Longitudinal changes in structural cortical networks after clinically isolated syndrome

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Introduction

Structural cortical networks (SCNs) are defined by covariance in grey matter thickness between cortical areas and may indicate underlying connections or functional connectivity between areas with similar functions.

We estimated SCN parameters and evaluated their changes over one year in patients with clinically isolated syndrome (CIS) of optic neuritis.

Methods

Patients within four weeks of CIS and age-matched controls underwent three-monthly clinical and brain MRI assessments for one year (1.5T, axial proton-density [PD, 0.9x0.9x5mm^3] and 3DT1-weighted [1.2x1.2x1.2mm^3]).

We estimated brain cortical thicknesses (68 areas, **Figure1**) for each time point and group. These were used to obtain eight (four time points x two groups) between-area correlation matrices, which were binarised according to different thresholds. Binary matrices were considered as numerical representations of networks with 68 nodes and edges indicating presence (=1)/absence (=0) of connection between two areas. For each network, connectivity (number of connections/ total number of possible connections) and nodal degree distribution parameters (nodal degree: number of edges emerging from a node) were obtained. Logistic or linear regression models,

with ‘time point’ as the only predictor variable, assessed longitudinal changes in network parameters.

Results

Seventeen patients and seven controls were included. Baseline network connectivity (**Figure2**) and mean network degree (**Figure3**) were not significantly different between groups. In patients, connectivity and mean degree decreased over time, with connectivity reaching statistical significance ($p<0.001$). No changes were observed in controls.

Conclusions

Early after CIS, subtle effects compatible with disconnection of SCNs can be detected, even with structural scans and at 1.5T.

Words: 250 (maximum: 250)

References

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Figures

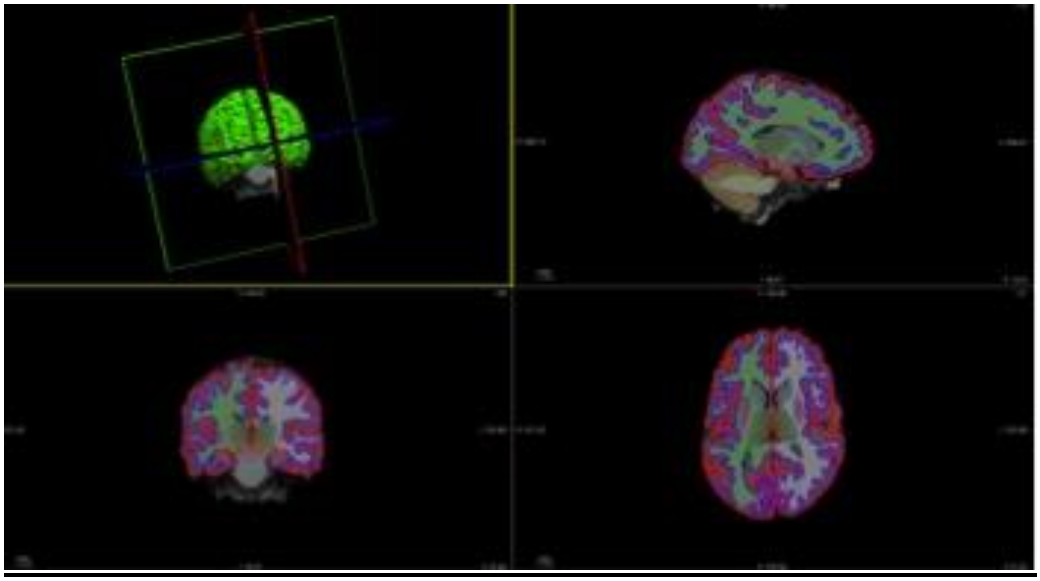

Figure 1. Extraction of cortical thickness using FreeSurfer® longitudinal pipeline. The red line defines the limit between pial surface and cortical grey matter; the blue line defines the limit between white matter and cortical grey matter. Based on this segmentation, cortical thickness is obtained.

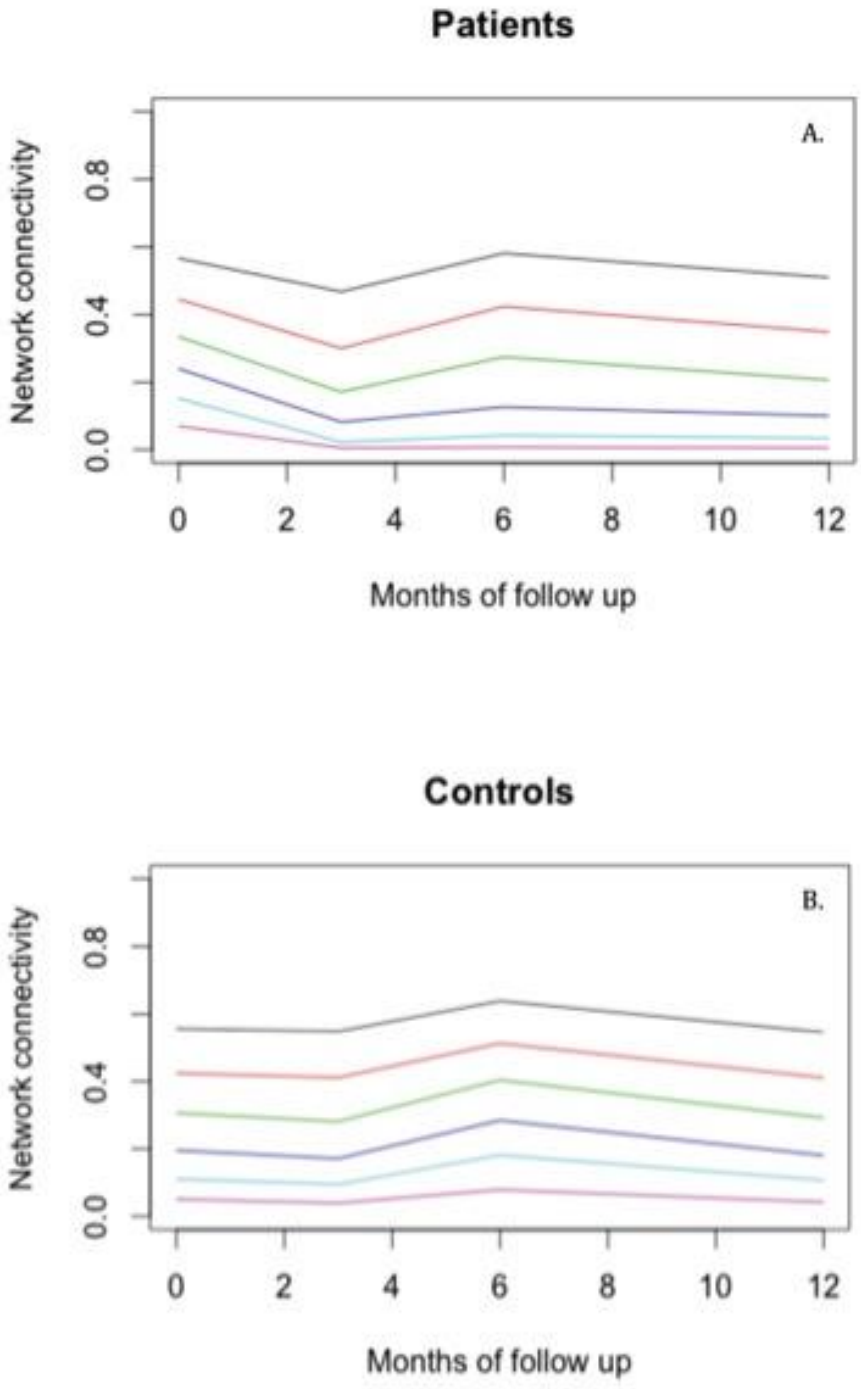

Figure 2. Network connectivity in patients (A) and controls (B) using different thresholds for (Pearson's) correlation coefficient (0.3: black, 0.4: red; 0.5: green; 0.6: dark blue; 0.7: light blue; 0.8: purple).

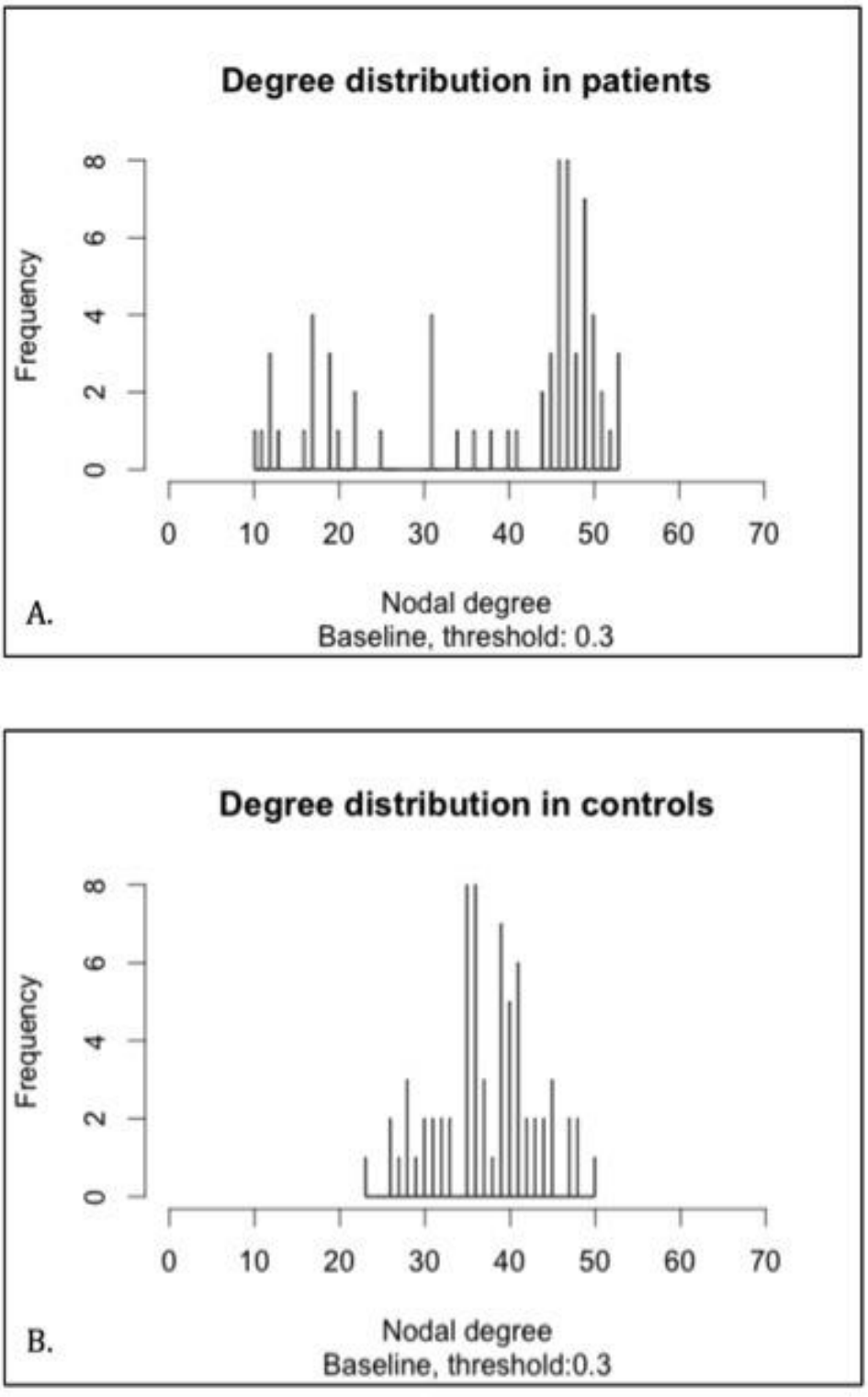

Figure 3. Degree distribution in patients (A) and controls (B) (baseline, threshold for Pearson's correlation coefficient: 0.3). Although no significant differences were found between patient and control groups in terms of mean degree, the distribution of nodal degree seemed much more dispersed in the patient group than in the control group.