The Crista Zygomaticomandibularis (New Term) on the Sulcus Zygomaticomandibularis in the Crab eating Monkey

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Abstract The tendon attachments of the superficial temporalis and the second layer of zygomaticomandibularis are clearly recognized on sulcus zygomaticomandibularis (YOSHIKAWA, 1963) which is made by the development of zygomaticomandibularis. The superficial temporalis embraces the outside of the first layer of the latter, attaching on the posterior wall of orbita. The attachments make generally the shallow sulci but rarely ridges in 3-4 years old.

The tendon attachments of the second layer of zygomaticomandibularis separate downwards from the frontoorbital margin and extend from the posterior wall of so-called zygomaticotemporal foramen to the posterior region of zygomaticoorbital margin. The traces of its attachments make simple low eminences as well as vague lines, but rarely the belt-like eminences, which were made by two ridges. Sometimes, the long one runs to pterygopalatine fossa and the other, which makes circular tubercle, ends suddenly or diminishes gradually on the way.

These cristae have been called by EHARA (1969) crista temporalis lateralis, but the authors wish to call them the crista zygomaticomandibularis.

PREFACE

The sulcus zygomaticomandibularis (YOSHIKAWA, 1963) is generated by the development of zygomaticomandibularis behind the orbital wall in the higher primate, including the man. The tendinous attachments of the superficial temporalis and zygomaticomandibularis are clearly recognized on it in the crab-eating monkey. The presence of crista was already noticed by EHARA (1969), who called it the crista temporalis lateralis. The pre-

sence of zygomaticomandibularis, however, has been proved by the incessant studies by YOSHIKAWA et al (1962 a and b, 1965, 1969 and 1974) as the independent muscle. So the crista temporalis lateralis (EHARA, 1969) must be replaced to the crista zygomaticomandibularis.

MATERIAL AND METHOD

112 examples of crab-eating monkey of 3-4 years old, which include 56 males, 40 females and 16 unknown sex, were studied. After removing the zygomatic arch

with the masseter, tendinous attachments of superficial temporalis and the second layer of zygomaticomandibularis were ascertained. After these dissections were made, the traces of tendinous attachments of these muscles were ascertained in the dried skull.

DESCRIPTION

The superficial temporalis, which embraces the anterior margin of the first layer of zygomaticomandibularis, attaches with thin tendinous membrane on the lateral surface of zygomatic bone on the sulcus zygomaticomandibularis (YOSHIKAWA, 1963), 7-8 mm below from the so-called zygomaticotemporal foramen (Fig. 1 and Photo. 1, 2, 3). When this thin tendinous membrane attaches on the zygomatic bone, almost all cases, 88.3%, makes the sulcus, 79.4% or the crista, 8.9%. In the remaining 11.6%, the bone surface is rough, 7.1% or smooth, 4.5%. The sulcus runs obliquely downwards to the anterior border of sphenozygomatic suture, 7-8 mm below from so-called zygomaticotemporal foramen at the rate of 71.4% or the sulcus diminishes on the way to spheno-

Fig. 1. Tendons of superficial temporalis (t) and zygomaticomandibularis, second layer (z) attached on zygomaticomandibular sulcus (YOSHIKAWA, 1963).

Photo. 1-3. The tendinous attachments of the superficial temporalis (t) and zygomaticomandibularis (z). There are many kinds of types, i. e., sulcus, crista, eminence and rough surface on the bone. Abbr.: sulcus zygomaticomandibularis (sz), processus marginalis (p), foramen zygomaticotemporalis (f), sutura sphenozygomatica (ss)

Table 1. The insertion of superficial temporo-
ralis on sulcus zygomaticomandibularis.

types of insertion	sides	%
The insertion is found,		88.3
a) as a sulcus,	160	(71.4)
b) as a sulcus, which diminishes on the way,	18	(8.0)
c) as a crista.	20	(8.9)
The insertion is not found.		11.6
a) The bone surface is smooth.	10	(4.5)
b) The bone surface is rough.	16	(7.1)
Total	224	99.9

zygomatic suture at the rate of 8.0%. On the other hand, the crista is made at the rate of 8.9% instead of sulcus, running in the same direction (Tab. 1 and Fig. 2).

The second layer of zygomaticomandibularis arises with strong tendon not only from the supraorbital torus and marginal process, but also attaches on the zygomaticomandibular sulcus, running downwards along the zygomaticofrontal suture,

Table 2. The insertion of zygomaticomandibularis, second layer, on sulcus zygomaticomandibularis.

types of insertion	sides	%
The insertion is found,	221	98.7
a) as a sulcus,	(107)	(47.8)
b) as a crista,	(42)	(18.8)
c) as two cristae, complex type, (53)	(23.7)	
d) as an eminence like a belt. (19)	(8.4)	
The insertion is not found.	3	1.3
Total	224	100.0

which locates on the anterior margin of the large wing of sphenoid bone (Fig. 1). When the tendon attaches on the lateral surface of zygomatic bone, only 1.3% show the flat bone surface, while 98.7% express a) the shallow sulcus, b) the crista, c) the complex type, which consists of two cristae and d) the rough eminence like a belt. The details are described as follows (Tab. 2):

a) A shallow sulcus has its origin in processus marginalis, which arises from the lateral posterior border of supraorbital torus in the anterior side of temporal fossa (Fig. 3). 1) It runs straightly downwards along the anterior margin of zygomaticofrontal and sphenozygomatic sutures and reaches to infraorbital fissure along the anterior border of the large wing of sphenoid bone at the rate of 48.1% (Fig. 3, a.1). There is also a case, in which the sulcus diminishes gradually before reaching to sphenozygomatic suture at the rate of 25.0% (Fig. 3, a.1'). 2) The terminal portion becomes a tubercle

Fig. 2. Various types of attached tendon of superficial temporalis (t).
1. Sulcus type, 2. Crista type,
3. Short sulcus type, 4. Rough surface type.

Fig. 3. Sulcus type of attached tendon of zygomaticomandibularis (z). a.2 and a.2' have the circular tubercle.

on the anterior margin of infraorbital fissure or becomes a circular tubercle on the way to infraorbital fissure at the rate of 26.9% (Fig. 3, a.2, a.2').

b) The crista reaches to the anterior margin of sphenozygomatic suture or partly along the anterior border of the large wing at the rate of 40.0% (Fig. 4, b.1). In the second case, the crista becomes small at the upper half of sphenozygomatic suture at the rate of 15.0% (Fig. 4, b.2). In the third case, it terminates on a circular tubercle at the rate of 45.0% (Fig. 4, b.3).

c) The complex type, which is consisted of two cristae, takes its origin in processus marginalis on the lateral border of supraorbital torus. The anterior crista lies at the lateral surface of zygomatic bone in the anterior side of zygomaticofrontal suture. The posterior crista lies on a little anterior side of zygomaticofrontal and sphenozygomatic sutures, continuing to the anterior margin of the large wing (Fig. 5). This type can be divided into three, namely, the first case, in which two cristae unite into one on sphenozygo-

Fig. 4. Crista type of attached tendon of zygomaticomandibularis (z). b.3 has the circular tubercle.

matic suture or then unite into one and the united crista runs to infraorbital fissure at the rate of 45.0% (Fig. 5, c.1, c.1'), the second case, in which two cristae unite into one, producing a circular or tubercular eminence at various levels, i.e., the inferior border of zygomaticofrontal suture, the anterior margin of sphenozygomatic suture or the anterior margin from sphenozygomatic suture partly to the large wing of sphenoid bone at the rate of 40.0% (Fig. 5, c.2, c.2' and c.2'') and the third case, in which two cristae do not unite each other and the anterior one runs downwards on the lateral surface of zygomatic bone along the anterior margin of zygomaticofrontal suture, diminishing the size to reach the anterior margin of the large wing, while the posterior one

Fig. 5. Complex type of attached tendon of zygomaticomandibularis (z).

runs straight along the anterior margin of zygomaticofrontal suture or on the zygomaticofrontal suture, reaching to the anterior margin of the large wing at the rate of 15.0% (Fig. 5, c.3).

d) The eminentia type like a belt is generated by the development of cristae (Fig. 6). In the first case, the eminentia reaches to infraorbital fissure along the anterior margin of zygomaticofrontal and sphenozygomatic sutures at the rate of 62.5% (Fig. 6, d.1). In the second case, its terminal portion is located in the anterior margin of sphenozygomatic suture at the rate of 31.3% (Fig. 6, d.2). In the third case, the portion becomes a circular tubercle at the rate of 6.2% (Fig. 6, d.3).

In this way, the attachment of tendon of zygomaticomandibularis on the zygomaticomandibular sulcus is more complex than that of superficial temporalis. They were called the crista temporalis lateralis by EHARA (1969). But the zygomaticoman-

Fig. 6. Eminentia type of attached tendon of zygomaticomandibularis (z). d.3 has a circular tubercle.

dibularis has been ascertained by the studies of YOSHIKAWA *et al* (1962 a and b, 1965, 1969 and 1974). So it is rather better to call them the crista zygomaticomandibularis and crista temporalis superficialis. The latter, however, is small and rare, while the former is more developed and complicated. So the authors wish to emphasize the former especially.

When the attachment of tendon of zygomaticomandibularis is compared on the right and left sides, including various types, the symmetrical condition is 42.9%, while the one, in which the right side is more complex, is 18.8% and the one, in which the left side is more complex, is

Table 3. Symmetrical and asymmetrical conditions of tendinous attachment of zygomaticomandibularis, including various types.

symmetrical and asymmetrical cases	examples	%
symmetrical case	48	42.9
asymmetrical case	56	50.0
a) Right side is more complex.	(21)	(18.8)
b) Left side is more complex.	(35)	(31.2)
vague	8	7.1
Total	112	100.0

31.2% (Tab. 3).

The case, in which the tendon of zygomaticomandibularis is attached on both of zygomaticofrontal and sphenozygomatic sutures is 37.2%. The case, in which it attaches to the anterior margin is 59.9%, while the case to the posterior border is only 2.9%.

CONCLUSION

It is strange, at first sight, that the tendons of superficial temporalis and zygomaticomandibularis make the sulcus or the crista on the sulcus zygomaticomandibularis. This is, however, explained reasonably when the muscle is attached on the sulcus zygomaticomandibularis with abundant muscular substance, the sulcus is made by the impression of the muscle, while when the tendon comes to be developed more and more, the developed tendon makes the crista distinctly on the sulcus zygomaticomandibularis.

When the temporal region was interpreted to be covered with the temporalis only, the crista temporalis lateralis (EHARA, 1969) can be used. But the presence of zygomaticomandibularis has been ascertained by YOSHIKAWA *et al.*, so the cri-

sta zygomaticomandibularis must be adopted instead of crista temporalis lateralis.

The simple, but exact proof of unilateral mastication seems to be very difficult. But the degree of unilateral mastication can be understood easily by the comparison of development of attached tendinous trace of zygomaticomandibularis, i. e., the crista zygomaticomandibularis on the sulcus zygomaticomandibularis in the crab-eating monkey, in which the mastication on the left side is far superior to that on the right side.

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カニクイザルの頬骨下顎筋溝に見られる頬骨下顎筋稜（新称）について

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頬骨下顎筋の発達により作られる頬骨下顎筋溝（吉川，1963）には，浅側頭筋腱付着線と頬骨下顎筋第二層腱付着線の二つがはつきり認められる。浅側頭筋は頬骨下顎筋第一層をおおい，その前縁をめぐって眼窩後壁に付着する。3～4才のカニクイザルでは，大部分浅い溝をなすが，隆起線をなすものもある。頬骨下顎筋第二層の腱付着線は，前頭眼窩縁からわかれ，頬骨側頭孔後壁から頬骨眼窩縁後面にのびる。それは単に，低い隆起をつくるもの，線状を呈するもの，まれに二本の線からなるもの，稜をつくるものなどがある。これらのなかには，翼口蓋窩に達する長いものもあるが，途中で結節をつくり急に終わるもの，結節をつくらずに消える短いものもある。これらの稜を江原（1969）は外側側頭筋稜とよんだが，われわれは頬骨下顎筋稜と改称したい。