).

and the superciliary arch are projected, but lower than those of No. 1 and No. 2 skeletons. The frontal suture remains open above the nasion (ca. 1 cm, Table 2). Posteriorly, the external occipital protuberance is not clear due to damage, but the superior nuchal line is seen to be usually developed.

Laterally, the mastoid process is of average for Jomon males. The supramastoid crest is weak above the external auditory meatus, but strongly projected above the mastoid. The external auditory meatus is large and has no exostosis (Table 2). The tympanic deficiency is absent. The foveola suprameatica is well developed. In addition, there is another foveola just anterior to this, above the meatus. Inferiorly, the condylar canal is present and the hypoglossal canal is not divided.

Facial skeleton

Only the mandible remains in good condition. Seen from above, the dental

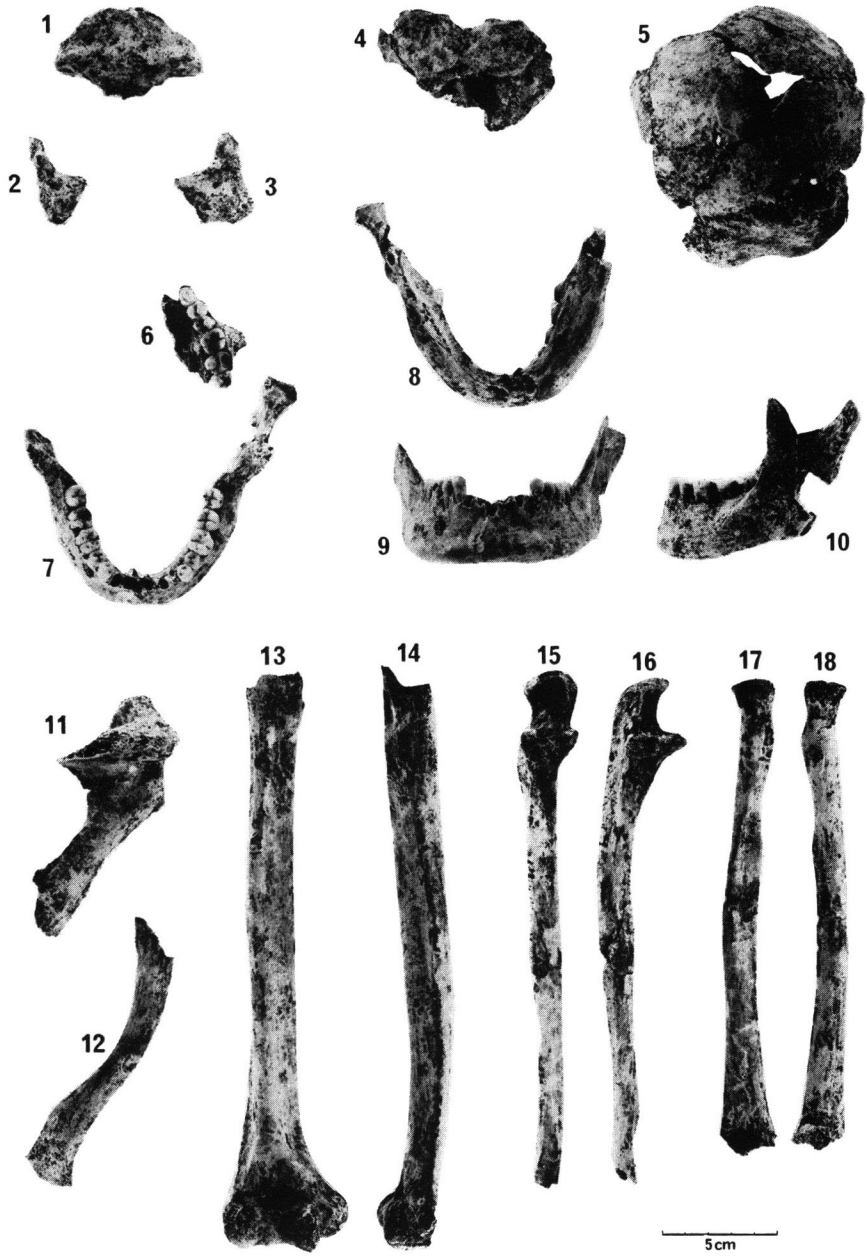

Fig. 13. Minamitsubo No. 3. 1, grabellar part of frontal bone. 2–3, right and left zygomatic fragments. 4, left temporal fragment. 5, fragment of left parietal and occipital bones. 6, left maxillary fragment. 7–10, mandible. 11, right scapula, posterior view. 12, right clavicle, superior view. 13–14, right humerus, anterior and medial views. 15–16, right ulna, volar and lateral views. 17–18, right radius, volar and dorsal views.

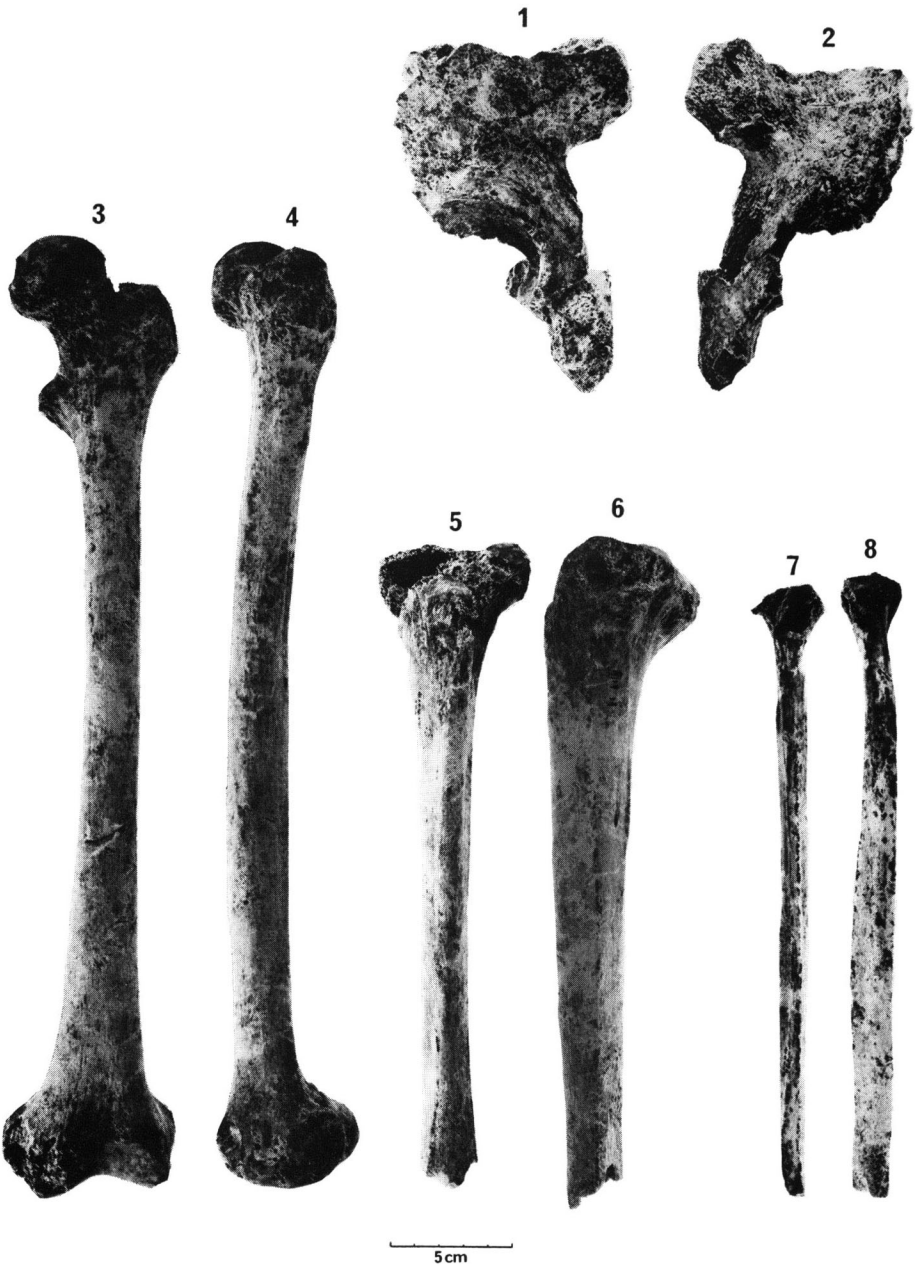

Fig. 14. Minamitsubo No. 3. 1–2, left hip bone, external and internal views. 3–4, left femur, anterior and lateral views. 5–6, left tibia, anterior and lateral views. 7–8, left fibula, anterior and lateral views.

archade and the corpus are wide and hemicircular in shape. The corpus is low and the posterior reduction of height is slight. The base outline is convex anteriorly and concave posteriorly with shallow preangular notch. The lateral prominence and the marginal torus are remarkably developed extending to the lower part of mental region. By this, the base of the mandible becomes very thick, and the outer surface of the alveolar process is depressed as if there were an infraalveolar sulcus. The mental foramen is below P2.

Internally, the linea mylohyoidea is sharp and no bridging is seen on the mylohyoid groove. The mental spine is large (6 mm right, 3 mm left).

The ascending ramus is moderate in size and the muscle markings are less developed as in No 1 and No. 2 skeletons.

Dentition

Status of the dentition:

			c						s	s				c	c
			6		4				1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1		1	2	3	4	5	6	7	8
		c			s	s	s		s	s	x					

The tooth crown diameters are nearly equal to or slightly smaller than those of the recent Japanese (Table 3). The attrition is weak. Only the first molars reach grade 2 by MOLNER, and other teeth remain in grade 1. There are caries on the upper right M1, upper left M2 and lower right M1. The lower left canine is lost and its root socket is closed. This canine should be artificially extracted.

Upper limb skeleton

The clavicle is thick but the muscle reliefs are not so clear as in No. 1 skeleton (Table 4). The scapula has wide acromioglenoid distance (19 mm), as is true in ordinary Jomon specimens. The groove pattern of the axillar border is of sapiens.

The humerus has similar character as in No. 1 and No. 2 skeletons, though the muscle markings and shaft flatness are moderate. The radius and the ulna possess roughly intermediate characters between No. 1 and No. 2 skeletons in thickness and development of muscle attachments.

Lower limb skeleton

The coxa is poorly preserved. The acetabulum is large with sharp supraacetabular fossa. The femur shows similar features to those in No. 1 and No. 2 skeletons, but the pilaster formation and other muscle markings are weak due to its younger age (Table 5). The tibia has a straight shaft with moderate flatness. The anterior margin is round. On the posterior surface, the vertical ridge is projected high. By this, the cross-section is somewhat rhombic. The fibula is thick and the muscle reliefs are strong.

Summary of Comparative Analyses

Skull as a whole

It is well known that the Jomon skeletons have lower but larger skull vault (cranial modules) than those of the recent ones (Table 1). The present Minamitsubo skull vaults match well to the Jomon standard in size, but apart from the standard in shape (Fig. 1). That is, they are high and narrow, especially in No. 2 skull, which is much higher and narrower than the recent mean.

Generally, the Jomon faces are wider, lower and project more anteriorlly when compared to the recent Japanese faces (Fig. 1). As is true for the present skulls. But the No. 2 skull is extreme in this character. This peculiar proportion of the face was made up by the shape of each facial element; not only the orbita and the nasal aperture are low and wide, but the maxilla and the mandible including dental archades are low, wide and situated anteriorly, which provide a suitable space in the oral cavity.

On the overall proportion, No. 1 skull should be fit to the typical Jomon skulls, but No. 2 skull has contradictory characters, i.e. the vault is too progressive (high) and the face is too primitive (low).

Supraorbital region

Many authors described that in the Jomon skulls the glabellar swelling and the adjacent supraciliary arch were strong, but the supraorbital region was moderately developed. In the present Minamitsubo No. 1 and 2 skulls, not only the glabella and the supraciliary arch is prominent but the superior margin of the orbita is thick, round and the supraorbital triangle is situated anteriorly to the frontal squama. There is no clear supraorbital groove between the margin and the triangle. Thus, a continuous prominent area is seen above the orbita, although it is much lower than the supraorbital torus of the Neanderthals (TOLDT, 1914). In the Japanese specimens these types of supraorbital projection sometimes occur in the Jomon age but quite rare in the later ages.

Facial flatness

According to YAMAGUCHI (1980), the Jomon crania are flat in the frontal and zygomaxillary regions and considerably protruding in the nasal region, while the recent Japanese crania are flat in the whole face (Table 6). The Minamitsubo No. 1 and No. 2 specimens do not differ much from the other Jomon and recent crania in the frontal and zygomaxillary regions, but they show contrasting features in the nasal region. That is, No. 1 has a high simotic index being above the Jomon mean, while No. 2 has a low index which is less than the recent mean.

If only the simotic index is taken into account, No. 2 crania is quite different from Jomon crania. But when compared the simotic chord and subtense, No. 2 crania exhibits typical Jomon characters in having both high values. All in all, with respect

to the structure of nasal region, No. 1 and No. 2 crania are distinguishable from the recent crania, which have narrow and low nasal bones.

Stature, limb segment proportion

HIRAMOTO (1972) reported a secular change of estimated stature of Japanese by FUJII's (1960) regression equation using femoral length. The authors estimated the statures of Minamitsubo No. 1, 2 and 3 individuals by this method, to be 155.9 cm, 158.8 cm and 158.6 cm respectively. The statures of No. 2 and 3 are almost equal to the Jomon mean, but the stature of No. 1 is considerably lower than the Jomon mean and matches that of the Early Modern mean.

OKAMOTO & SEKI (1930) suggested that the Jomon people had relatively longer distal segments, i.e. their radio-humeral and tibio-femoral indices are higher than those of the recent Japanese (Table 7). Both No. 1 and No. 2 skeletons show Jomon character in this respect. However, No. 1 has even relatively longer tibia than in usual Jomon skeletons.

Table 6. Comparisons of facial flatness.

Measurements and Indices	Minamitsubo		Jomon (YAMAGUCHI, 1980)			Recent Japanese (YAMAGUCHI, 1980)		
	No. 1	No. 2	*N*	*M*	S.D.	*N*	*M*	S.D.
FRONTAL								
Chord	100	107	28	99.6	3.3	86	97.8	4.3
Subtense	14.5	19	28	16.4	2.4	86	16.3	2.1
Index	14.5	17.5	28	16.5	2.4	86	16.7	1.9
SIMOTIC								
Chord	7.5	13.7	16	10.2	1.8	86	7.2	1.9
Subtense	3.9	4.7	16	4.6	0.8	86	2.7	1.0
Index	52	34	16	45.5	8.2	86	38.7	12.8
ZYGOMAXILLARY								
Chord	105	—	11	102.8	6.0	83	97.9	5.2
Subtense	21	—	11	22.9	3.2	83	23.6	2.9
Index	20	—	11	22.2	2.9	83	24.1	3.0

Table 7. Comparisons of proportions in male limb bones.

Proportions	Jomon Minamitsubo			Jomon Sanganji* (BABA, 1988)	Recent Kanto* (Tables 4, 5)
	No. 1	No. 2	No. 3		
RADIUS max. length /	L	R		R+L	R
HUMERUS max. length	80.2	77.3	—	79.4	76.1
TIBIA max. length /	R	L		R+L	R
FEMUR max. length	85.9	80.5	—	81.0	78.9
FIBULA circum. mid. /	R	R	R	R+L	R
TIBIA circum. mid.	58.8	64.1	68.8	64.9	55.4

*: The indices of Sanganji and Kanto are calculated by the means.

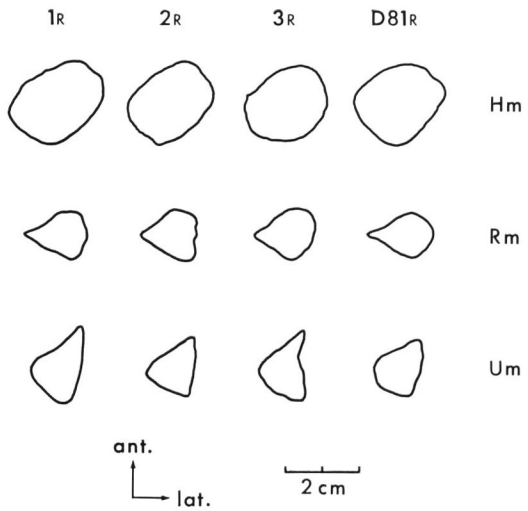

Fig. 15. Cross-sections of upper limb bones. Left to right: Minamitsubo No. 1, 2, 3, and recent Japanese (D81). Top to bottom: Mid-shafts of humerus (Hm), radius (Rm), ulna (Um).

Cross-section of limb bone shafts

It has been noticed that most Jomon limb bones show peculiar shape in the contour of cross-section. In the humerus, the contour at mid-shaft is rectangular having low cross-sectional index. This is true in Minamitsubo No. 1 and 2 humeri, but No. 3 humerus resembles recent humeri in this respect, which usually have a round cross-section (Fig. 15).

It is said that there is no significant difference in the cross-sections of radii between Jomon and recent specimens. However, No. 2 and 3 radii apart from not only recent but Jomon specimens in this respect, because of large sagittal diameters relative to transverse diameters. Jomon ulnae are characterized by their high interosseus margins with wide dorsal (posterior) surfaces. No. 1 and 3 specimens possess typical Jomon feature in this respect, but No. 2 specimen closes to the recent specimen in this character, which appears in the cross-section in Fig. 15.

Usually, the Jomon femora have well-developed pilaster as in No. 1 skeleton. However, the pilaster is moderate in No. 2 skeleton and slight in No. 3 skeleton, which might be due to their young age (Fig. 16). The cross-section index at mid-shaft, being partly related to the development of the pilaster, are high in No. 1 and 3 as in other Jomon femora but low in No. 2, which is similar to that of recent femora.

Most Jomon tibiae have the vertical lines on the posterior surface which divide the attachments of the digitorum longus and the tibialis posterior. By this the contour of cross-section of mid-shaft is, in some degree, rhombic and shows clear difference from a triangular contour in the recent tibiae. The present three specimens

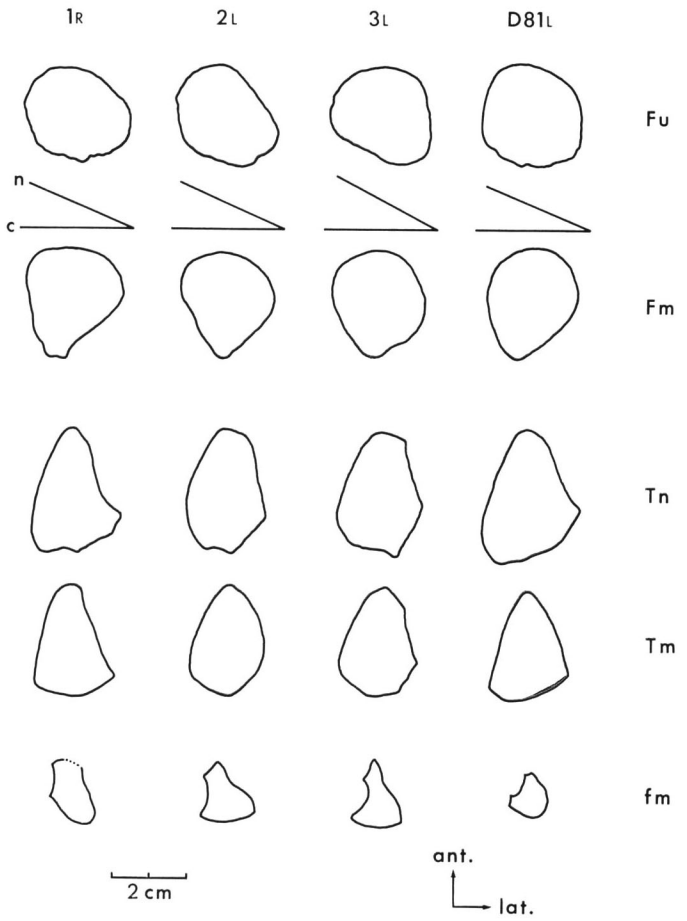

Fig. 16. Cross-sections of lower limb bones. Left to right: Minamitsubo No. 1, 2, 3, and recent Japanese (D81). Top to bottom: Upper shaft of femur (Fu), neck-condylar angle (n–c), mid-shaft of femur (Fm), level of nutrient foramen of tibia (Tn), midshaft of tibia (Tm), midshaft of fibula (fm).

exhibit typical Jomon features in this respect, though the degree is rather moderate. Many authors have suggested that the Jomon tibiae are flatter transversely than the recent ones. This is also true for the present tibiae.

The most clearly distinguishable character between Jomon and recent postcranial skeletons is so-called megaperonia in Jomon fibulae. That is, compared to the recent fibulae, the Jomon fibulae are remarkably thick, transversely flat, and possess strong muscle reliefs. In this character, the Minamitsubo three fibulae are of Jomon type and show sharp contrast to that of recent fibulae (Fig. 16).

Table 8. Measurements of Minamitsubo 1, 2, and 3: CRANIUM.

No., MARTIN (1928)		Minamitsubo		
		No. 1	No. 2	No. 3
1	Maximum cranial length	181	188	—
2a	Nasion-inion length	—	170	—
5	Naso-basilar length	105	110	—
7	Length of foramen magnum	32	—	—
8	Max. cranial breadth	139	136	—
9	Min. frontal breadth	97	103	—
10	Max. frontal breadth	118	119	—
11	Biauricular breadth	126	120	—
12	Max. occip. breadth	113	94	—
13	Bimast. breadth	(107)	(98)	—
14	Min. cranial breadth	67	—	—
14a	Ant. breadth of cranial base	85	87	—
16	Breadth of foramen magnum	29	(30)	—
17	Basi-bregmatic height	141	141	—
18	Whole cranial height	145	144	—
18(1)	Total cranial height	141	—	—
20	Auriculo-bregmatic height	116	117	—
21	Vert. cranial height	123	122	—
22	Calotte height	—	120	—
23	Horiz. circumference	520	527	—
24	Transv. arc	312	320	—
25	Medio-sagit. arc	373	378	—
26	Frontal arc	130	125	—
27	Parietal arc	129	130	—
28	Occipital arc	110	(123)	—
28(1)	Lambda-inion arc	((100))	88	—
29	Frontal chord	112	111	—
30	Parietal chord	113	116	—
31	Occipital chord	100	105	—
31(1)	Lambda-inion length	—	81	—
32(1)	Nasion-bregma angle	—	65°	—
32(1a)	Frontal inclination	61°	55°	—
32(5)	Frontal curvature angle	130°	136°	—
33(1)	Lambda-inion angle	—	70°	—
34	Inclinat. of foramen magnum	8°+	—	—
37	Calotte base angle	7°	10°	—
40	Basi-alveol. length	102	((114))	—
41	Ektokonchion-porion length	71	(74)	—
42	Basi-menton length	117	(113)	—
43	Upper facial breadth	108	112	—
44	Biorbital breadth	101	105	—
46	Middle facial breadth	104	((106))	—
47	Total facial height	119	110	—
48	Upper facial height	67	(64)	—
50	Ant. interorbit. breadth	20	26	—

Table 8. (Continued)

No., MARTIN (1928)		Minamitsubo		
		No. 1	No. 2	No. 3
51	Orbital breadth	41	41*	—
52	Orbital height	32	27*	—
54	Nasal breadth	27	((30))	—
55	Nasal height	49	44	—
55(1)	Rhinion-nasospinale length	(39)	—	—
56	Nasion-rhinion length	(15)	—	—
57	Min. breadth of nasal bone	7.6	13.5	—
60	Maxillo-alveol. length	51	—	—
61	Maxillo-alveol. breadth	67	—	—
63	Palatal length	42	—	—
64	Palatal height	14	—	—
65	Bicondylar breadth	119	115	—
66	Bigonial breadth	100	99	((100))
67	Bimental breadth	45	47	48
68	Mandibular length	72	71	((70))
69	Symphysial length	34	32	30
70	Height of ascending ramus	65	63	62*
70(1)	Ant. height of mandibular ramus	63	63	62
70(2)	Least height of mand. ramus	52	53	(49)
70(3)	Height of inc. mandible	15	14	13
71	Breadth of ascending ramus	37	34	32
71(a)	Least breadth of mandib. ramus	34	33	32
71(1)	Breadth of mandibular notch	37	38	33
72	Total facial angle	83°	((77°))	—
73	Nasal profile angle	(87°)	—	—
74	Alveolar profile angle	(81°)	—	—
78	Sagit. inclin. of orbital plane	85°	80°	—
79	Gonial angle	122°	130°	129°*
79(1b)	Mandibular profile angle	85°	80°	73°
79(4)	Angle of mandibular base	56°	51°	—
80(1)	Breadth of upper dental arch	67	—	((52))
80(a)	Length of lower dental arch	52	—	46
80(1)a	Breadth of lower dental arch	72	(66)	71
80(2)	Upper dental length	—	—	40
80(2)a	Lower dental length	49	43	44

Measurements were taken on the right side, however * mark indicates that measurement was taken on the left side.

Table 9. Measurements of Minamitsubo 1, 2, and 3: upper limb bones.

No., MARTIN (1928)		Minamitsubo					
		No. 1		No. 2		No. 3	
		R	L	R	L	R	L
CLAVICLE							
1	Maximum length	150	—	—	—	—	—
4	Vertical diam. of mid-shaft	10	11	10	10	10	10
5	Sagittal diam. of mid-shaft	14	13	15	15	15	(14)
6	Circumference of mid-shaft	40	39	42	42	45	42
SCAPULA							
12	Length of glenoid cavity	—	—	36	—	(33)	(32)
13	Width of glenoid cavity	—	—	25	—	24	—
13a	Distance of glenoid cavity	—	22	23	22	19	19
14a	Acromio-glenoidal depth	—	—	(5)	—	—	3.4
HUMERUS							
1	Maximum length	—	293	300	—	—	—
2	Total length	295	291	294	—	—	—
3	Upper epiphysial width	46	—	48	—	—	—
4a	Max. bicondylar width	—	58	61	62	(56)	—
5	Max. diam. of mid-shaft	27	26	24	(24)	24	23
6	Min. diam. of mid-shaft	18	18	17	17	17	17
6b	Transv. diam. of mid-shaft	24	22	23	23	20	22
6c	Sagit. diam. of mid-shaft	24	23	23	23	23	22
7	Least circumf. of shaft	67	67	65	65	66	65
7a	Circumf. of mid-shaft	74	70	70	70	69	67
9	Transv. diam. of head	—	—	42	—	—	—
10	Sagit. diam. of head	—	—	45	—	—	—
11	Width of trochlea	—	—	20	20	(21)	(20)
14	Width of olecranon fossa	27	27	27	28	28	27
15	Depth of olecranon fossa	14	15	15	16	11	12
16	Condyle-shaft angle	—	86°	80°	82°	—	—
17	Head-shaft angle	47°	47°	40°	—	—	—
17a	Sagit. vend. ang. of shaft	174°	175°	172°	171°	174°	176°
18	Torsion angle	—	—	147°	—	—	—
18b	Sagit. curvature of shaft	2.9	2.4	1.9	2.1	3.9	3
ULNA							
1	Maximum length	250	246	—	—	—	—
2	Physiological length	222	216	223	—	—	—
3	Least circum. of shaft	40	40	39	—	37	—
4	Max. height of curvature	—	197	201	—	—	—
5	Height of olecranon cap	55	53	48	47	51	52
6	Width of olecranon	—	—	(25)	25	—	—
7	D-V diam. of olecranon	—	—	29	30	25	—
8	Height of olecranon	22	20	22	22	22	—
9	A. width of ra. art. surface	—	—	8.3	(7.7)	(9)	—
10	P. width of ra. art. surface	—	16	15	15	(14)	—
11	D-V diam. of shaft	15	15	13	14	15	15
12	Transv. diam. of shaft	17	18	16	16	18	17

Table 9. (Continued)

No., MARTIN (1928)		Minamitsubo					
		No. 1		No. 2		No. 3	
		R	L	R	L	R	L
13	Upper transv. diam. of shaft	20	22	18	19	18	17
14	Upper D-V diam. of shaft	(26)	27	23	24	25	—
	Height of shaft curv. (h)	—	10	6	—	—	—
	Index of shaft curv. (h/a)	—	5.1	3	—	—	—
RADIUS							
1	Maximum length	236	235	232	—	—	—
2	Functional length	220	221	219	—	—	—
3	Least circumference	45	45	42	—	45	—
4	Transv. diam. of shaft	19	18	((15))	—	(16)	—
4a	Transv. diam of mid-shaft	16	17	15	—	16	—
4(1)	Transv. diam. of capit.	—	—	22	—	—	—
5	D-V diam. of shaft	12	12	13	—	(13.5)	—
5a	D-V diam. of neck	12	13	(15)	—	14	—
5(1)	D-V diam. of capit.	—	24	—	—	—	—
5(5)	Circumference of mid-shaft	47	47	45	—	49	—
5(6)	Width of lower epiph.	35	—	30	—	—	—
6	Height of curvature (a)	180	176	170	—	182	—
7	Neck-shaft angle	170°	170°	164°	—	162°	—
	Height of shaft curva. (h)	4	5	3	—	4	—
	Index of shaft curva. (h/a)	2	3	2	—	2	—

Table 10. Measurements of Minamitsubo 1, 2, and 3: lower limb bones.

No., MARTIN (1928)		Minamitsubo					
		No. 1		No. 2		No. 3	
		R	L	R	L	R	L
FEMUR							
1	Maximum length	409	408	—	421	(418)	420
2	Physiological length	405	407	—	419	(413)	416
3	Max. trochanter length	394	396	—	403	—	409
4	Physio. trochanter length	385	390	—	394	—	399
5	Shaft length	329	332	—	335	—	341
6	Sagit. diam. of mid-shaft	31	31	27	28	28	27
7	Transv. diam. of mid-shaft	26	27	26	26	24	25
8	Circumference of mid-shaft	88	91	85	85	84	84
9a	Transv. diam. upper of shaft	30	29	29	29	31	31
10a	Sagit. diam. upper of shaft	24	25	25	25	(22)	24
13	Upper width	87	89	—	90	—	85
15	Vert. diam. of neck	31	31	33	33	—	34
16	Sagit. diam. of neck	27	27	28	28	—	24
18	Vert. diam. of head	—	46	—	—	—	44
19	Transv. diam. of head	45	45	—	46	—	(44)
21	Biepicondylar width	77	78	80	—	—	77
21a	Ant. pr. width of m. cond.	41	44	43	—	—	48
21b	Ant. breadth of f. cond.	36	31	38	(36)	—	32
21c	Post. width of med. cond.	26	26	—	—	—	—
21d	Width of intercond. fossa	19	20	19	19	—	20
21e	Post. width of lat. cond.	—	—	—	—	—	19
23	Max. length of lat. cond.	55	(52)	60	60	—	55
24	Proj. length of med. cond.	58	57	—	—	—	—
25	Post. height of lat. cond.	35	—	—	34	—	34
26	Post. height of med. cond.	38	38	—	36	(36)	36
27	Height of curvature (a)	290	303	(304)	308	—	309
28	Torsion angle	25°	20°	—	26°	—	29°
29	Neck-shaft angle	130°	125°	133°	130°	136°	134°
30	Condyle-shaft angle	85°	85°	—	96°	—	98°
	Height of shaft curva. (h)	11	11	(12)	12	—	9
	Index of shaft curva. (h/a)	3.8	3.6	(3.9)	3.9	—	2.9
PATELLA							
1	Maximum height	(40)	42	45	—	(42)	(43)
2	Maximum breadth	42	42	43	—	(44)	(45)
3	Maximum thickness	19	19	19	—	(18)	18
4	Articular height	—	32	31	—	—	29
5	Breadth of medial facet	19	19	21	—	20	20
6	Breadth of lateral facet	28	27	23	—	27	27
TIBIA							
1	Total length	342	342	—	336	—	—
1a	Maximum length	348	347	—	339	—	—
2	Interarticular length	329	328	—	316	—	—
3	Width of upper epiphysis	73	73	—	—	—	73

Table 10. (Continued)

No., Martin (1928)		Minamitsubo					
		No. 1		No. 2		No. 3	
		R	L	R	L	R	L
4	Sagit. diam. at tuberosity	42	42	43	42	45	45
5	Transv. diam. at tuberosity	34	34	33	34	—	—
6	Width of lower epiphysis	52	(50)	47	46	—	—
7	Sagit. diam. of lower epiph.	(35)	47	38	39	—	—
8	Max. diam. of mid-shaft	30	31	29	29	29	29
8a	Max. diam. at nut. foram.	32	32	33	33	33	34
9	Transv. diam. of mid-shaft	22	22	19	19	21	20
9a	Transv. diam. at nut. foram.	24	25	22	22	21	21
10	Circumf. of mid-shaft	85	85	78	79	80	80
10a	Circumf. at nut. foram.	92	93	88	88	88	89
10b	Min. circumf. of shaft	75	75	76	75	—	—
13	Inclination angle	15°	17°	—	14°	—	—
14	Torsion angle	+26°	+27°	—	+6°	—	—
FIBULA							
1	Maximum length	—	—	330	—	—	—
2	Maximum diam. of mid-shaft	(18)	(16)	16	17	19	18
3	Minimum diam. of mid-shaft	(10)	(11)	14	14	12	13
4	Circumf. pf mid-shaft	50	47	50	49	55	55
4a	Upp. min. circumf. of shaft	42	41	44	43	43	45
	Lower min. circumf. of shaft	37	38	41	40	—	—
4(1)	Width of upper epiph.	—	—	—	—	—	27
4(2)	Width of lower epiph.	18	18	16	—	—	—
TALUS							
1	Length	50	51	52	53	—	—
1a	Maximum length	54	55	57	—	—	—
2	Width	(43)	(43)	44	44	—	—
2a	Post. oblique width	(41)	(41)	41	41	—	—
2b	Max. width of trochlea	46	46	50	49	—	—
3	Height (troch. canal)	29	29	30	30	—	—
3b	Thickness of body	24	24	25	25	—	—
3(1)	Height (medial)	30	31	32	32	—	—
4	Length of trochlea	31	32	30	30	—	—
5	Width of trochlea	31	30	30	31	—	—
5(1)	Post. width of trochlea	26	26	27	28	—	—
5(2)	Ant. width of trochlea	31	—	32	34	—	—
6	Height of trochlea	9	9	8.4	8	—	—
7	T. width of 1. mall. facet	22	23	26	28	—	—
7a	P. width of 1. mall. facet	21	21	24	25	—	—
8	Length of head and neck	21	21	22	21	—	—
9	Length of head facet	33	—	33	33	—	—
10	Width of head facet	21	—	22	22	—	—
11	Height of head facet	15	—	(15)	(16)	—	—
12	Length of post. cal. facet	—	31	32	33	—	—
13	Width of post. cal. facet	21.7	21	22	22	—	—

Table 10. (Continued)

No., MARTIN (1928)		Minamitsubo					
		No. 1		No. 2		No. 3	
		R	L	R	L	R	L
13a	M. width of po. cal. facet	20	20	22	21	—	—
14	Depth of post. cal. facet	—	7.8	7	7.3	—	—
15	Angle of post. cal. facet	47°	45°	55°	51°	—	—
16	Neck-body angle	28°	29°	7°	9°	—	—
17	Torsion angle of head (t.)	35°	—	45°	49°	—	—
17a	Torsion angle of head (i.)	36°	—	27°	30°	—	—
CALCANEUS							
1	Maximum length	76	76	78	—	—	—
1a	Total length	69	69	74	—	—	—
2	Middle width	41	41	41	43	—	—
3	Minimum width	25	27	—	—	—	—
4	Height	38	37	40	—	—	—
5	Length of the body	52	50	55	—	—	—
6	Width of sustentaculum	15	15	18	17	—	—
7	Height of calcaneal tuber	(40)	(40)	40	—	—	—
8	Width of calcaneal tuber	—	32	34	—	—	—
9	Length of posterior facet	30	30	30	32	—	—
10	Width of posterior facet	22	22	22	23	—	—
11	Height of posterior facet	6	6	7.5	7	—	—
12	Width of cuboid facet	27	—	—	26	—	—
13	Height of cuboid facet	25	—	—	—	—	—
14	Angle of posterior facet	53°	52°	47°	—	—	—
15	Taluso-calcaneal angle	5°	7°	10°	—	—	—

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