

Early Jomon Female Skull from Enshoji, Urawa City, Eastern Japan

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Abstract A female skull of Early Jomon period was excavated from Enshoji, Urawa City, Eastern Japan. Basic descriptions, measurements, and comparisons with other female Jomon and recent skulls were made. The skull revealed typical Jomon features, *i.e.*, a low skull vault, deep temporal fossae, a prominent glabella, a low and wide face, projected nasals, square-shaped orbits, and small teeth with marked wear. The face of the skull was reconstructed by sculptors under the supervision of the author. Collagen from the skull bone provided material for mitochondrial DNA sequence analysis, C^{14} dating by the AMS method, and food resource analysis by stable isotope ratios.

Introduction

Jomon period (ca. 11,000–300 B. C.) is usually referred to as Neolithic because the Jomon people had ceramics. However, they were hunter-gatherers and did not have true agriculture. Therefore, Jomon period is sometimes called Mesolithic. Due to the typology of ceramics, the Jomon period is divided into five phases, *i. e.*, Earliest, Early, Middle, Late, and Final. Most of their skeletons were found from burials in shell-mounds near the coast.

In general, compared to a contemporary skull, the Jomon skull vault and face are low, wide, and long (BABA *et al.* 1989, YAMAGUCHI 1992). The temporal fossae are deep suggesting the presence of thick temporalis muscles. The orbital openings are low and rectangular. The glabella is prominent, and the nasion is depressed. The nasal bones are projected and straight in profile. The alveolar processes are low but well developed and show little alveolar prognathism. The teeth are small, so-called Sunda-donty. The bite is edge-to-edge.

Taken together, Jomon people retained a number of archaic characters that were shared by Eurasian Upper Paleolithic hunter-gatherers (YAMAGUCHI 1992). Jomon people are considered to be descendants of the Late Pleistocene Minatogawa Man found on Okinawa Island (SUZUKI 1982, BABA & NARASAKI 1991).

Materials and Methods

In 1988, during the construction of a park in Enshoji, Urawa City, in Eastern

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Japan, a skull was found from a four meters deep sandish layer containing shells (OGURA 1990). The provenance of the skull was not clear because no artificial remain was found with it. However, a thick intact soil formation above the skull suggested it was derived from Jomon period. Later, C¹⁴ dating revealed that the skull was of the Early Jomon period, which will be mentioned below.

The skull was stored in the Urawa Municipal Museum and a short report on the morphology was published previously from the museum (BABA 1990). The skull is relatively complete, but it lacks most of the cranial base, the left lateral part of the face, and the mandible (Fig. 1). In some parts, the outer surfaces were weathered and lost. The bone is hard and well preserved.

Measurements were made according to the MARTIN's method (BRÄUER 1988, BABA 1991). Facial flatness was measured according to YAMAGUCHI (1973). The results of the measurements were compared with those of the other Jomon and recent Japanese females.

Sex and Age

The skull as a whole is small, the supraorbital region is moderately developed, and the mastoid process is low and narrow. Consequently, this individual must be female. The cranial sutures are almost closed in the inner table but still open in the outer table. The teeth were worn considerably (BROCA IV-V). These facts suggest she entered her middle age.

Description and Measurements

Neurocranium

The skull vault is long, wide and low, fitting well with the features seen in Jomon females. The thickness of the vault wall is 6 mm at bregma and 5 mm at lambda. Superiorly, the vault outline is ovoid with slight projection of the parietal and frontal tubercles (Fig. 1). The cranial index is 81 (brachycrany), which is comparable to the means of Early Jomon and recent Japanese females (Tables 1, 2). The sutures are rather complex, as is not the usual cases in Jomon skulls. However, no extra suture bone is seen. There is no parietal foramen.

Posteriorly, the vault outline is round with a narrow cranial base. The auriculo-bregmatic-height-width index is 78, which fits well to the mean of the Early Jomon females. The area of the external occipital protuberance is not preserved.

Laterally, the vault outline is rectangular in shape. That is, it exhibits a long flat superior line from the relatively projected metopion to the vertex (Fig. 2). The eminence of the glabella is moderate but distinct, as is the usual cases of Jomon females and not the case of recent females. The occipital bun is not present, as is usual for Jomon skulls. The temporal line is well developed, running obliquely (not circular as in recent ones) in the anterior portion making a sharp and thick crest (2 cm long),

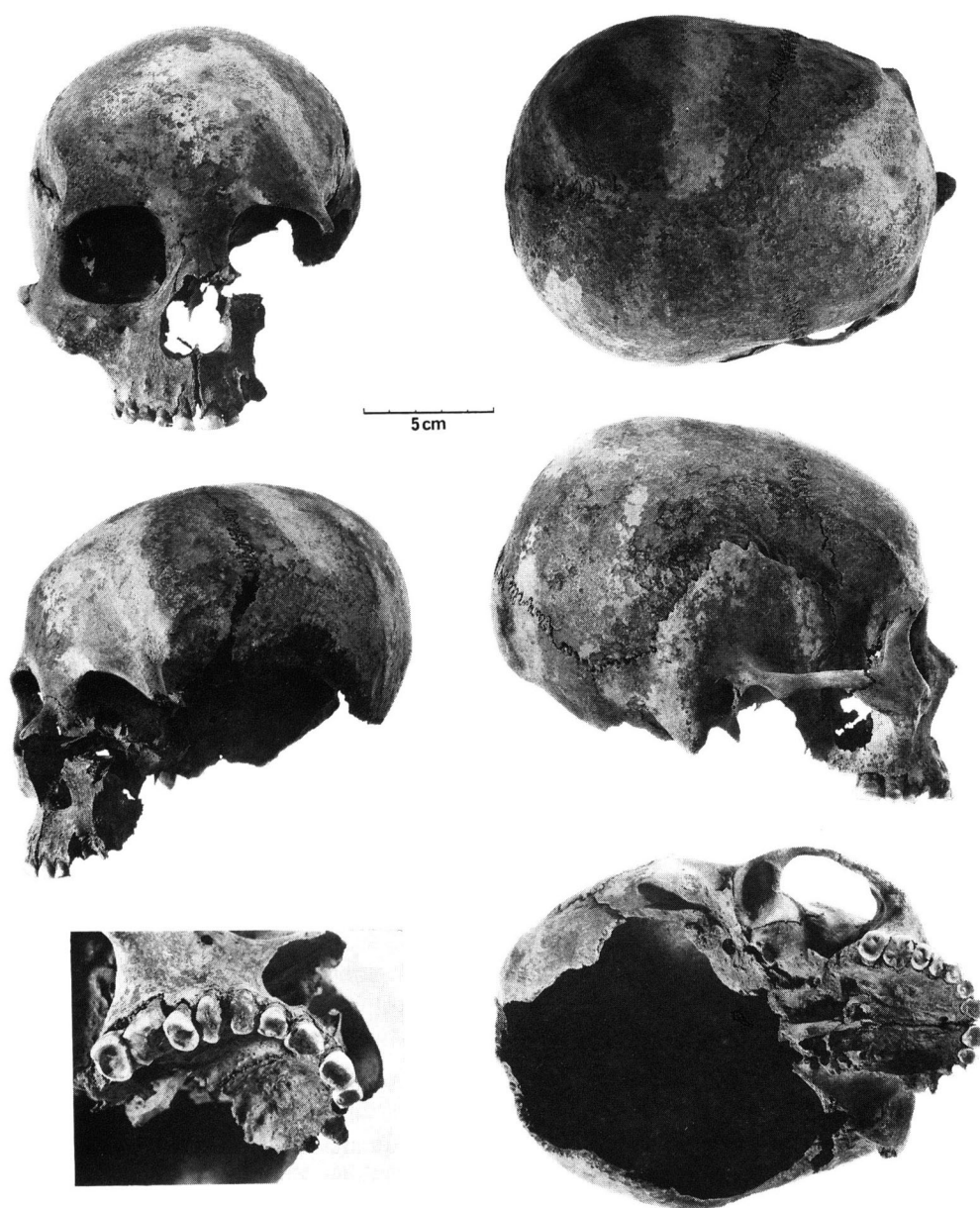


Fig. 1. Five views of the Enshoji Jomon female skull and close up of the teeth. Note abnormal wear in C and P3, and breakage in M1.

Table 1. Measurements of Enshoji Jomon Female Skull

Item with Martin's No.			Item with Martin's No.		
1	Max. l.	(175)	41	Lat. fac. l.	68
3	G-l l.	171	41b	Low. mal. l.	30
3a	N-l l.	171	41c	Max. mal. l.	47
4a	Max. temp. l.	87	41d	Malar subt.	7.5
4b	Max. squam. l.	70	43	Out. biorb. b.	102
4c	Max. mast. l.	42	44	Biorb. b.	(94)
8	Max. b.	141	45	Bizygom. b.	(136)
9	Min. fr. b.	(94)	46	Bimax. b.	(96)
10	Max. fr. b.	118	48	Up. fac. h.	65
10b	Steph. b.	118	48d	Malar h.	23
11	Biaur. b.	(130)	49a	Int. orb. b.	22
11b	Radic. b.	(126)	51	Orb. b.	40
12	Max. occ. b.	99	52	Orb. h.	34
13a	Mast. b.	11	54	Nasal b.	26
14	Min. cr. b.	(31)	55	Nasal h.	45
19a	Mastoid h.	27	56	Nas. bone l.	20
19b	Mas. reg. h.	36	57	Min. nas. b. b.	9
19c	Max. temp. h.	77	57a	Simotic subt.	3.2
19d	Max. squam. h.	50	57 (1)	Max. nas. b. b.	14
20	Aur.-br. b.	104	57 (2)	Up. nas. b. b.	11
20 (1)	Max. aur. b.	106	60	Max. -alv. l.	47
21	Aur. h.	104	61	Max. -alv. b.	(58)
23	Hor. circ.	505	61 (2)	Ant. ma. -al. b.	(42)
24	Trans. circ.	(306)	63	Palate b.	(37)
26	Fr. arc	122	64	Palate h.	(12)
27	Par. arc	117	72	Prof. angle	80°
29	Fr. chord	107	73	Nas. prf. angle	85°
29b	Fr. subt.	25	74	Alv. prf. angle	64°
29c	Subt. frac.	44	75	Nas. roof angle	47°
30	Par. chord	106			
30a	Par. subt.	21			
30b	Subt. frac.	61			
	Mast. notch b.	7			

it is not visible in the posterior portion because of post-mortem damage.

The supramastoid crest is not distinct, but the anterior supramastoid tubercle is present near the parietal notch. The temporal squama is relatively high and long anteriorly, narrowing the greater wing of the sphenoid bone. The squama is triangular in shape, having an apex in the middle, slightly posterior. Anterior to this apex, the superior border of the squama is thick and rounded. Posterior to this apex, the squamous suture is straight and inclines sharply downward.

The temporal fossa is very deep in the antero-inferior part, near the zygomatic arch, showing a *mons temporosphenoidalis*, but shallow in the superior part, near the temporal line, having an inferior frontal eminence (*c.f.* De VILLIERS 1968). So, the

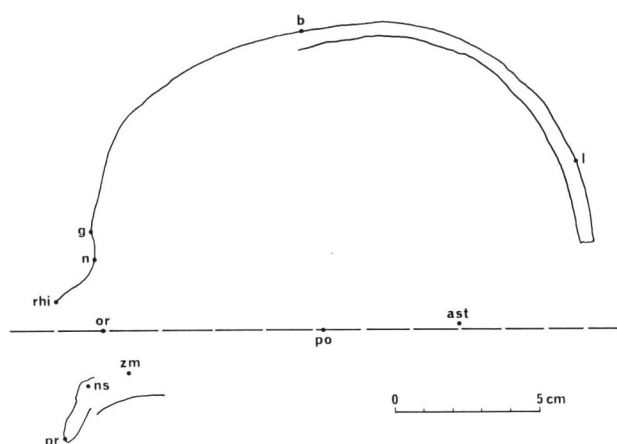


Fig. 2. Median sagittal outline of the Enshoji skull.

postorbital constriction is not marked, for all the development of the fossae. The pterion is H-shaped. The zygomatic arch is straight and rather narrow in side view, but is thick at the mandibular fossa, this is not seen in recent female skulls. The external auditory meatus is small and ellipsoid, inclining slightly anteriorly, with no exostosis. The suprameatal spine is not present. The mastoid process is small, as is the typical case of contemporary females. The mastoid foramen is not visible.

Inferiorly, although most of the cranial base was lost, the right mastoid and petrous regions are intact. The mastoid process is short and narrow. Medial to it is a wide mastoid notch. The mandibular fossa is rather deep and the articular surface extends anteriorly, indicating wide masticative movement. The zygomatic arch is rather thin but is set far aside to the cranial wall, having a deep infratemporal fossa.

Facial Skeleton

The overall size and shape of the face fit well to the features of Jomon females; lower, wider and (presumably) longer than those of recent females (Table 2). Viewed laterally, the facial projection is moderate having a profile angle of 80° .

In frontal aspect, the supraorbital region is well developed for a female, the glabella projects moderately, the zygomatic process of the frontal is set anteriorly forming a weak supraorbital trigon. However, the supraorbital margin is thin as in contemporary females. The impression of the supraorbital nerve, not the foramen, but the narrow notch is seen in both sides. The orbit is high for a Jomon female, comparable to those of recent females, and almost square in shape. Its superior border slopes slightly laterally and its inferior border slopes slightly medially. Consequently, its transvers axis is horizontal, showing marked contrast to those of recent skulls, in which the axis inclines laterally to a considerable degree. No *cribra orbitalia* is seen.

Table 2. Comparison of Jomon Female Skull Measurements

Item with Martin's No. (sample size)	Earliest-Early			Jomon EEJM (6-8)	M-L-F Sangan (1)	Jomon MLFJM (24)	Recent Kanto (82)
	Ensho (1)	Yukura (1)	Tochi (1)				
1 Max. l.	(175)	169	187	177	176	177	171
8 Max. b.	141	137	138	137	132	141	136
8/1	81	81	75	77	75	80	80
9 Min. f. b.	(94)	99	93	91	95	97	91
10 Max. f. b.	118	122	109	116	114	119	112
9/8	67	72	67	67	72	69	67
20 Aur.-b. h.	(104)	113	123	108	(98)	110	114
20/1	(59)	69	66	61	56	63	67
20/8	(74)	82	89	79	74	79	84
23 Hor. cir.	505	505	505	502	500	507	494
24 Tra. cir.	(306)	308	302	305	295	309	313
43 Biorb. b.	102	103	103	103	106	107	100
45 Bizyg. b.	(136)	(127)	125	130	(129)	134	125
46 Bimax. B.	(96)	93	—	99	92	98	94
48 Up. f. h.	65	66	—	60	65	64	67
48/45	(48)	(52)	—	47	50	48	54
48/46	(68)	71	—	60	71	66	72
51 Orb. b.	40	41	—	41	40	39	41
52 Orb. h.	34	33	—	31	31	33	34
52/51	85	81	—	77	78	84	82
54 Nas. b.	26	26	—	24	27	25	24.5
55 Nas. h.	45	48	—	43	50	46	49
54/55	58	54	—	66	54	54	50

Yukura, Morimoto (1986); Tochi (Tochibara), Suzuki (1968) and Morimoto & Takahashi (1986); EEJM (Earliest-Early Jomon Mean) and MLFJM (Middle-Late-Fiinal Jomon Mean), Ogata (1981); Kanto, Morita (1950); Ensho (Enshoji) and Sangan (Sanganji 25), present author.

The supra-nasal vestige of metopic suture is not present. The nasion is not depressed and the lateral profile from the glabella to the nasal roof is smooth. However, the nasal bone is wide and projects steeply upward, which is marked even for a Jomon female. The frontal process of the maxilla sits almost sagittally and supports the projected nasal bone, which is different from the recent feature. The nasal aperture is medium-sized and rather wide in proportion. There is a distinct sill in the lower margin.

The zygomatic bone is wide and faces anteriorly, showing typical mongoloid feature. Inferiorly, the attachment of the masseter is wide. It slopes straight downward from the temporozygomatic suture to the zygomaticomaxillary tubercle, characteristic of Jomon skulls. The infrazygomatic (zygomaticomaxillary) crest is thick, runs obliquely, and spreads widely onto the maxilla. Neither the infrazygomaxillary notch nor canine fossa is seen. The palate is small and shallow, with slight alveolar prognathism.

Dentition

Status of the dentition:

L	7	6	5	4	3	2	1		1	2	S	S	S	S	N	N
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L=socket closed; tooth lost ante-mortem or agenesis

S=socket present but tooth missing post-mortem

N=alveolous lost by breakage

The teeth are very small, although the measurements were not done because of heavy attrition. The right M1 crown was partly broken. The right C and P3 have oblique wear facets in the direction of bucco-superior to lingo-inferior (Fig. 1). Artificial tooth extraction, which is common in Jomon males and rather rare in Jomon females, is not seen.

Other Related Results from the Skull

Using collagen isolated from a 2×2 cm piece of the skull bone, the following analyses were made.

Carbon 14 Dating by AMS Method

T. NAKAMURA (1990) estimated the absolute age of the skull at 5790 ± 120 years B. P. by the direct detection of C^{14} using an accelerator mass spectrometer at Nagoya University. This age fits well to the Early phase of Jomon period determined by ceramic typology.

Food Resouce Analysis by Stable Isotope Ratio

H. KOIKE (1990) measured the carbon and nitrogen isotope ratios and suggested that this female had more meat from land mammals than usual Jomon people (KOIKE & CHISHOLM 1991).

Sequence Analysis of Mitochondrial DNA

S. HORAI *et al.* (1989) determined the mtDNA sequence of this individual by restriction enzyme analysis and revealed that the sequence does not fit that of recent Japanese, but does fit the sequence of recent Southeast Asians, which means that the Early Jomon people in Central Japan had a common origin with some of the recent Southeast Asians.

Comparison and Discussion*Secular Change of Female Face in Jomon Age*

According to OGATA (1981), the female face is lower in earlier (Earliest-Early) Jomon than in later (Middle-Late-Final) Jomon, although the sample size is not large (Table 2).

Recently MORIMOTO (1986) reported the face of the Earliest Jomon female skull from Yukura site is as high as those of later Jomon females. The face of the present Enshoji skull is also as high as in the later Jomon skulls. In addition, the author measured and compared the facial height in several earlier and later Jomon female skulls, which revealed the same tendency (BABA, unpublished data). Thus, as far as the available data suggest, there is no significant difference in female facial height between the two phases.

Facial Flatness and Nasal Prominence

According to YAMAGUCHI (1980), Jomon skulls show almost the same degree of flatness as in recent Japanese in frontal and zygomaxillary regions, but show marked prominence in the nasal saddle compared with recent Japanese, *i. e.*, the simotic index is higher in Jomon skulls than in recent ones.

The present specimen indicates typical Jomon features in this respect, except that the zygomaxillary flatness is more marked than in both recent and Jomon skulls, mainly because the palate is not protruded. The nasals project high even for a Jomon female, having a nasal profile angle of 47° (Fig. 2).

Abnormal Tooth Wear

In Jomon skulls, abnormal tooth wear was often reported (SUZUKI 1950, MORIMOTO 1986). In the C and P3 of this specimen there are heavy oblique wear facets and the secondary dentine was formed in the pulp cavity. In addition to this, the mandibular fossa is well-developed and the mastoid notch, to which the digastric muscle attaches, is very wide (7 mm). So, these oblique wear facets were made not only by usual mastication, but by some unknown tool used with the teeth.

Reconstruction of the Face

In order to provide a tangible image of this female, her face was reconstructed by K. YAZAWA and Y. YAZAWA under the supervision of the author. In the first phase, Mr. K. YAZAWA made a replica of the preserved skull from polyester and reconstructed the lost left part of the face by copying the mirror image shape of the right side, using same polyester (Fig. 3). Second, the author selected a mandible which fits well to this replica from the collection of Jomon female skulls housed in the National Science Museum, Tokyo. Third, K. YAZAWA made a replica of the mandible and modified it a little. Thus, a replica of the whole skull was made.

Once the skull replica was complete the fourth phase began. Mr. Y. YAZAWA made masticatory muscles (temporalis and masseter), eye bowls, nasal cartilage, and salivary glands of clay and attached them to the replica (Fig. 4). Fifth, he covered the whole skull with clay and made up the skin checking the thickness at various points. Finally, he reconstructed eyelids as single edged, ears with thick earlobes, and rather thick lips modeling after those of Ainu and Okinawan people, because

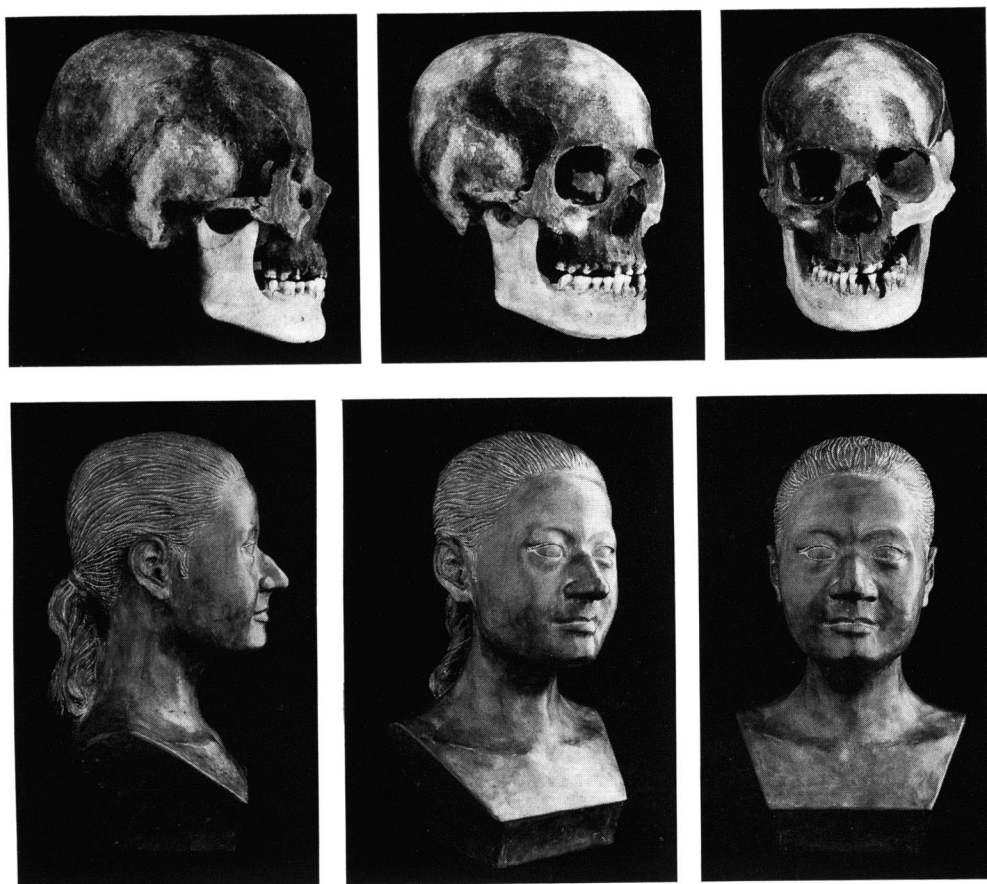


Fig. 3. Reconstructed whole skull and face with bust based on the Enshoji human skull.

recent morphological and genetical data suggest strongly that they are direct descendants of Jomon people (Fig. 3). This reconstructed face and the skull are exhibited in the Urawa Municipal Museum.

Conclusion

The skull from Enshoji, Urawa City is of a middle-aged female having typical Jomon characters such as low and wide vault and face, deep temporal fossae, prominent nasals, square-shaped orbits, small teeth with advanced attrition (edge-to-edge bite), etc. This is the first Jomon skull from which mitochondrial DNA sequence was determined, and of which a direct relationship with recent Southerst Asians was revealed. In addition to this, C^{14} dating by AMS method and food resource analysis by stable isotope ratios were made from its bone. Her face was reconstructed and exhibited in the Urawa Municipal Museum.

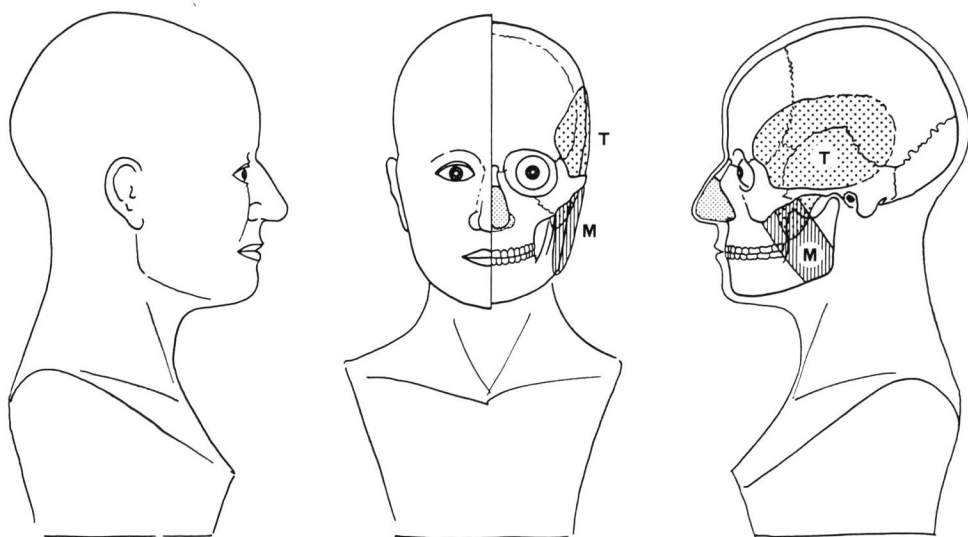


Fig. 4. Process of reconstruction of a Jomon woman face based on the Enshoji skull. T, temporalis muscle; M, masseter muscle.

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