INVITED EDITORIAL

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Promising potential of diffusion tensor imaging in cervical spondylotic myelopathy

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Cervical spondylotic myelopathy (CSM), a degenerative condition of the spine, is the most common cause of spinal dysfunction in adults. The disease is chronic and slowly progressive in nature, with clinical symptoms associated with direct compression of the spinal cord from structural changes of the vertebral body, intervertebral discs, ligaments and facet joints. CSM is diagnosed via a combination of clinical signs and symptoms and conventional magnetic resonance imaging (MRI). However, conventional MRI is of limited utility in the assessment and management of CSM, particularly due to its inability to highlight the microstructural cord alterations associated with CSM. Abnormal cord signal typically appears later in the course of the disease, by which time changes are often irreversible. As surgical intervention at earlier stages of disease is considered to be more effective than later treatment, improved methods for early diagnosis of CSM are needed. Diffusion-weighted imaging, including diffusion tensor imaging (DTI), has been increasingly used in the evaluation of CSM, and has potential utility in the diagnosis, prognosis, and assessment of therapeutic options in these patients.

In this issue of the *Polish Journal of Neurology and Neurosurgery*, Skotarczak et al. [1], describe the use of DTI as an adjunct to routine conventional MRI in the evaluation of patients with clinical signs of cervical spondylotic myelopathy. Importantly, their exclusion criteria include any increased signal on T2-weighted images in the cervical spinal cord. Specifically, the authors demonstrated significantly lower apparent diffusion coefficient (ADC) values and significantly higher fractional anisotropy (FA) values within the cervical cord at the stenotic level in patients compared to the same level in healthy volunteers. There was a similar significant difference of the ADC and FA values between stenotic and non-stenotic levels in patients. No significant differences were found in ADC and FA values at the C2–C3 level of patients and volunteers. They also showed a significant difference in the DTI parameters between four clinical subgroups based on the Japanese Orthopaedic Association (JOA) score, including negative correlation between the ADC value, and positive correlation between the FA value, at the most stenotic level and the JOA scale.

As the authors state, few studies have investigated changes in DTI parameters in CSM patients without cord signal change [2, 3]. Excluding patients with signal change is thus astrength of their paper, as well as the large sample size of both patients and healthy controls. The correlation between individual points on the JOA scale and DTI values is an important finding in this cohort. Other authors have correlated DTI metrics, MS spectroscopy, and mJAO scores in patients with CSM [4].

While DTI remains a powerful research tool, this technique also holds promise as a noninvasive imaging tool to assist clinical decision making, including deciding treatment options (surgical *vs.* conservative) in CSM patients, particularly in those with visible canal stenosis, no cord signal change, and early or minimal clinical symptoms. Long-term MRI follow-up to evaluate correlation of DTI metrics and symptoms in both operated and non-operated CSM patients can be performed.

There are some challenges that limit the universal smooth adoption of DTI into routine clinical practice. Areas requiring future work include standardisation of imaging parameters across different scanner types and strengths, and automation of the calculation of DTI metrics [5], in addition to calculation of additional DTI metrics such as mean diffusivity, axial diffusivity, and radial diffusivity [6]. Due to expected changes in DTI metrics associated with increasing age, correction for patient age is essential [7]. While techniques that correct for patient and physiological motion are critical in maximising image quality, studying the altered cord motion in patients with degenerative cervical myelopathy with phase-contrast

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MRI may prove useful in predicting disease progression and evaluating the impact of surgical intervention [8].

In conclusion, this paper contributes to the literature regarding the utility of DTI to provide additional information regarding the integrity of the cervical spinal cord in patients with cervical spinal myelopathy.

Clearly, DTI holds great promise in the non-invasive evaluation of these patients.

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