

 DEMENTIA

Shape asymmetry of brain structures predicts dementia

“ shape asymmetry ... could serve as a sensitive biomarker. ”

Asymmetries in the shapes of cortical and subcortical structures correlate with severity of cognitive impairment and can predict onset of Alzheimer disease (AD), according to recent work that used a novel approach to analysing neuroanatomical structures. The findings suggest that shape asymmetry could be a biomarker that allows early detection of dementia.

Metabolic and pathological asymmetries have previously been detected in the brains of patients with AD. However, whether morphological asymmetries also develop has remained unclear, largely because MRI volume measurements of brain structures have not revealed significant asymmetries. In the new work,

Christian Wachinger and colleagues have used a new, more sensitive imaging technique.

“We previously developed a new characterization of brain morphology based on shape descriptors, which we called the BrainPrint,” explains Wachinger. “The BrainPrint captures the rich geometric information of brain structures, which is only crudely represented by commonly used volume measurements. We aim to use the advanced computational modelling in the BrainPrint to assist in the diagnosis of AD.”

Wachinger and his team used BrainPrint to look at anatomical asymmetries in the brains of 697 people who had received at least three brain MRI scans as part of the Alzheimer’s Disease Neuroimaging Initiative, which aims to determine whether serial MRI and PET can be used to measure disease progression. Participants were grouped according to cognitive status: cognitively normal, stable mild cognitive impairment (MCI), progression from MCI to AD, and AD.

Analysis showed that asymmetry of many brain structures increased with age, but greater effects in some structures accompanied cognitive impairment. In particular, asymmetries in the hippocampus and amygdala were significant in all groups with cognitive impairment,

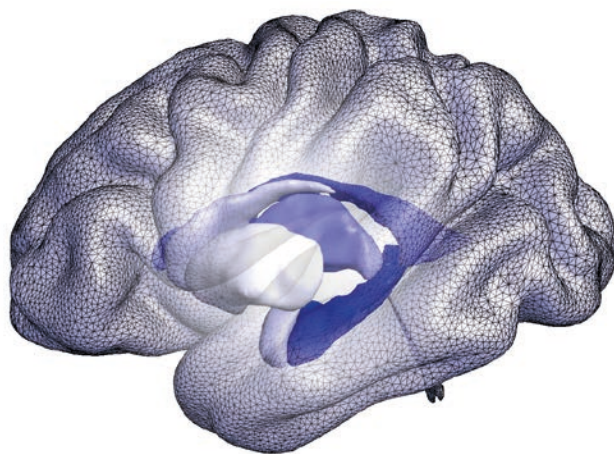
and a greater extent of asymmetry was seen with greater disease severity. Concurrent volume analysis failed to detect most of the asymmetries picked up by shape analysis.

The longitudinal design of the study also allowed the researchers to look for asymmetries that could predict progression from MCI to AD. They found that shape asymmetry in the hippocampus, amygdala, caudate and cortex was predictive of progression. By contrast, volume asymmetry detected no predictors.

“The differentiation between people with stable MCI and those who progress to AD is of high clinical relevance for selection into disease modifying therapies or drug trials,” says Wachinger. “Our results indicate that neuroanatomical shape asymmetry of several subcortical structures could serve as a sensitive biomarker.”

Wachinger says that the next steps are to further explore the relationship of shape asymmetries with established biomarkers of AD, and learn more about the mechanisms that underlie the asymmetries.

Ian Fyfe



Asymmetries in the shapes of cortical and subcortical structures were significant in cognitive impairment and dementia. Image courtesy of C. Wachinger.

ORIGINAL ARTICLE Wachinger, C. *et al.* Whole-brain analysis reveals increased neuroanatomical asymmetries in dementia for hippocampus and amygdala. *Brain* <http://dx.doi.org/10.1093/brain/aww243> (2016)
FURTHER READING Wachinger, C. *et al.* BrainPrint: a discriminative characterization of brain morphology. *Neuroimage* **109**, 232–248 (2015)