

The morphometry research of auditory speech cortex in bilateral cerebral hemisphere for preschool children on magnetic resonance imaging(MRI)

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Introduction The superior temporal gyrus (the rostral boundary of which is the rostral extent of the superior temporal sulcus, the caudal boundary is the caudal portion of the superior temporal gyrus, the medial boundary was the lateral fissure)⁴ is the auditory speech area of brain. The variety of changes such as volume, area and thickness of bilateral superior temporal cortex is significant for human population evolutionary. It was reported that some researches had been performed about gray matter volume and thickness during the range from children to adolescence^{1,2}, but there is still a vacancy about developmental studies of preschoolers in the auditory cortex, during this period the hearing will become more complex gradually.

Methods This study was approved by the local institutional review board. 12 female (age 2.60 ± 0.85 years, range from 1.58 to 4.00 years) and 17 male (age 2.79 ± 0.99 years, range from 1.00 to 4.25 years) who underwent MR scan and showed no abnormality were enrolled. They were sedated if necessary (oral chloral hydrate, 25-50 mg/kg). All scans were performed on a GE 3.0T Signa HDxt scanner with an 8-channel head coil, using the three-dimensional fast spoiled gradient echo (3D-FSPGR) T1WI (TR/TE = 10/4.6 ms, slice thickness = 1 mm, FOV = 180 mm \times 180 mm, matrix = 256 \times 256, NEX = 1). Data processing: (1) the imaging data of 3D-FSPGR T1WI were corrected for motion, averaged, normalized for intensity, and resampled to isotropic dimensions of 1 \times 1 \times 1 mm using the FreeSurfer 5.1 software package^{3,4}; (2) the skull was removed from the images using a skull-stripping algorithm; (3) the images were segmented to identify the dorsal, ventral and lateral extent of the gray/white matter boundary. All of the procedures above were automatically corrected for topological defects, occasionally need to have a manual adjustment by two experienced neuroradiologists when arising errors of program or/and anatomical structure recognition. Then, we obtained the measurements about volume, area, thickness of the superior temporal gyrus cortex automatically. Linear correlation between age and above morphological indexes was analyzed to evaluate the development of the superior temporal gyrus with aging. Two-sample t-test was performed to compare difference between right and left cerebral hemispheres. All tests were taken to be significant at $p < 0.05$.

Results The results of linear correlation analysis were showed in the **Fig 1. A-C**. Only the surface area showed significant correlations with age. The detailed correlation coefficients were listed as follows: for female in left cerebral hemispheres: $R = 0.594$, $p = 0.042$; for male in left cerebral hemispheres: $R = 0.580$, $p = 0.015$; for male in right cerebral hemispheres: $R = 0.528$, $p = 0.029$. The difference of three morphological indexes in superior temporal gyrus between right and left cerebral hemispheres were shown in **Fig.1 D-F**. Only the cortex thickness showed significant difference between two cerebral hemispheres ($t = 2.965$, $p = 0.006$).

Discussion These statistical results above showed the following phenomena, firstly, the increasing of surface area with aging is significant for female on the left superior temporal gyrus, male on the left and right, while there is no significant difference about the changes of the volume and thickness with aging; secondly, Bilateral superior temporal gyrus thickness variation showed that the dominant hemisphere of superior temporal gyrus was on the right side, while the variation about volume and surface area had no significant differences; finally, there was no gender difference in the study. The study is difficult to explain with the changes with aging, as there may be a superposition of multiple functional areas or remodeling changes; cortical thickness showed the right edge, which may be interpreted by that the right superior temporal gyrus is responsible for feeling, rhythm and intonation while these aspects will become more and more abundant in preschool, but cognitive education is lacking during this time.

Conclusions This research can suggest that for preschool children, the right superior temporal gyrus showed significant advantages owing to cognitive education but emotiona become more rich gradually, the right superior temporal gyrus showed significant advantages in exploring human evolution and progress.

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References 1. Gogtay N, Giedd JN, Lusk L, et al. Dynamic mapping of human cortical development during childhood through early adulthood[J]. Proceedings of the National Academy of Sciences of the United States of America, 2004, 101(21): 8174-8179. 2. Shaw P, Kabani NJ, Lerch JP, et al. Neurodevelopmental trajectories of the human cerebral cortex[J]. The Journal of neuroscience : the official journal of the Society for Neuroscience, 2008, 28(14): 3586-3594. 3. Pardoe HR, Abbott DF, Jackson GD. Sample size estimates for well-powered cross-sectional cortical thickness studies[J]. Human brain mapping, 2013, 34(11): 3000-3009. 4. Rahul S, Desikan, Florent Se'gonne, Bruce Fischl, et al. An Automated Labeling System For Subdividing the Human Cerebral Cortex on MRI Scans into Gyral Based Regions of Interest. Neuroimage . 31 (2006) 968 – 980.

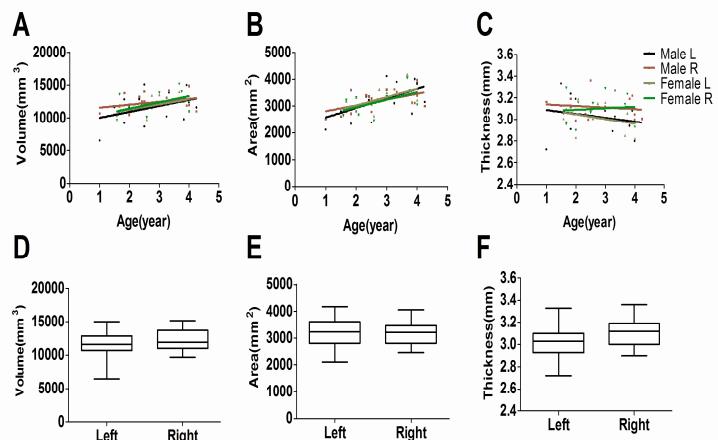


Fig.1 A, B and C exhibited the correlation between the three morphological indexes with age. **D, E and F** exhibited the difference of total bilateral superior temporal gyrus. Only total cortex thickness showed significant difference between two cerebral hemispheres ($t = 2.965$, $p = 0.006$).