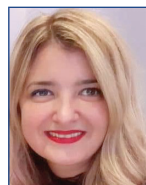


Radiological Assessment of DISH in the Lumbar and Lumbosacral Vertebrae of Dogs



Dženita Hadžijunuzović-Alagić and Nejra Hadžimusić*

Abstract

Diffuse idiopathic skeletal hyperostosis (DISH) is a non-inflammatory disorder characterised by extensive bony proliferation along the axial skeleton. This study evaluates the radiological features of DISH in the lumbar and lumbosacral vertebrae of dogs. Radiographic records from the University of Sarajevo, Faculty of Veterinary Medicine were analysed for dogs older than one year over a 12-month period. Thirteen cases of DISH were identified, predominantly in large breed dogs, with no cases observed in small breeds. Mixed-breed dogs, Labrador Retrievers, and Boxers were the

most frequently affected breeds, and incidence was highest in dogs aged 7–10 years. The hallmark radiographic findings included flowing calcifications along the ventrolateral aspects of at least four contiguous vertebral bodies, with preservation of disc height. The most pronounced changes were observed between the L3 and L4 vertebrae. These findings highlight the importance of recognising DISH as a distinct entity in veterinary practice to avoid misclassification as severe spondylosis.

Key words: *diffuse idiopathic skeletal hyperostosis; canine; lumbar and lumbosacral vertebrae*

Introduction

Variations in osteophyte formation signify two distinct disorders: spondylosis deformans (spondylosis) and diffuse idiopathic skeletal hyperostosis (DISH). Both disorders can be observed both independently and concurrently in humans and dogs (Kranenburg et al., 2011). Spondylosis, a non-inflammatory degenerative condition, involves new bone formation in the endplate region, producing osteophytes that range from small spurs to bony bridges (Kranenburg

et al., 2011). It is commonly observed in aging dogs, particularly German Shepherds and Boxers, which appear predisposed to this condition. Radiographic studies report its prevalence in 18 to 33% of dogs, while necropsy examinations indicate higher rates, ranging from 61 to 75% (Ortega et al., 2012). While usually clinically insignificant, severe spondylosis may reduce spinal flexibility, impairing activity in working dogs or causing nerve root compression, stiffness, and gait changes (Kranenburg et al., 2014). The precise mechanism is not fully understood, but it is

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believed to result primarily from age-related degeneration of the peripheral annulus fibres (Park et al., 2024).

DISH is relatively common in humans, with prevalence varying across geographical regions (Navarro and Buckberry, 2022). Identified risk factors in humans include the male sex, advanced age, obesity, type 2 diabetes mellitus, hypertension, and genetic predisposition (Kornmayer et al., 2013).

While DISH has been observed in several animal species (De Decker et al., 2015), it is increasingly diagnosed in dogs, with several case reports documenting the condition (Kranenburg et al., 2014). However, no definitive etiological factors for canine DISH have been identified. A genetic predisposition is suggested, as DISH seems to be prevalent in some breeds and absent in others (Kranenburg et al., 2011). The diagnosis of DISH in dogs is typically made through radiographic examination, although advanced imaging techniques such as CT and MRI are also used (Ortega et al., 2012). Morgan and Stavenborn (1991) noted that the radiographic and pathological features of canine DISH closely resemble extensive spondylosis, but identified significant differences in radiographic and morphological patterns. They found that vertebral osteophytes associated with spondylosis tended to be localised around individual degenerated discs, lacking the patterns of continuous bone growth spanning adjacent segments or dorsal peri-articular changes. They proposed that DISH in dogs might previously have been described as a variant of spondylosis. In the two cases of canine DISH they discussed, dogs exhibited orthopaedic and neurological abnormalities. In other cases, severe stiffness and pain in the axial and appendicular skeleton, likely related to DISH, were not responsive to treatment, leading to the decision of euthanasia (Kranenburg et al., 2014). Although three of the four cases previously reported by Kranenburg et al. (2011) also had comorbid

orthopaedic conditions, it is likely that the spinal new bone formation itself contributed to spinal pain and stiffness. Due to limited awareness of DISH in veterinary medicine, it may have been misdiagnosed as severe spondylosis (Kranenburg et al., 2010). This study aimed to investigate the breed, age, and sex associations with DISH in dogs.

Material and methods

Radiographic records of dogs older than one year, presented over a 12-month period to the University of Sarajevo, Faculty of Veterinary Medicine, Radiology Clinic, were reviewed for the diagnosis of diffuse idiopathic skeletal hyperostosis. A diagnosis of diffuse idiopathic skeletal hyperostosis (DISH) was confirmed based on specific radiographic findings. These included the presence of flowing calcification and ossification along the ventrolateral aspects of at least four contiguous vertebral bodies, which could appear with or without localised pointed excrescences at the junctions of vertebral bodies and intervertebral discs. Additionally, the relative preservation of disc height in the affected regions was a crucial criterion, with the absence of significant radiographic changes typically associated with degenerative disc disease, such as marginal sclerosis of the vertebral bodies. Importantly, the diagnosis required the exclusion of other conditions, as demonstrated by the absence of bony ankylosis in the apophyseal joints or any evidence of erosion, sclerosis, or intra-articular bony fusion in the sacroiliac joints (Kranenburg et al., 2011). The study involved 13 dogs of various ages and breeds (mixed breed, German Shepherd, Labrador Retriever and Boxer), and both sexes (Tables 1 and 2). Dogs were divided into four age groups: 1–2 years, 3–6 years, 7–10 years, >10 years. The localisation of radiologically diagnosed changes was assessed for each breed, covering the T13-S1 region. Native radiography was

performed on all dogs, utilising left lateral (LL) and ventrodorsal (VD) projections for detailed imaging.

Results

No cases of DISH were found in small breeds. The pathological changes

characteristic of DISH affected all the vertebrae of the lumbar and lumbosacral spine segments in large breed dogs. These changes were most frequently diagnosed from the L2 to L7 vertebrae, with the most pronounced pathological changes occurring between the L3 and L4 vertebrae.

Table 1. Breed and sex distribution diversity of radiologically diagnosed diffuse idiopathic skeletal hyperostosis (DISH) of the lumbar and lumbosacral spine in dogs (n=13). No cases of DISH were found in small breeds.

Breed*	Males		Females		Total	
	n	%	n	%	n	%
Mixed breed	2	15.38	3	23.08	5	38.46
German Shepherd	2	15.38	0	0.00	2	15.38
Labrador Retriever	0	0.00	3	23.08	3	23.08
Boxer	3	23.08	0	0.00	3	23.08
TOTAL	7	53.85	6	46.15	13	100

Table 2. Breed and age distribution of radiologically diagnosed diffuse idiopathic skeletal hyperostosis (DISH) of the lumbar and lumbosacral spine in large dogs (n=13). The disease was not diagnosed in any large breed dogs aged 1–2 years or in small breed dogs regardless of age.

Breed	Age						Total	
	3–6 years		7–10 years		>10 years			
	n	%	n	%	n	%	n	%
Mixed breed	1	7.69	3	23.08	1	7.69	5	38.46
German Shepherd	0	0.00	1	7.69	1	7.69	2	15.38
Labrador Retriever	0	0.00	2	15.38	1	7.69	3	23.08
Boxer	0	0.00	2	15.38	1	7.69	3	23.08
TOTAL	1	7.69	8	61.54	4	30.77	13	100.00

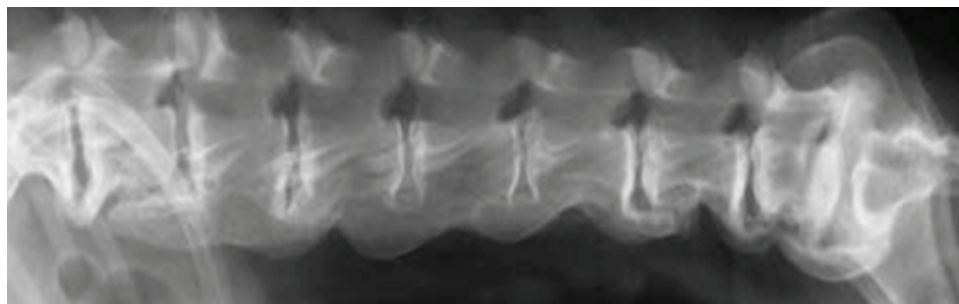


Figure 1. Native image of the lumbar and lumbosacral part of the spine of a dog in the lateral projection. Larger bony bridges are highlighted ventrally on the vertebral bodies, firmly connecting them to each other (DISH).



Figure 2. In the lateral projection of the lumbar spine of a dog, prominent bony bridges clearly connect the bodies of the lumbar vertebrae (DISH)

The diagnosis of diffuse idiopathic skeletal hyperostosis (DISH) was assigned in cases of continuous bony bridging of multiple vertebrae (Fig. 1, 2).

Discussion

It is noteworthy that DISH was not diagnosed in any small breed dogs, and of the total 13 cases of DISH, it was most frequently diagnosed in mixed-breed dogs ($n=5$; 38.46%), followed by three cases each of Boxers and Labrador Retrievers (23.08% each), and two German Shepherds (15.38%). Regarding age, DISH was most commonly diagnosed in dogs aged 7–10 years (61.54%), while no cases were found in dogs aged 1–2 years, with only one

mixed-breed dog in the 3–6 year age group (7.69%). Among dogs older than 10 years, one case each was recorded in mixed-breed dogs, German Shepherds, Labrador Retrievers, and Boxers ($n=4$; 30.77%). The pathological changes characteristic of DISH were localised in all vertebrae of the lumbar and lumbosacral segments of the spine. The most frequently diagnosed cases were from vertebrae L2 to L7, with the most pronounced pathological changes observed between vertebrae L3 and L4.

DISH is a systemic disorder of the axial and peripheral skeleton in humans, and until recently, it was only incidentally described in dogs (Kranenburg et al., 2010). In dogs, DISH has rarely been documented, with reports

of severe axial stiffness and pain leading to euthanasia (Morgan and Stavenborn, 1991). Those authors proposed that DISH in dogs has been identified as a severe form of spondylosis. This hypothesis was supported by many subsequent studies, which examined and described these conditions in greater detail and frequency in veterinary medicine. DISH and severe spondylosis share several clinical and radiographic characteristics (Langeland and Lingaas, 1995; Carnier et al., 2004; Kranenburg et al., 2011). However, despite these similarities, the two disorders exhibit distinct radiographic features, which can sometimes make differentiation challenging (Kranenburg et al., 2014).

Since DISH is still relatively unknown in veterinary practice, it is likely that many cases of this pathological change in earlier radiographic studies were classified as spondylosis deformans cases (Kranenburg et al., 2010; 2011; Morgan and Stavenborn, 1991). A case report (Ciepluch et al., 2015) described a dog with DISH presenting both ventral spinal new bone formation and pseudarthroses of several spinal processes. The dog was managed with oral NSAIDs for two years until mobility was severely impaired, at which point euthanasia was elected by the owners.

Kranenburg et al. (2010, 2011) conducted two retrospective radiographic studies on DISH in dogs. The first study included radiographs of 2041 dogs collected between 2003 and 2008, while the second was descriptive in nature, aimed at describing the imaging and post-mortem pathological and histopathological characteristics of the disease in four dogs. In the first study, the overall prevalence of DISH was 3.8%. The study reported an average age of 7.2 years (range 1–17 years) for a DISH diagnosis in dogs, with the 6–10 year age group accounting for the highest proportion of cases (51.28%), which is consistent with our finding that the disease was most prevalent in the 7–10 year age group (61.54%; Table 2). Furthermore, our study (Table 1) found that DISH was more

common in male (53.85%) than female dogs (46.15%), which is also consistent with the Kranenburg et al. (2010) study, which reported an incidence of 57.69 vs. 42.31% in male and female dogs, respectively. The present study focused on the lumbar and lumbosacral regions of the spine, and DISH was diagnosed in all lumbar and lumbosacral vertebrae, with the most intense changes observed between L2 and L7. Kranenburg et al. (2010) included radiographs of the entire spine, and of the 78 DISH cases, pathological changes in the lumbar and lumbosacral segments of the spine were observed in 24 dogs, or 30.77% of DISH cases. Our study identified DISH in three cases among Boxers (Table 1). Research suggests that the significantly higher prevalence of DISH in Boxer dogs (40%) compared to other breeds (4%) may point to a potential genetic predisposition for the development of the condition (Kuperus et al., 2020). Similar findings were reported by Kranenburg et al. (2010), who documented a 40.6% prevalence of DISH in Boxers. Although the number of Boxers examined in our study was small, the fact that DISH was found in three-fifths of all examined Boxers supports the findings of Kranenburg et al. (2010; 2011), and other authors (Morgan and Stavenborn, 1991; Langeland and Lingaas, 1995; Carnier et al., 2004).

DISH was diagnosed in cases of continuous bony bridging of three or more adjacent vertebrae, as shown in Figures 1 and 2. DISH appears to be a common ossifying condition in large and giant breeds, characterised by bony hyperostosis at tendon and ligament attachment sites, both axial and extra-axial. The most extensive manifestation involves widespread spinal osteophyte formation, while localised bony growths at extra-axial sites are less pronounced. It is believed that these two patterns represent different extremes of the same disease spectrum. While the changes associated with DISH may also be present in smaller dogs, they are likely to be milder and more localised (Oh et al., 2015). In humans,

DISH is recognised as a predisposing factor for spinal fractures and severe spinal cord injuries following minor trauma (Callahan and Aguillera, 1993; Belanger and Rowe, 2001). A recent case of a Weimaraner with DISH reported a fracture of the hyperostotic bony bridge and vertebral subluxation of L2-L3, which was stabilised with standard vertebral body plating. Two years later, the dog presented with a fracture of the cranial end-plate and right facet joint distal to the previously stabilised segment (L4-L5), which was stabilised using a second vertebral plate (Kornmayer et al., 2013). This case suggests that, similar to humans, dogs with DISH may be predisposed to spinal fractures.

Conclusion

This study highlights diffuse idiopathic skeletal hyperostosis (DISH) as a distinct and under-recognised condition in large breed dogs, with characteristic radiological changes localised to the lumbar and lumbosacral spine. The findings emphasise the importance of precise radiographic evaluation to differentiate DISH from other spinal pathologies, ensuring appropriate diagnosis and management. The predominance of the condition in specific breeds and age groups suggests a potential genetic predisposition and emphasises the need for further research to elucidate the underlying mechanisms and clinical consequences of DISH in dogs. Raising awareness of this condition among veterinary practitioners could aid in its timely recognition and treatment.

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Radiološka procjena DISH-a u lumbalnim i lumbosakralnim pršljenima pasa

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Difuzna idiopatska skeletna hiperostoza (DISH) je neupalni poremećaj obilježen opsežnom koštanom proliferacijom duž aksijalnog skeleta. Ovo istraživanje procjenjuje radiološke karakteristike DISH-a u lumbalnim i lumbosakralnim pršljenovima pasa. Analizirani su radiološki nalazi s Veterinarskog fakulteta Univerziteta u Sarajevu za pse starije od jedne godine tijekom razdoblja od 12 mjeseci. Identificirano je trinaest slučajeva DISH-a, pretežno u pasa velikih pasmina, dok u malih pasmina nisu zabilježeni slučajevi. Križanci, labrador retriveri i bokseri bile su najčešće pogo-

đene pasmine, s najvećom učestalošću u pasa u dobi od 7 do 10 godina. Ključni radiološki nalazi uključivali su kontinuirane kalcifikacije duž ventrolateralnih aspekata najmanje četiri uzastopna kralješka, uz očuvanje visine diskova. Najizraženije promjene uočene su između kralježaka L3 i L4. Ovi nalazi naglašavaju važnost prepoznavanja DISH-a kao zasebnog entiteta u veterinarskoj praksi da bi se izbjegla pogrešna klasifikacija kao teška spondiloza.

Ključne riječi: *difuzna idiopatska skeletna hiperostoza, psi, lumbalni i lumbosakralni pršljeni*