# A diffusion-tensor MRI study of brain and cervical cord in benign multiple sclerosis patients

B. Benedetti[1,2], P. Valsasina[1], E. Judica[1,2], V. Martinelli[2], A. Ghezzi[3], A. Pulizzi[1,2], G. Comi[2], M. Filippi[1]

[1]Neuroimaging Research Unit, Hospital San Raffaele, Milan, Italy, Italy, [2]Department of Neurology, Hospital San Raffaele, Milan, Italy, Italy, [3]Multiple Sclerosis Center, Ospedale di Gallarate, Gallarate, Italy, Italy

## Introduction.

There is a pronounced individual variability in the clinical course of multiple sclerosis (MS). A subgroup of MS patients has a benign form with little disease progression and minimal disability decades after the first manifestation[1]. Diffusion tensor (DT) MRI is able to quantify the severity of brain and spinal cord damage in MS, providing quantitative information on the extent of tissue damage undetected by conventional MRI. DT MRI could, therefore, help to explain the differences in disease dynamics and accumulation of disability between different phenotypes. Aim of this study was to achieve a better definition of the nature of disability in MS and to define the nature of tissue damage in BMS versus secondary-progressive MS.

## Methods

Using a 1.5 T scanner**,** brain diffusion-weighted scans and diffusion-weighted sensitivity-encoded (SENSE) echo planar images of the cervical cord[2] were acquired from 40 patients with benign MS (BMS) (16 men and 24 women; mean age=47 years [range=24-75 years]; median disease duration=22 years [range=15-40 years]; median EDSS=2 [range=1-4]), 15 secondary-progressive (SP) MS (8 men and 8 women; mean age=47.1 years [range=32-62 years]; median disease duration=15 years [range=5-31 years]; median EDSS=6 [range=4-7.5]) patients and 10 healthy controls (6 men and 4 women; mean age=42.1 years [range=30-56 years]). The diffusion tensor was calculated for each voxel of brain and spinal cord image, and mean diffusivity (MD) and fractional anisotropy (FA) were derived from it. Finally, MD and FA histograms were produced both for brain and cervical cord tissue.

## Results.

Brain histogram-derived metrics for the three study groups are reported in Table 1, whereas cervical cord metrics are reported in Table 2.

**Table 1.**

| | BMS patients | SPMS patients | Healthy controls |
|---|---|---|---|
| GM Average MD (SD) | 1.11 (0.09) | 1.21 (0.15) | 1.01 (0.07) |
| GM Average FA (SD) | 0.13 (0.01) | 0.12 (0.01) | 0.15 (0.01) |
| WM Average MD (SD) | 0.89 (0.08) | 0.93 (0.13) | 0.84 (0.04) |
| WM Average FA (SD) | 0.26 (0.03) | 0.23 (0.04) | 0.29 (0.02) |

MD and FA histogram-derived measures from BMS and SPMS patients, and from healthy control subjects. Average MD in units of $mm^2s^{-1}$ x $10^{-3}$; MD and FA peak heights expressed in ‰; average FA in percentage (%).

**Table 2.**

| | BMS patients | SPMS patients | Healthy controls |
|---|---|---|---|
| Average MD (SD) | 1.42 (0.11) | 1.49 (0.27) | 1.22 (0.09) |
| Average FA (SD) | 0.35 (0.06) | 0.31 (0.04) | 0.42 (0.03) |

MD and FA histogram-derived measures from BMS and SPMS patients, and from healthy control subjects. Average MD in units of $mm^2s^{-1}$ x $10^{-3}$; MD and FA peak heights expressed in ‰; average FA in percentage (%).

Compared to healthy controls, BMS patients had significantly lower average gray matter (GM) FA ($p<0.001$) and white matter (WM) FA ($p=0.003$), and significant higher GM MD ($p=0.005$). BMS patients had significantly lower average GM MD and the corresponding peak height ($p=0.012$ and $p=0.007$). As regards cord DT-MRI metrics, BMS patients had significantly increased cord average MD ($p<0.001$), significantly reduced cord MD histogram peak height ($p=0.001$) and significantly reduced cord average FA ($p=0.003$) in comparison with healthy subjects. There was no difference in DT- MRI cord metrics between BMS and SPMS patients.

## Conclusions.

This study shows that only the extent of brain GM damage is different between BMS and SPMS and that brain WM and cervical cord involvement do not differ between these two groups, despite having very different disabilities. This suggests the role of cortical functional reorganization in limit the consequences of tissue injury in BMS, possibly related to the sparing of the GM compartment.

## References.

1. McAlpine D. Brain 1961;84:186-203.
2. Cercignani M, Horsfield M, Agosta F, et al. AJNR Am J Neuroradiol 2003;24:1254-56.