

Four Leg News

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Factors in Caudal Cervical Spondylomyelopathy

This started from getting to meet my favourite researcher, Ronaldo da Costa. But it was also a great way for me to get caught up on all of the new Wobbler's research as well. I've chosen to divide the articles into two newsletters. So, this one contains a bit of Background, Etiology & Pathology, New Places to look for a problem, and Gait Analysis of affected canines. Enjoy the read!



Laurie Edge-Hughes & Ronaldo da Costa – Surrey, UK - 2019

A wee bit of background...

Caudal Cervical Spondylomyelopathy (CSM) is generally considered a multifactorial disorder in which caudal cervical spinal cord compression is caused by protrusion of one or more intervertebral discs. This can be seen in combination with vertebral abnormalities and ligamentum flavum hypertrophy, and is more common in medium to large dog breeds. The intervertebral disc spaces between the sixth and seventh (C6-C7) and the fifth and sixth (C5-C6) cervical vertebrae are most often affected. A diagnosis of DA-CSM (disc-associated caudal cervical spondylomyelopathy) can be established by myelography, CT myelography or MRI.¹ [...but only in conjunction with a physical neurological exam!]

1. De Decker S, da Costa RC, Volk HA, Van Ham LM. Current insights and controversies in the pathogenesis and diagnosis of disc-associated cervical spondylomyelopathy in dogs. Vet Rec. 2012 Nov 24;171(21):531-7.

*Research is to see
what everybody else
has seen, and to think
what nobody else has
thought.*
-Albert Szent-Gyorgyi

Etiology & Pathology

Is the condition genetic? Little evidence exists to suggest that this is the case. Dobermans are overly represented. However, no correlation was found between several conformational dimensions and radiographic evidence of CSM. There is also little evidence to support the hypothesis that nutritional factors are a possible cause for CSM.¹

Might shape of the facet joints might play a factor? Large breed dogs have more concave facet joints in the caudal cervical spine, which may allow for greater axial rotation.²

When comparing Dobermans and Great Danes, it was found that Dobermans had a higher proportion of concave articular surfaces than Great Danes, however, there were no differences in the angle, shape or position of the articular processes between normal and affected dogs in either group. As such, their relevance may not be contributory to CSM.³

How does stenosis play a role? Several studies have compared the morphometric dimensions of



the cervical vertebral column between Dobermans and other dog breeds, and between clinically normal and clinically affected Dobermans. The results of these studies suggest a potential role of pre-existent relative vertebral canal stenosis for the development of Disc Associated-CSM. In relative vertebral canal stenosis, the vertebral canal is smaller than what would be expected normally. This results in a decreased space between the spinal cord and the vertebral canal. There is evidence that in clinically affected Dobermans their vertebral canal is narrow over the entire cervical and even the cranial thoracic region, suggesting a more generalized vertebral canal stenosis.¹

Does the percentage of space that the spinal cord occupies within the spinal canal have an effect on symptomatic CSM? A study that compared Dobermans, Great Danes and small-breed dogs found that the mean percentage of the vertebral canal occupied by the spinal cord was greatest for small-breed dogs and lowest for Great Danes, but did not differ between Doberman Pinschers and small-breed dogs at approximately half of the locations evaluated or between Doberman Pinschers with and without CSM or between Great Danes with and without CSM. As such it was concluded that a higher percentage of occupancy of the spinal cord within the spinal canal is not a primary causal factor in development of CSM.⁴

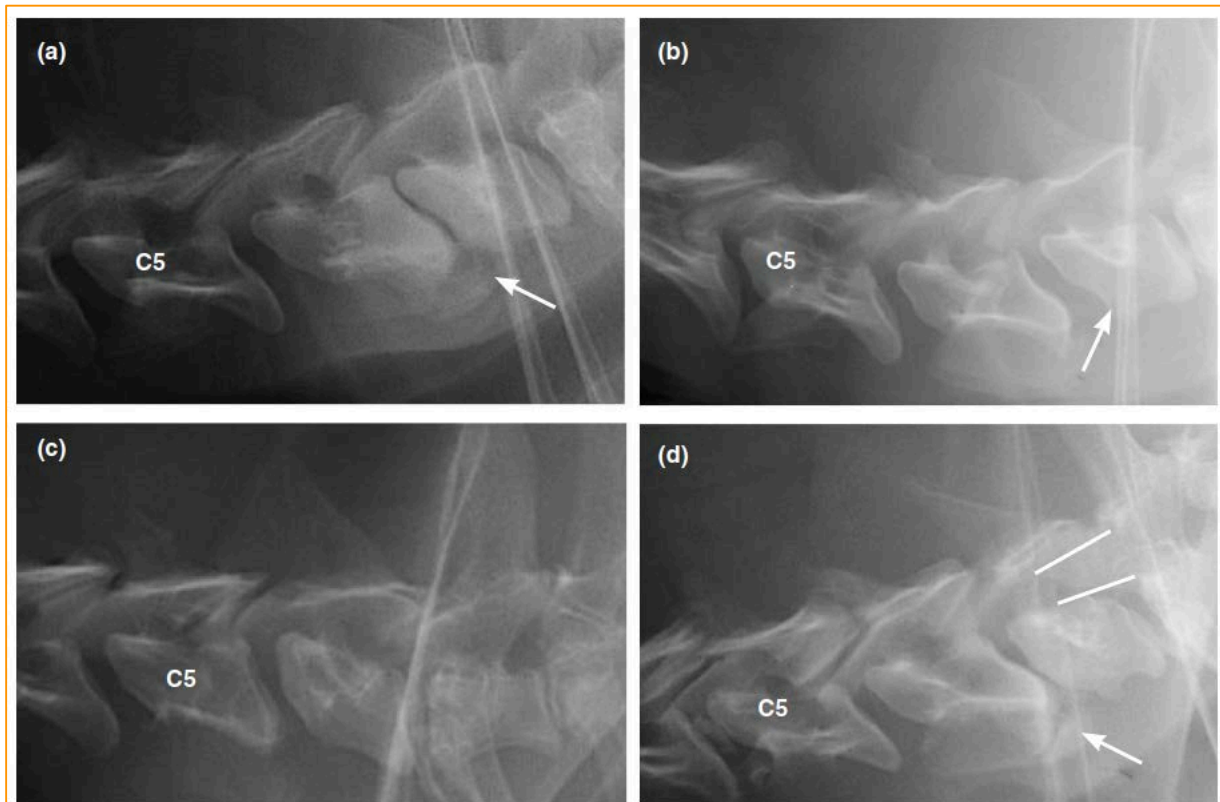


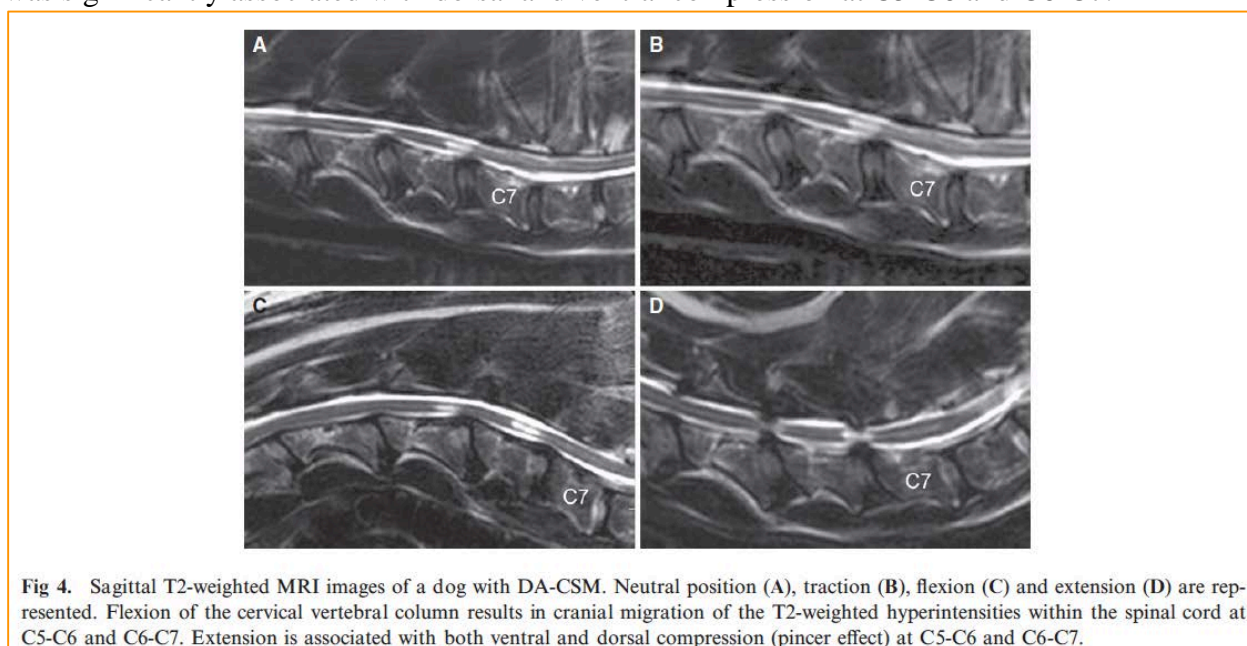
FIG 1: Radiographic abnormalities in four different dogs with disc-associated cervical spondylomyelopathy (a) Collapsed intervertebral disk space at C6-C7 (arrow) with sclerosis of the vertebral endplates and increased opacity of the vertebral bodies. Spondylosis deformans ventral to intervertebral disk space at C6-C7. (b) Abnormal shape of the vertebral body at C7, consisting of flattening of the cranioventral border (arrow). (c) Abnormally positioned vertebral body at C6 with craniodorsal tilting into the vertebral canal. Collapsed intervertebral disk space at C6-C7. (d) Funnel-shaped vertebral canal at the level of C7 (indicated by lines) leading to a narrowed cranial orifice. Spondylosis deformans ventral to intervertebral disk space at C6-C7 (arrow). Narrowed intervertebral disk space at C6-C7

What about the shape of the vertebra itself? In a study that evaluated shape of vertebra and the vertebral canal in normal English Foxhounds and Dobermans (both affected and non-affected), Doberman Pinschers with Disc Associated-CSM had significantly smaller vertebral canal heights and more square-shaped vertebral bodies, compared with unaffected Doberman Pinschers, combined with a funnel-shaped vertebral canal at C7.⁵

What about width of the disc? Dobermans clinically affected by CSM were demonstrated to have wider disc spaces.⁶ It was suggested that these wider intervertebral discs could potentially be at higher risk of herniation and that the volume of disc protrusion into the already narrowed, vertebral canal would be relatively higher than that of clinically normal dogs.¹ However, a newer study found that there was no evidence that wider intervertebral discs are associated with clinical status in dogs with and without DA-CSM. Instead, it seems that cervical intervertebral disk width in dogs is positively associated with increase in age.⁷

Is it just as simple to say that dogs affected with CSM have spinal cord compression? Yes and no! Severe degenerative changes can be seen in clinically normal dogs, while some MRI studies of dogs with DA-CSM demonstrate only mild imaging abnormalities.^{6, 8} In one study, 17 per cent of clinically normal dogs were categorized, based on the interpretation of low-field MRI studies, as suspected to be clinically affected and 10 per cent of dogs with DA-CSM were categorized as suspected to be clinically normal.⁸ This highlights the importance of evaluating imaging studies in the light of thorough neurological examination findings.

Is it more of a dynamic lesion then? Maybe, in part. To speculate on that, it's likely important to know what happens to the spinal canal with movement. Cervical vertebral canal diameter decreases significantly with extension as well as compression and increased with flexion and also with traction.⁹ It's also important to know what happens to the intervertebral foramina with movement. Extension and compression tend to decrease all foraminal dimensions significantly, whereas flexion increased all the foraminal dimensions significantly. Traction increased the foraminal height, but did not significantly change the foraminal width.¹⁰ Thus dynamic impingement may play a role in caudal cervical spondylomyelopathy. When evaluating 9 Dobermans with CSM using a kinetic MRI, the following was found: Flexion was associated with improvement or resolution of spinal cord compression in 4/9 patients, whereas extension caused worsening of compressions in 6/9 patients. Extension identified 6 new compressive lesions and was significantly associated with dorsal and ventral compression (pincer effect) at C5-C6 and C6-C7.¹¹



1. De Decker S, da Costa RC, Volk HA, Van Ham LM. Current insights and controversies in the pathogenesis and diagnosis of disc-associated cervical spondylomyelopathy in dogs. *Vet Rec.* 2012 Nov 24;171(21):531-7.
2. Breit S, Künzel W. Shape and orientation of articular facets of cervical vertebrae (C3-C7) in dogs denoting axial rotational ability: an osteological study. *Eur J Morphol.* 2002 40:43–51.
3. Bonelli MA, da Costa RC, Martin-Vaquero P, Lima CG. Comparison of angle, shape, and position of articular processes in Dobermans and Great Danes with and without cervical spondylomyelopathy. *BMC Vet Res.* 2017 Mar 24;13(1):77.
4. de A Bonelli M, da Costa RC. Comparison of the percentage of the C3-C7 vertebral canal occupied by the spinal cord in small-breed dogs with that in Doberman Pinschers and Great Danes with and without cervical spondylomyelopathy. *Am J Vet Res.* 2018 Jan;79(1):83-89.
5. De Decker S, Gielen IM, Duchateau L, Saunders JH, van Bree HJ, Polis I, Van Ham LM. Magnetic resonance imaging vertebral canal and body ratios in Doberman Pinschers with and without disk-associated cervical spondylomyelopathy and clinically normal English Foxhounds. *Am J Vet Res.* 2011 Nov;72(11):1496-504.
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7. De Decker S1, Gielen IM, Duchateau L, Volk HA, Van Ham LM. Intervertebral disk width in dogs with and without clinical signs of disk associated cervical spondylomyelopathy. *BMC Vet Res.* 2012; 8: 126.
8. De Decker S, Gielen IM, Duchateau, et al. (2011) Intraobserver and interobserver agreement for results of low field magnetic resonance imaging in dogs with and without clinical signs of disc associated wobbler syndrome. *J Am Vet Med Assoc.* 238, 74-80.
9. Ramos RM1, da Costa RC, Oliveira AL, Kodigudla MK, Goel VK. Effects of flexion and extension on the diameter of the caudal cervical vertebral canal in dogs. *Vet Surg.* 2015 May;44(4):459-66.
10. Ramos RM, da Costa RC, Oliveira AL, Kodigudla MK, Goel VK. Morphological changes of the caudal cervical intervertebral foramina due to flexion-extension and compression-traction movements in the canine cervical vertebral column. *BMC Vet Res.* 2015; 11: 184.
11. Provencher M, Habing A, Moore SA, Cook L, Phillips G, da Costa RC. Kinematic Magnetic Resonance Imaging for Evaluation of Disc-Associated Cervical Spondylomyelopathy in Doberman Pinschers. *J Vet Intern Med.* 2016 Jul;30(4):1121-8.

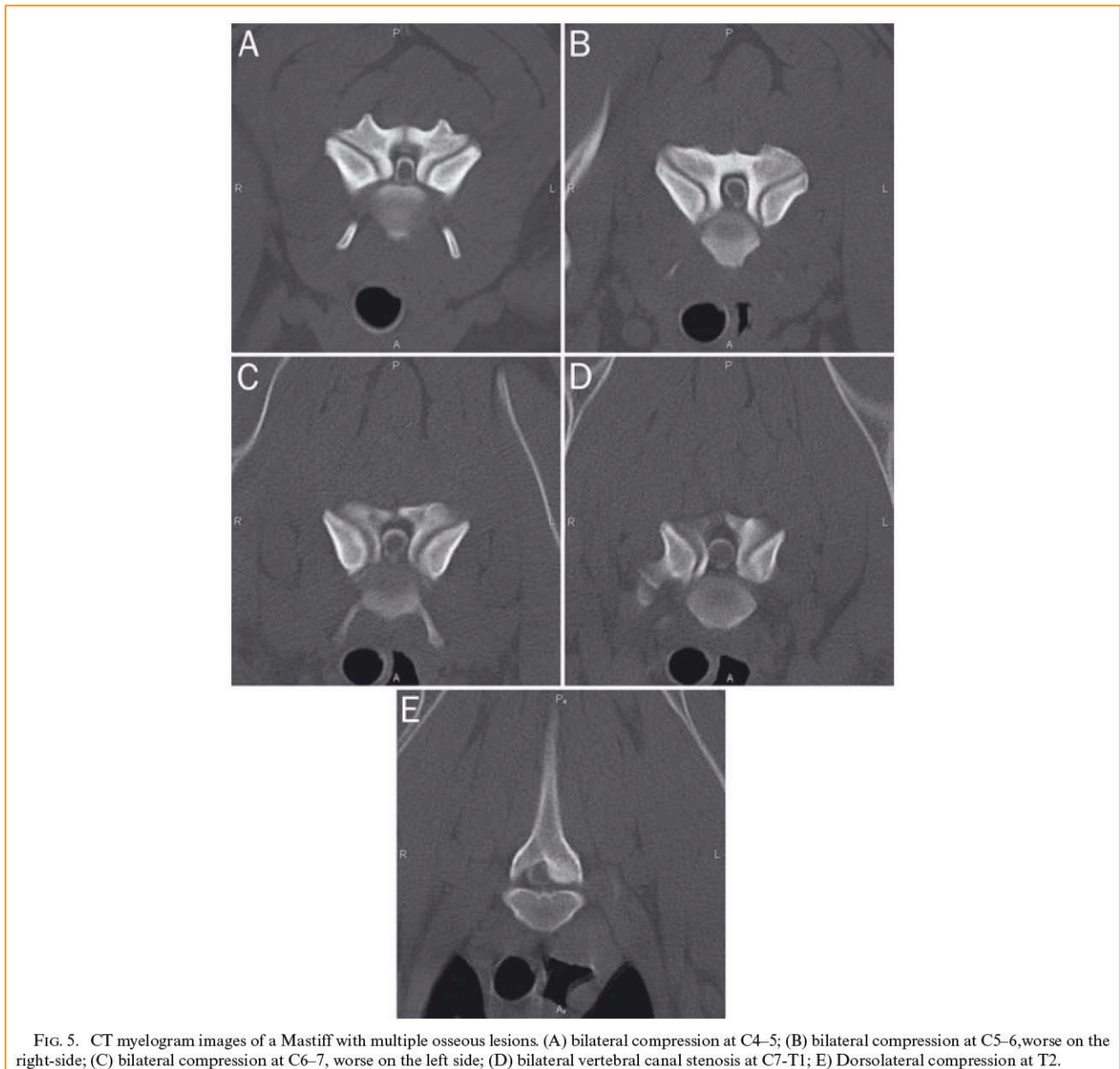
But not only the cervical spine can be affected!

In a study of large and giant breed dogs affected with CSM, CT myelography was used to determine the site of compressive lesions.¹²

- Fifty-eight dogs were retrospectively studied, 23 large-breed and 35 giant-breed dogs.
- Multiple sites of compression were found in 12 large-breed dogs (52.2%) compared to 30 (85.8%) giant-breed dogs.
- The main site of compression was at C5-6 and C6-7 in both large-breed (91.3%) and giant-breed (72.4%) dogs.
- The main cause and direction of compression was disc-associated in 19 (82.6%) of the large-breed dogs while osseous changes were the primary cause of compression in 27 (77.2%) of the giant-breed dogs.
- Osseous compression was observed at C7-T1 in eight giant-breed dogs (22.8%), and at T1-T2 or T2 only in five dogs (14.3%).

- Four of 23 large-breed dogs (17.4%), and seven (20%) of 35 giant-breed dogs had spinal cord atrophy.
- In giant-breed dogs most compressions were lateralized (51.4%), followed by dorsolateral (14.2%).
- In large-breed dogs most compressions are disc-associated and located ventrally (82.6%).

So, check T1-2 in your suspected Wobbler dogs as well as the caudal cervical spine!



12. da Costa RC, Echandi RL, Beauchamp D. Computed tomography myelographic findings in dogs with cervical spondylomyelopathy. *Vet Radiol Ultrasound*. 2012 Jan-Feb;53(1):64-70.

Gait analysis of the Wobber's Dog...

A handful of papers have endeavored to quantify gait in dogs with caudal cervical spondylomyelopathy.^{13, 14, 15}

- Significant kinematic gait differences included smaller minimum and maximum distance between the thoracic limbs in CSM-affected dogs compared to normal dogs.
- Compared to normal dogs, thoracic limb stride duration is smaller in CSM-affected dogs.
- Peak Mediolateral Force, Peak Vertical Impulse, and Peak Vertical Force (PVF) are found to be lower in CSM-affected dogs compared with normal dogs.
- PVF is most affected in the thoracic limbs of CSM-affected dogs as compared to normal dogs.
- Values for temporospatial variables (stance phase duration, swing phase duration, gait cycle duration, stride length, and gait velocity) are significantly smaller in the thoracic limbs of CSM-affected dogs, compared with values for thoracic limbs of clinically normal dogs.

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14. Foss K, da Costa RC, Rajala-Schultz PJ, Allen MJ. Force plate gait analysis in Doberman Pinschers with and without cervical spondylomyelopathy. *J Vet Intern Med.* 2013 Jan-Feb;27(1):106-11.

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Figure 4. Sequence of pictures showing the typical posture and gait of a Doberman affected by DAWS.

Laurie's Thoughts...

This is such a fascinating topic to me, because I think one of the keys for successful management lies rooted in physical therapy applications. From a compression standpoint, traction should help. From an inflammation perspective, laser should help. From the perspective of increasing blood flow for the health of the disc and spinal cord, then mobilizations should help. I've been thinking about this a lot. So, if it's not quite as simple as 'cord compression' (i.e. non-affected dogs can show cord compression), then is there more to do with spinal cord resiliency? Might it have something to do with the docked tails? (Hey... I'm not on one side or the other of that debate. I just wonder if lack of tail or scar tissue retraction could play a role in creating a tight dura.) That doesn't explain the old Newfoundland dogs and other breeds I've found to be affected over the years. However, I return to the thought about **Cord Resiliency**, and how that might fit into selection therapeutic interventions.



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