

Disrupted cortico-basal ganglia-thalamo-cortical network in Large Family with Inherited Stuttering

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Background

Developmental stuttering is characterised by speech pauses, prolongations, and sound or syllable repetitions.

It affects ~1% of the population with detrimental effects on mental health and earning potential.

Genetic heterogeneity is likely to play a part in inconsistent neurological findings in both grey and white matter.

No MRI study of individuals with homogeneous genotype developmental stuttering.

This is the first MRI study of a family with autosomal dominant inherited stuttering

MRI: 7 family members (6 male; aged 9-63 yrs)
14 controls (age and gender matched).

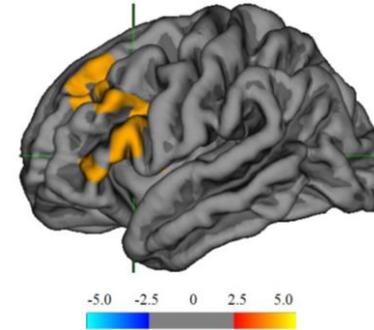
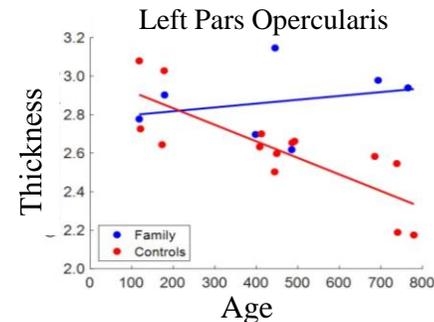
Conclusions

- Results allude to disruption within the cortico-basal ganglia thalamocortical loop.
- We suggest inhibitory control between Broca's area and the striatum necessary for fluent speech could not develop in this family due to neurodevelopmental anomalies within this network.

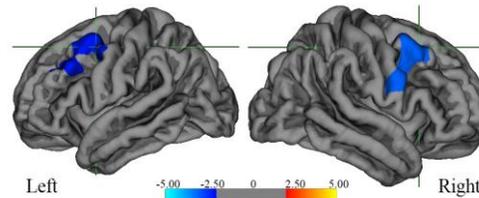
Significant Findings

Cortical thickness: Age x group interaction in the left hemisphere inferior frontal gyrus (peak cluster: pars opercularis)

Family members show a lack of cortical thinning with age

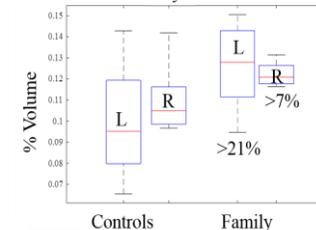


Bilateral surface area reductions in middle frontal gyrus family vs controls



Increased volume in bilateral globus pallidus in family vs controls

Left (L) and Right (R) Volumes of Globus Pallidus in family and controls



Grey matter analysis

T1-weighted: No. of slices = 160, TR/TE = 1900/2.6ms, flip angle=9°, voxel size=1mm³

Cortical Morphometry (FreeSurfer):

- Cortical thickness
- Surface area
- Local gyrification

Subcortical Volume (FreeSurfer)

- Pallidum
 - Putamen
 - Caudate
- (All corrected for ICV)

White Matter Analysis

Diffusion weighted: FoV 240x240 mm, 60 contiguous axial slices, 96x96 matrix, TR/TE=8300/110ms, voxel size: 2.5mm³, b value of 3000 s/mm²

Preprocessing: (TOPUP, EDDY, FSL, ANT4)

- Thermal noise correction and induced distortions
- Motion correction
- Correction for bias field
- Global intensity normalisation.

Probabilistic tractography (MRtrix3)

- Fractional anisotropy and mean diffusivity of
- Corticobulbar tract
 - Corticospinal tract
 - Arcuate fasciculus
 - Frontal aslant tract

Whiter matter results

Neither fractional anisotropy nor mean diffusivity differed between the family and controls in any tract (all $p > .39$).