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Kısa Bildiri ***Short Communication***

Vertebral Malformations in French Bulldogs

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Abstract

The aim of this study was to detect vertebral malformations among French Bulldogs admitted between the years 2011 – 2016 due to the high popularity of the breed and the intentions to increase the breed welfare by reducing the occurrence of congenital anomalies. Besides, we aimed to look for gender predisposition, possible vertebral predisposition, occurrence of clinical symptoms and radiographic findings. A total of 73 French Bulldogs met the inclusion criteria (radiographs of the whole spine). In 67.12% (49) dogs we confirmed a vertebral anomaly and 32.88% (24) dogs were free of any vertebral anomaly. We identified a total of 67 abnormal vertebrae in 49 dogs, 13 cervical vertebrae (19.4%), 43 thoracic vertebrae (64.2%), and 11 abnormal lumbar vertebrae (16.4%). In this study, we found 44 hemivertebrae (65.7%) out of 67 abnormal vertebrae. We identified 64.4% (47/73) dogs with clinical signs (30 males, 17 females) and 36.6% (26/73) dogs without clinical signs (19 males, 7 females). Although the incidence of male dogs was higher in this study, the statistical evaluation did not confirm any predisposed gender, and we found no statistically significant predisposition for any particular abnormal vertebra.

Introduction

The popularity of the French bulldog breed carries a significant concern, because the high degree of breeding entails a reduction in genetic diversity. This is the case also with other pure-breed dogs, which increases the risk of breed-related diseases (Bellumori et al., 2013; Gough and Thomas, 2011; De Decker et al., 2012). We know brachycephalic or so-called ”screw tailed dogs” such as French bulldogs are predisposed to vertebral anomalies, and there is a big concern of what is considered ”normal” for this breed by breeders and the impact of this on the dog’s welfare. When the vertebrae fail to develop normally, this may cause spinal cord compression and pain. Clinical signs including ataxia, kyphosis or incontinence are the most common reasons for owners to bring the dog to the veterinarian. Serious spinal cord diseases are one of the most frustrating diseases that must be treated in veterinary practice. Some international breeding associations and French bulldog clubs have already implemented systematic breeding programs based on phenotypic evaluation of radiographs of the vertebral column. The adoption of screening protocols by all clubs would be helpful for predicting the future breeding values and to ensure the future welfare of this breed. The aim of this study was to evaluate the occurrence of radiographic findings and clinical symptoms and to look for a gender predisposition and possible predisposition for abnormality affecting any particular vertebra in French Bulldogs.

Materials and Methods

In this retrospective study, we evaluated the occurrence of various types of vertebral anomalies in each spinal segment, gender predisposition, and occurrence of neurological signs in French Bulldogs admitted between the years 2011-2016. From the practice database, we identified all French Bulldogs with availability of radiographs of the whole vertebral column from C1 to S3. We did not evaluate the coccygeal vertebrae, because there is known to be abnormal vertebrae in the bulldog tail which are linked to the occurrence of abnormalities in the rest of spinal segments. We determined number of male and female dogs, number of dogs affected with radiologically visible vertebral anomaly and number of dogs with clinical signs, the total number of abnormal vertebrae and their types in each spinal segment. The representation of clinical and radiographic signs was compared between genders, gender predisposition was then tested in all groups: dogs with clinical signs, dogs without clinical signs, dogs with vertebral anomaly, and dogs without

vertebral anomaly visible on the radiographs. The Fisher´s exact test and the Chi square test of independence were used to determine the effect of gender on the occurrence of vertebral anomalies and the occurrence of clinical signs, and to verify a predisposition of vertebral anomaly for any particular vertebra from C1 to S3 (McDonald, 2008).

Results

The inclusion criteria of breed and radiographs availability matched 73 dogs (49 males, 24 females). There were 64.4% dogs with clinical signs (30 males, 17 females) and 36.6% dogs without clinical signs (19 males, 7 females). Clinical signs were mainly related to the general reluctance to walk associated with spinal pain, spinal ataxia, paresis, neurological deficits, especially proprioception disorders, incontinence, and in some cases also concurrent orthopedic diseases (patellar luxation, hip dysplasia). Clinical symptoms were more evident in the dogs with changes of the shape of vertebrae (Figure 1 and 2) than in the dogs with changes of the number of vertebrae (Figure 3). In 49 dogs (67.12%) we identified a vertebral anomaly and 24 dogs (32.88%) were free of any radiological signs of vertebral anomaly (Table 1). Among 49 dogs with vertebral anomaly, there were 67.34% dogs (21 males, 11 females) with clinical signs. Among 24 dogs with no vertebral anomaly detected on the radiographs there were 62.5% dogs (9 males, 6 females) with clinical signs.

Table 1. Number of males and females among dogs in respective groups.

Dogs n=73	**With vertebral anomaly** n=49		**Without vertebral anomaly** n=24	
	Males	Females	Males	Females
With clinical signs	21	11	9	6
Without clinical signs	13	4	6	3

From the total of 67 vertebral anomalies there were 44 hemivertebrae (65.7%), 11 cases of variations in the number of vertebrae (16.4%), 5 cases of block-vertebrae (7.5%), and remaining 7 cases are represented by atlantoaxial instability (5.9%), fusion of the spinous processes (3.0%), and spina bifida (1.5%).

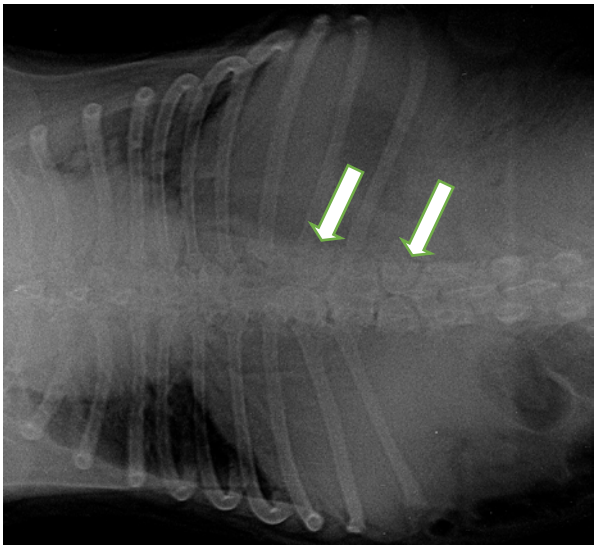

Figure 1. Radiograph of a dog with multiple anomalies in the thoracic and lumbar spine.

We identified in total 13 abnormal cervical vertebrae (19.4%). The abnormalities documented in the cervical region were 8 hemivertebrae (C5 2x, C6 3x, C7 3x) followed by four dogs with atlanto-axial instability, and one dog with block vertebrae (C2-C3).

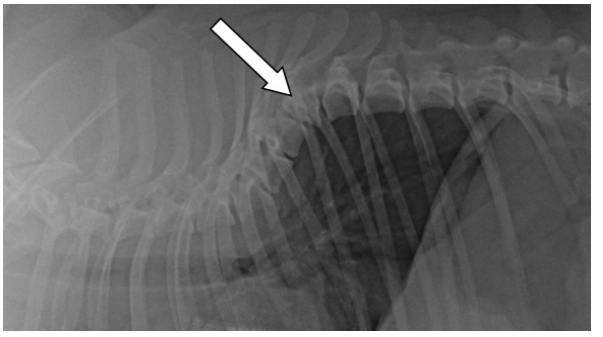

Figure 2. Radiograph of a dog with typical wedge shaped vertebra (hemivertebra).

In the thoracic region we identified 43 abnormal vertebrae (64.2%). There were 33 hemivertebrae (Th5 2x, Th6 4x, Th7 5x, Th8 8x, Th9 4x, Th10 7x, Th11 2x, Th13 1x), 3 dogs with a 14th thoracic vertebrae, 3 dogs with a block vertebrae (Th12-13 1x, Th13-L1 2x), 2 dogs with fused spinous processes (Th8-Th9, Th9-Th10), 1 dog with spina bifida, and 1 dog with only 12 thoracic vertebrae.

The anomalies found in the lumbar spine [11 abnormal lumbar vertebrae (16.4%)] were hemivertebrae (L3 3x), block-vertebrae (L2-L3 1x), eight lumbar vertebrae (5x), six lumbar vertebrae (2x). We found no anomalies of the sacrum.

Although the percentage of male dogs was higher than females in all four groups and in all three segments,

statistical analysis of the gender distribution among groups indicated that the disease was not more frequently expressed among males than females (Fisher´s exact test: P=0.555) and we also found no statistical predisposition for any particular abnormal vertebra (Chi square test: P=0.495). Statistical significance was confirmed only for increased incidence of hemivertebrae in the thoracic segment in females (Chi square test: P=0.066).

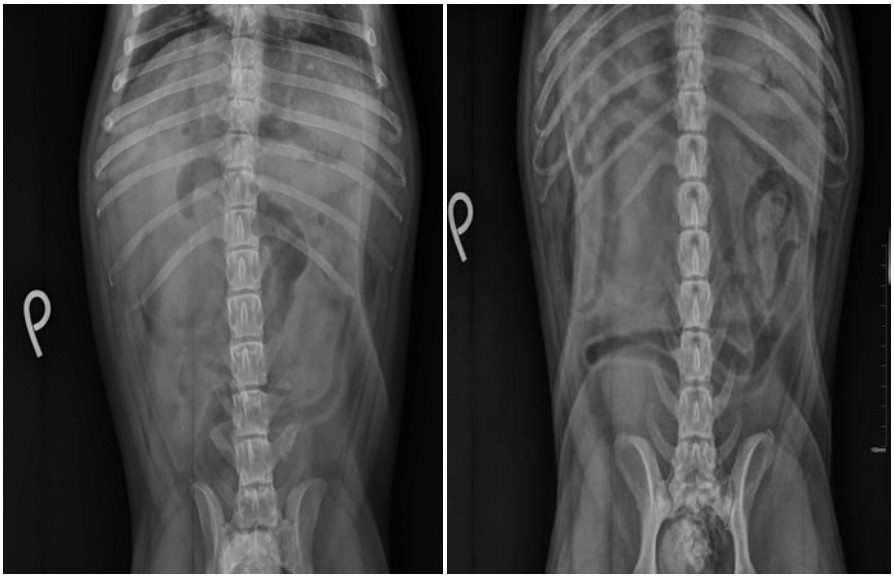

Figure 3. Radiographs of two dogs with changes of number of lumbar vertebrae.

Discussion

In the Slovak Republic we have so far been unable to perform a comprehensive study dedicated to the prevalence and heritability of spinal disorders in chondrodystrophic breeds. In some countries to maintain welfare, it is suggested to carry out the screening evaluation at a young age of 3 to 6 months. Diagnosing a serious impairment of vertebral development allows early prediction of the future welfare and the breeding value and it is recommended to not use seriously affected animals for breeding. Nevertheless, congenital vertebral anomalies are an incidental finding in many cases and they are usually detected in screw-tailed breeds, such as Pug, Boston Terrier, French Bulldog (Bailey and Morgan, 1992; Jeffery et al., 2007; Moissonnier et al., 2011). An increased number of vertebral anomalies is recorded in brachycephalic breeds in general, not only among those with a screwed tail. Breeder selection for screwed tails is believed to enhance the risk for hemivertebrae in the thoracic and lumbar spine (Schlensker and Distl, 2013; Schlensker and Distl, 2016). Changes in the number and shape of the vertebrae contribute to the abnormal curvature of the spinal axis and to varying degrees of vertebral canal stenosis (Falzone, 2011; Moissonnier et al., 2011; Walker, 2002; Westworth and Sturges, 2010) followed by neurological manifestations. Hemivertebrae may occur at one or more vertebrae, most commonly in the thoracic spine (Grenn and Lindo, 1969) and tail (Dennis et al., 2010). Congenital scoliosis and kyphosis are caused by a number of congenital deformities of the vertebrae, which can be recognized from the third month of age and are associated with symptoms of paralysis and ataxia (Carvallo et al., 2010). Neurological deficits are caused by a combination of stenosis and instability of the vertebral canal (Olby and Thrall, 2004). French bulldogs are usually clinically sound at a younger age and they are significantly more likely to be male, for example than Dachshunds (Aikawa et al., 2014). Even though it may appear to be a greater percentage of affected males reported in our study, it was not statistically proved that males or females are predisposed to vertebral anomalies.

The most frequently affected vertebral segment in brachycephalic dogs is the thoracic spine (Bailey and Morgan, 1992). In our study, we found 67 abnormal vertebrae in 49 dogs. A total of 43 abnormal vertebrae were in the thoracic spine, from which there were 33 hemivertebrae which represent 49.25% from all abnormal vertebrae, and 75% of all hemivertebrae found in this study. The most commonly affected vertebrae were Th8 and Th10 which is similar to previously published studies (Aikawa et al., 2007; Berlanda et al., 2011; Charalambous et al., 2014;

Gutierrez-Quintana et al., 2014), although we did not prove that these anomalies are concentrated on any particular vertebra of the thoracic segment. To predict the occurrence of clinical symptoms, we cannot rely only on the occurrence of hemivertebrae in the thoracic spine.

The prevalence of clinically affected brachycephalic screw-tailed dogs with congenital vertebral malformations is unknown, but due the high incidence of radiographic signs it could represent an important ''spontaneous'' model of spinal deformity (Guevar et al., 2014). The veterinary profession should take an active role in the improvement of pedigree dog welfare by educating breeders and potential owners, collecting data, supporting initiatives to eradicate specific conditions. Further revisions of breed standards are needed, so the breed societies must support any changes in breed standards and encourage their members towards the implementation of healthier breeding strategies (Hopkins, 2015; Morris, 2009; Thompson et al., 2010).

Conclusions

In the brachycephalic or screw-tailed breeds, it is important to introduce major changes in the breeding protocols. As a precaution, it would help to remove the appearance of the screwed tail from the breeding standard, because the tail straightening will possibly lead to a reduction in the incidence of hemivertebrae in other vulnerable spinal segments and improvement of the future breed welfare. The results of our study confirmed the high incidence of abnormalities as well as associated clinical signs. Although part of the population remain free of clinical signs most of the life, the next step is to prevent the mating of individuals with serious multiple anomalies which may lead to congenital abnormalities with more pronounced clinical symptoms. Since many dogs suffer from clinical symptoms without providing the radiographic diagnosis, it would be appropriate to introduce the advanced imaging techniques (CT, MRI) into the screening plan.

The owners of French Bulldogs must be fully informed about the importance of screening young animals and the available preventive examinations which will include X-ray of the spine. These methods are sufficient for diagnosis of severe anomaly at an early stage on the basis of it is possible to assess the future breeding value of each individual to ensure and maintain the animal´s welfare by means of starting the treatment or exclusion of severely affected animals from further breeding. Whereas the occurrence of clinical symptoms may be closely related to the body condition, nutrition, and the physical activity, future studies further emphasizing the predisposing factors are required.

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