

Spondylosis deformans and diffuse idiopathic skeletal hyperostosis in dogs: a radiographic study

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The study involved eight dogs presented with a history of progressive pelvic limb ataxia, paraparesis or paraplegia, spinal hyperesthesia, back pain, and difficulty in walking or climbing stairs. Radiographic examinations were performed on all dogs. Based on clinical and radiographic findings, seven dogs (five males and two females) were diagnosed with spondylosis deformans (SD), while diffuse idiopathic skeletal hyperostosis (DISH) was diagnosed in a 9-yr-old male non-descript dog. Large-breed dogs were more commonly affected. The diagnosis of SD was established using a four-point grading system that assessed the degree of enthesophyte development at each site. In contrast, DISH was identified by the presence of extensive bony outgrowths along the vertebrae, resulting in spinal stiffness and pain. DISH can be differentiated from SD by the location and extent of new bone formation, particularly its involvement of the ventral longitudinal ligament.

Keywords: Diffuse Idiopathic Skeletal Hyperostosis, Dog, Enthesophytes, Spondylosis deformans, Radiography

Spondylosis deformans (SD) is a non-inflammatory condition characterized by the formation of bony projections at the vertebral sites where the annulus fibrosus attaches to the cortical surface of adjacent vertebral bodies. It is a common finding in dogs, particularly in older individuals (Morgan *et al.*, 1967; Morgan, 1967). Although these bony proliferations are often referred to as osteophytes, the more accurate term in the context of SD is enthesophytes (Widmer and Thrall, 2013). The condition is distinguished by new bone formation adjacent to the intervertebral disc space, typically along the ventral and lateral aspects of the vertebral bodies within the endplate region (Kranenburg, 2010). SD most frequently affects the thoracolumbar and lumbosacral regions of the spine (Morgan *et al.*, 1967; Morgan, 1967; Levine *et al.*, 2006). In most dogs, SD is considered to have limited clinical significance; however, it has been suggested that it may reduce spinal mobility. Clinical signs such as back stiffness, lameness, altered gait, and pain have been reported, and a possible association with intervertebral disc protrusion has been proposed (Morgan *et al.*, 1967; Belanger and Rowe, 2001; Carnier *et al.*, 2004; Levine *et al.*, 2006; Olivieri *et al.*, 2007; Westerveld *et al.*, 2009; Verlaan *et al.*, 2011).

Similar to SD, diffuse idiopathic skeletal hyperostosis (DISH) is a non-inflammatory systemic

disorder characterized by ossification of soft tissues, including ligaments, tendons, and joint capsules at their attachment sites (entheses). In dogs, DISH is typically identified by generalized new bone formation that appears as flowing ossification along the ventral and lateral aspects of the vertebral column, attributable to its trabecular pattern (Woodard *et al.*, 1985; Kranenburg, 2010). Historically, DISH was poorly defined in dogs and may have been misdiagnosed as severe spondylosis on radiographic examination (Kranenburg, 2010; Morgan and Stavenborn, 1991). In contrast to SD, the osseous proliferation in DISH is more extensive and pronounced (Kranenburg *et al.*, 2011). Although animals affected with either SD or DISH may exhibit mild to moderate vertebral stiffness, pain, and reluctance to move, both conditions can be reliably diagnosed through thorough radiographic and, when necessary, histopathological evaluation (Morgan *et al.*, 1967; Morgan, 1967; Read and Smith, 1968; Langeland and Lingaas, 1995; Carnier *et al.*, 2004; Olivieri *et al.*, 2007).

The present study was conducted to evaluate the radiographic diagnosis of spondylosis deformans (SD) and diffuse idiopathic skeletal hyperostosis (DISH) in dogs.

Materials and Methods

The study was conducted on eight dogs presenting with a history of back stiffness, lameness, altered gait, difficulty in climbing stairs, pain, and hindquarter weakness. Patient data, case history, and clinical signs exhibited by each dog were systematically recorded (Table 1).

Radiographic examination was done to evaluate bony abnormalities of the vertebral column. Lateral view radiographs were obtained in all cases, while ventrodorsal views were taken in selected cases (Figs. 1-4). The radiographic diagnosis of spondylosis deformans (SD) was established based on the degree of enthesophyte development at each vertebral site, using a four-point grading system: Grade 0 (no ossification), Grade I (mild spondylosis; bony spur not extending beyond the caudal or cranial edge of the vertebral border), Grade II (moderate spondylosis; bony spur extending beyond the caudal or cranial edge of the vertebral border), and Grade III (severe spondylosis; presence of one or two non-flowing and/or contiguous bony bridges).

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Table 1: Signalment, clinical findings, and radiological signs of spondylosis deformans (SD) and diffused idiopathic spinal hyperostosis (DISH) in dogs.

Breed	Age	Sex	Body Weight	Clinical Signs	Radiological finding with Grade
German Shepherd	4 yr	M	22 kg	Paraparesis/pelvic limb ataxia and unable to climb stairs	SD-Grade 1
German Shepherd	1.5 yr	M	20 kg	Uncoordinated movement, head pressing, prolong paw replacement reflex.	SD-Grade 2
Labrador	5 yr	M	15 kg	Stiff gait, urinary and faecal incontinence, absent anal sphincter and tail tone with spinal hyperaesthesia.	SD-Grade 3
Dachshund	8 yr	M	28 kg	Severe pain at lumbar region, urine and faecal incontinence, recumbency	SD-Grade 3
Beagle	4 yr	F	10 kg	Stiffness, urinary and faecal incontinence, unable to clean perineal region, and painful on palpation of lumbar spine	SD-Grade 3
Pug	6 yr	M	9 kg	Paraparesis/pelvic limb ataxia and caudal lumbar pain	SD-Grade 3
Non-descript	5 yr	F	19 kg	Paraplegic, continuous urine dribbling, hyperaesthesia at lumbosacral region	SD-Grade 3
Non-descript	9 yr	M	13 kg	Paraplegic, muscular atrophy and pain on hyper-extension at vertebral region	DISH

Results and Discussion

The signalment, clinical findings, and radiological features of spondylosis deformans (SD) and diffuse idiopathic skeletal hyperostosis (DISH) in dogs are presented in table 1. Based on radiographic examination, SD was diagnosed in seven dogs, while one 9-yr-old male non-descript dog was diagnosed with DISH. SD was more frequently observed in male dogs (n=5) compared to females (n=2). The affected breeds included German Shepherd (n=2), non-descript (n=2), and one case each in Labrador, Dachshund, Beagle, and Pug. The age of the dogs ranged from 1.5 to 9 yr, with body weights ranging from 9 to 28 kg. Spondylosis is generally more prevalent in ageing dogs and shows a breed predisposition, particularly in German Shepherds and Boxers (Morgan *et al.*, 1967; Morgan, 1967; Read and Smith, 1968; Langeland and Lingaas, 1995; Carnier *et al.*, 2004).

All dogs had a history of progressive pelvic limb ataxia and paresis, accompanied by spinal hyperaesthesia. Two of the eight dogs were paraplegic (Cases 7 and 8). Clinical examination revealed back pain, difficulty in walking and climbing stairs, and varying degrees of nerve root involvement. Radiographic findings showed the presence of new bony spurs at multiple levels of the vertebral column. Previous studies have indicated that the extensive and exuberant new bone formation observed in dogs with DISH may displace and compress adjacent soft tissues, such as the ventral lumbar musculature, to a greater extent than the bony spurs or bridges seen in spondylosis deformans, thereby resulting in more pronounced pain (Kranenb-urg *et al.*, 2011; Ortega *et al.*, 2012). Additionally, involvement of the innervated periosteum in DISH may further contribute to the manifestation of spinal pain.

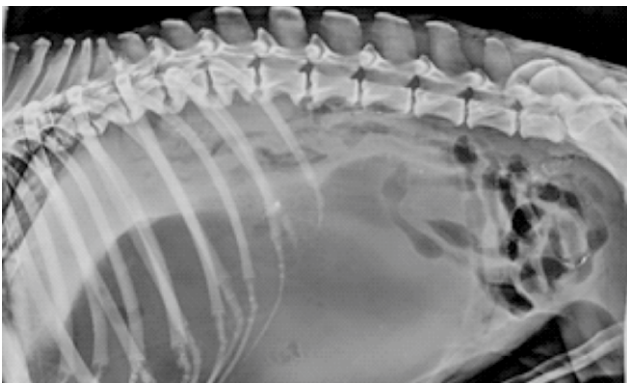


Fig. 1: Lateral radiograph of Case 1, demonstrating spondylosis deformans, Grade 1 (white arrow)-bony spur not protruding beyond the caudal/cranial edge of the vertebral border of T9-T13, and L1-L3.

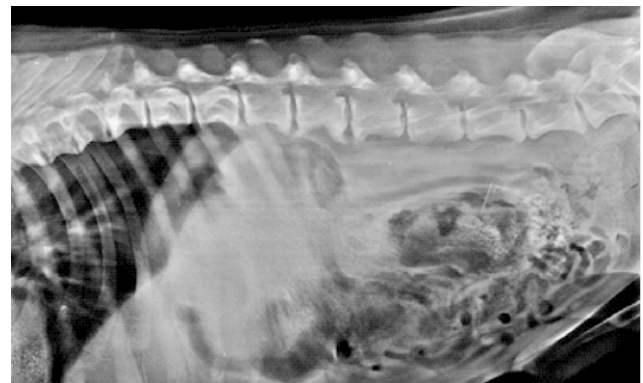


Fig. 2: Lateral radiograph of Case-2 demonstrating Spondylosis deformans, Grade 2 (white arrow)-bony spur protruding beyond the caudal/cranial edge of the vertebral border of L1-L3 and T8-T11.

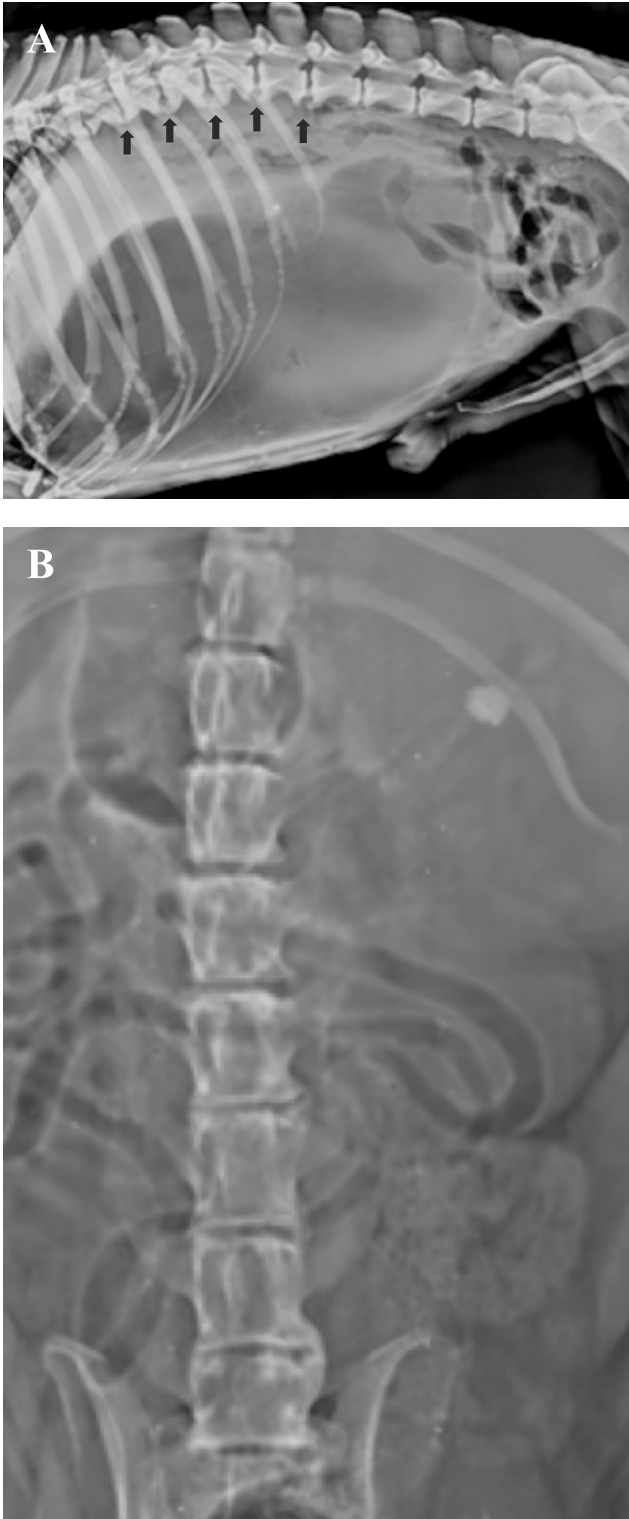


Fig. 3: Lateral (A) and ventro-dorsal (B) radiographs of Case-4 demonstrating spondylosis deformans, Grade 3 (arrow)- enthesophytes bridging are located on the ventral aspect of the vertebral bodies of L1-L7.

The radiographic examination also revealed that the dogs diagnosed with SD showed varying degrees of spinal fusion and bony outgrowths. Based on the 4-

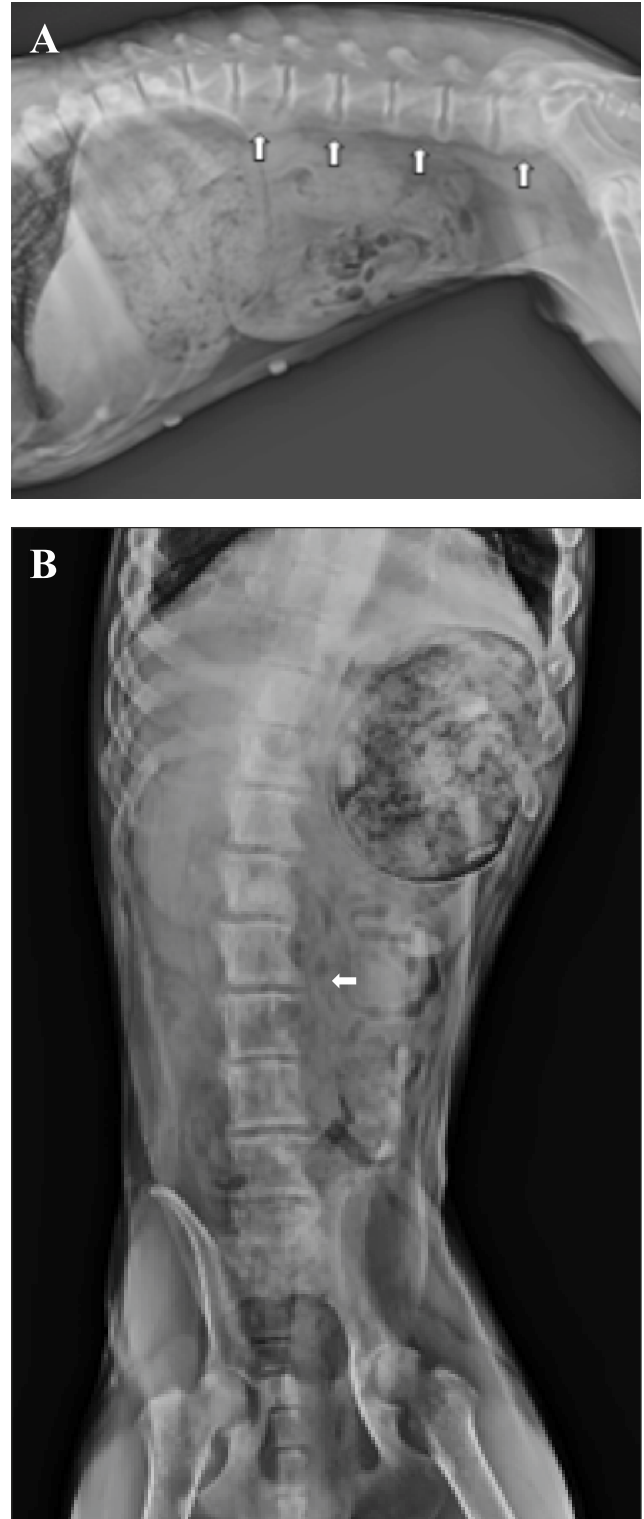


Fig. 4: Lateral (A) and ventro-dorsal (B) radiographs of Case-8 demonstrating (arrows) the newly formed bone DISH present along the ventral aspect of lumbar vertebrae(L1-L7) and (L7- Sacrum). Due to stiffness and back pain left vertebral curvature was also seen.

point grading system, mild and moderate form of SD was seen in one dog each, whereas, severe form of SD was recorded in five dogs. Morgan and Stavenborn

(1991) stated that intervertebral disc space obliteration caused by the pseudoarthroses due to new bone formation causes severity in condition.

The dog diagnosed with DISH on radiographic examination exhibited reduced mobility and discomfort associated with excessive new bone formation along the ventral aspect of the lumbar vertebrae (L1-L7), appearing as a flowing pattern parallel to the longitudinal ligament (Fig. 4). This extensive ossification resulted in restricted spinal mobility and pain. These findings underscore the occurrence of degenerative spinal disorders in dogs. Consistent with the observations of Kranenburg *et al.* (2011), the presence of flowing ossification spanning at least four contiguous vertebral bodies is considered a key radiographic feature of DISH in dogs. Similarly, Kranenburg (2010) reported a comparable case in an 8-year-old male Boxer with DISH affecting the last four lumbar and the first sacral vertebra.

Earlier studies on canine vertebral hyperostosis did not clearly differentiate between SD and DISH (Morgan, 1967; Read and Smith, 1968; Wright, 1982; Langeland and Lingaas, 1995; Carnier, 2004). In those reports, all forms of bridging ossification were generally classified as severe spondylosis. Although radiographic differentiation between DISH and advanced SD can be challenging, the two conditions exhibit distinct imaging characteristics (Morgan and Stavenborn, 1991; Kranenburg, 2010). In DISH, at least four contiguous vertebral bodies typically demonstrate continuous new bone formation along the ventral aspect, resulting from enthesophyte development involving the ventral longitudinal ligament (Resnick and Niwayama, 1976).

From the present study, it can be concluded that the radiographic features of SD and DISH are often similar. However, the presence of bridging ossification involving more than four continuous vertebral bodies along the ventral surface is considered diagnostic of DISH.

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