Prevalence of spinous process impingement in thoracic vertebrae on radiographs of clinically-unaffected dogs

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Abstract

OBJECTIVES: To assess the prevalence of impinged spinous processes in asymptomatic dogs. These lesions are characterized by a narrowing of the interspinous space, associated with sclerosis and bone remodelling. Such findings have only been reported in three dogs and one cat presenting with back pain. Impinged spinous processes are also occasionally noted on radiographs of healthy dogs with unknown clinical significance.

METHODS: 190 lateral thoracic radiographs of asymptomatic dogs radiographed for reasons other than spinal pain, were retrospectively reviewed by two boarded radiologists. Images were assessed for the presence of impinged spinous processes and graded for the presence of narrowing, sclerosis, or remodelling of the spinous processes.

RESULTS: The prevalence of impinged spinous processes in unaffected dogs was 33.2%. 95% (75/79) of lesions were located between the spinous processes T8 and T11. Impingement of the spinous processes was seen more frequently in older dogs. Size of dog was also related to the lesions, as larger breed dogs displayed more frequent and more severe impingement of the spinous processes compared to smaller breeds.

CLINICAL SIGNIFICANCE: Spinous process impingement appears prevalent in animals with no history of spinal pain, which indicates that this radiographic finding should be interpreted with caution.

Keywords: kissing spine, Baastrup's, spinous process, radiography, dog.

INTRODUCTION

Impingement of spinous processes is a common radiographic finding in horses and humans. It has been reported in the literature by different names such as "kissing spine" syndrome or Baastrup's disease and is a common cause of back pain in horses (Jeffcott 1980), and people (Maes *et al.* 2008). Lesions are characterized by a narrowing of the space between adjacent spinous processes associated with sclerosis, flattening or remodelling of the cranial or caudal border of the spinous process. To the authors' knowledge, radiologic findings of spinous process impingement have only been described in one cat (Gutierrez-Quintana *et al.* 2011) and three dogs (Beythien *et al.* 1994, Ragetly *et al.* 2009), all presenting with back pain. In our experience impinged spinous processes are also occasionally noted on radiographs of dogs presented for reasons unrelated to back pain. The clinical significance of such lesions has never been studied in dogs and no quantitative data exists within the literature. In horses, the reported prevalence of radiographic impinged spinous process lesions in clinically unaffected animals varies from 34% (Jeffcott 1979) to 91.5% (Holmer *et al.* 2007) and lesions mainly occur between T13 and T18. The prevalence rises to 86% (Townsend *et al.* 1986) or 92% (Haussler *et al.* 1999) when lesions are diagnosed post-mortem.

There have been two reports of canine spinous process impingement occurring either with a concomitant chronic back pain or bilateral iliopsoas contracture. In the first report (Beythien *et al.* 1994) radiographs showed a narrow interspinous space T10-T11 in two dogs, associated with sclerosis and radiolucencies within the spinous process. Treatment consisted of the surgical resection of the spinous process. The second report (Ragetly *et al.* 2009) described impinged spinous processes from T8 to L6. This unusual and wide localization was thought to be secondary to a concurrent iliopsoas contracture and continuous flexion of the hips.

The aim of this study was to assess the prevalence of impinged spinous process lesions in a population of asymptomatic dogs, which may help assessing their significance. We hypothesised that narrower interspinous widths would be associated with more severe lesions of sclerosis and bone remodelling.

MATERIALS AND METHODS

Inclusion criteria

Canine lateral thoracic radiographs obtained between April 2012 and September 2013 were retrieved from the database of a Veterinary Referral Hospital. Images were processed using either a Canon direct digital radiography system (Xograph) or a Fuji computed radiography system (Fuji Capsula, Fuji Medical). Patient records for all animals were reviewed and animals with a clinical suspicion or a history of neck or back pain were excluded. Breed, age, sex, and reason for presentation were recorded. Dogs were excluded from the study if no history was available in the database. In addition radiographs were only included if all thoracic spinous processes were clearly visible. If several lateral projections were available, the one with the best exposure and least rotation was chosen. Any radiograph with a major overlap of the ribs onto the spinous processes or with major vertebral malformations, such as hemivertebrae or fused vertebrae, was excluded.

Scoring system

Two board-certified radiologists blindly and independently reviewed the radiographs. They were asked to grade from 0 to 3 each spinous process / interspinous space from T1 to T11 according to four criteria: sclerosis, radiolucency, remodelling, and interspinous width. A grade 0 was defined as an absence of sclerosis or radiolucency, no remodelling of the cranial or caudal aspect of the spinous process, and a normal interspinous width. Mild lesions were assigned a grade 1 (Fig.1A) and moderate modifications a grade 2 (Fig.1B, 1C). Severe lesions, such as sclerosis, bone remodelling and narrowed interspinous width, as described in the case report of a German Shepherd dog with bilateral iliopsoas muscle contracture (Ragetly *et al.* 2009), were graded as 3. Post scoring, radiographs where there were any differences in scores were reviewed together by the reviewers and a consensus grade was determined.

Figure 1 (A), (B), (C)

In order to quantify the severity of the impingement of the spinous processes based on a single rating score, we defined for each pair of adjacent spinous processes a *severity index* computed as the sum of the three grades derived from the sclerosis, remodelling and radiolucency criteria. We chose not to include the interspinous width as part of the severity index, because this single criterion is not specific enough to define an impinged spinous process. Two spinous processes were considered impinged if the severity index was greater than 0.

Measurement method

We applied an additional method to obtain objective measurements of the interspinous widths from T8-T11, using reference lines perpendicular to each spinous process (Fig. 2). All measurements were done by the same operator to an accuracy of one tenth of a millimetre using a DICOM viewer (Osirix, Geneva, Switzerland) and magnified images. A second set of measurements was performed by the same observer on a 10% sub-sample. These radiographs were chosen randomly, in order to assess the reproducibility of the method. We computed an intra-class correlation coefficient (two-way mixed, absolute agreement, single measures) to assess the reliability of measurements using SPSS 20 software for Macintosh (SPSS Inc, USA).

In order to take into account the size of the dog, the measurements were normalised by using the following method. Breeds were split into three categories according to body size (small, medium and large). To avoid a possible bias of the age, we tested only individuals having reached full body size by excluding from the analysis all individuals less than 1 year-old. We then established a ratio between each measured interspinous width and the mean interspinous width of dogs of same size with no radiographic sign of impinged spinous process.

Figure 2

RESULTS

190 canine thoracic radiographs were assessed; the mean age of dogs was 7 years (range 2 months to 15 years). The study involved 91 males and 99 females. The most common breeds were Labrador and golden retrievers (*N* = 37), cocker and springer spaniels (*N* = 36) and Jack Russell terriers (*N* = 14). 18 brachycephalic dogs such as bulldogs, cavalier King Charles spaniels and boxers met the inclusion criteria.

33.2% of dogs (63/190) displayed signs of spinous process *impingement*. Observers differed on 55/7600 grades (0.007%) on 43/190 radiographs, and each time by only one grade. A mean grade was established in these cases. 98% of the disagreed grades occurred at the T10-T11 space. Of the affected animals, 25.4% of dogs (16/63) had two interspinous spaces involved, which was the maximum found per animal in our study. Only 4 lesions (in 3 dogs) affected spinous processes T1 to T8, while 95% (75 lesions in 61 dogs) occurred at spinous processes T8 to T11 (Fig. 3). The interspinous width was scored as narrowed (i.e. interspinous width score >0.5) in 81 dogs between T8 to T11 and in only 1 dog between T5-T6. Thus, we focused subsequent measurements on the intervertebral spaces from T8 to T11: 6/75 lesions were found on the spinous processes of T8-T9, 39 lesions on T9-10, and 30 on T10-T11.

Figure 3

The width between spinous processes, from T8 to T11, was measured at the narrowest point on all radiographs (Fig. 4). Measurements of the interspinous width were performed twice for 19 radiographs to test the repeatability of the method. The intra-observer agreements were good for the width of the three intervertebral spaces T8-T9 (*ICC* = 0.76, 95% confidence interval 0.37–0.91), T9-T10 (*ICC* = 0.93, 95% *ci* 0.80–0.97), and T10-T11 (*ICC* = 0.95, 95% *ci* 0.87–0.98). Mean difference values between these two sets of measurement were 0.6 mm for the interspinous width T8-T9 (range: 0-1.4 mm), 0.3 mm for T9-T10 (range: 0-1 mm), and 0.4 mm for T10-T11 (range: 0-1.2 mm). As shown on Figure 4, the median interspinous width consistently decreased from T8 to T11 in all breeds of dog, regardless of their body size.

Figure 4

To assess the relation between the severity of lesions and age and body size, we added up the severity indices from T1 to T11 for each dog to obtain a *total severity index*. The mean age of dogs having impingement of the spinous processes was 8.1 years (range: 10 months-15 years). Among the 63 dogs that had a total severity index equal to or greater than 0.5, 71.4% (45/63) were 6 years old or older. Dogs younger than 6 years old with radiographic lesions had a mean total severity index of 2.1 (N = 18, range: 0.5-7). The older population of dogs (6 years old or older) with impinged spinous processes had a mean total severity index of 2.0 (N = 45, range: 0.5-6). The percentage of dogs presenting a spinous process impingement were 22.2% (12/54) for small breeds, 40.3% (25/62) for medium breeds, and 43.8% (25/57) for large breeds. (Note that we excluded all individuals less than 1 year-old in these counts so that all individuals had reached their full body.) There was a trend for mean total severity index to increase with breed size, being 0.3 for small-sized dogs ($N = 54$, range: 0-4), 0.7 for medium-sized dogs ($N = 62$, range: 0-7), and 1.1 for large-sized dogs ($N = 57$, range: 0-6).

DISCUSSION

This study showed a prevalence of 33% of impinged spinous process in dogs, between T1 and T11. This prevalence may be underestimated due to the limitations of radiography and could actually be higher if assessed by computed tomography or post-mortem. In horses without back pain, an even higher prevalence of over 80% has been diagnosed at post-mortem (Townsend *et al.* 1986). Such a high prevalence in a population of asymptomatic dogs questions the clinical significance of these findings. Medical histories of dogs were thoroughly checked to exclude all dogs with any suspected neck or back pain. It should be noted, however, that an exhaustive history was not available for all animals. Some symptomatic dogs may have been included in the study population if their clinical signs were missed or not mentioned in the available clinical database.

Our results indicate that age could be related to the prevalence of spinous process impingement. Older dogs presented with these lesions more frequently, whereas the severity of the impingement did not appear to be linked to age. In comparison, the effect of age on the increase of radiological lesions remains controversial in horses; a previous study did not find any correlation between the two (Jeffcott 1979), but recent studies have suggested a link (Erichsen *et al.* 2004, Zimmerman *et al.* 2012). In humans the prevalence of Baastrup lesions does increase with age (Kwong *et al.* 2011, Maes *el al*. 2008). In the present study, the severity of radiographic lesions appears to be related to body size, with large breed dogs having more frequent and severe impinged spinous processes compared to smaller breeds.

Implementing a reliable method to measure the interspinous width in dogs is problematic. Canine spinous processes have a wide range of shapes, together with various inclinations, even within the same animal. Widths appear more easily measured in horses, since interspinous spaces are quite regular with a narrowest width often at the same level (Berner *et al.* 2012). An interspinous width less than 4 mm is considered narrowed in horses (Erichsen *et al.* 2004, Sinding *et al.* 2010), whereas in dogs, normal interspinous widths at the anticlinal vertebra were typically only 1-2 mm. Difficulties inherent in measuring at this order of magnitude may explain why we did not manage to establish a minimum interspinous width for dogs presenting lesions in this study. One limitation of this study is that measurements were only performed from T8 to T11; however a subjective score evaluating the interspinous width was given for all thoracic spinous processes.

Our results show that the interspinous width gets narrower between T8 and T11, which linked to proximity to the anticlinal spinous process. Large breed dogs are more likely to have T11 identified as anticlinal vertebra, and it has been reported to be at T10 in smaller breeds (Baines *et al.* 2009). Knowing that most spinous process impingements were between T9 and T11, it seems logical that the distance between spinous processes plays a major role in the occurrence of lesions. Grading the interspinous width T10-T11 was the most controversial for the observers. Indeed, this interspinous space was sometimes less clearly delineated on radiographs than the majority of others, which was likely to be the cause of disagreement by one point for 23% of radiographs.

An interesting finding is that no grade reached the maximum score of 3 for any of the criteria (sclerosis, remodelling or radiolucency). All grades were between 0 and 2. We therefore assume that our study did not include dogs with severe impingement of the spinous processes. Hence, we could hypothesise that asymptomatic dogs may have less severe radiological changes than clinically affected animals. That feature was generally observed by Jeffcott (1979) in horses. A further study should assess a group of dogs with spinal pain, to see if these dogs have higher grade lesions.

Impinged spinous processes constitute a common finding in horses having back pain, especially among jumping horses. It is believed that when the back is frequently required to extend and flex maximally, particularly when jumping, it results in more severe lesions and possible back pain (Jeffcott 1980, Townsend *et al.* 1986). A positive correlation has been reported between clinical signs and the severity of radiological findings in horses (Zimmerman *et al.* 2012). In humans the pain induced by the impingement of the spinous processes is thought to be mechanical, due to repetitive strain on the interspinous ligament. The degeneration and collapse of the ligaments leads to neoarthrosis and bony erosions between adjacent spinous processes (Mitra *et al.* 2007). The interspinous region forms a bursa with creation of a synovial joint, which will appear on MRI as fluid-like signal between consecutive spinous processes (Maes *et al.* 2008). Similar pseudoarticulation features on macroscopic examination were described in the only MRI report of such lesions in a cat (Gutierrez-Quintana *et al.* 2011). The authors hypothesise that it is likely impingement of the spinous processes results from the same process in dogs, with large breed dogs potentially putting more strain on interspinous ligaments than small breed dogs. Impingement of the spinous processes represents a progressive degenerative process in non-clinical animals, this is why it should not be considered as a disease as such. In rare cases when impinged spinous processes cause pain, an active inflammatory process is likely to trigger the clinical signs. True origin of the pain is still unclear in humans, since these lesions often have concurrent degenerative spinal lesions, and do not always respond well to surgical treatment. Surgical resection of spinous processes seems more successful in horses, with 72% of individuals in one study (Walmsley *et al.* 2002) returning to work.

In conclusion, impingement of the spinous processes appears prevalent within this population of asymptomatic dogs, with the changes concentrated in the T8-T11 region and being related to age and body size. The clinical significance of these lesions is questionable and their presence should be interpreted with caution.

References

Baines, E., Grandage, J., Herrtage M. (2009) Radiographic definition of the anticlinal vertebra in the dog. *Veterinary Radiology & Ultrasound* 50, 69-73.

Berner, D., Winter, K., Brehm, W., Gerlach, K. (2012) Influence of head and neck position on radiographic measurement of intervertebral distances between thoracic dorsal spinous processes in clinically sound horses. *Equine Veterinary Journal Supplement* 43, 21-26.

Beythien, R. (1994) Baastrup's-syndrome in dogs – 2 cases – painful degeneration of touching spinous processes of the thoracal spine. *Praktische Tierarzt* 75, 651.

Erichsen, C., Eksell, P., Holm, KR., *et al.* (2004) Relationship between scintigraphic and radiographic evaluations of spinous processes in the thoracolumbar spine in riding horses without clinical signs of back problems. *Equine Veterinary Journal* 36, 458-465.

Gutierrez-Quintana, R., Lindley, S., Sullivan, M., *et al.* (2011) Dorsal spinous process impingement syndrome ('kissing spine') in a cat: imaging appearance and surgical management. *Journal of Feline Medecine and Surgery* 13, 618-621.

Jeffcott, L. B. (1979) Radiographic features of the normal equine thoracolumbar spine. *Veterinary Radiology* 20, 140-147.

Jeffcott, L. B. (1980) Disorders of the thoracolumbar spine of the horse – a survey of 443 cases. *Equine Veterinary Journal* 12, 197-210.

Kwong, Y., Rao, N., Latief, K. (2011) MDCT findings in Baastrup disease: disease or normal feature of the aging spine? *American Journal of Roentgenology* 196, 1156-1159.

Haussler, K.K., Stover, S.M., Willits, N.H. (1999) Pathologic changes in the lumbosacral vertebrae and pelvis in Thoroughbred racehorses. *American Journal of Veterinary Research* 60, 143-153.

Holmer, M., Wollanke, B., Stadtbaumer, G. (2007) X-ray alterations on spinal processes of 295 warmblood horses without clinical findings. *Pferdeheilkunde* 23, 507-511.

Maes, R., Morrison, W.B., Parker, L., *et al.* (2008) Lumbar interspinous bursitis (Baastrup disease) in a symptomatic population: prevalence on magnetic resonance imaging. *Spine* 33, E211-215.

Mitra, R., Ghazi, U., Kirpalani, D., Cheng, I. (2007) Interspinous ligament steroid injections for the management of Baastrup's disease: a case report. *Archives of Physical Medicine and Rehabilitation* 88, 1353-1356.

Ragetly, G.R., Griffon, D.J., Johnson, A.L., *et al.* (2009) Bilateral iliopsoas muscle contracture and spinous process impingement in a German shepherd dog. *Veterinary Surgery* 38, 946-953.

Sinding, M.F., Berg, L.C. (2010) Distances between thoracic spinous processes in Warmblood foals: a radiographic study. *Equine Veterinary Journal* 42, 500-503.

Townsend, H.G., Leach, D.H., Doige, C.E., Kirkaldy-Willis, W.H. (1986) Relationship between spinal biomechanics and pathological changes in the equine thoracolumbar spine. *Equine Veterinary Journal* 18, 107-112.

Walmsley, J.P., Pettersson, H., Winberg, F., McEvoy, F. (2002) Impingement of the dorsal spinous processes in two hundred and fifteen horses: case selection, surgical technique and results. *Equine Veterinary Journal* 34, 23-28.

Zimmerman, M., Dyson, S., Murray, R. (2012) Close, impinging and overriding spinous processes in the thoracolumbar spine: the relationship between radiological and scintigraphic findings and clinical signs. *Equine Veterinary Journal* 44, 178-184.

FIGURE LEGENDS

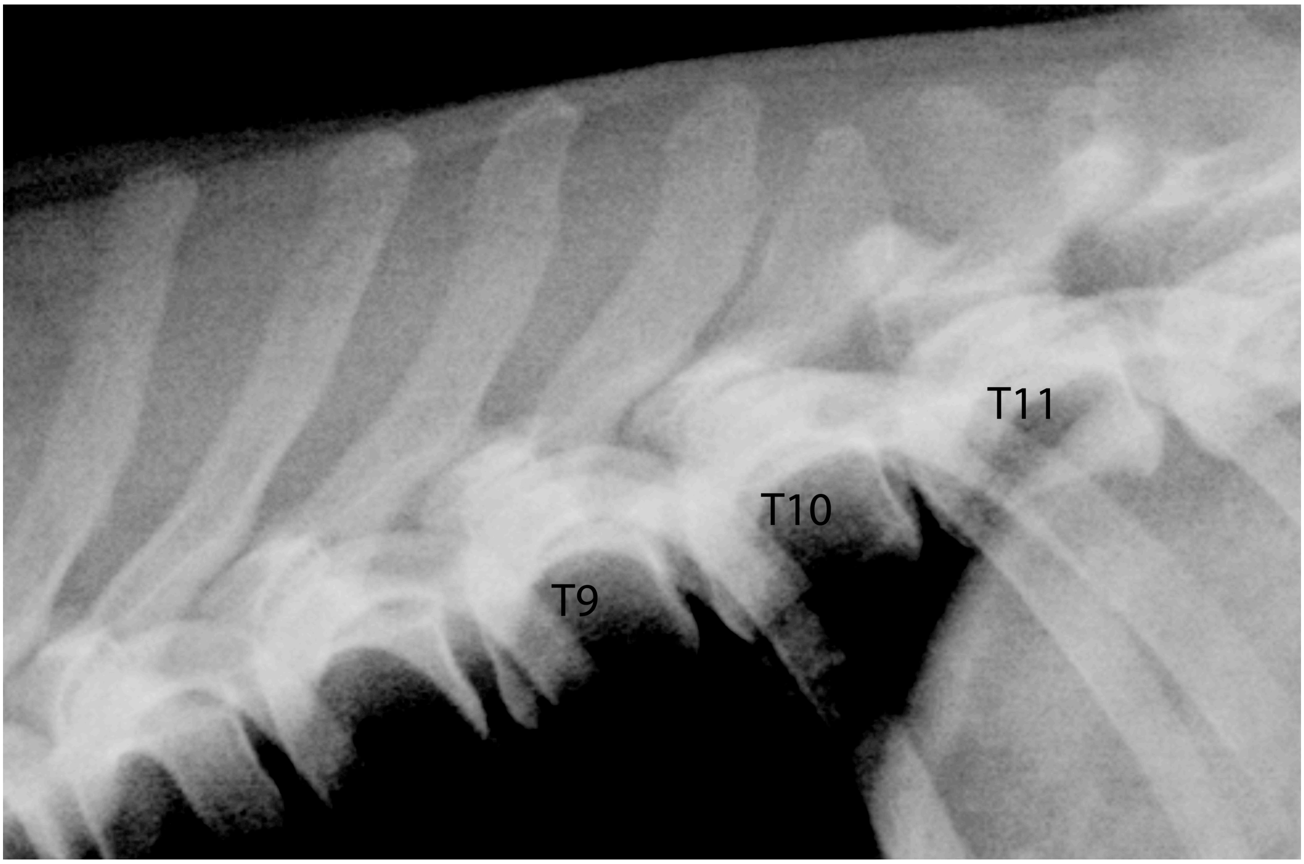
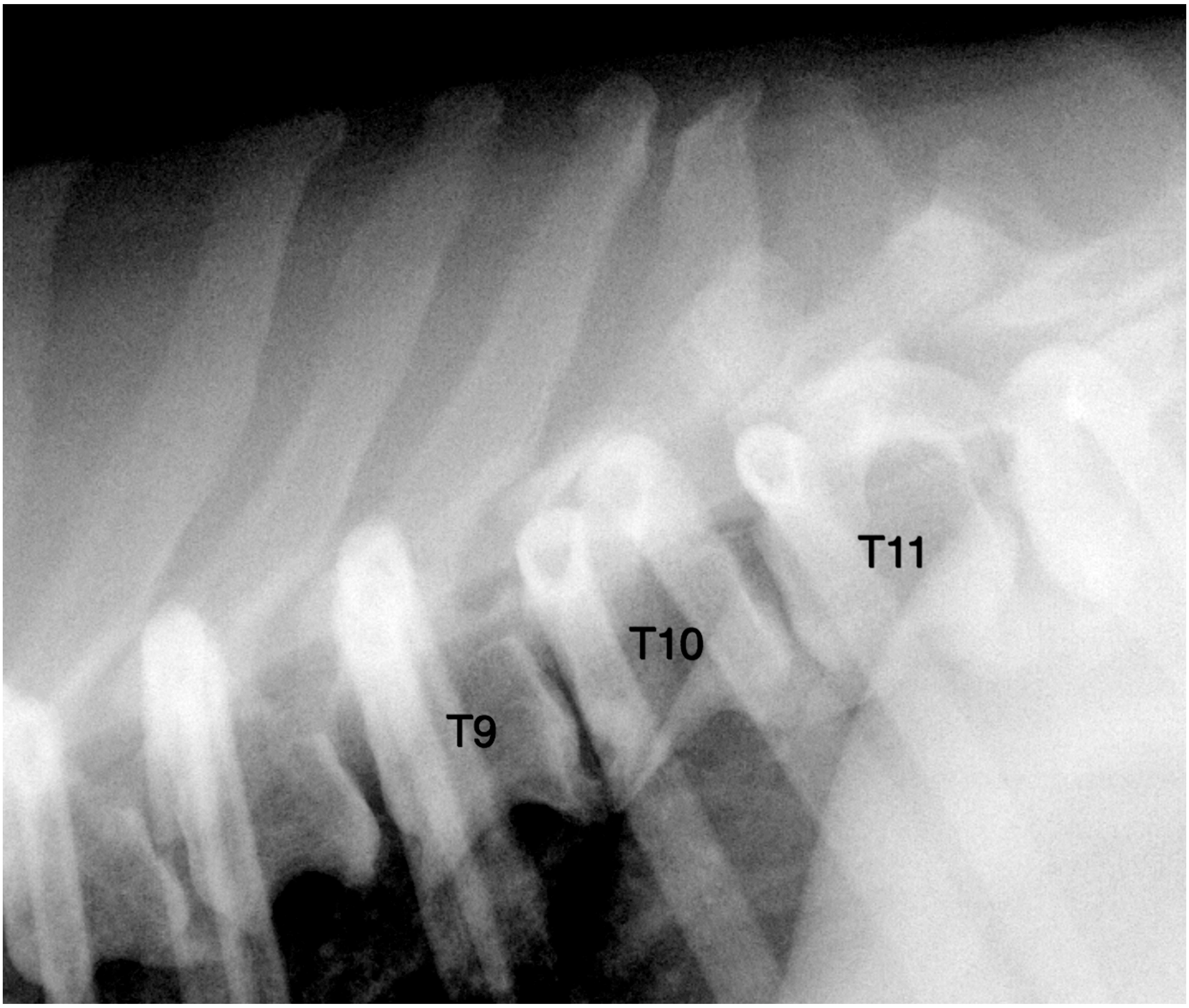
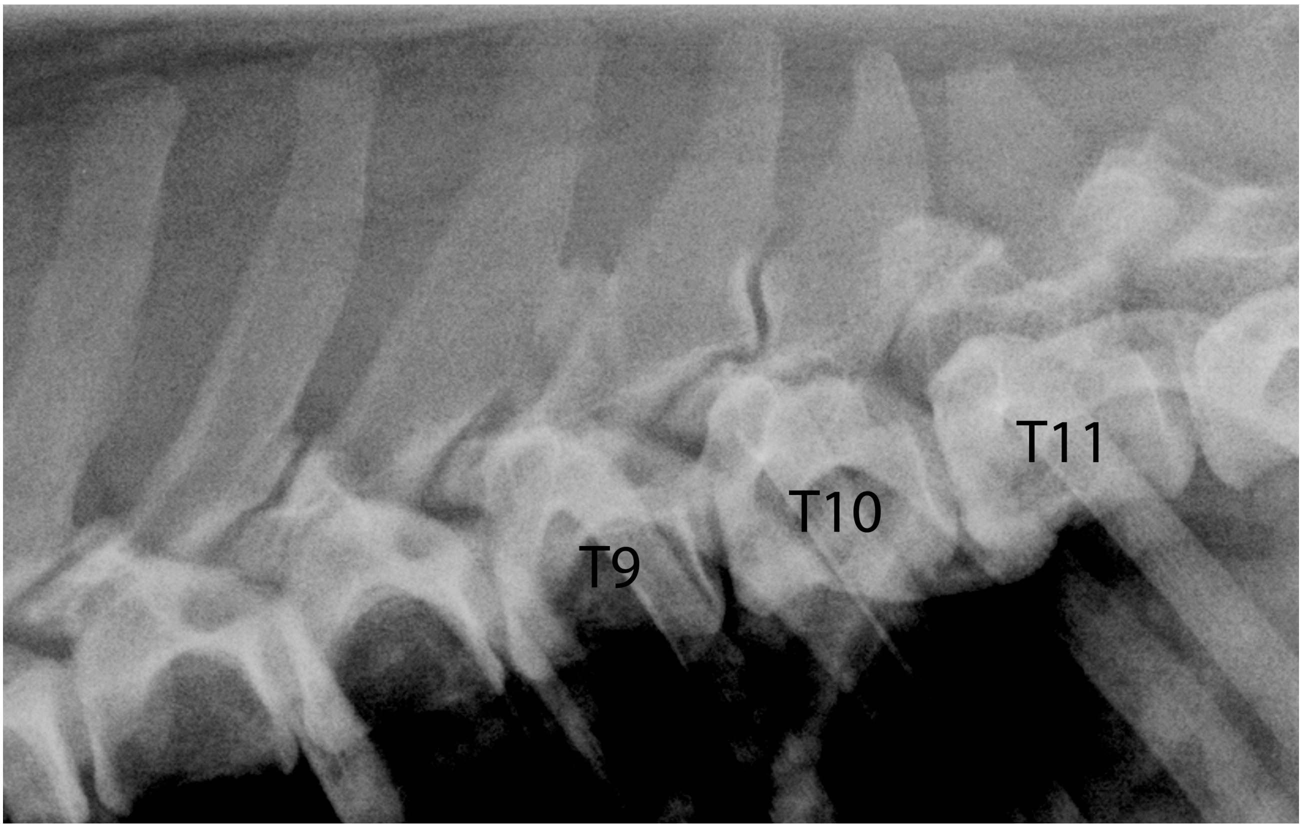


FIG. 1. (A) Impinged spinous process T9-T10 in a 6-year old female cocker spaniel (sclerosis: 1, radiolucency: 0, remodelling: 1, width: 1, severity index: 2);



(B) Impinged spinous process T9-T10 in a 4-year-old female boxer (sclerosis: 2, radiolucency: 0, remodelling: 2, width: 1, severity index: 4);



(C) Impinged spinous process T9-T10 in a 8-year-old male Labrador (sclerosis: 2, radiolucency: 0, remodelling: 2, width: 2, severity index: 4).

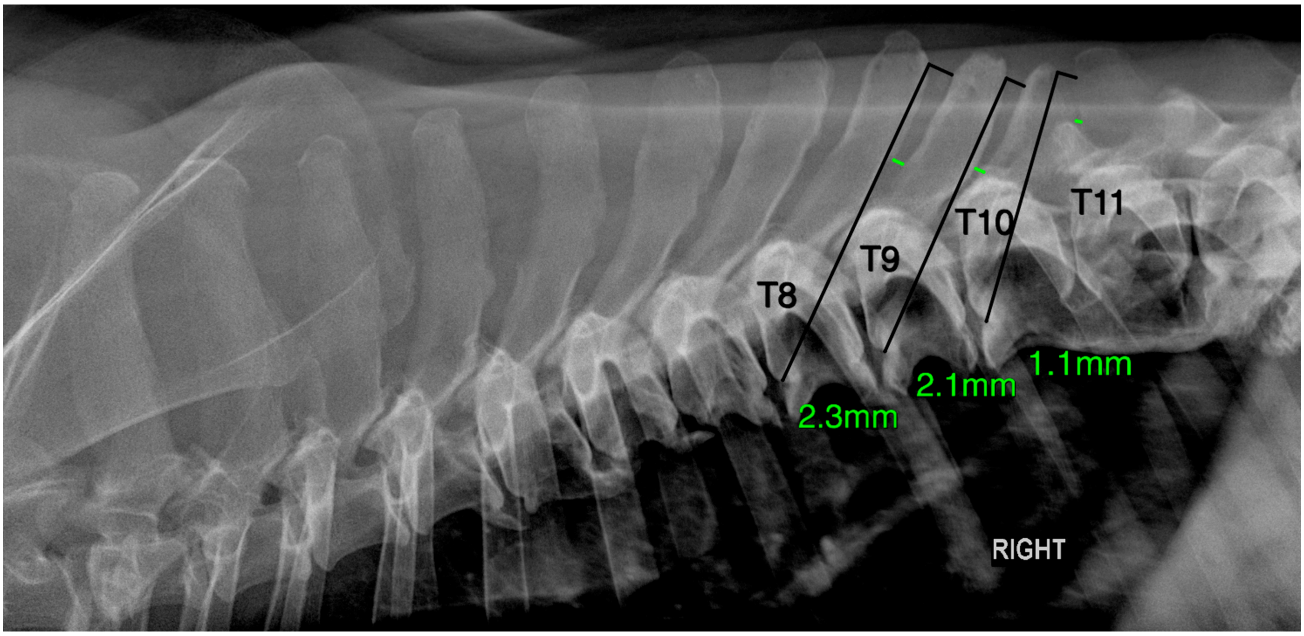


FIG. 2. Illustration of the method of measurement of interspinous width, for spaces T8-T9, T9-T10 and T10-T11. A line was drawn from the cranioventral border of the vertebral body to the caudal tip of its dorsal spinous process; a second line was drawn perpendicular (+/- 0.5 degree) to the first, at the tip of the dorsal

spinous process. The interspinous width was determined from a third line (green) parallel to the second, drawn at the narrowest point between the two spinous processes. Measurements were recorded to the nearest one-tenth of a millimetre.

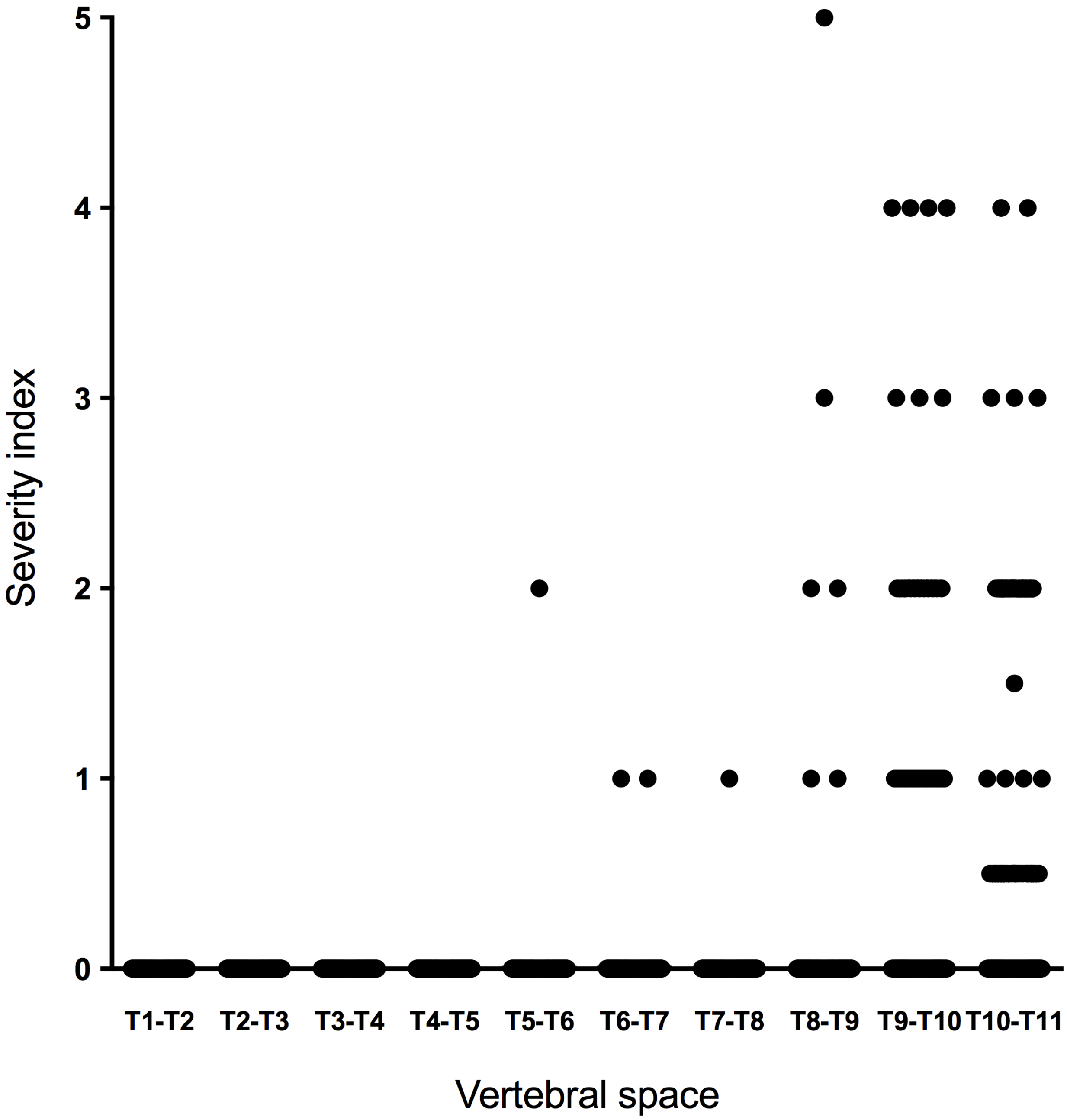


FIG. 3. Severity index for each pair of adjacent dorsal spinous processes from T1 to T11 in 190 dogs. Each dot represents one kissing spine lesion. Samples exceeding four lesions are represented by thick lines.

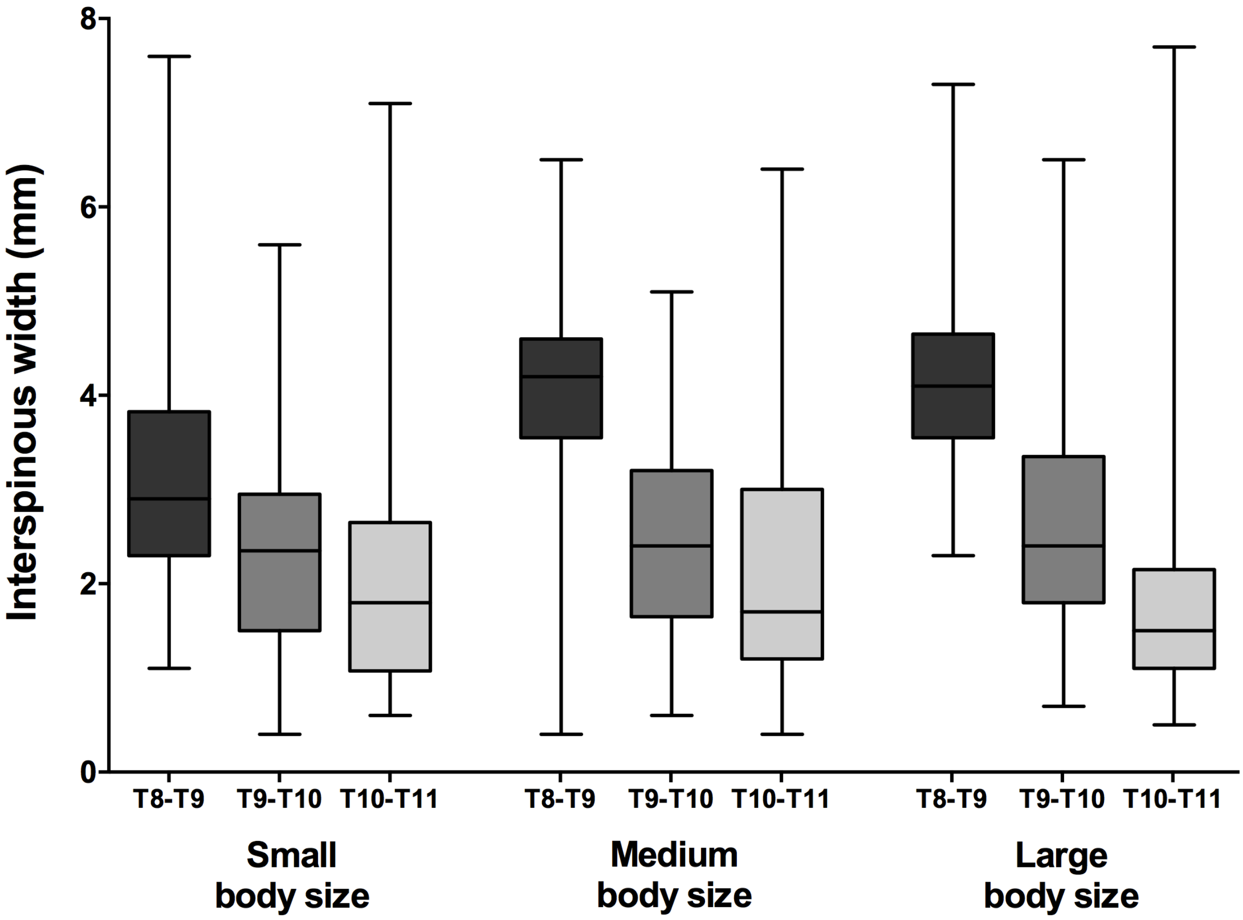


FIG. 4. Box plots of the interspinous width for spaces T8-T9, T9-T10, T10-T11 for small, medium and large body sizes (*N* = 173, medians, quartiles, range).