Brain Tissue and Microstructure Alternations in Children with Trichotillomania

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Introduction:

Trichotillomania (TTM) is a poorly understood disorder that is characterized by repetitive hair pulling that leads to noticeable hair loss, distress, and social or functional impairment. Very few neuroimaging studies have been conducted on patients with TTM. To the best of our knowledge, no study has investigated neural correlates, such as grey matter (GM) and diffusion alterations, in children and adolescent patients with TTM. The objective of this study, therefore, was to investigate specific brain tissue loss with structural MRI and microstructural changes with diffusion tensor MRI (DT-MRI) in children and adolescents with TTM.

Materials and Methods:

Data were reported for 9 subjects with TTM (7 females and 2 males) and 10 HC subjects (9 females and 1 male) who were group-matched for age, sex, and intelligence quotient (IQ). The mean age for the TTM subjects was 12.0 ± 3.4 years (range, 7.0-17.5 years). MR imaging was performed on a 3.0T MR system (Achieva, Philips Medical System, Best, The Netherlands). To investigate gray matter volume changes, an isometric sagittal structural volumetric T1-weighted image (3D T1WI) was acquired by using a magnetization-prepared rapid acquisition of gradient echo (MPRAGE) sequence. In order to investigate the microstructural alterations, DT-MRI was performed using a single-shot spin-echo EPI sequence with the b-values of 0 and 800 sec/mm^2 applied along 32 diffusion-encoding directions.

Post-processing of 3D T1WI and DT-MRI data was performed with the Statistical Parametric Mapping, version 8 software for co-registration and spatial normalization. Before the 3D T1WI was spatially normalized onto a standard brain template, we created a study-specific brain template using all subjects' 3D T1WI. Finally, using the transformation parameters, FA and trace maps were also normalized onto the template. DTI indices of FA and trace values were smoothed by 6 × 6 × 6 mm of full width of half maximum (FWHM) Gaussian kernel for statistical tests. For the GM analysis, the normalized 3D T1WI was smoothed by 4 × 4 × 4 mm FWHM Gaussian Kernel. In order to investigate the differences between the two groups, the smoothed 3D T1WI, FA, and trace values were tested by voxel-wise two-sample *t*-tests with age as a covariate. Statistical thresholds were set at p = 0.0005 for the GM analysis and p = 0.001 for the FA and trace maps without using multiple comparisons. The minimum cluster size was 10 contiguous voxels.

Results :

Fig. 1 shows results of 3D T1WI overlapped onto the rendering images. In TTM patients, there were regions of brain tissue loss (red color in Fig. 1) in the middle frontal gyrus, the insula, the lingual gyrus, and the middle temporal gyrus compared with HCs. However, there was no area of increased brain tissue in patients with TTM compared with HCs.

Fig. 2 shows the trace results (left) and the FA results (right) overlapped onto the two-dimensional (2D) template image. We found both decreased (red) and increased (blue) trace values (left) and FA values (right) in TTM patients compared with HCs. In TTM patients, trace values were increased in the left middle frontal gyrus (BA 11) and decreased in the cuneus (BA 23, 30), the precentral gyrus (BA 6), and the precuneus (BA 7). In TTM patients, FA values were decreased in the precentral gyrus and the inferior frontal gyrus and increased in the cingulate gyrus, the middle frontal gyrus, the inferior temporal gyrus, the fusiform gyrus, and the insula.

Discussions:

In this study, we investigated abnormalities in grey matter density and white matter integrity in TTM patients compared to HC subjects. The first major finding of the present study was that there were brain tissue changes in the medial frontal gyral area in TTM patients on both GM and DT-MRI. In particular, there were regions of brain tissue loss and increased trace values in the left middle frontal gyrus, which was the region that showed the most overall brain tissue loss in patients with TTM. In contrast, there was brain tissue loss in the right middle frontal gyrus and increased FA values in this area. These results suggest the possibility of selective brain tissue loss in this area.

The second major finding of the present study was that the trace values were decreased in the precuneus area in TTM patients compared with HC subjects. Recently, the precuneus, which is the posteromedial portion of the parietal lobe, has received attention for its central role in a wide spectrum of highly integrated tasks, including visuospatial imagery, episodic memory retrieval, and self-processing operations. In our previous study using functional MRI in TTM patients, we also found that there was higher activity in the precuneus in the TTM group.

Conclusion:

In summary, using 3D T1WI and DT-MRI, we identified regions of significant brain tissue loss and white matter abnormalities in the middle frontal gyrus in pediatric TTM patients. These findings support the concept that TTM shares some neurobiological mechanisms with other putative obsessive-compulsive spectrum disorders (OCSDs). Future studies should examine the neurobiological overlap between TTM, other impulse control disorders, Tourette's syndrome, and obsessive-compulsive disorder (OCD) using other modalities and a larger sample.

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References: Chamberlain SR, et al Arch Gen Psychiatry. 2010 Sep;67(9):965-71. Chamberlain SR, et al Br J Psychiatry. 2008 Sep;193(3):216-21. Yoo SY, et al J Korean Med Sci. 2008 Feb;23(1):24-30. Menzies L, et al Am J Psychiatry. 2008 Oct;165(10):1308-15. Lee JA et al. prog Neuropsychopharmacol Biol Psychiatry 2010; 34(1):1250-1258

Fig.1 VBM with 3D T1WI

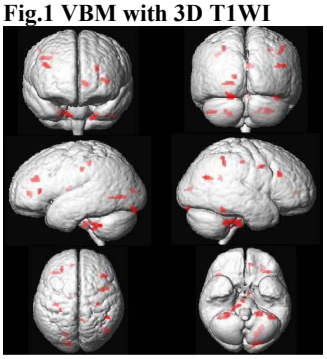

Fig.2 VBM with DTI indices

Trace **FA**