

COMMENTARY TO HABILITATION THESIS¹

Degenerative cervical myelopathy (DCM) is the leading cause of myelopathy in subjects above 55 years old and the major cause of spasticity acquired in the aged population. Regarding the clinical onset, a large number of patients with DCM are asymptomatic at first, but once the symptoms start, most present in a stepwise manner, with periods of stability of the symptoms, alternating with worsening. Clinically, the most characteristic symptoms of DCM are instability of gait, loss of fine motor control of the upper limbs, weakness, and neck pain with reduced range of motion in this region and urinary emergency. Mostly, the diagnosis of DCM is based on the signals observed in the clinical examination supported by radiological studies showing spinal cord compression. However, there is wide variation in diagnosis and symptoms presented by patients suffering criteria.

In this habilitation thesis we have presented several studies which could, in our opinion, be useful in the diagnosis and management of patients with DCM.

The aim of the first study was to verify whether an objective and easily used walk and run test can detect early gait impairment in a practical proportion of NMDCCC (non-myelopathic degenerative cervical cord compression) patients and reveal any correlation with severity of disability in DCM. We have proved that a standardized 10-meter walk/run test has the capacity to disclose locomotion abnormalities in NMDCCC subjects who lack other clear myelopathic signs and may provide a means of classifying DCM patients according to their degree of disability. This may be confirmed as another risk factor for progression into symptomatic DCM in future longitudinal studies. The second (prospective observational follow-up) study targeted predictors of neurological dysfunction in the non-myelopathic patient with degenerative cervical spinal cord compression. Multivariate analysis showed that radiculopathy, CSA ≤ 70.1 mm², and compression ratio (CR) ≤ 0.4 were the only independent significant predictors for progression into symptomatic myelopathy. It could help the decision-making process for preventive surgical decompression and, more importantly, in defining a subgroup of NMDCCC individuals at higher risk of DCM, among whom a randomized trial evaluating the benefit of such decompression would be justifiable.

The third study explored the presence and character of vertigo in patients with

¹ The commentary must correspond to standard expectations in the field and must include a brief characteristic of the investigated matter, objectives of the work, employed methodologies, obtained results and, in case of co-authored works, a passage characterising the applicant's contribution in terms of both quality and content.

DCM, because so-called “cervical vertigo” (CV) represents a very controversial entity. This term is used (and probably overused) very often in clinical practice. We have found that, despite a high prevalence of vertigo in patients with DCM, the aetiology could be (in all of them) attributed to causes outside cervical spine and related nerve structures. Clinicians should seek other (often treatable) aetiologies of vertigo in DCM patients, thus avoiding the possibility of overlooking other serious disease.

Four papers presenting new MRI techniques (MR spectroscopy, diffusion tensor imaging and high-resolution 3 T diffusion MRI, Semi-automated detection of cervical spinal cord compression with the Spinal Cord Toolbox) are included in the thesis. These techniques demonstrated sufficient sensitivity to reveal early changes in the cerebral spinal cord, and for the first time, even in NMDCCC participants. This might allow the stratification of non-myelopathic subjects in the future. Introduction of these techniques into radiological evaluations may bring more reliable results to longitudinal and multicentre studies. The approach also saves a great deal of time, perhaps enabling its routine use in the assessment of the natural course of NMDCCC and mild DCM; the rate of progression may well become a valid predictor of whether the patient would benefit from surgery or not.

The habilitation thesis contains six reviews as well (“Asymptomatic Spondylotic Cervical Cord Compression”, “Cervical vertigo – fiction or reality?”, “Management of patients with degenerative spondylotic cervical spine compression”, “Cervical plexus lesions in clinical praxis“, “DCM - clinical manifestation, diagnosis and practical management”, “Asymptomatic Spondylotic Cervical Cord Compression”). One cross-sectional population-based observational study was done to estimate the prevalence of NMDCCC and DCM in a population older than 40 years and to evaluate the MRI characteristics of these conditions (“Prevalence and imaging characteristics of asymptomatic and symptomatic spondylotic cervical spinal cord compression”). Two papers concerning differential diagnosis of degenerative cervical spinal cord compression were added too (“Flexion Cervical Myelopathy (Hirayama Disease) – Reality or Myth?”, “Malignant Peripheral Nerve Sheath Tumour of Cervical Plexus – a Case Report”).

We hope that our results can help clinicians to improve the diagnostic process in DCM patients. We propose that our findings will have consequences for surgical decision-making in early or mild cases of DCM, and that these findings will help to respond to continuous debate regarding the benefits vs. risks of surgical intervention. Determination of predictors of neurological dysfunction in the non-myelopathic patient with degenerative cervical spinal

cord compression, and the application of advanced MRI techniques in the CSC, are both extremely challenging.

[1]² Kadanka Z Jr., Kadanka Z Sr., Skutil T, Vlckova E, Bednarik J. Walk and Run Test in Patients with Degenerative Compression of the Cervical Spinal Cord. *J Clin Med* 2021; 10(5): 927. doi.org/10.3390/jcm10050927.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	-	80	30

[2] Kadanka Z Jr, Kadanka Z Sr., Jura R, Bednarik J. Vertigo in Patients with Degenerative Cervical Myelopathy. *J Clin Med* 2021; 10(11): 2496. doi:10.3390/jcm10112496.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
90	-	70	40

[3] Kadanka Z Jr, Adamova B, Kerkovsky M, Kadanka Z, Dusek L, Jurova B, Vlckova E, Bednarik J. Predictors of symptomatic myelopathy in degenerative cervical spinal cord compression. *Brain Behav* 2017; e00797. doi.org/10.1002/brb3.797.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
60	-	50	20

[4] Horáková M, Horák T, Valošek J, Rohan T, Koriťáková E, Dostál M, Kočica J, Skutil T, Keřkovský M, Kadaňka Z Jr, Bednařík P, Svátková A, Hlušík P, Bednařík J. Semi-automated detection of cervical spinal cord compression with the Spinal Cord Toolbox. *Quant Imaging Med Surg* 2021; 12(4): 2261–2279. doi: 10.21037/qims-21-782.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
20	-	10	10

² Bibliographic record of a published scientific result, which is part of the habilitation thesis.

[5] Valosek J, Labounek R, Horak T, Horakova M, Bednarik P, Kerkovsky M, Kocica J, Rohan T, Lenglet R, Cohen-Adad J, Hlustik P, Vlckova E, Kadanka Z Jr., Bednarik J, Svatkova A. Diffusion magnetic resonance imaging reveals tract-specific microstructural correlates of electrophysiological impairments in non-myelopathic and myelopathic spinal cord compression. *Eur J Neurol.* 2021; 28(11): 3784-3797. doi.org/10.1111/ene.15027.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
30	-	10	10

[6] Horak T, Horakova M, Svatkova A, Kadanka Z Jr., Kudlicka P, Valosek J, Rohan T, Kerkovsky M, Vlckova E, MD, Kadanka Z, Deelchand D.K., Henry P.G., Bednarik J, Bednarik P. In vivo Molecular Signatures of Cervical Spinal Cord Pathology in Degenerative Compression. *J Neurotrauma* 2021; 2999-3010. doi:10.1089/neu.2021.0151.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
30	20	20	10

[7] Kovalova I, Kerkovsky M, Kadanka Z, Kadanka Z Jr, Nemec M, Jurova B, Dusek L, Jarkovsky, Bednarik J. Prevalence and Imaging Characteristics of Nonmyelopathic and Myelopathic Spondylotic Cervical Cord Compression. *Spine* 2016; 41 (24): 1908-1916. doi:10.1097/BRS.0000000000001842.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
20	10	20	10

[8] Bednarik J, Sladkova D, Kadanka Z, Dusek L, Kerkovsky M, Vohanka S, Novotny O, Urbanek I, Nemec M. Are subjects with spondylotic cervical cord encroachment at increased risk of cervical spinal cord injury after minor trauma? *J Neurol Neurosurg Psychiatry* 2011; 82(7): 779-81.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
20	-	20	20

[9] Keřkovský M, Bednařík J, Jurová B, Dušek L, Kadaňka Z, Kadaňka Z Jr, Němec M, Kovařová I, Šprláková-Puková A, Mechl M. Spinal Cord MR Diffusion Properties in Patients with Degenerative Cervical Cord Compression. *J Neuroimaging* 2017; 27(1): 149-157. doi:10.1111/jon.12372.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
20	-	10	-

[10] Kadaňka Z. Jr., Adamová B. Flekční cervikální myelopatie (Hirayamova choroba)- skutečnost, nebo mýtus? Dvě kazuistiky. [Flexion Cervical Myelopathy (Hirayama Disease) – Reality or Myth? Two Case Reports]. *Cesk Slov Neurol N* 2014; 77/110(3): 362-367.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
80	30	70	80

[11] Kadaňka Z Jr., Hanák J, Gál B. Maligní tumor z pochvy periferního nervu v oblasti cervikálního plexu- kazuistika. [Malignant Peripheral Nerve Sheath Tumour of Cervical Plexus – a Case Report]. *Cesk Slov Neurol N* 2013; 76/109(6): 751-755.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
60	90	80	70

[12] Kovalová I, Bednařík J, Keřkovský M, Adamová B, Kadaňka Z Jr. Asymptomatická spondylogenní komprese krční míchy. [Asymptomatic Spondylotic Cervical Cord Compression]. *Cesk Slov Neurol N* 2015; 78/111(1): 24-33. doi:10.14735/amcsnn201524.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
20	80	30	40

[13] Kadaňka Z. Jr., Bednařík J. Cervikální vertigo- fikce či realita? [Cervical vertigo – fiction or reality?]. *Cesk Slov Neurol N* 2018; 81/114(5): 1–6. doi: 10.14735/amcsnn2018521.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
90	70	90	-

[14] Kadaňka Z Jr., Horák T, Bednařík J. Současný management pacientů s degenerativní kompresí krční míchy. [Current management of patients with degenerative cervical spine compression]. *Cesk Slov Neurol N* 2019; 82/115(6): 616-620. doi:10.14735/amcsnn2019632.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
90	70	90	70

[15] Kadaňka Z Jr., Bednařík J. Klinické syndromy z oblasti cervikálního plexu [Cervical plexus lesions in clinical practice]. *Cesk Slov Neurol N* 2019; 82115(6): 632-636. doi:10.14735/amcsnn2019616.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	80	90	80

[16] Kadaňka Z Jr, Bednařík J. Degenerativní cervikální myelopatie – klinický obraz, diagnostika a strategie léčby. [Degenerative cervical myelopathy- clinical manifestation, diagnosis and practical management]. *Neurol. praxi* 2023;24(1):12-16. doi:10.36290/neu.2022.061

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
80	90	90	70