A cross-sectional and longitudinal study correlating brain volumes, RNFL, and cognitive functions in MS patients

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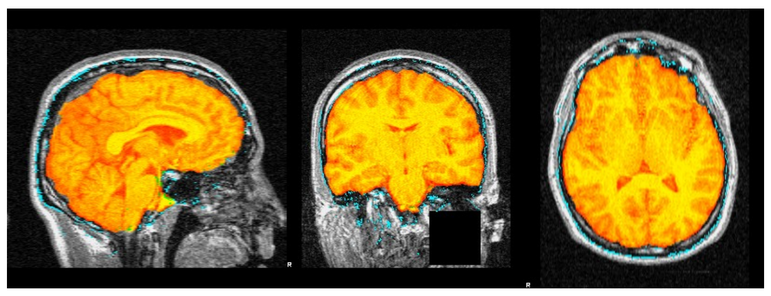
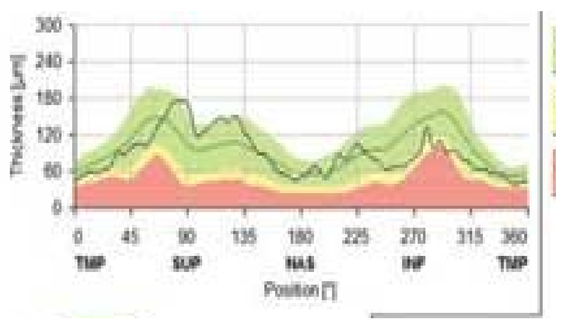
Background. The principal biomarker of neurodegeneration in MS is believed to be brain volume (BV), which is related with cognitive functions (CF) and retinal nerve fibre layer (RNFL). The *aim* of the study was to assess, by both cross-sectional and longitudinal design, the relationship between RNFL, CF and BV.

Methods. At baseline (T1), relapsing patients and healthy controls underwent 1.5 T MRI. SIENAX software estimates the normalized volume of the brain (NBV), grey (NGV), white (NWV) and peripheral grey (pNGV) matter. CF were evaluated by BICAMS, including SDMT, CVLT and BVMT, RNFL by Spectral Domain OCT (Heidelberg Engineering). Patients were re-evaluated after 12 months (T2).

Results

In the 66 patients and 16 healthy controls included, CF, BV, and RNFL were different. Baseline features are shown in Table 1. The cross-sectional partial correlations among OCT, cognitive and MRI parameters are reported in Table 2, Figure 1 and 2.
Since p-NGV resulted correlated with both OCT and cognitive performances, a multivariable model was performed. After selection, SDMT and TEMP-RNFL together with age and disease duration resulted significantly associated with p-NGV.
From T1 to T2, we found a change decreased for BV (p<0.001), average-RNFL (p=0.001), temporal-RNFL (p=0.006), papillo-macular bundle-RNFL (p=0.009). No correlation was found between OCT, MRI, and cognitive changes.





	MS (n=66)	HC (n=16)	p-value
Age, mean (SD)	43.4 (12)	46.8 (9)	0.32
Gender, n(%)			0.21
Females	48 (72.7)	9 (56.3)	
Males	18 (27.3)	7 (43.7)	
Education (years), median (range)	13 (5-21)	13 (8-19)	0.096
Disease duration, mean; median (range)	10.8; 8.5 (0-34)		
EDSS, median (range)	2 (0-7.5)		
NBV, mean (SD)	1473.5 (81.9)	1519.6 (38.4)	0.006^
NWV, mean (SD)	694 (39.9)	728.1 (19.1)	0.003^
NGV, mean (SD)	777.7 (72)	791.5 (33.1)	0.14^
p-NGV, mean (SD)	609.6 (52.1)	616.2 (28.7)	0.11^
SDMT, mean (SD)	45.1 (12.3)	53.3 (8.4)	0.037*
CVLT-II, mean (SD)	41.6 (10.3)	-	
BVMT-R, mean (SD)	47.6 (10.8)	-	
RNFL, mean (SD)	93.8 (10.7)	101.8 (9.9)	0.014
TEMP-RNFL, mean (SD)	63.3 (11)	-	
PMB-RNFL, mean (SD)	49.6 (9.4)	-	
CRI, mean (SD)	93.9 (13.6)	-	

Table 1 ^- linear regression model adjusted for Age; *linear regression model adjusted for education

Neurodegenerative assessment	Variables	r	p-value
SD-OCT			
Average-RNFL	SDMT	0.01	0.96
	CVLT-II	0.20	0.18
	BVMT-R	0.08	0.60
	NBV	0.25	0.095
	NWV	0.16	0.28
	NGV	0.22	0.14
	p-NGV	0.29	0.06
	CRI	-0.02	0.92
TEMP-RNFL	SDMT	0.01	0.95
	CVLT-II	0.09	0.57
	BVMT-R	0.08	0.58
	NBV	0.40	0.007
	NWV	0.37	0.012
	NGV	0.30	0.048
	p-NGV	0.36	0.021
	CRI	0.14	0.41
PMB-RNFL	SDMT	0.044	0.78
	CVLT-II	0.09	0.55
	BVMT-R	0.13	0.38
	NBV	0.37	0.013
	NWV	0.35	0.02
	NGV	0.30	0.049
	p-NGV	0.33	0.032
	CRI	0.055	0.75
SDMT	NBV	0.20	0.10
	NWV	-0.07	0.56
	NGV	0.21	0.11
	p-NGV	0.31	0.022
	CRI	0.29	0.07
CVLT-II	NBV	0.09	0.48
	NWV	0.06	0.66
	NGV	0.04	0.78
	p-NGV	0.01	0.97
	CRI	0.09	0.52
BVMT-R	NBV	0.11	0.38
	NWV	0.05	0.68
	NGV	0.18	0.17
	p-NGV	0.22	0.11
	CRI	0.33	0.016

Table 2

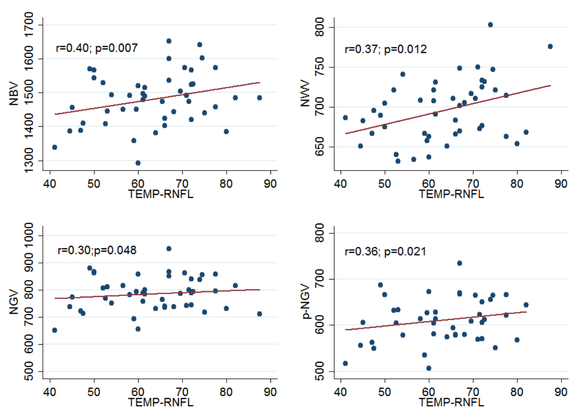


Figure 1

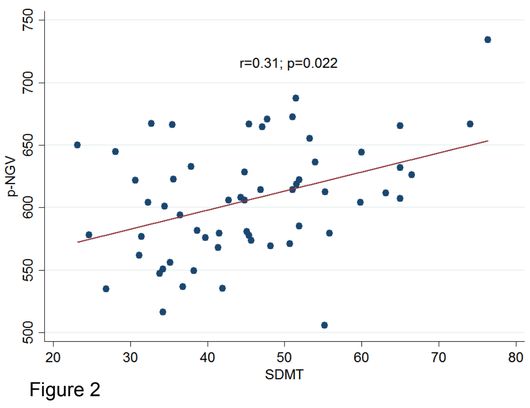


Figure 2

Conclusions

BV, CF, and RNFL are continuous measures of different neurodegenerative aspects. BICAMS and OCT have low costs and can be easily used in clinical practice in order to monitor neurodegeneration.