Diffusivity and diffusion anisotropy of cerebellar peduncles in the cases of spinocerebellar ataxia.

-Short-range tractography based analysis in order to avoid crossing fiber problem-

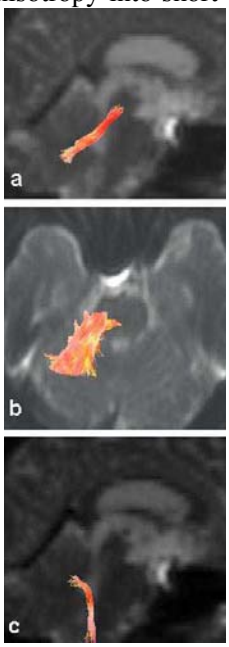
T. Taoka[1], T. Kin[2], H. Nakagawa[1], M. Sakamoto[1], S. Iwasaki[3], M. Hirano[2], S. Ueno[2], and K. Kichikawa[1]

[1]Department of Radiology, Nara Medical University, Kashihara, Nara, Japan, [2]Department of Neurology, Nara Medical University, Kashihara, Nara, Japan, [3]Department of Radiology, Higashiosaka City General Hospital, Higashiosaka, Osaka, Japan

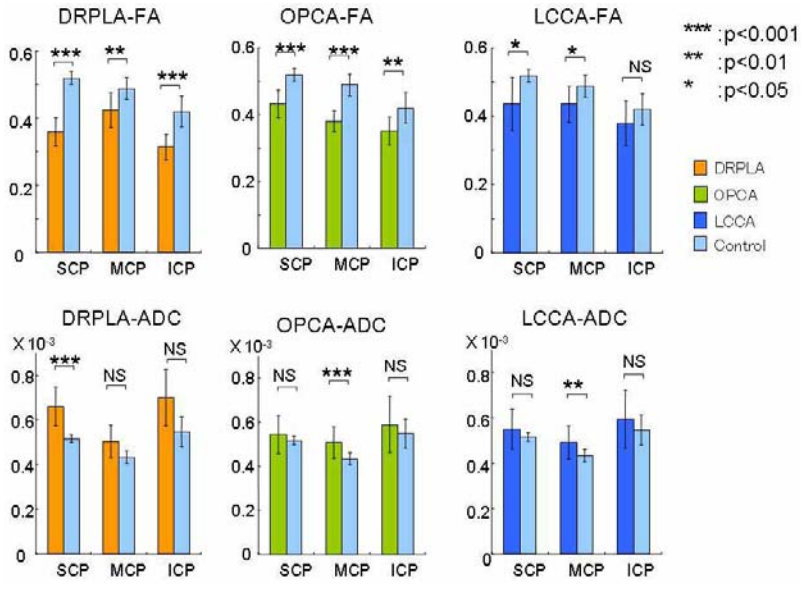
Purpose: The purpose of this study is to evaluate diffusivity and diffusion anisotropy of three cerebellar peduncles in the cases of spinocerebellar ataxia using diffusion tensor based measurement. In order to avoid crossing fiber problem, we limited the tractography for measuring diffusivity and diffusion anisotropy into short range of cerebellar side.

Materials and Methods: The subjects were 14 cases with spinocerebellar ataxia, which include 7 cases of dentatorubro-pallidoluysian atrophy (DRPLA), 4 cases of olivoponto-cerebellar atrophy (OPCA) and 3 cases of late cortical cerebellar atrophy (LCCA). Age matched 7 control subjects were also studied.

Diffusion tensor images were obtained using a single shot echo planar sequence (TR=4900 ms, TE=85 ms, b=1000 sec/mm^2, 6 axes encoding). Tractographies of superior cerebellar peduncle (SCP, **Fig. a**), middle cerebellar peduncle (MCP, **Fig. b**) and inferior cerebellar peduncle (ICP, **Fig. c**) were constructed using diffusion tensor imaging software developed by Masutani et. al (Tokyo University, "dTV II", available at *http://www.ut-radiology.umin.jp /people/masutani/dTV.htm*)[1]. We limited the range of tractography into 30 steps (voxel lengths) of cerebellum side as shown in figures. We measured fractional anisotropy (FA) and apparent diffusion coefficient (ADC; sec/mm^2) values of the three cerebellar peduncles. We made statistical analysis (t-test) between control group and each spinocerebellar ataxia group.



Results: As shown in the graphs bellow, there were statistically significant differences in FA between DRPLA cases and control in all three cerebellar peduncles. While ADC showed significant difference only in SCP. On the other hand, OPCA cases showed statistically significant lower FA and higher ADC in MCP compared to the controls. In LCCA cases, only slight or no statistically significant difference could be observed.



Discussion and Conclusion: Since whole tract of these cerebellar peduncles has crossing, ordinary tractography could not trace the whole pathways precisely. In order to avoid this problem, we did not tried to cover whole length of tracts. Instead, we limited the tractography into short range of cerebellum side.

In the current study, DRPLA cases showed decreased FA and increased ADC in SCP, which consist mainly of efferent fibers. This seemed to agree with the fact that efferent system of cerebellum is predominantly affected in DRPLA. In contrast, OPCA predominantly affects afferent system of cerebellum. Since MCP mainly consists of afferent fibers, decreased FA and increased ADC of MCP in this study also agree with the character of OPCA. LCCA mainly affects the cerebellar cortex and fiber degeneration is not prominent. Findings of the current study also agree with this fact.

The pattern of affected cerebellar peduncle described by this short-range tractography based measurement of FA and ADC seems to be feasible as a tool for differential diagnosis of spinocerebellar ataxia.

Ref.: 1. Eur J Radiol. 2003; 46:53-66