A DTI Study of Monozygotic Twins Discordant for Obsessive-Compulsive Symptoms

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Introduction: Obsessive-compulsive disorder (OCD) affects approximately 2-3% of the population and is characterized by recurrent, persistent, and intrusive anxiety-provoking thoughts or images (obsessions) and subsequent repetitive behaviors (compulsions). A clinical diagnosis of OCD requires impairment, but OC symptoms (OCS) are highly prevalent in the general population (70-80%). Structural magnetic resonance imaging studies indicated several gray matter abnormalities in OCD patients compared to unaffected controls that overall point to a deficit in cortico-striatal-thalamo-cortical circuits. Recent diffusion tensor imaging (DTI) studies also find white matter abnormalities generally overlapping with the reported gray matter findings. However, there are still inconsistencies regarding the brain structures involved and the direction of anatomical changes. A reason for this could be the differential impact of genetic and environmental risk factors for OCD that do not necessarily lead to identical underlying neurobiological changes. Heritability for OCS ranges from 27-47% in adults and 45-65% in children. If genetic factors explain 27-65% of the variability in OCS, as much as 35-73% should be accounted for by environmental stressors. The discordant monozygotic (MZ) twin design can reveal brain differences specifically due to influences of environmental risk factors. MZ twins are genetically identical; therefore differences in behavior must reflect exposure to individual-specific environment. Here we used DTI to scan twin pairs discordant for OCS to highlight white matter brain regions linked to OCS that are particularly susceptible to environmental factors.

Methods: 19 MZ twin pairs discordant for OCS (age range 18-60 years) were scanned on a 3.0 T Intera MR system (Philips, Medical Systems). DTI data were acquired (33 directions) with the following parameters: slice thickness=3mm, TR=4863 ms, TE=94 ms, matrix =256x256, FOV=230 mm, b-value=1000 s/mm^2. One volume without diffusion-weighting was also acquired. DTI analysis was performed using software from the Laboratory of Neuro Imaging, UCLA, including fluid registration of DTI data to a common template. Voxelwise comparison, using a paired t-test, was performed to indicate regions of significantly altered fractional anisotropy (FA) in the OCS high-scoring twins compared to their OCS low-scoring co-twins.

Results: Compared to OCS low-scoring twins, OCS high-scoring twins exhibited significantly decreased FA in the left inferior parietal lobe and right occipital lobe (Figure 1a). Increased FA for the OCS high-scoring twins compared to their OCS low-scoring co-twins was observed in the left medial frontal lobe and multiple regions of the right temporal lobe (Figure 1b).

Conclusions: Environmentally-mediated OCS were associated with decreased white matter anisotropy in the left parietal and right occipital lobe and increased white matter anisotropy in the left medial frontal and right temporal lobe. These results generally overlap with white matter abnormalities reported in previous DTI studies of OCD patients. Therefore, our findings suggest that neurobiological changes underlying the environmentally-mediated risk for OCD, partly, correspond with the neurobiological abnormalities that originate from a combination of adverse genetic and environmental influences.

References:

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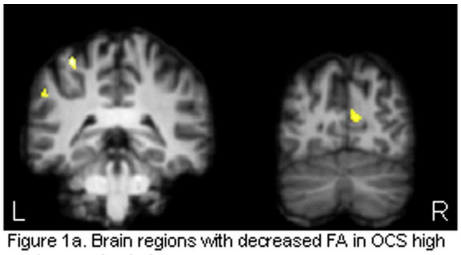

Figure 1a. Brain regions with decreased FA in OCS high vs. low-scoring twins.

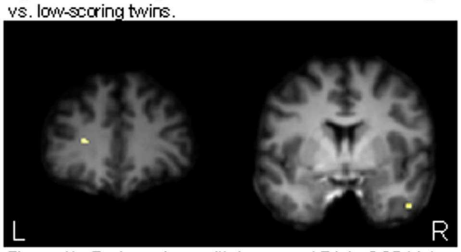

Figure 1b. Brain regions with increased FA in OCS high vs. low-scoring twins (significance level p< 0.001, uncorrected, extend treshold 5 voxels).

Category: *Neuroanatomy*
Sub-Category: *DTI studies, application*