Ultrastructure of Vascular Capillary of Lingual Filiform Papillae in the Mole (*Mogella wogura wogura*)

By

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Summary: Detailed observation of the structure of filiform papillae (FP) and microvasculature of those papillae in Japanese Azuma mole were described. In the anterior and medial regions, FP was cylinder in shape with two processes. In the posterior region, it had a long, sharp conical shape. The microvascular casts showed two types of hairpin-shaped capillary loops on three regions of the tongue. In the anterior and medial regions, the end of the capillary loops were shaped like a spoon. In contrast, in the posterior region, it was knot-like end of capillary loop. Since the shape of capillary loop was more complex in the anterior and medial regions than that in the posterior region, it was speculated that the spoon-like end of capillary loops of the FP in the anterior and medial regions supply nutrients to the filiform papillary cells and may be related to the movement of the tongue during mastication in Japanese Azuma mole.

There are four different kinds of papillae (filiform, fungiform, foliate and circumvallate) in the tongue of mammals, with the filiform papillae (FP) covering the whole dorsum of the tongue. The morphology, distribution and keratinization of the FP have been studied and described in a variety of mammalian species (Kobayashi *et al.*, 1988; Kuramae, 1989; Iwasaki *et al.*, 1987, 1997, 1999). Furthermore, the microvascular cast of the FP has shown morphological differences of hairpin-shaped capillary loops among mammals (Kuramae, 1989; Kishi *et al.*, 1990; Okada *et al.*, 1993; Selliseth and Selvig, 1993; Stręk *et al.*, 1995; Ojima *et al.*, 2000). However, little is known about the relationship between the morphology of the capillary loop and that of the filiform papillae.

The aim of this study is to examine the morphological characteristics of the FP and its microvasculature on the dorsal surface of the mole tongue using a scanning microscopy.

Materials and Methods

Six Japanese Azuma moles (*Mogella wogura*

wogura), (three male and three female, 100 to 120 g body weight) were used in this study. Each animal was anesthetized with an overdose of sodium pentobarbital solution.

Light microscopic study

The tongues were removed from the moles (each male and female) and fixed in 10% formalin. After washing in water, dehydrated in ethyl alcohol and embedded in paraffin, they were serially sectioned in 4 µm thickness on sagittal plane (Reichert, Austria). Each section was stained with hematoxylin-eosin and examined under a light microscope (Olympus Vanox-S, Tokyo, Japan).

Scanning electron microscopic (SEM) study

The tongues (each male and female) were fixed with 0.2 M glutaraldehyde in 2% cacodylate buffer (pH 7.2) and postfixed in 1% osmic acid after washing cacodylate buffer (pH 7.2). These specimens were dehydrated by a critical point dryer (Hitachi HCP-2, Tokyo, Japan).

Synthetic resin cast specimens for SEM

Two animals were perfused through an injection

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needle inserted into the aorta. Vascular perfusion with 0.9% physiological saline solution and then 2% glutaraldehyde solution in phosphate buffer (pH 7.4) was injected. The synthetic resin (Mercor, Dainippon Ink Chemical Co. Ltd., Tokyo, Japan) was perfused through the aorta. After polymerization of the resin, the tongues were removed from the animals and soft tissues were dissolved by 10% NaOH solution. The specimens were cleaned carefully with flowing water and dried.

These specimens were mounted on aluminium stubs and coated with platinum-palladium by an ion sputter (Hitachi E-1030, Tokyo Japan) and examined under a scanning electron microscope (Hitachi S-4300, Tokyo, Japan).

Results

Light microscopic study

The dorsal surface of the mole tongue was covered by filiform papillae (FP). Keratinized epithelium was observed in the surface of these papillae. Numerous blood capillaries were found in the lamina propria beneath the epithelium of tongue and fine blood capillaries were found in the connective tissue papillae of FP (Fig. 1).

Scanning electron microscopic study

The shape of FP in the anterior and medial regions was different from that in the posterior region. In the anterior and medial regions, FP was cylinder in shape with two processes; anterior and posterior processes (Type I FP). The posterior process was sharp and larger than that of the anterior (Fig. 2-a). In the posterior region, FP was long and sharply cone (Type II FP) (Fig. 2-b).

The microvascular casts showed two types of hairpin-like loops, its roots were from vascular network plexus. In the anterior and medial regions, the end of the capillary loops was shaped like a spoon or lacrosse racket (50–65 μm width). The outer frame of the loop was horseshoe-shaped with its concave surface facing the anterior direction. The subpapillary capillary network formed a plexus beneath the FP. A narrow vessel gave off capillary branches that formed end of capillary loops shaped like a spoon and then descended as a thick vessel to the plexus (Fig. 3-a). In the posterior region, the end of the capillary loops was shaped like a knot (30–35 μm width). A narrow ascending vessel evolved into capillary loops shaped like a knot and then descended as a thick vessel to the plexus (Fig. 3-b).

Discussion

In the mole, the FP covering the dorsal surface of the tongue was divided into two types; type I and type II, according to the shape and size. In type I FP, the upper part of papilla was branched into two processes whereas type II was longer non-branched conical in shape. Type I FP was distributed on the anterior and medial regions, and type II FP was on the posterior region of mole tongue. In the rat, the non-branched conical-shaped FP was distributed on the anterior and medial regions of the dorsal surface of the tongue (Iwasaki *et al.*, 1987). In the rabbit, the non-branched conical FP was distributed on the anterior region, and branched conical FP was distributed on the medial and posterior regions (Iwasaki, 1987). In those mammals having intermolar eminence on the tongue, the body of tongue was divided into two portions: unfixed portion (anterior region) and fixed portion (posterior region) (Shimizu, 1986). The shape of FP was different between the unfixed portion and fixed portion of the dorsal surface of the tongue (Fig. 4). Although there was no intermolar eminence on the mole tongue, anterior and medial regions contained myloglossus muscle, which corresponded to the unfixed portion of tongue. Weijs (1974) suggested that there was a relationship between the shape of FP and the movement of tongue. The difference in the shape of FP of mole tongue may be related to the transportation of masticated food. In the anterior and medial regions of the tongue in mole, the end of the microvascular loop in FP was shaped like a spoon and in the posterior region it was shaped like a knot. In the rat, simple, small hairpin-like loops were found in the FP in the anterior region of the tongue (Iwasaki *et al.*, 1987). Yamashita (1985) made observation on the two types of the FP and the capillary loops in the Japanese mole, and no mention was made of the relationship between the form of FP and the capillary loop in the different regions of the mole tongue. Because the shape of capillary loops was more complex in the anterior and medial regions, it seemed that the FP with two processes in that region of mole tongue receive rich blood supplements in comparison to the FP in the posterior region (Fig. 5). Selliseth and Selvig (1993) also suggested that the capillary loops supply nutrients to the FP that cause extensive wear on the tips of the papilla because the keratinized surface of FP in the anterior and medial regions of tongue, which are movable during mastication, may be worn down more rapidly than that in the posterior region. As a mole feeds worms and insects from the earth and sand underground, we speculate that this feeding process is related to the wearing down of FP. Fur-

Fig. 1. Light micrograph of filiform papillae (FP) in the dorsal surface of the mole tongue by hematoxylin-eosin stain. Blood capillaries (Arrows) were observed in lamina propria (Lp) and connective tissue papilla (Cp). Scale bar = 100 μ m.

Fig. 2. Scanning micrograph of FP in the dorsal surface of the mole tongue. a) Type I FP was cylinder in shape with anterior (Ap) and posterior processes (Pp). b) Type II FP was long and sharply cone. Scale bar = 50 μ m.

Fig. 3. Scanning micrograph of the end of the capillary loops of the microvascular casts in the mole tongue. a-1) The spoon-like shape capillary loops were observed in the anterior and medial regions (Scale bar = 100 μ m). a-2) Large magnification view of a spoon-like shape capillary loop (Scale bar = 50 μ m). b-1) The knot-like shape capillary loops were observed in the posterior region (Scale bar = 100 μ m). b-2) Large magnification view of a knot-like shape capillary loop (Scale bar = 50 μ m).

Fig. 4. Schema of the distribution of filiform papillae (FP) in the mole tongue. The area that type I FP (I) distributed in the anterior and medial region corresponded to the unfixed portion (UFP) of the tongue. The area that type II FP (II) distributed in the posterior region corresponded to the fixed portion (FP) of the tongue. T: tip of the tongue, R: root of the tongue.

Fig. 5. Schematic drawing outline (dotted line) of filiform papillae (FP) with scanning micrograph of the end of the capillary loops of the microvascular casts in the mole tongue. a) Type I FP, b) Type II FP. Scale bar = 50 μ m.

thermore, the spoon shaped end of capillary loops of the FP on the unfixed portion of the mole tongue may supply nutrients to the papillary cells and hence facilitate the epithelial cells of FP to be replaced.

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