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Computed tomography and magnetic resonance imaging findings for the initial stage of equine temporohyoid osteoarthropathy in a Thoroughbred foal

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Temporohyoid osteoarthropathy (THO) is characterized by progressive osseous proliferation of the stylohyoid and petrous temporal bones. Generally, diagnosis is confirmed by guttural pouch endoscopy and skull radiography. In the present case, computed tomography (CT) and magnetic resonance imaging (MRI) were performed in a 6-month-old Thoroughbred foal showing signs of head tilt and unilateral ear droop, consistent with the presence of a vestibular disease and unilateral facial paralysis. CT revealed bony fusion and proliferation of the right temporohyoid joint, while MRI revealed that otitis media was responsible for THO. In conclusion, this report suggests that CT and MRI provide a more concrete diagnosis and better understandings of the mechanism of THO etiology.

Key words: *computed tomography, magnetic resonance imaging, otitis media, temporohyoid osteoarthropathy*

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Temporohyoid osteoarthropathy (THO) is characterized by progressive osseous proliferation of the stylohyoid and petrous temporal bones [2, 4, 10]. The progressive proliferation of the proximal stylohyoid and the petrous temporal bones can lead to ankylosis of the temporohyoid joint (THJ), causing fractures of the petrous temporal bone during normal movement of the tongue or larynx [2, 8]. Due to the proximity of the THJ to cranial nerves, such as the facial and vestibulocochlear nerves, THO can cause clinical signs of vestibular diseases and facial paralysis [9]. The etiology of THO remains poorly understood; nevertheless, otitis media, guttural pouch infection, trauma, and noninfectious degenerative THJ disease have been suggested to result in THO [2, 10]. It has been reported that THO can occur in horses at any age, but it is commonly diagnosed in middle-aged horses. It is also suggested that age is associated with an increasing severity of degenerative changes in THJ and that similar changes are commonly found bilaterally [6].

Typically, guttural pouch endoscopy and skull radiography are used for the diagnosis of THO [2, 3]. Endoscopic examination is considered a sensitive tool, but the middle ear, temporal bone, and some portions of the hyoid are not accessible endoscopically [3]. Skull radiography can confirm the diagnosis as well, but it is difficult to identify the osseous proliferation due to the overlapping structure [10]. Computed tomography (CT) allows simultaneous evaluation of the hyoid, auditory apparatus, and temporal bone; its utility in THO diagnosis has been reported [5]. Magnetic resonance imaging (MRI) provides better images for soft tissues and identifies inflammatory changes within the wall of the guttural pouch [10]. In this study, we report a case of the initial stage of THO in a Thoroughbred foal diagnosed using CT and MRI.

Case: A 6-month-old Thoroughbred horse (bay, male, body weight: 262 kg) was presented at the hospital of Obihiro University of Agriculture and Veterinary Medicine

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Fig. 1. Right-sided head tilt: clinical sign of vestibular disease.

Fig. 2. Right-sided ear and muzzle droop: clinical sign of facial nerve paralysis.

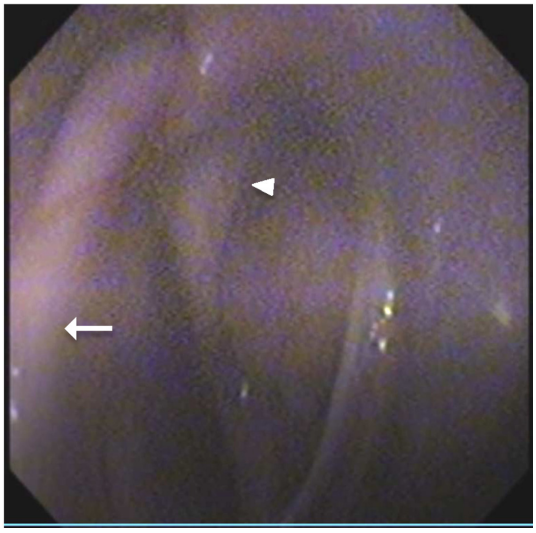

Fig. 3. Endoscopic examination of the right guttural pouch identifying a mild enlargement of the stylohyoid bone (arrow) and bulging around cranial nerves (CNs) IX, X, and XI (arrowhead).

Fig. 4. Radiographic image of the head in a right anterior oblique view. Bony fusion of the right temporohyoid joint (arrowhead).

with a history of signs of vestibular disease and facial nerve paralysis for 2 months. Blood tests revealed no significant abnormalities (white blood cell count, 8,100 cells/μl: red blood cell count, 1,062 × 10^4 cells/μl: hematocrit, 35.0%: Na, 131 mEq: K, 4.7 mEq: and Cl, 90 mEq). Upon physical examination, the foal exhibited right-sided head tilt, right ear droop, and right-sided muzzle droop. These signs suggested a vestibular disease and unilateral facial nerve paralysis (Figs. 1 and 2). Both eyes showed the presence of pupillary light reflex and menace response.

Endoscopy of the right guttural pouch demonstrated a mild thickening of the proximal stylohyoid bone and bulging around cranial nerves (CNs) IX, X, and XI, while infection, hemorrhage, and inflammation in the mucous membrane of the guttural pouch were not observed endoscopically (Fig. 3). A plain skull radiograph in a right anterior oblique position (image conditions: 80 kv, 125 mA, 0.1 sec) confirmed slight bony fusion of the right THJ (Fig. 4).

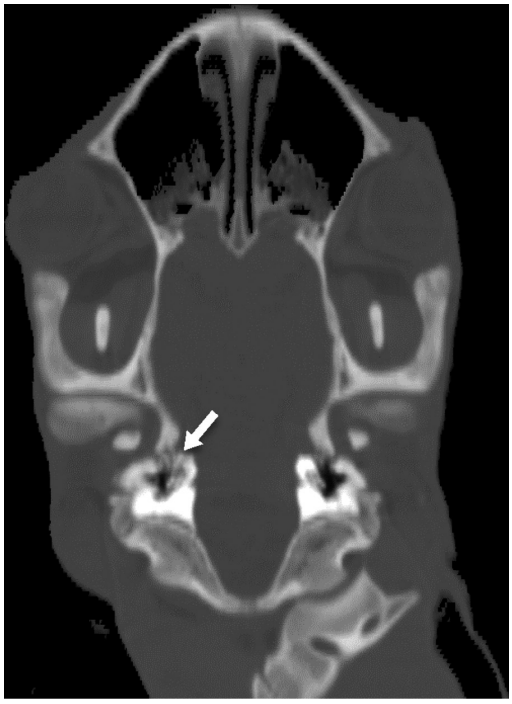

Fig. 5. Computer tomographic (CT) image of the dorsal plane. Swelling of tissue in the right middle ear (arrow).

Fig. 6. Computer tomographic (CT) image of the head. A cross-sectional view of the stylohyoid region reveals bony fusion of the joint (arrow) and constriction of the external ear canal (arrowhead).

CT and MRI examinations were performed under general anesthesia. General anesthesia for neurological disorders includes a degree of risk. However, due to the much smaller changes endoscopically and radiographically compared with previous reports [4, 10], we were unable to confirm the cause of the vestibular disease and unilateral facial nerve paralysis. It is necessary to rule out other possible complications, such as otitis media/interna, skull fracture, equine protozoal myeloencephalopathy, intracranial abscess, brain tumor, and meningitis. CT and MRI were performed for this reason. The horse was first sedated using medetomidine hydrochloride (5 μg/kg, intravenous [i.v.], Nippon Zenyaku Kogyo, Koriyama, Japan). After administration of diazepam (0.03 mg/kg, i.v., Horizon 10 mg, Astellas Pharma, Japan), guaifenesin (ALPS Pharmaceutical Industry, Hida, Japan) was rapidly infused until the horse became ataxic. Subsequently, thiamylal sodium (4 mg/kg, i.v., Nichi-iko Pharmaceutical, Tokyo, Japan) was administered. General anesthesia was maintained with a triple drip containing 5% guaifenesin, 0.1% ketamine (Ketalar For Intramuscular Injection 500 mg, Daiichi-Sankyo, Tokyo, Japan), and 0.05% xylazine (xylazine 2% injection, Fuzita Pharmaceutical, Tokyo, Japan).

The CT examination was performed with a 16-detector multi-slice CT (Aquilion Tsx-201A, Toshiba Medical Systems Corporation, Tokyo, Japan). Imaging conditions were as follows: 135 kv, 345 mA, and 2-mm slice thickness. Image data were processed using an image analysis software (Virtual Place Fujin, AZE, Tokyo, Japan). A transverse image of the THJ revealed mild bony fusion and proliferation of the right THJ, swelling within the right middle ear (Fig. 5), and constriction of the right external auditory canal (Fig. 6). Caudocranial 3-dimensional (3D) reconstruction of the head showed bony fusion and proliferation of the right THJ, which indicated the initial stage of THO (Fig. 7).

For the MR imaging examination, the horse was placed in the right lateral recumbency position on a nonmagnetic trestle for large animals, which was connected to a permanent magnet open MRI system (APERTO Lucent, Hitachi, Tokyo, Japan). Following injection of meglumine gadopentetate (0.2 m*l*/kg, i.v., Magnevist, Bayer HealthCare Pharmaceuticals Inc., Tokyo, Japan), contrast-enhanced T1-weighted images were acquired using the following conditions: slice thickness, 6 mm; repetition time, 360 msec; and echo Time, 13 msec. The dorsal contrast-enhanced T1-weighted MR image revealed a contrast-enhanced swelling of tissue in the right middle ear (Fig. 8).

Discussion: THO has been described as a common cause of peripheral vestibular disease and unilateral or bilateral facial nerve dysfunction. Due to the proximity of the THJ to

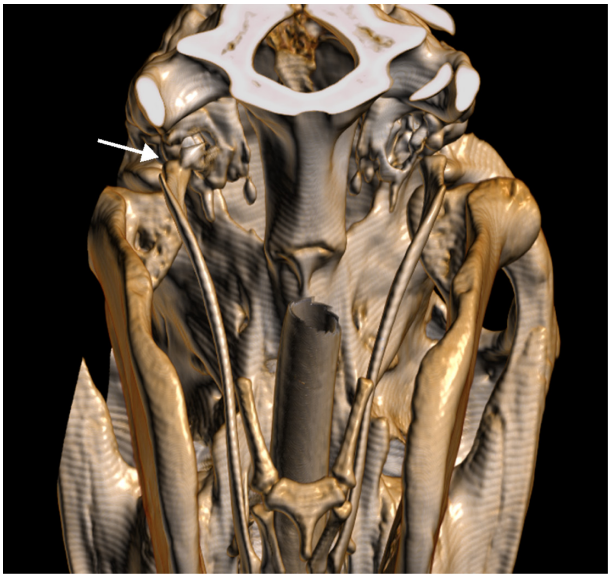

Fig. 7. Three-dimensional (3D) computer tomographic (CT) image of the head demonstrating bony fusion of the right temporohyoid joint (arrow).

Fig. 8. Contrast-enhanced magnetic resonance (MR) image of the dorsal plane. Swelling of tissue in the right middle ear (arrow).

cranial nerves such as facial and vestibulocochlear nerves, THO can cause clinical signs of vestibular diseases and facial paralysis [1]. In our present case, THO was diagnosed by osseous fusion and proliferation of the THJ detected by endoscopy, skull radiography, and CT. Thus, the signs of head tilt and unilateral muzzle and ear resulted from dysfunction of the vestibular and facial nerve, which were caused by THO.

It has been previously suggested that guttural pouch endoscopy is a sensitive test for the diagnosis of THO [3]. Affected horses often have fractures and osseous proliferation of proximal stylohyoid and temporal bone. Diagnosis can be confirmed by enlargement of the stylohyoid bone and hemorrhage or inflammation in the adjacent mucosa [2]. However, the middle ear, temporal bone, and some portions of the hyoid are not accessible endoscopically [3]. In this case, the osseous proliferation of the THJ revealed using CT was difficult to detect using guttural pouch endoscopy. Indeed, the mild enlargement of the stylohyoid may make it difficult to observe endoscopically.

Skull radiography allows for a more global evaluation of the skull base and hyoid apparatus, but it is hampered by anatomic superimposition [3]. In this case, THJ inflammation can be detected by a right oblique view, but the abnormality is subtle. Quality radiographs under general anesthesia are occasionally required to compare the right and left tympanic bulla and THJ [2, 10]. Thus, the absence of radiographic changes in the THJ does not rule out THO.

CT allows simultaneous evaluation of the hyoid and auditory apparatus, temporal bone, and upper airway [5]. In the present case, CT revealed pathological changes of the THJ that were difficult to detect radiographically and endoscopically. In addition, otitis media and constriction of the external ear canal were detectable simultaneously. CT showed a great advantage in investigating small changes in the THJ, which is an anatomically complex organ. It has been reported that in THO, horses showing neurological signs have significantly larger THJ and stylohyoid bone widths compared with those showing no clinical signs; moreover, the widths are correlated with the development of neurological signs [3]. Improvement of prognosis can be expected if earlier therapeutic intervention is available owing to earlier diagnosis using CT. The surgical procedures described for THO include ceratohyoidectomy and partial stylohyoidectomy [7, 8]. The affected horses may have a bilateral disease, enlargement of the ceratohyoid, and cerato-stylohyoid osteoarthropathy [7]. CT allows the identification of these abnormalities. Therefore, CT plays a role in determining the surgical procedure and probably in decreasing postoperative complications.

MRI provides a better image for soft tissues and can visualize inflammatory fluid accumulation around the proximal stylohyoid bone and wall of the guttural pouch [7, 10]. The etiopathology of THO remains poorly understood, but otitis media, guttural pouch infection, trauma, and noninfectious THJ degenerative disease have been suggested as causes of THO [2, 10]. In the present case, MRI revealed swelling of tissue in the middle ear, which has not been previously

reported in equine MRI.

CT in the present case revealed constriction of the external ear canal, and MRI revealed the otitis media responsible for THO. Therefore, the foal showed signs of vestibular disease and unilateral facial nerve paralysis, because otitis media/externa may have spread to the THJ. In conclusion, this report suggests that the combination of CT and MRI provides a more concrete diagnosis, better understandings of the mechanism of THO etiology, and better therapeutic directions for THO.

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