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Assessment of Olfactory Processing in Parkinson's Disease Patients

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Background: Hyposmia is an early symptom of Parkinson's Disease (PD) that often predates motor symptoms by years. Hyposmia has been shown to have a more consistent link to idiopathic PD than to other movement disorders. Olfaction has the potential to be used as a biomarker for PD, either through clinical evaluation or imaging.

Objectives: This study uses functional magnetic resonance imaging (fMRI) to assess differences in olfaction pathways between anosmic early PD patients and age and gender-matched controls.

Methods: 12 PD patients and 12 age- and gender-matched control subjects were recruited from the subject panel of a previous UMMS study on olfaction and PD. All PD patients were determined to be anosmic, and all controls were determined to have normal olfaction for their age and gender. All subjects underwent fMRI including periods with and without odorant exposure. Statistical analysis was performed using SPM8, using a general linear model to calculate BOLD signal changes for each scent relative to room air. A random effect model was used to infer general population effects.

Results: Control subjects showed significant activation in the piriform cortex, anterior olfactory nucleus, insula, hippocampus and temporal lobe, all regions associated with olfactory processing. Relative to control subjects, PD patients showed no significant BOLD activation in the olfactory pathways of the brain. In response to a citrus scent, PD patients showed activation in the superior and middle frontal lobe, as well as the cingulate gyrus. In response to a cinnamon scent, PD patients showed significant activation in the precuneus and paracentral lobule as well as lower levels of activation in the frontal lobe. PD patients showed no significant areas of activation in response to a mint scent.

Conclusion: Our results suggest that anosmic PD patients do not show activation of the olfactory pathways in the brain on exposure to these odorants. Taken together with previous studies, this suggests that BOLD activation in these regions of the brain can reflect clinical olfactory capability. In addition, PD patients show areas of increased activation, particularly in the frontal lobe. These distinct patterns of BOLD activation allow us to consider the feasibility of fMRI as a biomarker for diagnosis and evaluation of PD.