別紙様式８

研　究　主　論　文　抄　録

論文題目　Effects of Theta Burst Transcranial Magnetic Stimulation on Brain-Motor System in Humans

（ヒト大脳皮質運動系へのシータバースト経頭蓋磁気刺激の効果　）

熊本大学大学院自然科学研究科　情報電気電子工学　専攻　人間環境情報　講座

（　主任指導　村山　伸樹　教授　）

論文提出者　サグラム　ムラット

(by　Saglam Murat　)

主論文要旨

Previous studies demonstrate the importance of the dynamic connectivity between the cortex and the muscles and also within intra-cortical areas in human brain in order to perform voluntary contractions. To study such dynamic and anatomical connections of healthy human brain, repetitive transcranial magnetic stimulation (rTMS) is a widely-used tool which induces plastic changes in the synaptic connectivity of cortical circuits by stimulating the brain noninvasively. The effects of rTMS can be controlled by adjusting the stimulation parameters, e.g. intensity, duration, total number, and frequency of TMS pulses applied. Recently, a well-known stimulation pattern called theta burst stimulation (TBS) has been adopted as a novel rTMS paradigm for clinical studies on humans. It has been shown that TBS significantly improves the efficiency of the rTMS applications by shortening stimulation duration, decreasing the number of pulses applied and yet prolonging the after-effects in the cortical plasticity. However to asses TBS-induced changes, in almost all of the cases, motor evoked potentials (MEP) were employed whose amplitude stands for the quantification of cortico-spinal excitability. But this measure necessarily uses exogenous TMS pulses for eliciting response potentials that last less than 100 milliseconds; this puts a limitation to the quantification of ongoing cortico-musclar and cortico-cortical information processing. By contrast, the functional coupling within the cortices and between cortex and the corresponding muscles can be investigated by means of the coherence function in the frequency domain and of cumulant density function in the time domain. Since these measures require no exogenous stimuli, but recordings of cortical and muscular activities, e.g. electroencephalographic (EEG) and electromyographic (EMG) signals, one can quantitatively examine the cortico-muscular/-corical synchronizations during

voluntary muscle contractions in rather near-natural conditions. But so far, those synchronizations were not studies by inducing temporary plasticities in human brain using TBS. In this study, we examined how TBS applied either over primary motor (M1) or sensory (S1) cortices can affect the cortico-musclar and cortico-cortical coherence during voluntary isometric contraction of the first dorsal interosseous (FDI) hand muscle. To validate our results on the effects of TBS on coherence, we assessed cortico-spinal excitability by measuring MEPs to reproduce the previous results in the literature. First, we have found that only after TBS-on-M1, cortico-spinal excitability and beta band (13-30 Hz) cortico-muscular coherence suppressed for 30 and 50 minutes after the stimulation and both recovered to the original levels in 90 and 120 minutes. These parallel changes indicate that mechanisms for cortico-spinal excitability and widespread cortical changes by means of delta (1-3 Hz) and alpha band (8-12 Hz) cortical power or theta bnad (4-7 Hz) cortico-cortical coherence lasting for 120 minutes after the stimulation, indicating that TBS way induce plastic changes at distal cortical locations over functional or anatomical intra-cortical connections. To sum up, the present study combines cTBS stimulation with coherence analysis of EEG and EMG signals during an isometric contraction task of a peripheral muscle for the first time, thus providing the first evidence that cTBS can alter cortico-muscular/-cortical synchronized and oscillatory activity.