TRACT-BASED SPATIAL STATISTICS(TBSS) INVESTIGATION OF THE DEVELOPMENT OF WHITE MATTER BETWEEN TWIN INFANTS AND PRETERM INFANTS AT TERM EQUIVALENT AGE

Hye Jin Jeong[1], So Yeon Shim[2], Joon Sup Jeong[1], Se Hong Oh[1], Sung Yeon Park[1], Young Bo Kim[1], and Zang Hee Cho[1]

[1]Gachon University of Medicine and Science, Neuroscience Research Instiute, Namdong-gu, Incheon, Korea, Republic of, [2]Gachon University Gil Hospital, Department of Pediatrics, Namdong-gu, Incheon, Korea, Republic of

Introduction

Diffusion tensor imaging (DTI) enables the visualization and quantitative characterization of white matter *in vivo*. Especially tract-based spatial statistics (TBSS) performed spatial normalization for group analysis in brain white matter. Due to the limited size of the mother's womb, twin has a high incidence of the prematurity. [1] Our previous study, we show that growth of brain white matter in preterm infants is gestational age dependent. In this study, we aim to compare the development of brain white matter between preterm infants and twin infants at term gestational age using tract-based spatial statistics (TBSS).

Method

Subject : We studied 28 infants who were obtained on 14 twin infants and 14 preterm infants at term-equivalent age. Infants were recruited from the Gil Hospital in Korea. The median gestational age of the preterm infants at birth was 31^{+1} (26^{+1}-36^{+4}) weeks, and the median birth weight was 1396 (550-2800) g. The median post-menstrual age at the time of imaging was 37^{+4} (35^{+2}-42^{+2}) weeks. The median gestational age of the twin infants at birth was 30^{+1} (25^{+5}-38^{+4}) weeks, and the median birth weight was 1528 (720-2750) g. The median post-menstrual age at the time of imaging was 37^{+1} (34^{+1}-41^{+4}) weeks. There were no significant differences in age at scanning (*p=0.14*) between the twin group and the preterm group.

MRI acquisition : We used a conventional 3.0T MRI (Verio, Siemens) using Siemens matrix coil. The DTI sequence parameters used were as follows : b = 0 and 700 s/mm^2, TR/TE= 6600/74 ms, number of diffusion gradient directions = 30, number of excitations =2, FOV = 230mm, matrix = 128x128, slice thickness = 1.8mm, voxel = 1.8 x 1.8 x 1.8 mm, Flip angle = 90°. The scanning time for the DTI sequence was 7min 36seconds.

Image analysis : DTI data was processed with FMRIB Software Library (FSL, Oxford, United Kingdom). [2] The DTI data was first registered to non diffusion weighted (b=0) image to correct for differences in spatial distortion caused by eddy currents. Images were brain-extracted by using BET [3] and fractional anisotropy (FA), mean diffusivity (MD) , λ_1, λ_2 and λ_3 maps were generated using DTIFit. [4] Voxelwise statistical analysis of FA was carried out with Track-Based Spatial Statistics (TBSS).[5] To normalize FA image, we aligned each FA image to every other one using a non-linear registration algorithm. Then, the mean FA image created a mean FA skeleton which represented the centres of all tracts common to the group. Threshold-free cluster enhancement (TFCE) was used to obtain the significant differences between group at p<0.01 after accounting for multiple comparisons.

ROIs : Seven ROIs were measured for each subjects. The portions corresponded to the corpus callosum, left and right posterior limb of internal capsule (PLIC), left and right interior limb of internal capsule (ILIC), optic radiation, and cerebral peduncle.

Results

According to the voxel-wise analyses there was no significant FA difference between twin infants and preterm infants at term equivalent age (TFCE-corrected ; p<0.01). **Figure 1.** shows the mean FA image for all subjects who participated in the experiment with the FA skeleton superimposed. **Table 1.** shows mean FA value for twin infants and preterm infants in seven ROIs. There was also no significant mean FA difference in the seven ROIs in preterm infants compared to twin infants at term equivalent age.

Discussion

Diffusion tensor imaging is being developed for studying the neurodevelopmental outcome of the brain white matter. Using tract-based spatial statistics (TBSS), the comparison of FA map between preterm infants and twin infants at term equivalent age revealed no significantly differences in mean FA. Namely the development of brain white matter was no significant difference between preterm infants and twin infants at term equivalent age

Acknowledgements

This research was supported by the Original Technology Research Program for Brain Science through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (Grant No. 20110030089) and Gachon University Gil Hospital (Grant no. 03).

Reference

[1] Elliott, JP et al. *Clinical Perinatology* **34** (4): 599–609 (2008), [2] Smith, et al. *Neuroimage* 23 Suppl 1: S208-19 (2004), [3] Smith, et al. *Hum Brain Mapp* 17(3): 143-55. (2002), [4] Behrens, et al. *Magn Reson Med*. 50(5): 1077-882003. (2003), [5] Smith, et al. *Neuroimage*. 31(4): 1487-505(2006.)

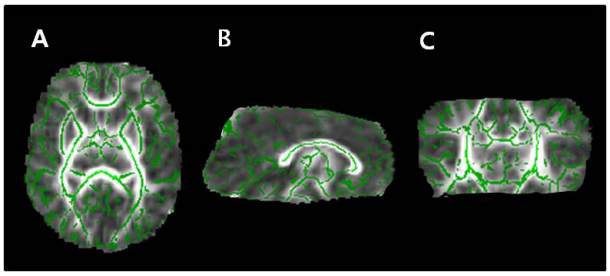

Fig 1. Mean FA skeleton (green) overlaid on mean FA map in axial (A), sagittal (B) and coronal (C) plane. There were no significantly different voxels between the twin infants and preterm infants at term equivalent age. (TFCE-corrected ; p<0.01)

Table 1. Mean FA in selected white matter areas.

	Twin (n=14)	Preterm infant (n=14)	*p-value*
Corpus callosum	0.325±0.017	0.316±0.012	0.154
Left PLIC	0.373±0.033	0.361±0.027	0.847
Right PLIC	0.345±0.023	0.344±0.035	0.937
Left ILIC	0.271±0.031	0.285±0.038	0.586
Right ILIC	0.255±0.038	0.265±0.050	0.303
Optic radiation	0.336±0.035	0.313±0.035	0.096
Cerebral peduncle	0.370±0.039	0.398±0.057	0.156