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Variations of *Fovea anterior* in Upper Molars among some Fossil and Recent Hominids*

By

Hajime SAKURA

Department of Anthropology, National Science Museum, Tokyo

Introduction

In my preceding article (SAKURA, 1979), variations of the *fovea anterior* in lower molars were examined among some fossil and recent hominid groups, and it was concluded that the differential occurrence of two principal types of the *fovea*, the types of transverse furrow and bifurcated furrow, could be interpreted as a manifestation of the racial differentiation.

The present study is intended to reveal whether an analogy of the condition which led to the above conclusion can be found also in the *fovea anterior* in upper molars.

Typology of *Fovea anterior* in Upper Molars

Basic Morphology

Morphological elements of tooth crown are basically the same in the three kinds of upper permanent molars, as well as upper second deciduous molar. In typical upper molars with four main cusps, a longitudinal groove runs in mesio-distal direction between the lingual cusps (protocone and hypocone) and buccul ones (paracone and metacone). The term "central groove" is applied to the middle part of the longitudinal groove which lies between protocone and metacone.

The central groove is directed not quite mesio-distally but somewhat obliquely, and ends in disto-lingual fossa distally and in mesio-buccal fossa mesially. From the latter fossa, two grooves run off in mesial and buccal directions. FUJITA (1964) called these two grooves together "mesio-buccal grooves". But I propose to apply the term "mesial groove" to the former groove, which forms the mesial part of the longitudinal groove, and the term "buccal groove" to the latter groove, which runs between paracone and metacone.

At the mesial end of the mesial groove, it is usually bifurcated into two arms of furrow. The region of the bifurcation itself rarely forms a marked depression to be called *fovea anterior*, especially in recent hominid molars. But sometimes a buccal

* This study was preliminarily presented at the 28th Joint Meeting of the Anthropological Society of Nippon and the Japanese Society of Ethnology in 1974 (SAKURA, 1974).

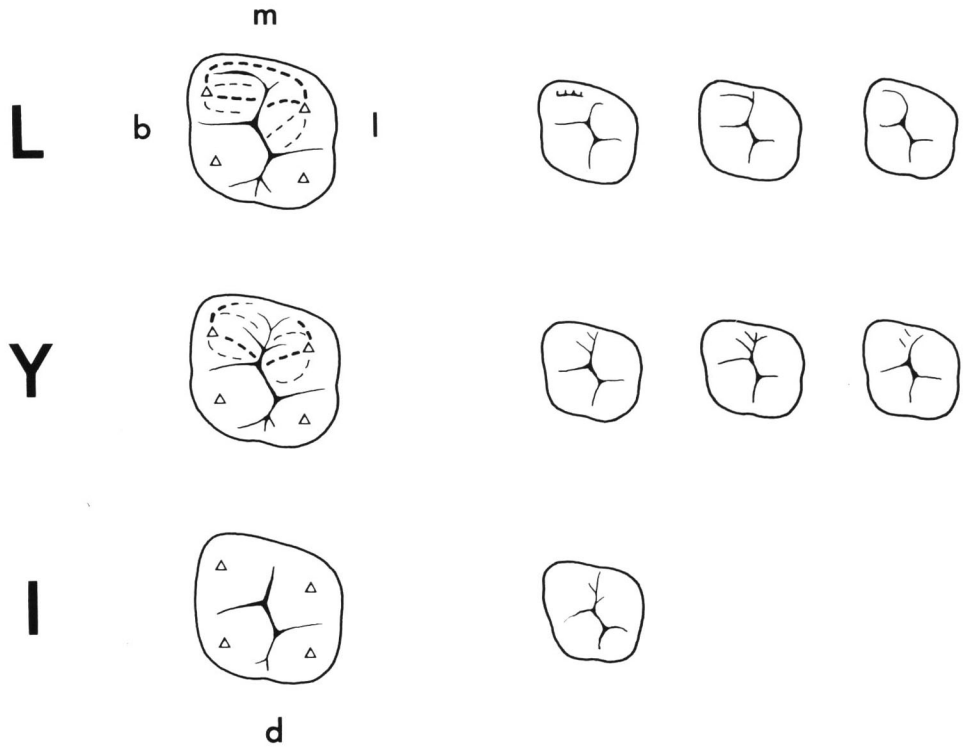

Fig. 1. Diagram of the main types of *fovea anterior* in upper molar. (Occlusal views of right teeth: m, mesial; d, distal; b, buccal; l, lingual sides)

L, type of transverse furrow; Y, type of bifurcated furrow; I, type of longitudinal furrow.

In two of the three larger figures (left), showing typical forms, thick and thin interrupted lines indicate relatively marked and less marked ridges respectively. Small triangles indicate the tips of cusps. The smaller figures (right) show some of the variations in each type.

arm of the furrow turns buccally and extends considerably between the mesial marginal ridge and the mesial accessory ridge of the paracone, and forms a marked *fovea anterior* of transverse furrow type.

Typology

In this study, as in the case of lower molars, the variations of *fovea anterior* in upper molars are classified into the following types according to the pattern of furrow in the region, regardless of the degree of development of the *fovea* (Fig. 1).

Type L (*Transverse furrow*)

A relatively straight furrow runs in bucco-lingual (transverse) direction, and forms an L-shaped pattern together with the longitudinal mesial groove, though the two portions are occasionally separated from each other by a well-developed anterior

transverse crest. In some cases, accessory furrows diverge from the main transverse furrow.

This type has been noticed as the real *fovea anterior* in the literature (Cf. GORJANOVIĆ-KRAMBERGER, 1906: Fig. 43B).

Type Y (*Bifurcated furrow*)

The mesial groove is bifurcated into a small V-shaped furrow, forming as a whole a Y-shaped pattern. The arms of the furrow do not show any transverse extension, but may extend close to the mesial margin of the crown. WEIDENREICH (1937) describes some upper molars of Peking man with a triangular area bordered by such a V-shaped furrow.

Type I (*Longitudinal furrow*)

The mesial groove may end with or without a small pit. In some cases, a longitudinal furrow as a continuation of the mesial groove exists and may extend close to the mesial margin of the crown. The groove and furrow forms a simple longitudinal I-shaped pattern in the region of *fovea anterior*, though some faint accessory furrows may be diverged from the part near the main ridges of protocone and paracone. This type is seen most frequently in the teeth with markedly reduced enamel structures.

Besides the three types defined above, there may be cases of the following categories.

Undefinable

The mesial part of the tooth is amorphous, so that the region of the *fovea* can not be classified into any of the three defined types.

Not Observable

The region of the *fovea* can not be observed because of the loss of enamel substance.

Materials and Results

Materials

Materials used in this study are largely the same as those used in my preceding study on the lower molars. Here I should note those points which differ from the above.

Authors of the source publications used for the examination of fossil hominid teeth, and their symbols that will appear in the tables, are as follows:

GORJANOVIĆ-KRAMBERGER, 1906 (G)
WEIDENREICH, 1937 (W)
MCCOWN and KEITH, 1939 (M)
ROBINSON, 1956 (R)
KORENHOF, 1960 (K)
TOBIAS, 1963 (T)

The recent European sample is the teeth of European crania series at the University

of Tokyo. The number of the upper molars examined is 144, implanted in 39 upper jaws. Of them, 19 have their origins in Germany, 9 in Czechoslovakia, 8 in Russia, 2 in France, and 1 in the Netherlands.

The recent Japanese sample consists of 160 male Japanese upper molars derived from a cemetery and deposited in my laboratory.

Results

The results obtained are shown in Tables 1–4, and summarized below.

Australopithecus (Table 1)

The enamel structure of the upper molars of *Australopithecus* is rich in relief. They generally have well-developed ridges as well as grooves and furrows. The

Table 1. Occurrence of the types of *fovea anterior* in upper molars of *Australopithecus* from South and East Africa.

Type	Species	Occurrence		
		M1	M2	M3
L	*A. africanus*	2 Sts 57, l (R) MLD, r (R)	2 Sts 1, l (RK) Sts 52a, r (R)	1 T.M. 1511, r (RK)
	A. robustus	3 SK 13, r (R) SK 89, r (R) SK 829, l (R)	6 SK 13, rl (R) SK 27, r (R) SK 48, l (R) SK 98, l (R) SK 826, l (R)	2 SK 31, r (RK) SK 835, l (R)
	Total	5	8	3
Y	*A. africanus*	1 Taung, l (WK)	1 Sts 8, l (R)	1 Sts 28, r (R)
	A. robustus	3 SK 102, l (R) SK 832, l (R)	1 SK 831, l (R)	2 SK 48, l (R) OH 5, r (T)
	Total	4	2	3
I	*A. africanus*	0	0	2 Sts 52a, r (R) T.M. 1561, r (R)
Undefinable	*A. robustus*	0	0	4 SK 41, l (R) SK 49, r (R) SK 836, l (R) OH 5, l (T)

Sts: Sterkfontein (also T.M.).
MLD: Makapansgat.
SK: Swartkrans.
OH 5: Olduvai, Zinjanthropus.

Table 2. Occurrence of the types of *fovea anterior* in upper molars of Peking Man (Sinanthropus).

Type	Occurrence		
	M1	M2	M3
L	0	0	2 Sin 47, l (W) Sin 49, r (W)
Y	3 Sin 32, r (W) Sin 33, l (W) Sin 140′, l (W)	3 Sin 40, l (W) Sin 41, l (W) Sin 42, r (W)	5 Sin II, l (W) Sin 46, r (W) Sin 49, r (W) Sin 112, r (W) Zd, r (W)
I	0	0	0
Undefinable	0	0	0

Sin: Sinanthropus (*Homo erectus*).
Zd: Tooth reported by Zdansky.

Table 3. Occurrence of the types of *fovea anterior* in upper molars of Neanderthals from Europe and West Asia.

Type	Occurrence		
	M1	M2	M3
L	4 Krapina B, l (G) Krapina C, l (G) Skhul I, r (M) Skhul V, r (M)	7 Moustier, rl (MW) Krapina D, l (G) Tabun S. I, r (M) Skhul I, r (M) Amud I, rl	2 Krapina, r (G) Amud I, l
Y	1 Krapina, l (W)	0	0
I	2 Krapina, l (G) Tabun S. II, r (M)	0	0
Undefinable	0	0	2 Krapina, r (W) Amud I, r

Amud I: SAKURA, 1970.

fovea anterior is clearly observed in most cases, though several cases of the category "undefinable" and type I are found especially in the third molars. Both the principal types, L and Y, occur in both the species, and the frequencies are not significantly different between the two types because of the small sample size.

Peking Man (Table 2)

Table 4. Occurrence of the types of *fovea anterior* in upper molars of the recent European White and Japanese.

Type	European			Japanese		
	M1	M2	M3	M1	M2	M3
L	5	12	14	2	13	11
Y	5	6	4	20	15	16
I	10	7	7	10	12	16
Undefinable	6	5	8	3	4	11
Not Observable	28	23	4	17	6	4
Total	54	53	37	52	50	58

In the teeth of Peking man, cusps and grooves are in general well-developed and distinct. But some ridges tend to be weakened. Of 13 specimens observed, only two bear the type L of *fovea anterior*, and the others all type Y. Most probably the type Y is dominant in the upper molars of Peking man.

Neanderthals (Table 3)

The upper molars of this group have in general well-developed marginal and accessory ridges, relatively to the groove formation. The *fovea anterior* is frequently separated from the mesial groove by an anterior transverse crest. Of the 18 specimens observed, the type L of *fovea anterior* occurs in 13 cases, while the type Y in only one. It can be said that the type L is apparently dominant against the type Y in this group, even on the basis of such a small sample.

Recent Hominid Groups (Table 4)

The features of reduction of morphological elements in recent upper molars are similar to those in lower molars I already mentioned. Of the defined types of *fovea anterior* in upper molars, it is noticed that the type I occurs considerably even in the Japanese sample.

So far as the principal two types, L and Y, are taken into account, the European and Japanese samples show different tendencies of occurrence. In the European sample, the type L is dominant in the second and third molars, while in the Japanese sample, the type Y is dominant in the first molars. As a whole, it seems that the European molars have a relatively high tendency to the type L, and the Japanese molars to the type Y.

Discussion and Conclusion

Comparing the results of the present study with those of my preceding one on lower molars, and considering the principal types L and Y of *fovea anterior* in upper molars to be corresponding to the types T and Y in lower molars respectively, it becomes apparent that the conditions of upper molars are recognized to be quite similar to those of lower molars on the following counts:

(1) Both the two types exist in early hominid *Australopithecus*.
(2) The type L is dominant in the Neanderthal group, while the type Y seems to be dominant in Peking man.
(3) In view of the occurrence of these types, recent European and Japanese appear to have different tendencies. The former has a closer affinity to the Neanderthals, and the latter to Peking man, although these affinities are not so clear-cut as in the case of lower molars.

As GREGORY and HELLMAN (1926) have mentioned, the *fovea anterior* in upper molars is regarded to be not homologous, but merely analogous, with that in lower molars. But in both the structures, differentiation of the types is mainly due to similar morphological elements, i.e., the degree of development of the ridges and grooves in the mesial part of the molar, and their interrelationships. So it is not surprising to find a certain parallelism in both upper and lower molars.

KORENHOF (1960), in his comprehensive comparative study of upper molars, has concluded that the mesial disclosure of the *fovea anterior* is a process of fairly recent date. His classification of the types is mainly based on the degree of disclosure or breach of the distal and mesial boundaries of the *fovea*. However, the condition of his "mesial disclosure" is nearly comparable with the type Y of mine. I agree to a certain extent with his opinion, but I should point out that in Mongoloid racial groups the breach of mesial marginal ridge seems to have a date as early as the time of *Homo erectus*.

To conclude, the results of the present study do not conflict with my previous supposition that the different occurrences of the types of *fovea anterior* characterize two hominid lineages, which have been led to Caucasoid and Mongoloid races.

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