CT Examination of the Guttural Pouch (Auditory Tube Diverticulum) in Przewalski’s Horse (Equus przewalskii)

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ABSTRACT . The domestic horse (Equus caballus) have the large symmetrical guttural pouches (the auditory tube diverticulum) formed by saccate bulge of the auditory tube. In this study, CT examination was carried out in the head of Przewalski’s horse (Equus przewalskii), the only true wild horse living at present. As results of the examination, Przewalski’s horse possessed the large symmetrical guttural pouches divided into medial and lateral compartments by the stylohyoid bone. Moreover, the right and left guttural pouches meet each other at the median part to form a thin septum. As CT sections get close to the part of the occipital condyle, the lateral compartment disappeared, and the medial compartment gradually became small toward the base of the skull. These results indicate that the nuchal-basal part of the medial compartment is not well-developed as compared with the domestic horse.—KEY WORDS: CT, equine (domestic), guttural pouch, Przewalski’s horse.


MATERIALS AND METHODS
We used the heads of two female adult Przewalski’s horses (Table 1). Carcasses of Przewalski’s horse were donated by the Tama Zoological Park (Tokyo, Japan) to the National Science Museum, Tokyo. The larynx and esophagus have already been removed from the heads before donation. Fixation of the heads was avoided. The heads were stored at $\approx 20^\circ C$. We could not find the morphological abnormality in the heads. CT examination was performed as follows. Heads of Przewalski’s horses were serially sectioned with the CT scanner (CT-W450-10A, HITACHI, Japan) from nasal to nuchal part with 2 mm pitch in 2 mm thickness (scanning conditions: 120 kV, 50 mA). The internal shape of the guttural pouches was observed in these sections.

RESULTS
The guttural pouches were observed in serial CT sections of the head of Przewalski’s horse (Fig. 1). Right and left guttural pouches start to appear on both sides of the pharyngeal recess (Fig. 1A). In the more nuchal part, the each pouch spreads in the basal and lateral directions and meets at the median part to form a thin septum (Fig. 1B). Moreover, with appearance of the head of mandible in the section, the guttural pouch starts to be divided into medial and lateral compartments by the stylohyoid bone (Fig. 1C). The nuchal-basal part of medial compartment is not well-developed as compared with the domestic horse.
and were informed from National Science Museum, Tokyo. All biological data have been recorded in the Tama Zoological Park.

Table 1. Specimens used in this study

<table>
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<th>Museum Number</th>
<th>Age (Year)</th>
<th>Sex</th>
<th>Body Weight (kg)</th>
<th>Donor</th>
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<td>15</td>
<td>female</td>
<td>357.4</td>
<td>Tama Zoological Park</td>
</tr>
<tr>
<td>M31303</td>
<td>6</td>
<td>female</td>
<td>345.1</td>
<td>Tama Zoological Park</td>
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</tbody>
</table>

All biological data have been recorded in the Tama Zoological Park and were informed from National Science Museum, Tokyo.

Each medial compartment is distant from the center line of the head (Fig. 1D). In the joint part of the hyoid bone to the temporal bone, the lateral compartment of the pouch is completely separated from the medial compartment by the stylohyoid bone (Fig. 1E). As CT sections get close to the part of the occipital condyle, the lateral compartments disappear (Fig. 1F), and the medial compartments gradually become small toward the base of the skull (Fig. 1G). In the head of the other Przewalski’s horse (M31302), the guttural pouch showed the same structure in serial CT sections.

DISCUSSION

In this study, CT examination was carried out to observe the guttural pouch of Przewalski’s horse. By utilization of the CT scanner, the outline of the guttural pouches was shown clearly, and the relationship between the location of the pouches and that of the bones was visualized.

In results of the examination, Przewalski’s horse possessed the large symmetrical guttural pouches, divided into medial and lateral compartments by the stylohyoid bone in the same way as those of the domestic horse. Moreover, the formation of a thin septum by the joint of right and left guttural pouches was also confirmed in Przewalski’s horse. It is suggested that the shape of the guttural pouch in Przewalski’s horse is basically similar to that of the domestic horse.

In the guttural pouch of the domestic horse, the nuchal-basal part of the medial compartment is well-developed in the nuchal direction [4, 5, 10]. However, in the guttural pouch of Przewalski’s horse, it is suggested that the nuchal-basal part of its medial compartment is not enlarged more than that of the domestic horse because its medial compartment gradually becomes small toward the base of the skull in the serial CT sections.

Przewalski’s horse is characterized by a stocky body, short legs and a heavy head to all appearances [8]. It has been reported that morphological character of the domestic horse is well-adapted for speed and endurance as compared with that of Przewalski’s horse [1, 16]. It may be assumed that the wild horse has changed morphologically during domestication for heavy exercise such as fast running. Several functions of the guttural pouch have been reported [3, 6, 10]. Baptiste et al. [3] stated that air ventilation of the equine guttural pouch might cool the blood flowing within the internal carotid artery to perform a brain-cooling. So, the efficient brain-cooling will be indispensable for heavy exercise in the horse. To get more brain-cooling effect of the guttural pouch, the domestic horse may have developed nuchal-basal part of its medial compartment as compared with Przewalski’s horse.

In conclusion, we first observed the equine guttural pouch in serial CT sections and demonstrated that Przewalski’s horse possesses the large symmetrical guttural pouches. Moreover, it was suggested that nuchal-basal part of its medial compartment would not be developed more than that of the domestic horse.

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REFERENCES


Fig. 1. CT serial sections of the head of Przewalski’s horse (M31303) from nasal to nuchal part. R: right side, L: left side. (A) Most nasal section in this Figure. Right and Left guttural pouches start to appear (large arrows). Intermediate arrow and small arrows respectively indicate the pharyngeal recess and the mandible. (B) 10 mm from A. Each pouch spreads in the basal and the lateral directions (large arrows) and forms a thin septum (small arrow). (C) 28 mm from A. The guttural pouch is divided into medial and lateral compartments by the stylohyoid bone. Arrows indicate the head of mandible. (D) 46 mm from A. The stylohyoid bone divides the pouch into each compartment more clearly. (E) 54 mm from A. The lateral compartment of the pouch is completely separated from the medial compartment by the stylohyoid bone. (F) 66 mm from A. The lateral compartments disappear. (D-F) The basal part of the right medial compartment is broken. (G) 80 mm from A (28 mm from the most caudal border of the ramus of the mandible). The medial compartments gradually become small toward the base of the skull. (A-G) Arrowheads: stylohyoid bone, m: medial compartment, l: lateral compartment.


