

Human Metacarpal Bone Found at Kuzuu, Northern Kanto, Japan*

By

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Abstract A human metacarpal fragment, probably of Upper Pleistocene age, found in December 1984 at Kuzuu limestone zone, was reported and morphologically described. The fragment was about proximal three-fourth of a right fifth metacarpal. Compared to typical modern metacarpals, it was noticed that the Kuzuu metacarpal had the long basal swelling, the sharp and linear cristae on the body surfaces, and particularly the palmar crista which was increasingly prominent from the middle to the distal part of the body shaft. Some of these characteristics were recognized also in Jomon and even earlier metacarpals, suggesting strong muscle attachments to the body.

The Site

The human metacarpal bone reported here was found in December of 1984, at Kuzuu limestone zone in Tochigi Prefecture, northern Kanto District, eastern Japan. The name Kuzuu is well-known for yielding abundant mammalian and other vertebrate fossil bones. The fossil-bearing deposit, in fissures and caves there, can be divided palaeontologically into the Upper and Lower Kuzuu Formations, which may be correlated to the Upper and Middle Pleistocene, respectively (SHIKAMA, 1949; KAMEI *et al.*, 1988).

Also, several possibly Pleistocene human or human-like bones, including humeral and femoral fragments, were collected in the past at various sites of Kuzuu, by the late Dr. Nobuo NAORA and others. Though some preliminary reports and speculations on them were given (e. g. NAORA, 1952 a, 1952 b), no concrete morphological descriptions nor proper comparative studies of them have yet been done.

The present metacarpal was found by three students, members of the Geology Club of Katsushikano Highschool, Tokyo Metropolitan. According to the finders, they went to Kuzuu and were collecting fossils, at a locus close to the formerly known "femur site" in Maegawara, situated on the outline of a tongue terrace, near the western bank of the Akiyama River, west of Kuzuu Town. There existed a rock wall of limestone, about 10 m high, the slope of which was nearly vertical in the upper part but step-like in the lower part. Many small fossae were formed on the lower surface of the slope, in which small fossils, such as species of *Fusulina*, *Crinoidea*

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and Brachiopoda, were occasionally found with residual clay. The metacarpal was in one of the fossae together with those small fossils. They had probably fallen from above, and stayed there.

As the bone was a surface find, its original horizon could not be determined. But the limestone in Kuzuu region is covered by the thick Kanuma Pumice Bed, consisting of acid volcanic ash deposit, dated $32,000 \pm 4,000 \sim 31,000 \pm 8,000$ yr BP (KAMEI *et al.*, 1988; KAWAMURA, 1988), which is not suitable for bone preservation. Therefore, the original horizon was probably not much upper than the base of Kanuma Bed, corresponding to a date of Upper Pleistocene. Nevertheless, possibility cannot be totally neglected that the bone is more recent one, without rigid evidences for dating it available.

Observation and Comparison

Morphological Elements of the Fifth Metacarpal

General morphology of the modern ordinary fifth metacarpal is referable to current textbooks of anatomy. As the Kuzuu specimen lacks its distal one-fourth, some morphological elements of importance in the proximal part (basis) and shaft (body) of the fifth metacarpal, such as muscle attachments and articulations with other bones, are illustrated in Fig. 1, for the sake of consideration.

The proximal part of the bone, which is swelling bilaterally and palmarly in particular, has two articular facets, facing to the *Os hamatum* proximally and to the *Os metacarpale IV* radially. This part also has an ulnar prominence, the *Tuberculum*, which forms insertion of the ulnar carpal extensor muscle.

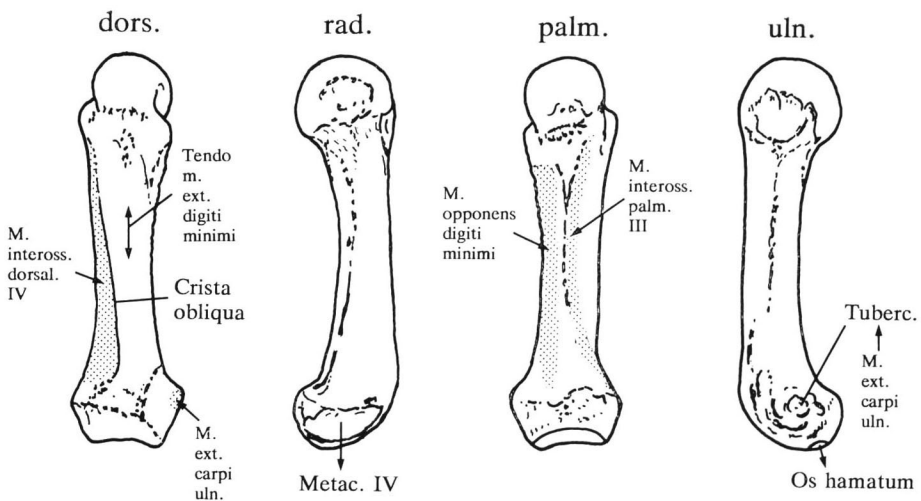


Fig. 1. Illustrations of the fifth metacarpal (*Os metacarpale V*) showing articulations and muscle attachments. Dorsal, radial, palmar and ulnar views.

In dorsal view, the surface of the body is largely divided by the *Crista obliqua*, which borders two areas concerning two muscles: attachment of the fourth dorsal interosseous muscle in the radial side, and course of the tendon of the little finger extensor muscle in the ulnar side. The radial area is relatively narrow, but increases its width to the basal part.

In palmar view, longitudinal attachment areas for the third palmar interosseous muscle and the little finger opponens muscle are present in the radial and ulnar halves of the surface, respectively, with extension of nearly whole length of the body. On the borderline of the two areas, near the central axis of the body surface, a more or less dull crista appears, which is usually clear in the middle to distal part, but tends to be bifurcated and weakend in its distal end.

On the radial and ulnar surfaces of the body, there also exist crista-like ridges, though usually not so marked as the dorsal and palmar ones mentioned above. The radial ridge corresponds to the radial margin of the fourth dorsal interosseous muscle, and the ulnar ridge does to the ulnar margin of the little finger opponens muscle. In most cases of modern fifth metacarpals, the ulnar ridge does not appear with a smooth continuation, but is interrupted or shows irregular fluctuations. This condition may be an indication of some mode of muscle function, such as decreased use of the little finger opponens muscle in modern man.

Features of the Kuzuu Metacarpal

Photographs of the Kuzuu metacarpal in four different views are shown in Figs. 2 and 3, with other four right fifth metacarpals, i. e., specimens of a prehistoric Jomon (Ebishima shell mound), two Early Modern Japanese (Edo, ca. 18 c) and a recent non-Japanese. The latter three samples are chosen to show variety in modern man.

Measurements of Kuzuu metacarpal are taken on diameters of the midshaft and basis, compared in Table 1 with those of some other specimens, including Edo, Ebishima, Minatogawa (Okinawa, ca. 15,000~20,000 yr BP), Amud and Shanidar. The latter two (three specimens) are both Neanderthals from western Asia.

The overall size of the Kuzuu, though the length cannot be measured, seems to be intermediate within the variation of the specimens compared. And so does every diameter of it in Table 1. Only one unique feature noticed on the Kuzuu is that the dorso-palmar diameter of the midshaft exceeds the transverse diameter, the condition which is not observed in all other specimens compared here. This is resulted mainly from relative greatness of the dorso-palmar diameter, due to development of the palmar crista.

When results of observations are compared to those of typical modern metacarpals, morphological characteristics of the Kuzuu specimen are recognized on some points. The curvature of the body is relatively strong, particularly in the proximal part of the palmar surface. In dorsal or palmar view, the proximal swelling part is long proximo-distally. This means in the ulnar side the position of *Tuberculum* is relatively apart from the proximal end. The four cristae on the body surfaces are



Fig. 2. Dorsal (top) and radial (bottom) views of right fifth metacarpals compared. Proximal ends orientated downwards.

From left to right: Kuzuu; Jomon, male (Ebishima No. 63); Edo (Early Modern), male (robust specimen); Edo, female (gracile specimen); and recent, male (probably Indian).



Fig. 3. Palmar (top) and ulnar (bottom) views of right fifth metacarpals compared. Proximal ends orientated downwards. Specimens are the same as in Fig. 2.

Table 1. Measurements of the body and basis of fifth metacarpal (mm).

		Midshaft		Basis	
		Dorso-palmar diameter	Transverse diameter	Dorso-palmar diameter	Transverse diameter
Kuzuu	r	7.6	7.4	10.6	13.4
(present study)					
Edo (Early Modern)					
robust specimen, ♂	r	7.7	8.2	(11.2)	14.2
gracile specimen, ♀	r	5.5	6.0	9.7	10.0
Ebishima (Jomon)					
No. 63, ♂	r	7.1	7.6	10.9	12.1
Minatogawa (BABA & ENDO, 1982)					
III, ♀	r	5	6.5	8.5	10.5
J, ♀?	r	5.5	7.5	10	11
Amud I, ♂	l	6.4	8.2	14	15
(ENDO & KIMURA, 1970)					
Shanidar (TRINKAUS, 1983)					
No. 4, ♂	r	7.2	8.1	10.7	11.0
	l	7.5	8.0	12.0	13.0
No. 5, ♂	r	6.0	7.0	8.8	12.9

all well-developed and linear. The *Crista obliqua* on the dorsal surface is marked and fairly oblique. The attachment area of the fourth dorsal interosseous muscle, radial to the crista, is broad especially in the proximal part. Its proximal extension reaches the dorsal surface of the basis, and ends in a shallow depression. This condition is rarely seen in modern metacarpals. The ulnar ridge appears as a distinct crista on the distal half of the body, which is not fluctuated or interrupted as frequently seen among modern metacarpals. The palmar crista increases its prominence distalwards from the middle of the body. The above-mentioned dorso-palmar diameter becomes even greater at the broken end in distal body than at the midshaft.

Some Prehistoric Fifth Metacarpals Compared

To examine morphological affinity of the Kuzuu specimen, characteristics of several prehistoric fifth metacarpals available are summarized as the followings. *Jomon* (Neolithic Japanese)

In my observation, the Jomon metacarpals in general, as typically represented by the specimen of Ebishima No. 63 here, are stout in structure as a whole. The distal part of the body is transversely wide. The body is thick dorso-palmarly not only in the distal part but also in the proximal part. The cristae of body surfaces are all sharp and linear, and fluctuation is scarcely seen on the ulnar surface. All these features are similarly observed in the Kuzuu specimen.

On the other hand, the degree of development of the palmar crista, broad basal extension of the attachment area of the fourth dorsal interosseous muscle, and the long basal swelling observed in the Kuzuu specimen are not usual in Jomon metacarpals.

Minatogawa

BABA & ENDO (1982) gave the measurements and description on overall sizes of the fifth metacarpals of Minatogawa man, but no morphological details. I observed two of the three specimens of Minatogawa (casts). It is recognized that the Minatogawa III (female, right) has the well-developed *Crista obliqua* and the marked *Tuberculum*, despite the small overall size of the bone. While in the Minatogawa J (female, right), the body is somewhat curved ulnarly, and development of the *Crista obliqua* is not marked. Moreover, the ulnar surface of this specimen shows certain irregular appearance, indicating fluctuation of the ulnar ridge. This may be a case of Pleistocene metacarpal with modern characters.

Amud

According to ENDO & KIMURA (1970), the specimen of Amud I (male, left) has the developed ulnar margin, similar to the metacarpal of La Chapelle Neanderthal.

Adding to this fact, my observation reveals that the Amud I specimen (cast) has some peculiar features, i. e., the sigmoidally curved body shaft and the radially protruded basal part. But the *Crista obliqua* is naturally well-developed, and the palmar crista is marked and largely divided.

Shanidar and other Neanderthals

The fifth metacarpals of Shanidar consist of seven specimens belonging to five individuals, Shanidar 1, 3, 4, 5 and 6. According to the detailed study by TRINKAUS (1983), the fifth metacarpals of four Shanidar individuals, except Shanidar 5, have prominent ulnar crests, as in the Amud I, the Tabun C1, and four out of the six European Neanderthal specimens. And he notes that the specimens of Shanidar 4 and 5 have large tuberosities (*Tuberculum*) on the ulnar sides, which extend distally along the diaphysis (body). This condition is apparently similar to that of the Kuzuu specimen, in having the distant position of the *Tuberculum* from the proximal end, which is clearly visible in the photographs of hand bones of both Shanidar 4 and 5 (TRINKAUS, 1983: Figs. 52, 53).

Summary and Conclusion

The morphological characteristics of the Kuzuu fifth metacarpal are largely different from those of ordinary modern ones, especially in thickness of the body and distinct cristae or ridges on the body surfaces. On the other hand, in many of these characters, the Kuzuu specimen is similar to the prehistoric ones: in most characters, to Jomon, and in a few others, even to Neanderthals.

All the characters common in the Kuzuu and the compared prehistoric metacarpals are possibly related to mechanical properties of the bone and activities of the muscles attached to it.

It is difficult to determine the age of the Kuzuu metacarpal on the morphological evidence alone, because there exists a wide variation among every population in the same age. But it can be said, based on the above comparisons, that the Kuzuu metacarpal is most likely of prehistoric age, and probably derived from the Upper Pleistocene.

Expected is that the other human remains, formerly found at Kuzuu, would become subjected to thorough morphological and chronological analyses before long.

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