

강박장애에서 LORETA 영상을 이용한 P300 국소원의 통계적 분석*

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The P300 Source Localization in the Patients with Obsessive-Compulsive Disorder using the LORETA Imaging and SPM*

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ABSTRACT

Objectives : We investigated the characteristics of P300 generators in obsessive - compulsive disorder(OCD) patients by using voxel - based statistical parametric mapping of current density images.

Methods : P300 generators, produced by a rare target tone of 1500Hz under a frequent non - target tone of 1,000Hz, were measured in 15 right - handed OCD patients and 15 controls. Low Resolution Electromagnetic Tomography(LORETA), using a realistic head model of the boundary element method based on individual MRI, was applied to the 128 - channel EEG. Statistical parametric mapping(SPM) was applied for the statistical analysis.

Results : We found that both groups had the mean current density of P300 in the parietal, temporal and prefrontal lobe. There was a trend for decreased current density in the prefrontal area in OCD patients. The statistical comparison showed current density increase in the supraparietal area, a statistically significant longer P300 latency and a trend for reduced P300 amplitude in OCD patients.

Conclusion : It suggests that P300 source of both groups exists in multiple brain regions at the same time. And both groups had no statistically significant differences in the current density of P300 except for increased current density in the supraparietal area in OCD patients. But, considering the statistically significant longer P300 latency, a trend for reduced P300 amplitude and relative mean current density reduction in the prefrontal area in OCD patients, this study suggests that the frontal lobe may have a reduced normal inhibitory process in OCD patients.

KEY WORDS : Obsessive - compulsive disorder · P300 · Source localization · LORETA · SPM.

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서론

1965 Sutton P300 (deep electrode recordings),¹⁸⁾¹⁹⁾ (discrete neural lesions)²⁰⁻²²⁾ (thalamus), (hippocampus)/ (parahippocampal areas), (insula), (superior temporal area), (inferior parietal area)가 P300²³⁻²⁵⁾ (functional MRI) (SPECT) (functional neuroimaging studies) (middle frontal gyrus), (superior temporal gyrus), (supramarginal gyrus of parietal lobe) P300 (generator)²⁶⁾²⁷⁾ 가 P300 가 P300 가⁶⁻⁸⁾ 가 P300 가 2가 가 (temporal resolution) 가 Towey⁹⁾ 가 가 P300 3 (inverse problem) Low Resolution Electromagnetic Tomography(LORETA)가²⁸⁾ (dipole)²⁹⁾ “smoothest constraint” 가 가³⁰⁾ (Laplacian) P300 가 P300 P3a, P3b 가 Mavrogiorgou¹³⁾ 가 LORETA 가³⁰⁾³¹⁾ spherical boundary element method(BEM) (simulation)³²⁻³⁴⁾ 128 -³⁵⁾³⁶⁾ Sanz¹⁷⁾ 가 P300

, P300 (topography)가
 (vertex)
 가 ,¹²⁾ 2
 - (temporo - basal) P3b
 2 - (temporo - superior) P3a
¹³⁾
 (region of interest)
 가
 128 - LORETA
³⁵⁾³⁶⁾ BEM 600
 realistic head model
 P300 LORETA
 (voxel)
 (statistical parametric mapping, SPM)
 P300
³⁷⁾³⁸⁾

연구 대상 및 방법

1. 연구 대상
 15 (8 , 7)
 SCID - DSM -
 Yale - Brown Obses-
 sive - Compulsive Scale(Y - BOCS) ³⁹⁾
 Y - BOCS 25.6(6.2)
 28.1 (6.9)
 7.3 (6.7) 4
 15 (10 , 5)
 27.9

2.9, 0.5 ; 3.1, 0.5)
 가
2. P300 신호원의 국소화 추정
1) Oddball paradigm
 가 oddball paradigm
 Neuroscan STIM , 80dB
 SPL tone pip
 3 (block) 200 ,
 15%
 (1,500Hz) , 85% (1,000Hz)
 (plateau) 40msec ,
 (interstimulus interval : ISI) 1,200msec

2) 뇌파 측정
 Neuroscan Quik - Cap 128 -
 (sensor)
 (digitizer)
 3 Polhemus Fastrak
 1,000Hz (sampling rate)
 100ms 0ms
 (baseline correction)
 - 100uV 100uV
 (artifact rejection)
 가
 (landmark, nasion, preau-
 ricular point) FASTRAK
 3
 3

3) LORETA를 이용한 전류밀도 측정(1)
 1

1.5 Tesla GE SIGNA Scanner (GE Medical Systems, Milwaukee, USA) (intensity map) (40)41)

24 x 24cm, image matrix 256 x 256 12mm FWHM (full width half maximum) 가

3 T1-weighted MR Curry (isotropic Gaussian kernel)

V4.5 LORETA Gaussian smoothing

SPM99 (Institute of Neurology, University College of London, UK)

3 (nasion, pre-auricular points)

4,000 3- (three-compartment) boundary element model (BEM) 가

(conductivity) (proportional scaling) (42)43)

0.33, 0.0042, 0.33 t- (two-sample t-test)

3mm LORETA

3cm (constraint) (37)38)

P300 mean global field power (MGFP) (peak point) t-

P300 Y-BOCS r (Pearson r correlation)

4) 통계 (2)

LORETA

1mm

18,000~20,000

LORETA

P300

가

결과

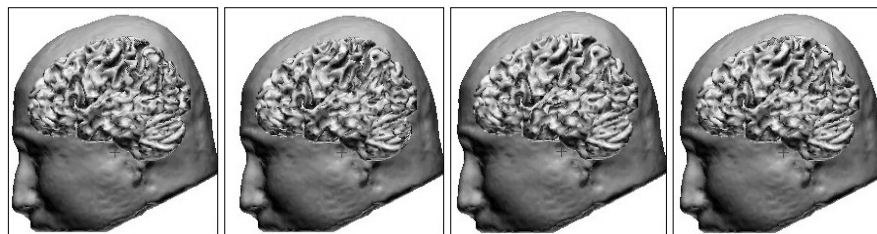


Fig. 1. The current density of P300, calculated by LORETA We calculated LORETA at a peak time point of the mean global field power (MGFP) of P300 at each subject. Then we reconstructed three-dimensional volumetric current density images using realistic head model. All peaks were located around 300msec from the stimulus onset.

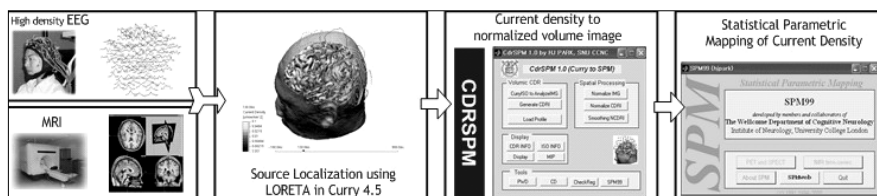


Fig. 2. The procedure of statistical evaluation used in this study EEGs were recorded via a 128-channel Quik-cap and three-dimensional T1-weighted standard MR images were used for all subjects. We calculated LORETA at a peak time point of the mean global field power (MGFP) of P300 at each subject. Spatial normalization and intensity normalization of the current density image were carried out using SPM99. In comparing P300 generators of OCD patients and control group, statistical parametric mapping with two-sample t-test was applied using SPM99. OCD : obsessive compulsive disorder.

가 (p<0.01).
 가 (uncorrected significance level)
 P300
 25, 0.05
 가 가
 P300
 1 가 가
 3 (2, 4).
 가 P300
 Y - BOCS
 가 가
 P300
 가 가

Table 1. Mean amplitudes and latencies of P300 at Fz, Cz, Pz and Oz for OCD and control groups*

	Amplitude(μ V)		Latency(msec)	
	OCD (n=15)	Control (n=15)	OCD (n=15)	Control (n=15)
Fz	5.1(4.0)	8.1(3.6)	348.3(14.5)*	323.0(19.1)
Cz	7.2(5.0)	10.0(3.7)	353.1(14.1)*	328.2(19.3)
Pz	7.4(4.4)	10.0(3.8)	353.3(17.0)*	329.0(21.4)
Oz	7.3(4.5)	8.9(4.0)	347.9(20.0)*	328.0(20.3)

* : OCD : obsessive-compulsive disorder, SD in parenthesis p<0.01 (compared with the controls)

Table 2. Area showing increased current density of P300 in OCD

Region(Brodmann area)	Coordinates(mm)	Z	K
Superior parietal area(7)	18 -66 66	2.74	28

OCD : obsessive-compulsive disorder p<0.05(uncorrected) ; extent threshold=25 voxels Coordinates refer to the 3 axes(x, y, z) of Talairach coordinate system Z and k refer to the maximum excursion and the vowel extent, respectively

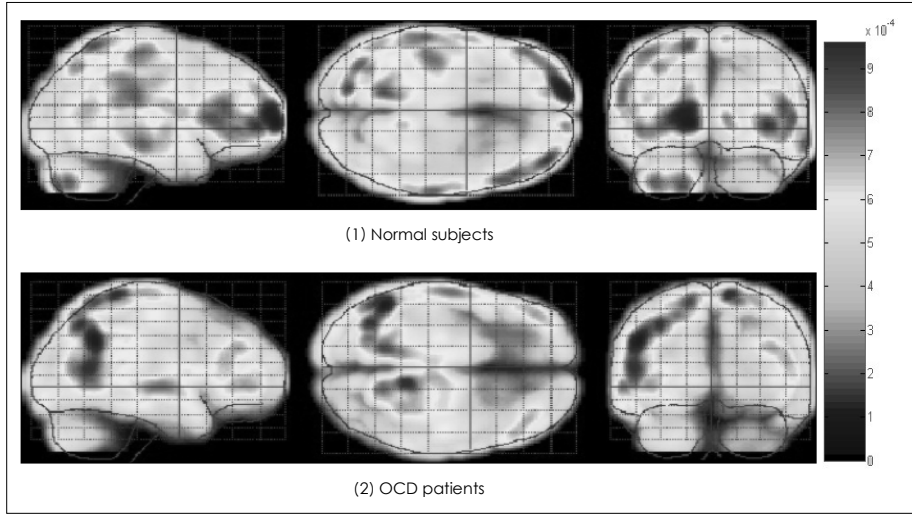


Fig. 3. Mean current density image of P300 in normal subjects(1) and OCD patients(2) ; The average sources of P300 by displaying the mean of the normalized current densities of all subjects within each group. This image was done with the normalized images in order to focus on the regional activity of P300 sources relative to the global activity, specific to subject characteristics. OCD : obsessive-compulsive disorder.

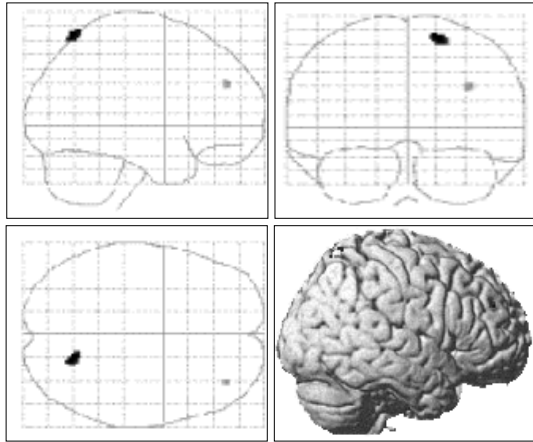


Fig. 4. Statistical parametric maps displaying increased current density of P300 in OCD : increased areas ($Z > 1.96$, $k > 25$) of P300 sources in OCD compared with control subjects are shown on the Talairach coordinate. P300 sources were increased at the superior parietal area [TC 18/-66/66 ; BA 7] in OCD. OCD : obsessive-compulsive disorder, TC : Talairach coordinate system, BA : Brodmann area, Z and k refer to the maximum excursion and the vowel extent, respectively.

가 . P300

P300 가

가 가 ,

(orbitofrontal cortex) (ven-

tromedial)

가

¹³⁾ ,

(basal ganglia), (tha-

lamus), (cingulate gyrus) 가 ⁴⁷⁾

가 가

가 P300 가 가

가 ,

가 P300

P300

(intracortical recordings)

P300 , , , 가

¹⁸⁾¹⁹⁾²⁵⁾ , LORETA

P300 Winterer ⁴⁴⁾ 가

7 가 240~420ms

Winterer P300

P300

⁴⁵⁾ Winterer P300 가

Moores ⁴⁶⁾ P300

P300 P300

(intraparietal sulcus), , 가

14 - 17) 가 가 가 .

가 가 가 .

가 가 가 .

가 가 PET 가 48)

가 가 가

결 론

가 P300 . 128 - realistic head model (conductivity model)

MRI (general linear model) P300 가

가 가 가 P300 P300

P300 가 가

가 가 ,

가 가 가 .

중심 단어 : P300 . LORETA .

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