

Brain microstructure alterations in early cognitive decline assessed using MRI:
Potential biomarker in the prodromal stages of disease

Gross cerebral atrophy (Gispert et al., 2015) and white matter degeneration (Chang et al., 2015; Choo et al., 2010; Dong et al., 2020) are relevant biomarkers of neurodegenerative cognitive decline. However, it is challenging to characterize the specific microstructure changes in white and gray matter non-invasively, and post-mortem data are typically available only for the late stages of disease.

Our group, the Microstructure Mapping Lab, focuses on the development of new MRI techniques to quantify brain tissue microstructure, mainly using diffusion MRI. Our research aims to propose new tools to evaluate the healthy and pathological human brain non-invasively and longitudinally. Translation of our methodological developments to patient populations is key.

In this project, we propose to use new methodologies that map the brain white and gray matter microstructure to characterize the pathology in early neurodegenerative cognitive decline. Features of interest in the white matter include markers of axonal injury, axonal loss, demyelination and inflammation. In the gray matter, quantifiable features are neurite and soma density, intra- and extra-cellular crowding and cell membrane permeability. We are particularly interested in the diagnostic and prognostic value of these microstructure markers, in comparison with other available biomarkers. The spatial distribution of microstructural alterations in the brain, and their temporal evolution with disease progression can also unveil pathological trajectories that are disease and patient-specific.

This project is in collaboration with Dr. Giulia Bommarito (CHUV, Department of Clinical Neurosciences, Lausanne) and Prof. Giovanni Frisoni (HUG, Memory Clinic, Genève).