

Localization of Dysplastic Cortex Using Diffusion Tensor MRI: New Solution for Epilepsy Imaging

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Introduction

The aim of this study was to evaluate the utility of applying diffusion tensor imaging in localization of dysplastic cortex and investigate the potential use of fiber tractography to detect alterations in the fiber connectivity in the case of cortical dysplasia.

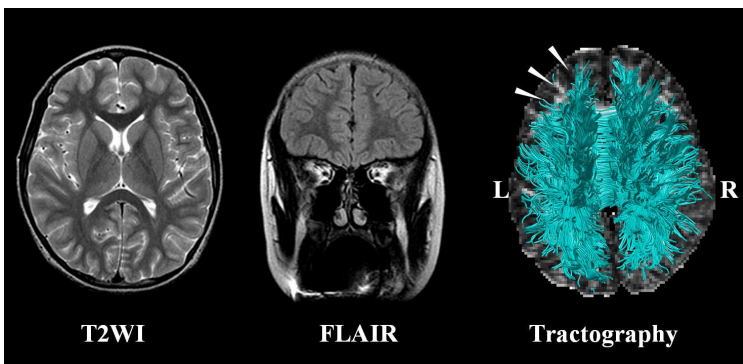
Methods

Thirty patients with focal or diffuse cortical dysplasia (M:F=17:13, Mean age=14.7 years) were evaluated by DTI. All the patients were diagnosed with FCD in frontal or occipital cortex using multimodality approach by MRI, PET and SPECT (ictal and interictal scans), and 13 of them received epilepsy surgery of which the pathologic specimen revealed cortical dysplasia. Age matched normal controls were recruited from the patients who received an MR examination due to a simple febrile convulsion or a headache in pediatric patients and were found to have normal MRI findings and no neurological abnormalities clinically.

All the studies were performed using a 1.5T scanner (Intera, Philips Medical Systems, Best, Netherlands) using a 6-channel Sensitivity Encoding (SENSE) head coil. After anatomic T2 and T1 weighted imaging, DTI was performed using a single-shot spin echo – echo planar imaging, with SENSE factor 2. Imaging parameters: 96 matrix, 128 reconstruction, 22cm FOV, 2.3mm thickness, TE = 70ms; TR = 6599-8280ms; 2 NSA, b = 600 s/mm², 32-different diffusion gradient directions.

The data was processed on a PC and fiber tractography was obtained by our own research software (DoDti: <http://neuroimage.yonsei.ac.kr>) with threshold values of fiber tracking termination as FA = 0.2 and trajectory angle = 45°. Localization of dysplastic cortex by visual analysis was performed by two experienced neuroradiologists (S.K.L and D.I.K.) from conventional T2WI, FLAIR and tractograms. Accuracy and inter-observer agreement of each imaging modalities were evaluated.

Results



Dysplastic cortex showed thickened cortex, blurring of gray-white matter junction or increased signal in the adjacent white matter on T2WI. Detection rate of dysplastic cortex was 83% by T2WI and 86% by FLAIR. On tractography, a decreased subcortical fiber bundle was demonstrated comparing to the normal contralateral cortex (arrowheads in the left figure). With combination of tractography, every patient was found to have dysplastic cortex, which were confirmed by surgery, clinically or nuclear medicine studies.

Normal controls showed symmetric distribution and shape of fiber bundles. In the case of prominent signal change in white matter on T2WI, more apparent reduction of fiber connections between longitudinal fibers and dysplastic cortex.

Conclusion

DTI can be used for the evaluation of cortical dysplasia and demonstrate abnormalities which were not evidence on conventional MRI techniques. Ten-minutes DTI scan will help differential diagnosis of epilepsy patients if implemented to clinical scan protocol.

References

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- Lee SK et al. Neuroimage 2004 ;22 :1826-1829