# TRANSVERSAL AND LONGITUDINAL VOXELWISE WHOLE BRAIN EVALUATION IN THE EARLIEST STAGES OF MULTIPLE SCLEROSIS

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## Introduction

In patients with multiple sclerosis (MS) diffuse MRI abnormalities have been described in both white (WM) and grey matter (GM). However, the relationship between WM and GM damage evolution is not fully understood [1]. In a transversal study on clinically isolated syndrome (CIS) patients, voxel-based morphometry (VBM) analysis did not show volume loss in grey matter structures whereas tract-based spatial statistics (TBSS) analysis revealed widespread FA decrease in most WM fiber tracts [2]. In this study we aimed at longitudinally evaluating the WM and GM damage in the same coohort, after one year follow-up. For this purpose, VBM and TBSS have been used in combination.

## Methods

Thirty four consecutive CIS patients (F/M=21/13; mean age=31.7 [SD=7.7]) were longitudinally evaluated. At baseline and 12 months later, all patients underwent a neurological examination and an MRI scan at 1.5 T, including: axial dual-echo turbo spin echo (TSE), axial 3D T1-MPRAGE, axial diffusion tensor imaging (DTI) with gradients applied along 6 noncollinear directions. T2-lesion volumes (LV) were assessed using a semi-automatic technique. VBM and TBSS were used for longitudinal analyses of GM and WM, respectively [3,4].

## Results

At one year follow-up, 33/34 patients with CIS converted to MS.
At one year follow-up, global brain volumetric assessment showed a significant ($p<0.001$) reduction of GM in the coohort of patients (average GM volume: 675 ml baseline; 663 ml at one year follow-up). The VBM longitudinal analysis (baseline > follow-up) showed GM volume reduction in MS patients ($p< 0.05$, corrected for family wise error), located bilaterally in ten clusters: the thalamus, cuneus, paracentral lobule and insula (Fig.1). Longitudinal TBSS of MS patients did not reveal areas of decreased FA over time ($p > 0.05$).

## Discussion

While WM damage is detectable early and widely involves most WM tracts, it shows little changes over one year follow-up period. Conversely, GM damage is not early detectable, but a significant decrease in cortical and deep GM volume is observed at 1 year follow-up evaluation.

## References

[1] Geurts JJ, Stys PK, Minagar A, Amor S, Zivadinov R.J. Gray matter pathology in (chronic) MS: modern views on an early observation. Neurol Sci. 2009 Jul 15;282(1-2):12-20.
[2] Raz E, Cercignani M, Sbardella E, Totaro P, Pozzilli C, Bozzali M, Pantano P. Clinically Isolated Syndrome Suggestive of Multiple Sclerosis: Voxelwise Regional Investigation of White and Gray Matter. Radiology, in press.
[3] Ashburner J, Friston KJ. Why voxel-based morphometry should be used. Neuroimage 2001;14(6):1238–1243.
[4] Smith SM, Jenkinson M, Johansen-Berg H, et al. Tract-based spatial statistics: vox elwise analysis of multi-subject diffusion data. Neuroimage 2006;31(4):1487–1505.

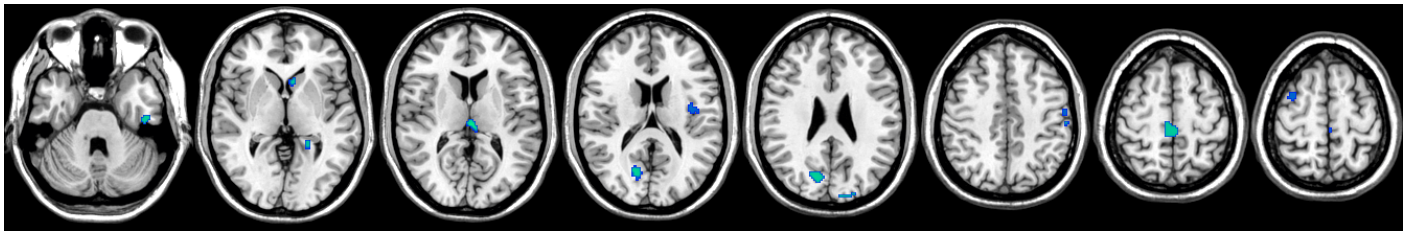

**Figure 1**. Regions with decreased gray matter concentration in follow-up examination compared to baseline in patients recruited with a clinically isolated syndrome examined at baseline and 1-year follow-up; these data were obtained using statistical parametric mapping (SPM). Significant clusters, in light blue, are overlaid on the MNI152 average brain axial sections. Volume reduction are found in several cerebral grey matter regions, i.e. thalami, cuneus, paracentral lobule, insula, temporal cortex, caudate head, supplementary motor areas.