contralaterally controlled functional electrical stimulation to improve upper extremity motor outcomes and activities of daily living.

Recommendation

22. There is insufficient evidence to recommend for or against non-invasive brain-computer interface to improve upper extremity motor outcomes and activities of daily living.
    (Neither for nor against | Reviewed, New-added)

Discussion

Brain-computer interface is a growing area of interest in rehabilitation research. It consists of capturing the subject's brain signals via EEG obtained during a motor imagery task and converting the signal into a stimulus that provides feedback for the patient through electrical stimulation, sensory feedback (auditory/tactile/visual), or robotics. BCI can be applied non-invasively on the scalp or invasively on the cortex of the brain. The following studies included in this systematic evidence review were all non-invasive using EEG.

An NMA by Zhu et al. (2023) included 101 publications (n=4,702) that compared BCI with electrical stimulation against a control group of usual care, rehabilitation robots (RT), VR, remote rehabilitation (a model of service delivery using internet communication technology), intelligent rehabilitation (intelligent biofeedback therapy devices), and RT+VR.(116) There was no statistically significant improvement in upper limb motor function or ADLs with the use of BCI compared with usual care or the other interventions as measured by the FMA-UE (its subparts) and the mBI. There was statistically significant improvement in upper extremity distal motor function for all the listed interventions compared with usual care as measured by the ARAT. According to the results of the analysis, RT+VR (SUCRA, 99.6%) and VR (SUCRA, 60.9%) were more effective than BCI (SUCRA, 57.7%).

An SR/MA by Peng et al. (2022) included 16 RCTs (n=488) that compared BCI intervention with a control group consisting of usual care, sham BCI, motor imagery, FES, or Manus robot (Manus Robotics, Inc., Lexington, Massachusetts).(128) Frequency of interventions ranged from two to five times per week for two to eight weeks. A statistically significant difference was found in upper extremity motor function (SMD: 0.53; 95% CI: 0.26–0.80; p≤0.05) and ADLs (SMD: 1.67; 95% CI: 0.61–2.74; p≤0.05) with the use of BCI versus the respective control groups as measured by the FMA-UE and mBI. Only 6 of the 16 studies used the Modified Ashworth Scale (MAS) to address the effects of BCI on spasticity. The MA did not show a significant difference in spasticity between BCI intervention and matched control groups.

An SR by Xie et al. (2022) included 17 studies (n=410) that compared BCI intervention with control conditions of usual care, motor imagery, sham BCI, and isolated FES/robotics.(128) A statistically significant difference in motor function (SMD: 0.62;