

Hippocampal changes in Alzheimer, fronto-temporal and Lewy body dementia patients: a radial atrophy mapping study.

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Objective. To assess the morphological changes of the hippocampus in Alzheimer's disease (AD), Lewy body dementia (LBD), fronto-temporal dementia (FTD), we used radial atrophy mapping, a method based on mathematical models sensitive to subtle changes in the shape of hippocampus.

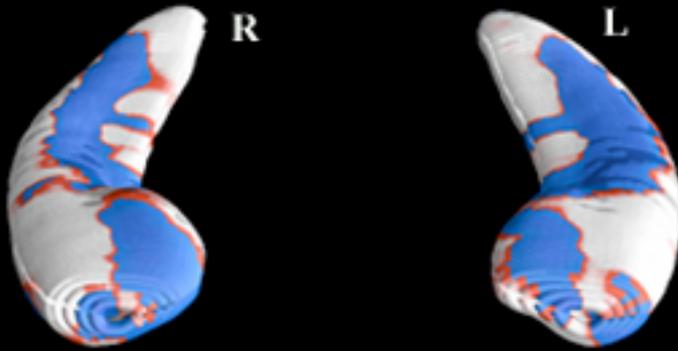
Methods. High-resolution T1-weighted fast field echo (FFE) (TR = 20 ms, TE = 5 ms, flip angle = 30°, field of view = 220 mm, acquisition matrix 256x256, slice thickness 1.3 mm) magnetic resonance (MR) scans were acquired at 1.0 Tesla from 22 AD (age: 73.8±8.4), 7 LBD (age: 76.8±6.3), 7 FTD patients (age: 70.3±4.3), and 40 controls of similar age (age: 71.2±6.8) and gender. Disease severity was similar in AD (Mini-Mental State Exam score [MMSE]: 19.6±4.2), LBD (MMSE: 22.9±6.2), and FTD (MMSE: 17.0±10.0). MR images (including brain, cerebellum, and brainstem) were normalized by linear (12 parameter) transformation to a customized template using the Statistical Parametric Mapping (SPM99) software. The hippocampi were manually traced according to a formal protocol with established inter- and intra-rater reliability and 3D parametric surface mesh models were created to represent the hippocampus in each subject¹. To assess hippocampal morphology, a medial curve was automatically defined as the 3D curve traced out by the centroid of the hippocampal boundary in each image slice. The radial size of each hippocampus at each boundary point was assessed by automatically measuring the radial 3D distance from the surface points to the medial curve defined for individual's hippocampal surface model. Shorter radial distances were used as an index of atrophy. Statistical maps were generated indicating local group differences in radial hippocampal distance¹.

Results & Discussion. The hippocampi of AD patients showed severe and widespread atrophy ($p=0.0001$ for left and right hemispheres; permutation test) along the medial and lateral aspects of the entire structure bilaterally (head, body, and tail; *see figure, top panel*). Atrophy in LBD was mainly confined to the anterior and lateral aspects of the hippocampal head (*see figure, middle panel*; $p=0.003$ for the left hemisphere and $p=0.002$ for the right hemisphere). In patients with FTD, hippocampal atrophy was less severe and especially prominent on the left (*see figure, bottom panel*; $p=0.01$ for left hemisphere and $p=0.05$ for right hemisphere).

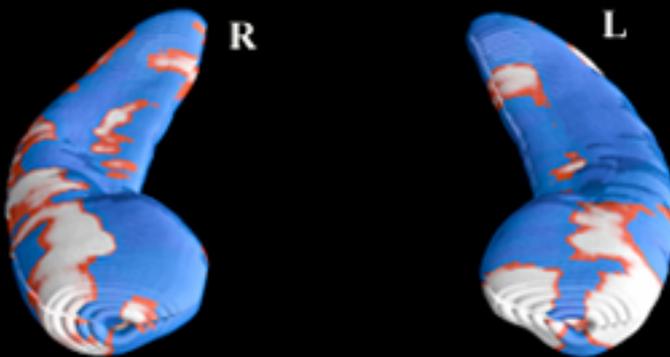
Conclusion. Radial atrophy mapping is sensitive to local differences in hippocampal atrophy in patients with different clinical forms of degenerative dementia. These maps can help distinguish the patterns of atrophy associated with forms of dementia that differentially impact the human brain.

¹ Thompson PM, Hayashi KM, de Zubicaray GI, Janke AL, Rose SE, Semple J, Hong MS, Herman DH, Gravano D, Doddrell DM, Toga AW. Mapping hippocampal and ventricular change in Alzheimer disease. *Neuroimage* 2004;22:1754-66.

Alzheimer's disease



Lewy body dementia



Fronto-temporal dementia

