Guo et al. INPLASY protocol 202460070. doi:10.37766/inplasy2024.6.0070 Downloaded from https://inplasy.com/inplasy-2024-6-0070/

INPLASY

The effect of brain-computer interface on lower limb function in stroke patients:a meta-analysis

INPLASY202460070

doi: 10.37766/inplasy2024.6.0070

Received: 18 June 2024

Published: 18 June 2024

Guo, XZ; Li, Pan.

Corresponding author:
Xiaozhen Guo

11105@tongji.edu.cn

Author Affiliation:
Tongji university.

ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - The review has not yet started.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202460070

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 18 June 2024 and was last updated on 18 June 2024.

INTRODUCTION

Review question / Objective This study explored the effect of BCI on the recovery of lower limb motor function in stroke patients, aiming to systematically evaluate and summarize the current research progress and clinical application effect of BCI technology in the field of stroke rehabilitation. By quantitatively analyzing data from multiple studies, we can more accurately understand whether BCI technology is effective in promoting lower limb motor function (FMA) recovery, activity of daily living (MBI), and Berg balance scale (BBS) in stroke patients. And what is the consistency and differences between different studies? In addition, this study may also reveal the key factors that influence the efficacy of BCI technology, providing guidance for future research directions and clinical practice.

Condition being studied Adults aged 18 years and older who were diagnosed as stroke patients with residual lower extremity motor dysfunction and cognitive function according to the diagnostic criteria of the Consensus on Clinical Research Criteria for Acute Stroke in China formulated in 2018 have cognitive function.

METHODS

Search strategy CNKI, Wanfang Wang Fang, VIP, PubMed, Web of Science, EMbase, and The Cochrane Library were searched for literatures published from the database establishment to March 2024.

Participant or population Adults aged 18 years and older who were diagnosed as stroke patients with residual lower extremity motor dysfunction and cognitive function according to the diagnostic criteria of the Consensus on Clinical Research Criteria for Acute Stroke in China formulated in 2018 have cognitive function.

Intervention The experimental group used brain-computer interface as intervention.

Comparator The control group received conventional rehabilitation training (such as physical therapy, manual therapy, neuromuscular electrical stimulation, psychological therapy, etc.).

Study designs to be included Randomized controlled trials.

Eligibility criteria Inclusion Criteria:
Adults aged 18 years and older who were diagnosed as stroke patients with residual lower extremity motor dysfunction and cognitive function according to the diagnostic criteria of the Consensus on Clinical Research Criteria for Acute Stroke in China formulated in 2018 have cognitive function.
The experimental group used brain-computer interface as intervention.
The control group received conventional rehabilitation training (such as physical therapy, manual therapy, neuromuscular electrical stimulation, psychological therapy, etc.).
Lower limb Motor Function Fugl-Meyer(FMA), Modified Barthel Index (MBI), Berg Balance Scale (BBS)
Randomized controlled trial
Exclusion Criteria:
① The subjects have received psychiatric treatment or suffer from other serious heart, liver, brain, lung and other diseases; (2) Exercise intervention combined with other intervention methods (such as medication or cognitive behavioral therapy); ④ Animal studies, conference abstracts, reviews, and republished literature; ⑤ Data is missing or cannot be converted to mean and standard deviation (M±SD).

Information sources CNKI, Wanfang Wang Fang, VIP, PubMed, Web of Science, EMbase, Cochrane Library.

Main outcome(s) A total of 11 studies reported the improvement effect of brain-computer interface training on lower limb motor function in stroke patients, as shown in Figure 2. Heterogeneity test results showed that I2=70%, indicating heterogeneity among studies, so the random effects model was used to combine effect sizes. The results of meta-analysis showed that the combined effect size was 3.47, 95%CI(2.32,4.62), P < 0.00001, and the difference was statistically significant, indicating that BCI training had an effect on the improvement of lower limb motor function in stroke patients.

Quality assessment / Risk of bias analysis n this study, publication bias analysis was carried out on the outcome indicators of lower limb motor function that were included in more than 10 studies and Egger test was as follows: t=-1.50, P> |t| =0.1682. This indicates that there is no publication bias in the study.

Strategy of data synthesis RevMan 5.4.1 software was used for heterogeneity assessment of all outcomes in the included studies. The sample sizes as well as the mean and standard difference of the improvement values before and after interventions were assessed. The included outcomes were all continuous variables. For outcomes with the same measurement method and unit, MD was used, and for those with different measurement methods or units, the standard mean difference (SMD) was used. We used a threshold of P less than 0.05 and I^2 greater than 50% to represent heterogeneity for studies, and a random-effects model would be employed. Conversely, if there was no significant heterogeneity among studies ($P \geq 0.05$ or $I^2 \leq 50\%$), a fixed-effects model would be used. The outcomes of our meta-analysis were presented with a 95% confidence interval (95% CI) and the publication bias test was conducted using Stata 17.0.

Subgroup analysis In this study, the course of disease and BCI combined training methods were analyzed by subgroups. The results of disease course were shown in Figure 3, with statistical significance in both acute stage and convalescent stage (P < 0.0001). The results of BCI joint training are shown in Figure 4. Both BCI-MI and BCI-robot groups have statistical significance, with P < 0.00001.

Sensitivity analysis The combined effect was analyzed by eliminating individual studies one by one, as shown in Table 5. The combined effect of lower limb motor function after excluding the four-week study results of Zhang Ruiping et al. 2021 was SMD=3.14, 95%CI was (2.30, 3.98), P < 0.00001. I^2 decreased from 70% to 31%, and the heterogeneity was significantly reduced, and the difference was statistically significant compared with the control group. After excluding the results of Rosie 2020, the combined effect of lower limb motor function was SMD=3.66, 95%CI was (2.45, 4.87), P < 0.00001. I^2 decreased from 70% to 57%, and the heterogeneity decreased, and the difference was statistically significant compared with the control group. After excluding other single studies, the SMD range of the combined effect was (2.09~4.83), and the I^2 range was (68%~73%), with P < 0.00001. Only the included subjects of Luo Xi 2020 and Zhang Ruiping 2021 were patients

Guo et al. INPLASY protocol 202460070. doi:10.37766/inplasy2024.6.0070 Downloaded from https://inplasy.com/inplasy-2024-6-0070/

with acute stroke, which may be the source of heterogeneity.

Country(ies) involved China (Tongji university).

Keywords brain-computer interface, lower limb, stroke, a meta-analysis.

Contributions of each author
Author 1 - Xiaozhen Guo.
Author 2 - Pan Li.

Guo et al. INPLASY protocol 202460070. doi:10.37766/inplasy2024.6.0070 Downloaded from https://inplasy.com/inplasy-2024-6-0070/