Mapping the Development of the Basal Ganglia in Children With Attention-Deficit/ Hyperactivity Disorder

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Objective
The basal ganglia are implicated in the pathophysiology of attention-deficit/hyperactivity disorder (ADHD), but little is known of their development in the disorder. Here, we mapped basal ganglia development from childhood into late adolescence using methods that define surface morphology with an exquisite level of spatial resolution.

Method
Surface morphology of the basal ganglia was defined from neuroanatomic magnetic resonance images acquired on 270 youth with DSM-IV-defined ADHD and 270 age- and sex-matched typically developing controls; 220 children were scanned at least twice. Using linear mixed model regression, we mapped developmental trajectories from age 4 through 19 years at approximately 7,500 surface vertices in the striatum and globus pallidus.

Results
In the ventral striatal surfaces, there was a diagnostic difference in developmental trajectories (t=5.6, p<0.0001). Here, the typically developing group showed surface area expansion with age (increase of 0.54mm²/yr, SE 0.29mm²/yr) whereas the ADHD group showed progressive contraction (decrease of 1.75mm²/yr, SE 0.28mm²/yr). The ADHD group also showed significant, fixed surface area reductions in dorsal striatal regions, which were detected in childhood at study entry and persisted into adolescence. There was no significant association between history of psychostimulant treatment and developmental trajectories.

Conclusions
Progressive, atypical contraction of the ventral striatal surfaces characterizes ADHD, localizing to regions pivotal in reward processing. This contrasts with fixed, non-progressive contraction of dorsal striatal surfaces in regions that support executive function and motor planning.