Structural cortical network reorganization associated with early conversion to multiple sclerosis

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Author(s) Tur, C.; Eshaghi, A.; Altmann, D. R.; Jenkins, T. M.; Prados, F.; Grussu, F.; Charalambous, T.; Schmidt, A.; Ourselin, S.; Clayden, J. D.; Wheeler-Kingshott, C. A. M. G.; Thompson, A. J.; Ciccarelli, O.; Toosy, A. T.
Author(s) at UniBasel Schmidt, André ;
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Brain structural covariance networks (SCNs) based on pairwise statistical associations of cortical thickness data across brain areas reflect underlying physical and functional connections between them. SCNs capture the complexity of human brain cortex structure and are disrupted in neurodegenerative conditions. However, the longitudinal assessment of SCN dynamics has not yet been explored, despite its potential to unveil mechanisms underlying neurodegeneration. Here, we evaluated the changes of SCNs over 12 months in patients with a first inflammatory-demyelinating attack of the Central Nervous System and assessed their clinical relevance by comparing SCN dynamics of patients with and without conversion to multiple sclerosis (MS) over one year. All subjects underwent clinical and brain MRI assessments over one year. Brain cortical thicknesses for each subject and time point were used to obtain group-level between-area correlation matrices from which nodal connectivity metrics were obtained. Robust bootstrap-based statistical approaches (allowing sampling with replacement) assessed the significance of longitudinal changes. Patients who converted to MS exhibited significantly greater network connectivity at baseline than non-converters ($p = 0.02$) and a subsequent connectivity loss over time ($p = 0.001$-0.02), not observed in non-converters' network. These findings suggest SCN analysis is sensitive to brain tissue changes in early MS, reflecting clinically relevant aspects of the condition. However, this is preliminary work, indicated by the low sample sizes, and its results and conclusions should be treated with caution and confirmed with larger cohorts.
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