

A Comparison of the Prefrontal Activation between an Added-purpose Task and a Single-purpose Task for Upper Limbs: A Near-infrared Spectroscopy Study

Fubiao HUANG¹, Daisuke HIRANO², Kotaro TAKEDA^{3,4}, Takamichi TANIGUCHI⁵, Yoshishige OGIHARA⁵

¹Department of Occupational Therapy, China Rehabilitation Research Center, Beijing, China, ²Nasu Institute for Developmental Disabilities, Otawara, Tochigi, Japan, ³Department of Neurology, International University of Health and Welfare Hospital, Nasushiobara, Tochigi, Japan, ⁴CREST, Japan Science and Technology Agency, Kawaguchi, Saitama, Japan, ⁵Graduate School of Health and Welfare Sciences, International University of Health and Welfare, Otawara, Tochigi, Japan

[Introduction] Occupational therapists often employ various added-purpose activities as a means of occupational therapy. The relationship between the added-purpose activities and cerebral activation has been incompletely understood. Near-infrared spectroscopy (NIRS) provides non-invasive measurement of the changes in concentrations of oxygenated and deoxygenated hemoglobin (Oxy-Hb and Deoxy-Hb, respectively) in response to cerebral activities. [Objectives] We used NIRS to measure the prefrontal activations of an added-purpose task and a single-purpose task, and compared the activation areas of these tasks. [Methods] Six healthy right-handed adults were examined. The subjects were required to move a peg from one to the other hole on the peg-board by pinching with thumb and index fingers for the added-purpose task, and required to move the same motion of the added-purpose task without pegs for the single-purpose task. These tasks were carried out with right hand and left hand. According to the international 10-20 system (Fz), the NIRS probes were placed on the scalp overlying the prefrontal cortex. The changes in the concentrations of Oxy-Hb and Deoxy-Hb in the prefrontal cortex were measured. We compared the number of activation channels (9 channels in all), which showed significant Oxy-Hb increase, between the two tasks. [Results] More widespread activation was observed in the prefrontal cortex during added-purpose task than that during single-purpose task. These results were shown in both conditions of right hand (paired t-test, $p = 0.029$) and left hand ($p = 0.007$). [Conclusion] Our findings suggest that added-purpose activity can bring about more activation in the prefrontal cortex. Several items should be taken into account during the pulling out, holding, moving and inserting of the pegs in this study, for instance, the location of the peg, its size, color and the proper position of the finger to guarantee the smooth movement and correct inserting of the pegs. [Contribution to the evidence base of occupational therapy] The introduction of pegs in the experiment might help to heighten the motive of the activity, since the fulfillment of this task required particular concentration. Our findings of the cerebral activations may provide occupational therapists with effective guides in therapeutic practice.