

Lateralization of language pathways during adolescence and early adulthood

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Introduction

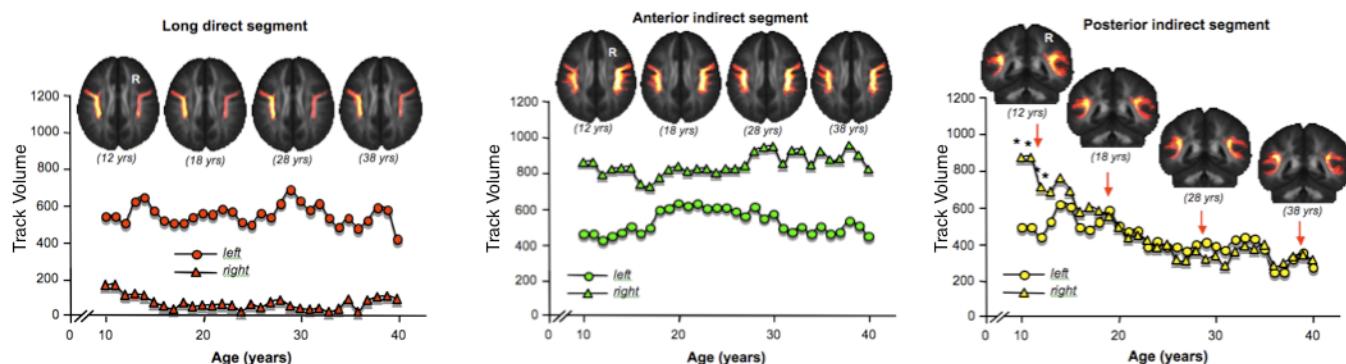
During adolescence a number of genetic, hormonal, and environmental factors contribute to significant modifications of human brain anatomy¹. Modifications in white matter tracts are of particular importance as these may underlie the acquisition of specific cognitive functions². Here we used diffusion tensor imaging (DTI) tractography to study age-related differences in lateralization of the perisylvian language pathways from late childhood to early adulthood.

Material and Method

We included 102 right-handed healthy volunteers aged 9-40 years. DTI were acquired on a 1.5 T GE Signa NV/i LX (General Electric, Milwaukee, WI). We performed virtual in vivo dissections of the three segments of the arcuate fasciculus³. For each subject and segment, a binary map was computed by assigning each pixel a value of 1 or 0 depending on whether the pixel was intersected by the tract segment. For each segment, the binary maps from all subjects were spatially normalized to the MNI space⁴. A moving average technique (window width \pm 5 years) was applied to create age-dependent group visitation map. For each dependent group visitation map track volume was calculated for each segment as the number of visited voxels by at least 50% of the subjects. Tract volumes of each segment in both hemispheres were correlated with age (**figure 1**).

Results

There was a highly significant relationship between the laterality index of the temporo-parietal connections and age (Pearson's correlation = .355, $p < .001$). This was mainly driven by a reduction in the number of streamlines in the right hemisphere, and especially between 14 and 17 years of age. Streamlines between temporal and frontal language areas were already lateralized at the age of nine and remained left lateralized throughout adolescence and early adulthood. Similarly no statistically significant correlations were found for the streamlines connecting the inferior parietal and frontal regions.



Conclusion

These results suggest that, in contrast to other regions language regions⁵, lateralization of the most posterior part of the arcuate fasciculus occurs during late adolescence and early adulthood, probably due to reorganization of white matter connections in the right hemisphere. These modifications are particularly intense during a period when the highest incidence for early onset psychosis is observed.

Reference

- 1) Giedd, J.N. Nat Neurosci. 1999;2:861-3. 2) Paus, T et al. Science 1999;283:1908-11. 3) Catani M. et al Ann Neurol. 2005;57:8-16. 4) Catani, M. PNAS. 2007;104:17163-8 5) Eluvathingal, T. et al Cerebral Cortex 2007;17:2760-68.