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# EFFECTS OF LUMBAR INTERVERTEBRAL DISC HERNIATION ON ADJACENT MUSCULATURE ON COMPUTED TOMOGRAPHY (CT) EXAMINATION

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**Abstract**

In the late 1800s Dexler used for the first time the term IVDD (Intervertebral disc disease), which was described as the presence of cartilaginous material in vertebral canal. Intervertebral disc herniation (IVD) refers to the part of the disc that is within vertebral canal.
The aim of the paper was to highlight the morphometric changes of the dorso-lumbar musculature occurring in dogs diagnosed with the presence of hyperattenuating material in vertebral canal by CT.
Thirteen dogs from varying breeds of dogs (French bulldog, Dachshund, Bichon, Pekingese) age from 2 to 8 years old, with hind limbs locomotory disease were scan with a Somatom Scope 16-slices CT scan. **Results**: Pronounced muscle contracture was seen on CT scan thus: 1,4 mm $^{(+-0,6mm)}$ in Bichon on left multifidus muscle in the area of the protrusion, 1.6 mm $^{(+-0,6mm)}$ in Dachshund on left multifidus muscle in the area of the protrusion, 2,1 mm $^{(+-3mm)}$ in Pekingese on left multifidus muscle in the area of the protrusion and 1,2 mm $^{(+-0,5mm)}$ in French bulldogs on the right multifidus muscle in the area of the protrusion.
An increased muscle contracture was seen in all patients in the area of the herniation.

**Key words**: herniation, ct scan, IVD

Introduction: In the late 1800s Dexler used for the first time the term IVDD (Intervertebral disc disease), which was described as the presence of cartilaginous material in vertebral canal. Intervertebral disc herniation (IVD) refers to the part of the disc that is within vertebral canal (Fenn J et al, 2020). In almost all the cases the IVD herniation can occur after a physical activity such as jumping or running and just in few cases can occur spontaneously (Tamura S et al, 2015).

An emerging area of research in veterinary medicine is the analysis of epaxial muscle size and composition in connection to intervertebral disc disease (IVDD) and lumbosacral stenosis (Bostrom A et al, 2022). The epaxial muscles in dogs with spinal disorders show atrophy comparable to those seen in humans (Bostrom A et al, 2022). Dogs with progressive lumbosacral stenosis were found to have multifidus muscle atrophy and muscle stiffness and function loss are caused by changes in muscle structure (Tokunaga A, and Shimizu M, 2020).

Conservative therapies (rest and the prescription of anti-inflammatory and analgesic drugs) and surgical decompression are available for dogs with intervertebral disc disease (Steffen F et al, 2014).

Surgical decompression is the standard treatment for non-ambulatory dogs. Over 90% of dogs with incomplete injuries recover independent ambulation and continence with surgical care. Nearly 60% of dogs with functionally complete injuries eventually recover, but the prognosis is less favorable (Zidan N et al, 2018).

The aim of this study was to highlight the morphometric changes of the dorso-lumbar musculature occurring in dogs diagnosed with the presence of hyperattenuating material in vertebral canal by CT.

## MATERIAL AND METHOD

Thirteen dogs were part of the current study. Seven males, aged 2-8 years and six females, aged 3-6 years, of the breeds Bichon, Dachshund, Pekingese and French Bulldog.

All patients were seen in the Veterinary Radiology and Imaging Clinic of the Faculty of Veterinary Medicine in Cluj-Napoca, coming from different backgrounds. All patients were diagnosed with various locomotor disorders.

All patients were scan with a Somatom Scope 16-slices CT scan. All images were acquired in the local PACS and the measurements were done through an oblique line on the muscle, in Biotronics 3D Dicom Viewer.

Normal values for dogs without any tomographic spinal changes (at first three lumbar vertebras) are shown in table 1 and the methodology for measuring in the figure 1. M1 comes from Multifidi muscles and M2 comes from Longissimus dorsi muscle. The measured values are shown in figure 2.

## RESULTS AND DISCUSSIONS

| | L1 mm | | | | L2 mm | | | | L3 mm | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Muscle | M1R | M2R | M1L | M2L | M1R | M2R | M1L | M2L | M1AR | M2R | M1L | M2L |
| Means | 7.1 | 21.9 | 7.2 | 22.1 | 8.1 | 21.9 | 8.1 | 21.9 | 8.2 | 22.2 | 8.2 | 22.3 |
| SD | 2.1 | 1.4 | 1.8 | 2.6 | 1.2 | 1.4 | 2.2 | 3.2 | 3.1 | 2.5 | 1.32 | 1.7 |

Table 1. Normal values

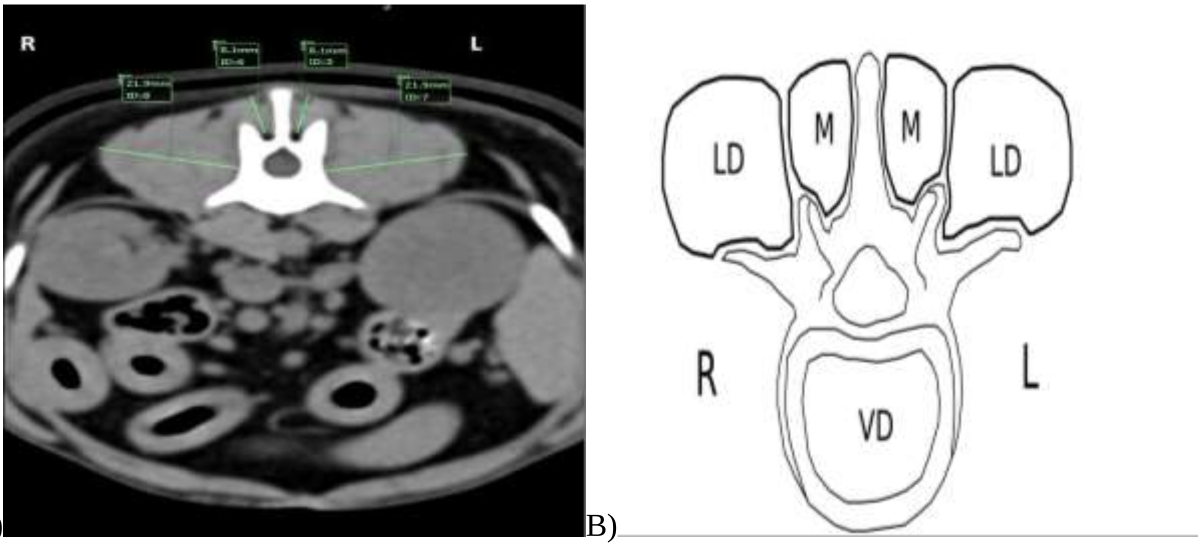


Figure 1 A) CT scan at level of L2 – original; B) Schematic draw of the vertebral body and adjacent musculature (M- Multifidi muscle, LD- Longissimus dorsi muscle and VD – vertebral body); Source: Bostrom A et al, 2022)

In Bichon patients we obtain the following results: in the area of disc protrusion on the left side a 0.6 mm more pronounced contracture is observed compared to the left side. The dorsolumbar musculature covering the vertebra anterior to the disc protrusion shows a 1.4 mm more pronounced contracture on the left side and the dorsolumbar muscle covering the vertebra posterior to the disc protrusion shows a 2.9 mm more pronounced contraction on the left side. on the right side.

In the Dachshund breed in the area of disc protrusion on the left side, a more pronounced contraction of 1.6 mm is observed on the left side. The superficial dorsolumbar muscle, anterior to the site of protrusion, shows a 2.2 mm more pronounced contracture on the right side, while the deep dorsolumbar muscle shows a 2.3 mm more pronounced contracture on the right side. The dorsolumbar muscle covering the posterior vertebra at the site of protrusion is 1.5 mm more contracted on the right side

In the Pekingese breed - in the case of right-sided disc protrusion a 2.4 mm more pronounced muscle contraction is observed on the right side compared to the muscles on the left side. The dorsolumbar muscles of the vertebra anterior to the disc protrusion site show a 5.0 mm more pronounced contraction on the right side. The dorsolumbar muscles of the vertebrae located posterior to the disc protrusion site show a 2.1 mm more pronounced contracture on the left side than on the right side.

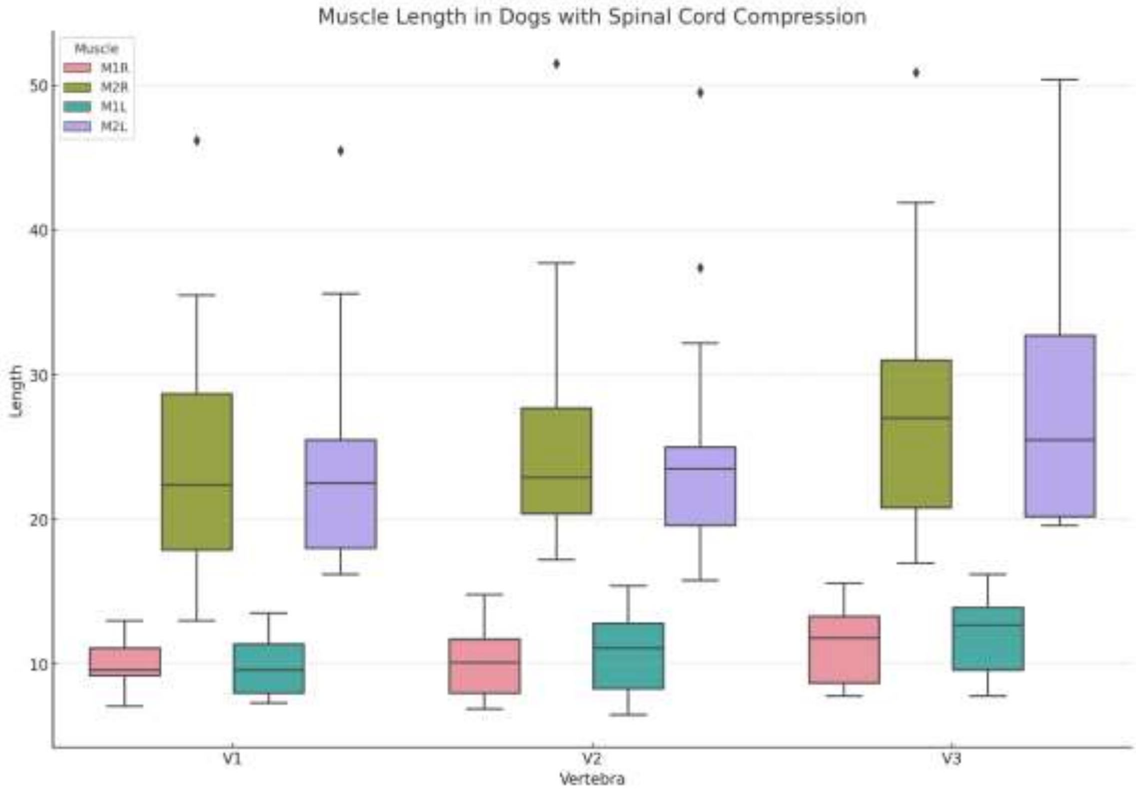


Fig. 2 Value distribution in dogs with spinal cord compression

In the French Bulldog breed in the case of right-sided ventro-dorsal disc protrusion, a 1.5 mm more pronounced muscle contraction is observed on the left side at the protrusion site than on the right side. The muscles on the vertebra anterior to the disc protrusion show a more pronounced contraction on the left side by 1.2 mm. The muscle on the posterior vertebra of the disc protrusion is 0.6 mm more contracted on the right side.

For diagnosing changes that occurs at the spine level, after a neurological examination, radiography can be the next step but is a screening tool method with some limitations, while CT and MRI are more accurate for diagnosing diseases from the spine and vertebral canal (Jeffery NC, et al, 2013; da Costa et al, 2020).

In both dogs and people, IVD degeneration precedes IVD disease and has a similar etiopathogenesis. The term IVD herniation, which is defined as localized displacement of the intervertebral disc beyond the normal 3-dimensional anatomic limits of the disc, can be used to summarize the methods through which a degenerating disc can induce pain and neurologic impairments. Consequently, this can be roughly separated into 2 categories, each of which is connected to a different form of IVD degeneration: either the degenerating nucleus (type I) or the degenerating annulus (type II) protruding into the spinal canal (Jeffery NC, et al, 2013).

All dog breeds are susceptible to intervertebral disc herniation, but chondrodystrophic breeds including the Dachshund, Pekingese, French Bulldog, Basset Hound, Welsh Corgi etc. are those susceptible to be affected by it (Chai O et al, 2018).

Due to the distribution of locomotor forces provided from the pelvis to the vertebral column and the prevalence of congenital abnormalities in this intervertebral area, the lumbosacral region may be extremely vulnerable to IVD herniation (Jeffery NC, et al, 2013).

Similar to other studies, in the present paper chondrodystrophic breeds had higher prevalence for IVD herniation and subsequently pronounced muscle contracture. Obesity, genetic predisposition, and spinal kyphosis, in case of French bulldogs, should be taken into consideration as risk factors for development of clinically relevant thoracolumbar IVD herniation (Chai O et al, 2018; Inglez de Souza et al, 2018).

## CONCLUSIONS

**Muscles around V1 (Vertebra cranial to the compression site):**

For M1R and M1L, the mean lengths in dogs with spinal cord compression are generally lower than those in the healthy dog.

For M2R, the mean length is significantly higher in dogs with spinal cord compression.

**Muscles around V2 (Vertebra at the compression site):**

For M1R, M1L, and M2R, the mean lengths are generally lower in dogs with spinal cord compression compared to the healthy dog.

**Muscles around V3 (Vertebra caudal to the compression site):**

For M1L, the mean length is lower in dogs with spinal cord compression.

For M2R, the mean length is higher in dogs with spinal cord compression.

Implications

Lower muscle lengths in dogs with spinal cord compression around V1 and V2 might indicate muscle atrophy or other structural changes due to compression (contraction).

Higher muscle lengths, particularly for M2R, might suggest compensatory hypertrophy or other adaptive responses.

All the patients with IVD herniation from this study presented muscular contracture in the compression area.

The limitation of this study was the relatively small number of patients, for further studies a bigger number of patients from a single breed is recommended in order to establish the normal and abnormal values.

## REFERENCES


**Boström AF, Parzefall B, Blutke A, Davies ES**. (2022) Epaxial muscle atrophy is more evident in large dogs with intervertebral disc disease than in dogs with ischaemic myelopathy. Research in veterinary science, 146, 60–69.

**Chai O, Harrosh T, Bdolah-Avram T, Mazaki-Tovi M, Shamir MH.** (2018). Characteristics of and risk factors for intervertebral disk extrusions in Pekingese. *Journal of the American Veterinary Medical Association*, *252*(7), 846-851.

**da Costa RC, De Decker S, Lewis MJ, Volk H**; Canine Spinal Cord Injury Consortium (CANSORT-SCI). (2020) Diagnostic Imaging in Intervertebral Disc Disease. Frontiers in veterinary science, 7, 588338.

**Fenn J, Olby NJ**; Canine Spinal Cord Injury Consortium (CANSORT-SCI). (2020) Classification of Intervertebral Disc Disease. Frontiers in veterinary science, 7, 579025.

**Inglez de Souza MCCM, Ryan R, Ter Haar G, Packer RMA, Volk HA, De Decker S**. (2018) Evaluation of the influence of kyphosis and scoliosis on intervertebral disc extrusion in French bulldogs. BMC veterinary research, 14(1), 5.

**Jeffery ND, Levine JM, Olby NJ, Stein VM**. (2013) Intervertebral disk degeneration in dogs: consequences, diagnosis, treatment, and future directions. Journal of Veterinary Internal Medicine;27(6):1318-1333

**Steffen F, Kircher PR, Dennler M**. (2014) Spontaneous regression of lumbar Hansen type 1 disk extrusion detected with magnetic resonance imaging in a dog Journal of the American Veterinary Medical Association, 244(6), 715–718.

**Tamura S, Doi S, Tamura Y, et al**. (2015) Thoracolumbar intradural disc herniation in eight dogs: clinical,low-field magnetic resonance imaging, and computed tomographic myelography findings. Veterinary Radiology and Ultrasound, 56(2):160-167.

**Tokunaga A, Shimizu M.** (2020) Age-related change in shear elastic modulus of the thoracolumbar multifidus muscle in healthy Beagle dogs using ultrasound shear wave elastography. Journal of Veterinary Sciences, 22(1): e3

**Zidan N, Sims C, Fenn J, Williams K, Griffith E, Early PJ, Mariani CL, Munana KR, Guevar J, Olby NJ**. (2018) A randomized, blinded, prospective clinical trial of postoperative rehabilitation in dogs after surgical decompression of acute thoracolumbar intervertebral disc herniation. Journal of Veterinary Internal Medicine; 32(3):1133-1144