

INTER-HEMISPHERIC ASYMMETRY AND VISUOSPATIAL DEFICITS IN DEMENTIA

L. Serra¹, V. Viola¹, E. Tuzzi¹, M. Torso¹, C. Mastropasqua¹, G. Olivito¹, B. Spanò¹, G. Giulietti¹, E. Makovac¹, C. Marra¹, C. Caltagirone³, M. Bozzali¹

¹Santa Lucia Foundation IRCCS, Neuroimaging Laboratory ²Institute of Neurology, Università Cattolica, Rome, Italy

³Santa Lucia Foundation IRCCS, Dep. of Clinical and Behav. Neurology ⁴'Tor Vergata' University of Rome, Dep. of Neuroscience

INTRODUCTION

Hemispheric asymmetries (HA) play an important role in many cognitive functions (Thiebaut de Schotten et al., 2011) and this could explain the presence of more severe visuo-spatial deficits in Dementia with Lewy Bodies (DLB) when compared to Alzheimer Disease (AD).

To test this hypothesis we took into account the HA of two white matter tracts in DLB, AD patients and Healthy Controls (HC):
 - the inferior-frontal-occipital-fasciculus (IFOF) (Catani et al., 2003)
 - the Cingulum (CI) (Bozzali et al., 2012).

Additionally, to clarify the potential role of the HA in visuo-spatial deficits, we correlated an index of HA with visuospatial abilities.

PREPROCESSING & DATA ANALISYS

They all underwent an MRI protocol at 3T, which included:

DTI sequence (single-shot EPI, no. of diffusion directions=61, with 7 b0 images, max b factor = 1000 smm⁻²; TE=85 ms, isotropic resolution=2.3 mm³);

DTI analysis and tractography:

individual IFOF and CI were reconstructed their mean fractional anisotropy (FA) and mean diffusivity (MD) values were assessed (i.e., a measure of microscopic tract integrity/damage) for each hemisphere.

A between group comparison of the mean FA and MD in the IFOF and CI was carried out.

The index of HA was extracted using the following formula, allowing to calculate the prevalence of anisotropy in left hemisphere when compared to the right one.

$$AI = (FA \text{ left hemisphere} - FA \text{ right hemisphere}) / (FA \text{ left hemisphere} + FA \text{ right hemisphere})$$

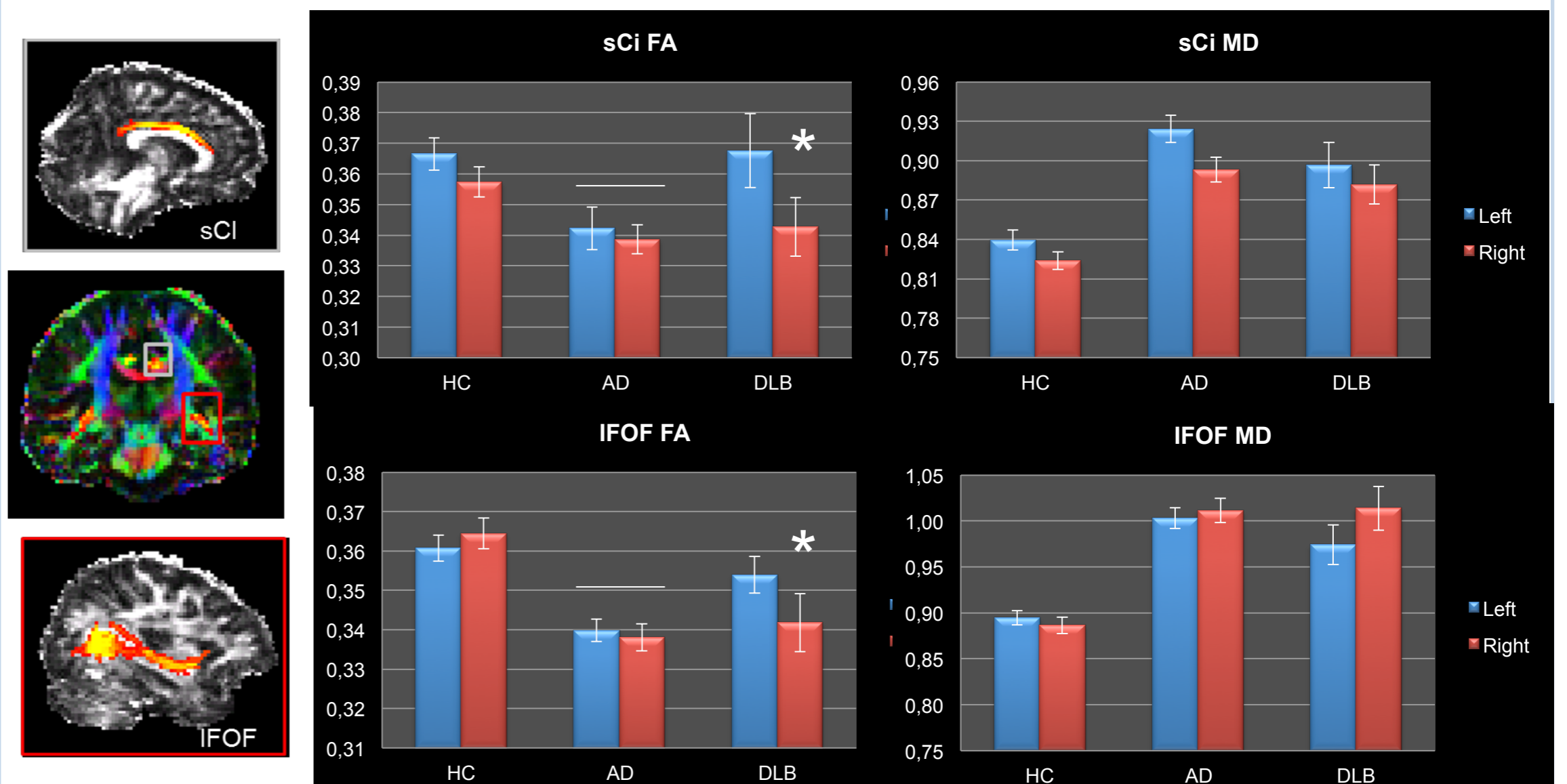
Neuropsychological scores and structural correlations:

- HA data were correlated with patients' visuo-spatial scores.

RESULTS

Structural connectivity:

- Cross-sectional comparisons revealed a bilateral reduction of FA values in the IFOF of AD patients, and a unilateral (right) reduction in the same tract of DLB patients:
- Group x Side: sCI: F = 4.534; p = 0.014; IFOF : F = 3.538; p = 0.034



Neuropsychological scores and structural correlations:

- a significant positive correlation was found between DLB patients' HA in FA of the IFOF and visuospatial deficits (r = -0.348; p = 0.038)

SAMPLE

Participants enrolled for this study had the following characteristics:

- 37 patients with a diagnosis of Alzheimer disease (AD)
- 12 patients with a diagnosis of dementia with Lewy Body (DLB)
- 22 healthy controls participants (HS)

Group	mean age	SD age	mean education	SD education	Gender	MMSE
DLB	*74.16	6.33	*9.58	2.81	F=4 M=8	*21.05
AD	*71.32	6.730	*9.02	4.206	F=22 M=15	*18.77
HS	61.90	8.70	13.59	2.82	F=10 M=12	29.14

* Significant difference between patients (DLB; AD) and HS

MATERIALS

Each participant underwent:

- diffusion MRI at 3T (Magnetom Allegra, Siemens)
- an extensive neuropsychological assessments evaluating several cognitive domains:

MEMORY	REASONING
VERBAL <ul style="list-style-type: none"> Rey's 15 words memory Immediate Delayed Short story recall <ul style="list-style-type: none"> Immediate VISUO SPATIAL <ul style="list-style-type: none"> Rey's figure memory <ul style="list-style-type: none"> Immediate Delayed 	<ul style="list-style-type: none"> Raven's Coloured Progressive Matrices
	CONSTR. PRAXIS <ul style="list-style-type: none"> Copying designs: <ul style="list-style-type: none"> simple copy copy with landmarks
EXECUTIVE FUNCTIONS <ul style="list-style-type: none"> Modified Card Sorting Test (M-CST) Phonologic Word Fluency 	LANGUAGE <ul style="list-style-type: none"> Naming
	COGNITIVE STATE <ul style="list-style-type: none"> MMSE

CONCLUSIONS

- We speculate that the visuo-spatial deficits in DLB might be explained by the presence of this strong hemispheric asymmetry.
- This study confirms the involvement of the posterior part of the brain (i.e. a prevalence of occipito-parietal areas) in the copy drawing performance (Serra et al. 2014).
- In the present investigation, correlating the asymmetry index with the copy drawing performance in patients with dementia, we confirmed that this unbalanced connectivity was a possible cause of the visuo-spatial deficits in DLB patients.
- This highlights that the parieto-occipital disconnections may have a role in causing symptoms in DLB.

REFERENCES

- Thiebaut de Schotten M, Dell'Acqua F, Forkel SJ, Simmons A, Vergani F, Murphy DG, Catani M. A lateralized brain network for visuospatial attention. *Nat Neurosci.* 2011 Sep 18;14(10):1245-6.
- Catani M, Jones DK, Donato R, Ffytche DH. Occipito-temporal connections in the human brain. *Brain* 2003;126:2093e107
- Bozzali M, Giulietti G, Basile B, Serra L, Spanò B, Perri R, Giubilei F, Marra C, Caltagirone C, Cercignani M. Damage to the cingulum contributes to Alzheimer's disease pathophysiology by deafferentation mechanism. *Hum Brain Mapp.* 2012 Jun;33(6):1295-308.