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Human Brain activation during a handgrip force task

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【背景】

Grip force control depends on the integrity of the sensorimotor system, when injury to sensorimotor areas of the brain occurs there may be impairment in controlling force. Several studies have shown the importance of sensorimotor cortical regions in human motor control, however the relationship between force output control and brain activation remain unclear. The purpose of this study was to investigate and to characterize cortical responses by changes of hemoglobin oxygenation measured by functional near-infrared spectroscopy (fNIRS) during control of two different voluntary force matching handgrip task for five minutes.

【方法】

Seven (2male and 5 female, aged 20.5 ± 0.84 years) right-handed healthy volunteers participated in this study. We used 43-channel (34 channels with 2.5-3.0 cm and 9 channels with 1.5cm of distance) NIRS system (OMM-3000/1, Shimadzu) with 12 light-incident and 12 detector fibers and it was place over the sensorimotor region of the left hemisphere.

Participants sited on a chair with the elbow flexed at 90° and with the forearm rest in a desk and then were asked to squeeze a hand dynamometer repetitively. Prior to the experiment, the force level of maximal voluntary contraction (MVC, 24.77±9.54 Kg) during handgrip was measured for each participant, and all participants trained to exert target forces at two different levels, 10% and 50% of the MVC (Fig.1).

Fig. 1: Experiment setting

The exerted force levels was continuously monitored by software (PowerLab; AD Instruments) and displayed on a monitor as visual feedback. The electromyogram (EMG) was measure from the extensor digitorum muscles. The handgrip task was performance for 300 s. Rest period was given before (30s) and after (60s) of the motor task. Each task was recorded twice.

We used 43-channel (34 channels with 2.5-3.0 cm and 9 channels with 1.5cm of distance) NIRS system (OMM-3000/1, Shimadzu) with 12 light-incident and 12 detector fibers (Fig.2).

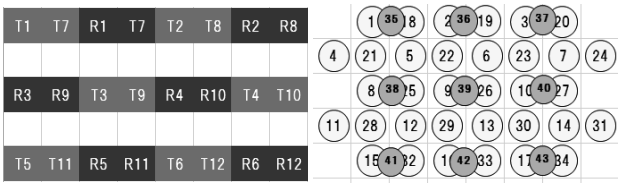
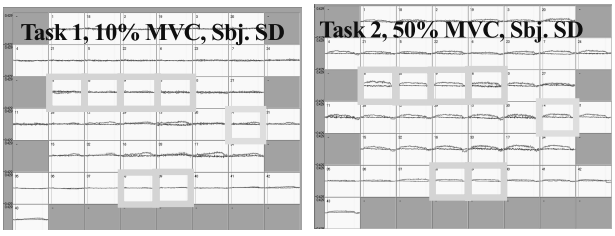
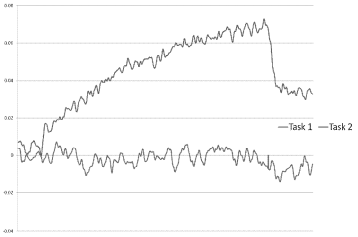


Fig.2: probe setting ◯34 channels with 3cm and ● 9 channels with 1.5 cm of distance.

【結果】





【結論】

The result demonstrated a stronger △oxyHb signal during higher force (50% MVC) than 10%MVC task condition, indicating that more cortical output neurons and interneurons participate in generating descending commands and processing additional sensory information

【文献】

1) Jeremy W. Noble, Janice J. Eng, ·, Kristen J. Kokotilo, Lara A. Boyd . Aging effects on the control of grip force magnitude: An fMRI study. Experimental Gerontology 46 (2011) 453-461