Alteration of functional connectivity in MCI evaluated by magnetoencephalography

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Objectives

Finding a reliable and early biomarker for Alzheimer's disease (AD) could improve clinical management. Previous findings suggest a reorganization of the brain network in AD. Magnetoencephalography (MEG) is a non-invasive technique for the study of neuronal activity in the human brain that measures the weak magnetic fields generated by neuronal currents. Aim of our work is to find reliable, objective and replicable network metrics to distinguish subjects affected by mild cognitive impairment (MCI) from healthy controls, using a MEG system.

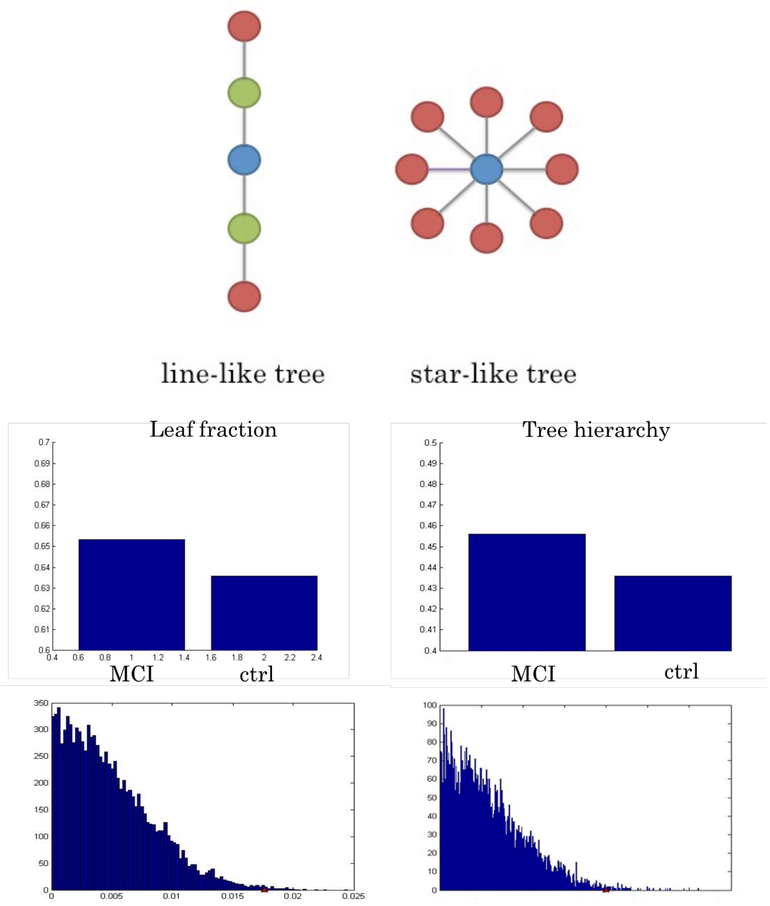
	MCI	controls
n°	11	13
M/F	5/6	8/5
age	72.82±5.76	70.08±7.83
MMSE	25.25±2.31	28.08±1.16

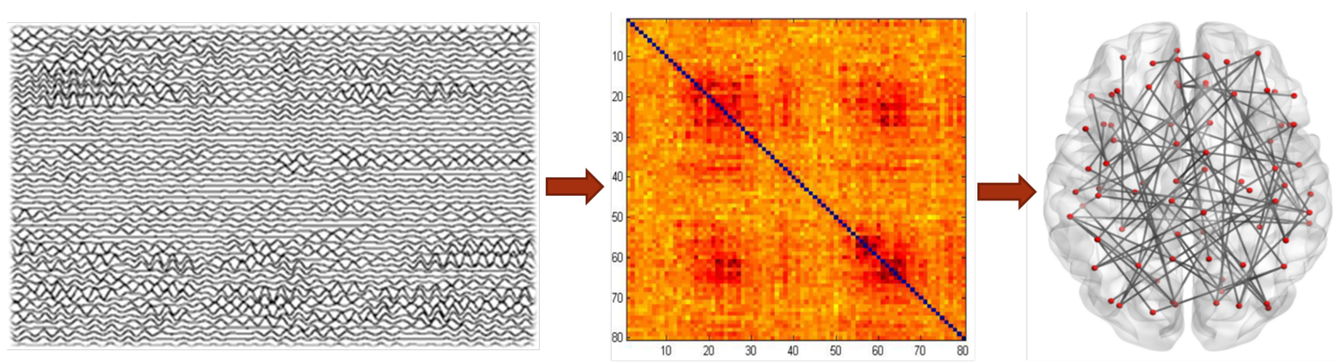
Materials

We recruited 11 patients affected by MCI and 13 control healthy subjects that underwent a 5 minutes closed eyes resting-state magnetoencephalographic recording.

Methods

The MEG signals underwent principal component analysis (PCA) and independent component analysis (ICA) to improve the signal to noise ratio. Ten clean epochs were bandpass filtered in the canonical frequency bands (delta, theta, alpha1, alpha2, beta, gamma). To assess functional connectivity we used the phase lag time, since it quantifies to what extent a given channel is leading of lagging other channels. An adjacency matrix, for each epoch in each frequency band, was obtained. The Minimum Spanning Tree (MST) was calculated for each adjacency matrix. Several network metrics were computed, and compared by permutation testing corrected for multiple comparisons.





Results

In delta band, the tree hierarchy (Th) and the leaf fraction (L) were found to be higher in the MCI group as compared with the controls. Th is a measure that captures the fine tuning of the network between a star–like conformation and a line–like network. L is the fraction of nodes that have degree (the number of links) equal to 1.

Discussion

These findings indicate a greater tendency towards integration in MCI that can be interpreted as a compensatory mechanism occurring when the damages are not yet structural. It is possible to hypothesize that global measures (Th) might be able to identify early alterations of brain networks. The leaf fraction confirms that the change in hierarchy is driven by a global feature of the network rather than by changes in a specific area (since we failed to show any difference in centrality measures).

Conclusions

Our preliminary findings suggest a useful role of network theory applied to MEG in discriminating patients with MCI from healthy subjects.

References

❖ Stam CJ, Tewarie P, Van Dellen E, van Straaten ECW, Hillebrand A, Van Mieghem P. (2014) The trees and the forest: Characterization of complex brain networks with minimum spanning trees. Int J Psychophysiol 92, 129–138
❖ Tewarie P, Van Dellen E, Hillebrand A, & Stam CJ. (2015). The minimum spanning tree: an unbiased method for brain network analysis. Neuroimage, 104, 177-188.

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