

TREATMENT EFFECTS OF TAI CHI EXERCISE IN A PATIENT WITH MAJOR DEPRESSION USING MISMATCH NEGATIVITY (MMN) AND EARLY NEGATIVE DIFFERENCE (NDE)

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Abstract : The present study examined whether Tai Chi exercise had treatment effects for major depression using objective measures. We used mismatch negativity (MMN) and early negative difference (Nde), one of event-related potentials (ERPs) as objective measures. We administered 24-style Tai Chi exercise twice a week during 3 months to a patient with major depression. Consequently, not only depressive symptoms but also small MMN and Nde amplitudes improved accompanying 24-style Tai Chi exercise. Therefore, Tai Chi could be recommended as a mental training method to ameliorate cognitive function, especially attention function.

Key words : Tai Chi, major depression, event-related potential, mismatch negativity, early negative difference

INTRODUCTION

Tai Chi has become an eye-catching exercise for its beneficial effects physiologically and psychologically.¹⁾ Also, Tai Chi could be recommended as a mental training method to ameliorate cognitive function, especially attention function.²⁾ However, to our knowledge, there is no report indicating Tai Chi's effect on cognitive function using event-related potentials (ERPs).

Early negativity, one of ERPs, has drawn attention, since there are some disabilities of early negativity in the attention-deficit hyperactivity disorder (ADHD) group.^{3,4)} The mismatch negativity (MMN) component, one of those components, reflects an automatic cerebral discrimination process, not under attentive control.³⁾ The early negative difference (Nde) component, another of those components, which reflects a conscious and active attention function, is considered an indicator of selective attention.⁴⁾

In the present study, we examined Tai Chi's effect on cognitive function using MMN and Nde to a major depression patient.

METHODS

We administered 24-style Tai Chi exercise twice a week during 3 months to a patient with major depression. The patient was a 51-year-old man diagnosed as having major depressive disorder according to DSM-IV.⁵⁾ We measured MMN and Nde before and after the Tai Chi exercise term. His medications were not altered during the Tai Chi exercise term. Prior to participation, he gave informed consent to the study. In addition, this study was approved by the Institutional Review Board of Nara Medical University Hospital.

Stimulus and task presentation

MMN was obtained by auditory odd-ball tasks, and Nde by selective attention tasks. A NEC Multi Stim II was used as the auditory stimulus system.

MMN measurement

Standard stimuli ($P=0.9$) were tone bursts at 1000-Hz and deviant stimuli ($P=0.1$) were tones at 1100-Hz, with all stimuli lasting 50 msec at 500-msec intervals and an intensity of 80 dB. These infrequent and frequent stimuli were given in random order through headphones. MMN was measured while the subjects were reading books of their choice, without paying particular attention to the auditory stimuli given, as instructed (READ condition).

Nde measurement

Stimuli were given as tone bursts (each stimulus lasting 50 msec) at a fixed intensity (80dB). To the right ear non-attended standard stimuli at 400 Hz ($P=0.7$) and non-attended deviant stimuli at 500 Hz ($P=0.3$) were delivered in random order. To the left ear attended standard stimuli at 800 Hz ($P=0.7$) and attended deviant stimuli at 1000 Hz ($P=0.3$) were given. These infrequent and frequent stimuli were presented at 1.5 sec intervals binaurally through headphones. He was instructed to pay attention to the sounds delivered to the left ear to detect deviant stimuli and to ignore the sounds presented to the right ear. He was also instructed to press the button as quickly as possible when each deviant stimulus was presented in the attended channel.

ERP recording and analyses

ERPs were recorded with MEB 2200 (Neuro Pack). Electroencephalograms (EEGs) were obtained at Fz, Cz, Pz, C3, and C4 on the scalp using disk electrodes, with both ear lobes as the reference electrode sites. MMN was analyzed during the period between 100 msec pre-stimulus and 400 msec post-stimulus. The Nde was analyzed during the period between 120 msec the pre-stimulus and 480 msec post-stimulus.

MMN

One hundred responses to infrequent deviant stimuli and 900 responses to frequent standard stimuli were averaged separately. The waveform of the latter responses was subtracted from that of the former. The MMN was identified as negativity with the peak latency from 100 to 250 msec based on the subtraction waveform.

Nde

Forty responses to attended and forty responses to unattended standard stimuli were averaged separately. The waveform of the latter response was subtracted from that of the former. The Nde was identified as negativity that emerges at about 50 msec after the stimulus presentation up to about 200 msec.

RESULTS

Score of Hamilton Rating Scale for Depression (HAM-D)⁶⁾ varied from 22 to 10 after the Tai Chi exercise term.

Before the Tai Chi exercise term, at Fz, Cz, Pz, C3, and C4, MMN latencies and amplitudes were 197.8(ms) 1.1(uV), 197.8(ms) 1.8(uV), 195.4(ms) 2.0(uV), 196.6(ms) 3.6(uV), 196.6(ms) 1.8(uV); Nde latencies and amplitudes were, 194(ms) 4.8(uV), 192(ms) 5.1(uV), 197(ms) -0.8(uV), 197(ms) 3.6(uV), 192(ms) 3.3(uV), respectively.

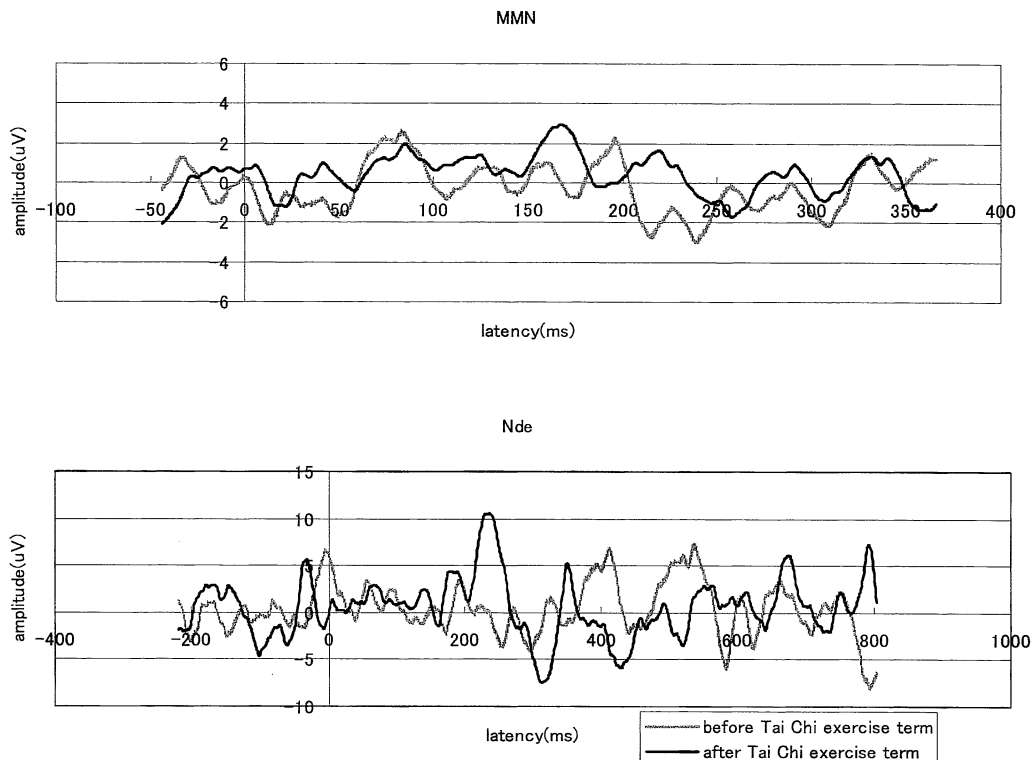


Fig. 1. average MMN and Nde waves at Fz, Cz, Pz, C3, and C4 before/after Tai Chi exercise term

After the Tai Chi exercise term, at Fz, Cz, Pz, C3, and C4, MMN latencies and amplitudes were 168.6(ms) 3.1(uV), 169.8(ms) 3.8(uV), 164.8(ms) 3.0(uV), 164.8(ms) 3.2(uV), 169.8(ms) 1.7(uV); Nde latencies and amplitudes were, 235(ms) 9.9(uV), 238(ms) 10.6(uV), 232(ms) 11.0(uV), 229(ms) 11.0(uV), 240(ms) 10.9(uV), respectively.

Figure 1 shows average Nde and MMN waves at Fz, Cz, Pz, C3, and C4.

DISCUSSION

Major depression is one of the typical disorders which cause patients loss of concentration and inattention. We previously reported that MMN and Nde amplitudes of ADHD children were smaller than those of healthy control children.⁷⁾ Therefore small MMN and Nde amplitudes might be related to loss of concentration and inattention.

In this study, we indicated that not only depressive symptoms but also small MMN and Nde amplitudes might be improved accompanying 24-style Tai Chi exercise in a major depression patient. Therefore, Tai Chi could be recommended as a mental training method to ameliorate not only depressive symptoms but also cognitive function, especially attention function.

However, this is actually a case report. Therefore, future studies with large samples are

needed to determine whether small MMN and Nde amplitudes improve accompanying 24-style Tai Chi exercise and whether 24-style Tai Chi exercise helps a major depression patient to ameliorate cognitive function, especially attention function.

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