

Computed Tomographic Evaluation of the Nasal Septum Deviation in Clinically Normal Dogs

Ki-Ja Lee*, In Lee, Hee-Chun Lee**, Woo-Sok Han***, Ho-Jung Choi and Young-Won Lee¹

College of Veterinary Medicine · Research Institute of Veterinary Medicine, Chungnam National University, Daejeon 305-764, Korea

*Department of Clinical Veterinary Science, Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Hokkaido 080-8555, Japan

**College of Veterinary Medicine, Gyeongsang National University, Jinju 660-701, Korea

***College of Medicine, Konyang University, Daejeon 302-718, Korea

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Abstract : This study was performed to determine a comprehensive anatomic variation and deviation of the nasal septum in clinically normal dogs by use of computed tomography (CT). The nasal septum was evaluated in 36 shih-tzu dogs and 16 beagle dogs. A degree of a septal deviation was evaluated by measuring a maximum angle and a distance of the septal deviation. The angle and distance of the septal deviation were significantly higher in shih-tzu dogs than in beagle dogs. There was no significant relationship between body weight and age and all measurements (angle and distance) in both breed dogs. Results of this study suggest that nasal septum deviation and its defect are observed on CT images of clinically normal dogs, especially in shih-tzu dogs.

Key words : nasal septum deviation, computed tomography, dog.

Introduction

Computed tomography (CT) is becoming more widely used in small animal clinics and supports clinical practice in the evaluation of the nasal cavity (1,2). Nasal CT is useful for evaluating chronic nasal disease in dogs (8). Criteria for diagnosing diseases of the nasal cavity in CT images include changes of the nasal septum, and symmetry and size of the nasal cavity (18,20). Deviation and defects of the nasal septum have been reported as a criterion for evaluating nasal disease (13). These findings were shown in chronic rhinitis, fungal rhinitis, foreign body rhinitis and nasal neoplasia (18,20). However, nasal septal deviation is often observed in some clinically normal dogs.

The purpose of this study is to compare the prevalence of nasal septal deviation, and to evaluate a comprehensive anatomic variation and deviation of the nasal septum by use of CT in clinically normal shih-tzu and beagle dogs.

Materials and Methods

Experimental Animals

Thirty six shih-tzu and 16 beagle dogs were included in this study. The signalment of the experimental animals was summarized in Table 1. Prior to enrollment, dogs were considered healthy and free from evidence of nasal disease on the basis of

history taking and complete physical examinations. Complete blood count, serum biochemical analysis and thoracic radiography were also taken to evaluate the health condition of each dog. The procedures were approved by the Institute of Laboratory Animal Resources at Chungnam National University, and informed owner consents were obtained prior to the study enrollment.

Anesthesia

Prior to CT, the dogs were premedicated with atropine (0.04 mg/kg, SC, Atropine sulfate inj.[®], Jeil, Korea) and anesthetized with medetomidine (0.03 mg/kg, IV, Domotor[®], Orion, Finland) and midazolam (0.3 mg/kg, IM, Dormicum[®], Roche, Switzerland). When an appropriate level of anesthesia was reached, dogs were positioned in ventral recumbency on the CT table. Heart rate and respiratory rate were continually monitored. On completion of the procedure, dogs were allowed to recover from anesthesia by using atipamezol (0.04-0.12 mg/kg, IV, Antisedan[®], Orion, Finland).

Computed Tomography

The CT images were obtained with a third-generation whole body scanner (CTmax[®], GE, USA). Continuous 2.0 mm thickness images were obtained from the nares to the caudal level of the frontal sinuses.

Data Analysis

All images were reviewed by CT workstation displayed with

¹Corresponding author.
E-mail : lywon@cnu.ac.kr

Table 1. Signalment of experimental animals

	Age		Body weight		Sex			
	Range	Mean	Range	Mean	Male		Female	
	(year)	(year)	(kg)	(kg)	Intact	Castrated	Intact	Spayed
Shih-tzu	0.4-8.0	3.3	1.9-7.0	4.7	5	9	22	0
Beagle	2.0	2.0	7.0-10.5	9.1	15	0	1	0

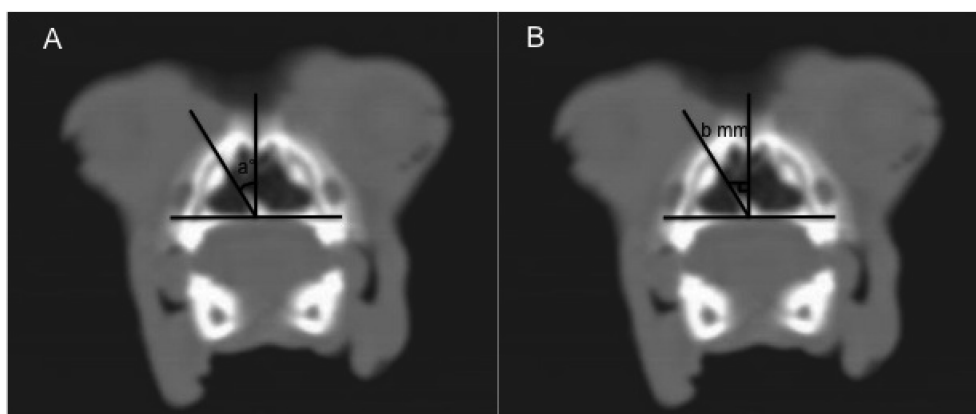


Fig 1. Transverse computed tomographic image of the nasal cavity in a normal shih-tzu dog. A horizontal line is parallel to the hard palate and the midline is vertical to the hard palate. An angle of deviation (a°) is obtained from the angle between a midline and a deviated septum (A). A distance of deviation (b mm) is measured from midline to the maximum point of deviation (B).

a bone window (window level, 200; window width, 2000). The nasal septum was evaluated for a presence of deviation with the following features; location of deviation within the nasal cavity and the extent of deviation. A degree of septal deviation was evaluated by measuring a maximum angle of deviation and a distance of maximum deviation from the midline. A maximum angle of deviation was the largest measured angle between the midline which is vertical to a hard palate, and a deviated septum (Fig 1A). A distance of maximum deviation was the maximum distance vertical to the midline (Fig 1B) (11). The maximum angles and distances obtained three times in each dog were averaged. In dogs with more than one site of deviation, the larger set of measurements was recorded for the statistical analysis. In addition, a presence of the nasal septal defect was recorded.

Statistical Analysis

All analyses were performed with a commercially available software program (SPSS, version 12.0, SPSS Inc, Chicago, IL). Mean and standard deviation (SD) were calculated for the measurements. Recorded data including an angle and distance of the septal deviation were expressed as a mean and 95% confidence interval. A Mann-Whitney U test was used to compare a maximum angle of deviation and a distance of maximum deviation between shih-tzu and beagle dogs. Spearman’s correlation test was used to evaluate the relationship of measurements with both body weight and age. A value of $p < 0.05$ was considered significant.

Table 2. Measurements of an angle and distance of the septal deviation in shih-tzu and beagle dogs

	Angle ($^\circ$)		Distance (mm)	
	Mean \pm SD	95% CI	Mean \pm SD	95% CI
Shih-tzu (n=36)	29.23 \pm 8.27	26.43-32.03	2.86 \pm 1.05	2.50-3.21
Beagle (n=9)	10.80 \pm 4.46	7.37-14.23	1.57 \pm 0.60	1.12-2.03

CI: confidence interval, SD: standard deviation

Results

Nasal septal deviation was observed in all Shih-tzu dogs (100%) and in 9 Beagle dogs (56.3%). In total, 21 of the 36 shih-tzu dogs (58.3%) had the convexity to the right and 15 (41.7%) had the convexity to the left. Of the 9 beagle dogs, 4 (44.4%) had the convexity to the right and to the left in 5 (55.6%). Partial defects of the nasal septum were revealed in 19 of the 36 shih-tzu dogs (52.8%) and in 7 of the 9 (77.7%) beagle dogs.

The mean \pm SD of the maximum angle of the septal deviation was 29.23 \pm 8.27 $^\circ$ and 10.80 \pm 4.46 $^\circ$ in shih-tzu and beagle dogs, respectively. The mean \pm SD of the distance of maximum deviation was 2.86 \pm 1.05 mm and 1.57 \pm 0.60 mm in shih-tzu and beagle dogs, respectively. The angle and distance of the septal deviation were significantly higher in shih-tzu

dogs than in beagle dogs ($p = 0.001$, Table 2).

There was no significant relationship between body weight and angle of the septal deviation, body weight and distance of the septal deviation, age and angle of the septal deviation, and age and distance of the septal deviation in shih-tzu and beagle dogs.

Discussion

The nasal septum, which divides the cavity into two, is mostly cartilaginous but does have an osseous periphery. Canine nasal septum composes septal processes of the frontal bone and perpendicular plate of the ethmoid bone. The perpendicular plate of the ethmoid bone, which is median vertical sheet of the bone, forms the osseous nasal septum. This bony septum is prolonged rostrally by the cartilaginous nasal septum (5).

Because CT has several advantages such as high speed of the procedure, high resolution, and the elimination of superimposition (8,12), there are numerous reports on the diagnostic value of CT in the diagnosis of neurological disorders (15), musculoskeletal disease (9), lung disease (11), and nasal cavity disease (2,18,19) in veterinary clinical practice. In particular, CT is useful for evaluating abnormalities in the nasal cavity, paranasal sinuses, tympanic bulla, periorbital region, and the skull (8,12). CT is superior to conventional radiography for detecting some changes within the nasal cavity, determining the extent and severity of the disease process, and in differentiating infectious or inflammatory disease from nasal neoplasia (7). The most frequently encountered CT features in nasal cavity diseases are neoplasia, aspergillosis and nonspecific rhinitis (4, 16,17,19). Nasal CT provides accurate assessment of neoplastic versus non-neoplastic disease, and further helps to differentiate idiopathic inflammatory disease from fungal rhinitis (8). The detailed information obtained with regard to the extent of disease is essential for planning radiation therapy in patients with neoplasia. In addition, it provides direction for a surgeon when intranasal surgery is required to obtain a diagnosis (8).

Previous studies demonstrated that a presence of extensive soft tissue opacities or mass and septal changes including deviation and lysis are highly associated with neoplasia (2,3,6, 10,14). Unlike the CT of neoplasia of the nasal cavity, rhinitis revealed cavitating lesion that spared the paranasal sinuses, thickened and distorted or destroyed the turbinates, and widened the meatus (3,21).

On the study for feline nasal septum and paranasal sinus, a presence of nasal septal deviation alone cannot be used as a criterion to diagnose nasal disease, but cats with rhinitis or neoplasia have more marked deviation than normal cats as it is often greater than 1.0 mm (13). In that study, a nasal mass and lysis of the nasal septum was only seen in cats with nasal disease. Furthermore, a mass is more likely to be caused by neoplasia than rhinitis (13). However, to the authors' knowledge, there are currently no reports on CT-based evaluation of the nasal septum and its normal variation with respect to breed in dogs.

In the present study, CT images on the all shih-tzu dogs and 56.3% of the beagle dogs revealed a deviation of the nasal septum. There are nasal septal defect in 52.8% of the shih-tzu dogs and 77.8% of the beagle dogs with a nasal septal deviation. The results demonstrate that deviation of the nasal septum is common in shih-tzu dogs. In addition, the mean angle and distance of deviation from the midline to the nasal septum in shih-tzu dogs is larger than those in beagle dogs. This may be relation to a different head types. Shih-tzu dog is a brachycephalic breed, short-broad head with a cephalic index of over 80, and beagle dog is a mesaticephalic breed, intermediate length and width of the head. Further studies are required to evaluate an anatomic variation and deviation of the nasal septum in different head types of dogs.

There was no significant relationship between body weight and the degree of the septal deviation in shih-tzu and beagle dogs. There was no significant relationship between age and the degree of the septal deviation in shih-tzu dogs. The relationship evaluation between age and the degree of the septal deviation in beagle dogs was not performed because the age ranges of beagle dogs are narrow in this study. This study suggests that nasal septum deviation and its defect are well observed on CT images of clinically normal dogs, especially in shih-tzu dogs. Therefore only the sign of nasal septal deviation could not suggest the nasal disease like rhinitis or nasal tumor. Additionally it was suspected that other brachycephalic breeds such as pug, Pekingnese, and bull dogs would have nasal septal deviation. Further studies are required in these breed dogs.

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정상 개에서 컴퓨터단층촬영을 이용한 비중격 편위 평가

이기자* · 이인 · 이희천** · 한우석*** · 최호정 · 이영원¹

충남대학교 수의과대학 · 동물의과학연구소, *오비히로 농과대학 임상수의학부

경상대학교 수의과대학, *건양대학교 의과대학

요 약 : 본 실험은 임상적으로 건강한 시츄 견 36 두, 비글 견 16 두에서 컴퓨터단층촬영을 이용하여 비중격의 해부학적 차이와 편위 정도를 평가하고자 실시되었다. 비중격의 편위 정도는 비중격 편위의 각도 및 거리 측정에 의해 평가되었다. 비중격 편위의 각도 및 거리는 비글 견보다 시츄 견에서 유의적으로 높은 수치를 나타냈다. 시츄, 비글견 두 품종에서 체중 및 나이는 비중격 편위의 각도 및 거리와 모두 유의적인 관계는 관찰되지 않았다. 이 결과에 기초하여 비중격의 편위는 임상적으로 건강한 개에서도 관찰 가능하며, 특히 시츄 견에서 쉽게 관찰되는 것으로 생각된다.

주요어 : 비중격편위, CT, 개