Spinal cord white matter integrity in patients with cervical spondylosis is related to severity of spinal canal stenosis: a combined MRI and diffusion tensor imaging study

A. Feydy[1], P. Lindberg[1], F. Rannou[2], J-L. Drape[3], and M. A. Maier[4]
[1]Radiology B, Hopital Cochin, Paris, Paris, France, [2]Rehabilitation, Hopital Cochin, Paris, France, [3]Radiology B, Hopital Cochin, Paris, France, [4]LNRS, Universite Paris Descartes, Paris, France

Spinal cord white matter integrity in patients with cervical spondylosis is related to severity of spinal canal stenosis: a combined MRI and diffusion tensor imaging study

Background- Diagnosis of cervical spondylotic myelopathy is based on clinical assessment of neurological symptoms. Spinal canal stenosis with compression of the spinal cord is considered the major cause of such symtpoms. Compression of spinal cord results in direct neuronal damage and compromised arterial supply, resulting in demyelination of white matter tracts, infarction of both white and gray matter and neuronal loss (Brain et al, 1952; Ogino et al. 1983). Cervical MRI allows measurement of the degree of spinal cord compression by calculation of the stenosis ratio, i.e., the diameter of the spinal canal compared to the diameter of the cervical vertebrae (Pavlov et al. 1987). With increased sensitivity for quantification of white matter integrity in the spinal cord, diffusion tensor imaging (DTI) may better quantify the impact of the spinal canal stenosis (Demir et al, 2003; Facon et al, 2005).

Objectives- We used DTI to test the hypothesis that degree of spinal canal stenosis is related to the degree of spinal white matter integrity in patients with cervical spondylosis.

Methods- 15 patients with cervical spondylosis and 10 healthy subjects of similar age were studied. Two patients had radiculopathy in the upper limb, 2 in the lower limb, 6 in both upper and lower limbs and 5 patients had no radiating symptoms. Ten of the patients had frequent neck pain. DTI was used for quantification of spinal white matter integrity (fractional anisotropy, FA; Apparent Diffusion Coefficient, ADC) of whole spinal cord at C2-C3, C4-C5, and C6-C7 levels (Lindberg et al, 2009). Sagittal T2-weighted imaging allowed for calculation of spinal canal stenosis (ratio) at C3, C5 and C7 levels.

Results- The patients had lower FA than controls at C2-C3 (0.52±0.05 vs 0.56±0.04) and C4-C5 (0.51±0.05 vs 0.55±0.04) levels ($p=0.05$), but not at C6-C7. Patients also had increased spinal canal stenosis at C3, C5 and C7 levels compared to controls ($p<0.05$). The group difference in FA was not present when the degree of stenosis was controlled for in a multiple regression analysis. When averaged across all cervical levels the mean degree of spinal canal stenosis correlated with mean FA ($R=0.69$, $P<0.001$), i.e., patients with least cervical canal space had lowest FA values of the whole cervical spinal cord (Fig).

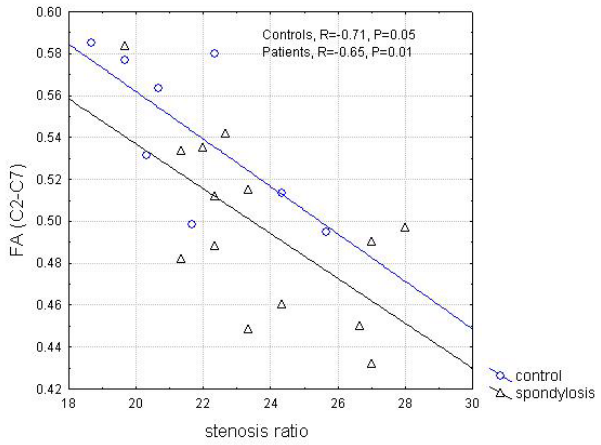

Fig. Relation between cervical spinal cord FA and stenosis ratio in patients with spondylosis and healthy controls.

Conclusions- DTI can quantify spinal cord white matter degeneration related to spinal canal stenosis in patients with cervical spondylosis. Spinal DTI may prove useful for guiding treatment in cervical spondylosis.

References

Brain WR, Northfield D, Wilkinson M. The neurological manifestations of cervical spondylosis. Brain. 1952 Jun;75(2):187-225.
Demir A, Ries M, Moonen CT, Vital JM, Dehais J, Arne P, Caillé JM, Dousset V. Diffusion-weighted MR imaging with apparent diffusion coefficient and apparent diffusion tensor maps in cervical spondylotic myelopathy. Radiology. 2003 Oct;229(1):37-43.
Facon D, Ozanne A, Fillard P, Lepeintre JF, Tournoux-Facon C, Ducreux D. MR diffusion tensor imaging and fiber tracking in spinal cord compression. AJNR Am J Neuroradiol. 2005 Jun-Jul;26(6):1587-94.
Ogino H, Tada K, Okada K, Yonenobu K, Yamamoto T, Ono K, Namiki H. Canal diameter, anteroposterior compression ratio, and spondylotic myelopathy of the cervical spine. Spine (Phila Pa 1976). 1983 Jan-Feb;8(1):1-15.
Lindberg PG, Bensmail D, Bussel B, Maier MA, Feydy A. Wallerian Degeneration in Lateral Cervical Spinal Cord Detected with Diffusion Tensor Imaging in Four Chronic Stroke Patients. J Neuroimaging. 2009 Sep 1. [Epub ahead of print]
Pavlov H, Torg JS, Robie B, Jahre C. Cervical spinal stenosis: determination with vertebral body ratio method. Radiology. 1987 Sep;164(3):771-5.