Regional cortical thinning of the aging brain

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Introduction

Brain atrophy has been reported in a number of MR studies of aging [e.g. 1, 2]. Importantly, age-related alterations in regional volumes have been correlated with performance on neuropsychological and experimental cognitive tasks [3, 4]. Thus, changes in cortical morphology may have clinical significance. Similarly, understanding patterns of regional degeneration in the brain may aid in distinguishing between normal aging and preclinical dementia.

Volumetric studies have provided valuable information on changes in the brain associated with aging [1]. Still, few studies have examined changes over the entire cortex due to the labor-intensive nature of such measurements. We employed measurements of cortical thickness [5] based on accurate, automated reconstructions of the brain from MR scans [6, 7] allowing visualization of change across the complete cortical surface.
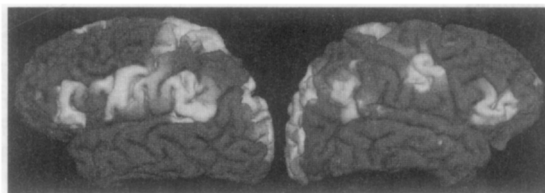
Methods

Structural MR scans were obtained from younger (YP; n = 19; mean age = 23.6, 18-31; 9M/10F) and older participants (OP; n = 10; mean age = 75.9, 66-89; 3M/7F). All participants were nondemented (CDR = 0). YP were recruited from the Washington University community. OP were recruited through the Washington University Alzheimer's Disease Center. OP were excluded if they had a history of neurologic, psychiatric, or medical illness that could contribute to dementia. Two to four MP-RAGE scans were averaged per participant (Siemens 1.5-T Vision System, resolution 1 X 1 X 1.25 mm, TR = 9.7ms, TE = 4ms, FA = 10°, TI = 20ms, TD = 500ms).

Thickness measurements were obtained by reconstructing representations of the gray/white matter boundary and the cortical surface and then calculating the minimal distance between those two surfaces for each point on the gray/white matter boundary [5]. Thickness maps were averaged across participants using a spherical morph to align cortical folding [8].

Results

Preliminary results suggested OP had significantly thinner cortex bilaterally in regions including the prefrontal cortex (near Brodmann Area [BA] 44), pre/postcentral regions (near BA 4/6), parietal (near BA 40/39), and occipital cortex (near BA 17/18) with a relative sparing of superior prefrontal cortex (e.g. near BA 8/9) and temporal lobes. The figure shows regions of statistically thinner cortex in OP with red to yellow indicating less to greater significance, respectively). Differences were preliminarily estimated between ~0.25 to 0.50 mm.

Discussion

Aging is accompanied by thickness changes in prefrontal, somatosensory and occipital cortex. These conclusions must be considered with caution as there are potential confounds. Importantly, changes in tissue signal properties in aging and disease may contaminate measures of thickness. Additionally, larger groups of matched subjects should be examined. Nonetheless, these preliminary results suggest great promise for using cortical thickness measures to detect preclinical dementia and anatomic changes associated with cognitive decline [9].

References

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