

# INPLASY

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## Non-invasive brain-computer interfaces can effectively improve motor function in patients with spinal cord injury: systematic review and meta-analysis

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**Review Stage at time of this submission** - Piloting of the study selection process.

**Conflicts of interest** - None declared.

**INPLASY registration number:** INPLASY2023120124

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 31 December 2023 and was last updated on 31 December 2023.

**INTRODUCTION**

**Review question / Objective** After spinal cord injury (SCI), severe limb motor, sensory, and autonomic dysfunction occurs below the injury plane, significantly reducing the patient's ability to perform activities of daily living (ADL) and quality of life. Brain-computer interface (BCI), as a new rehabilitation intervention, can extract brain signals, bypass the diseased segments, and form commands to control external devices to restore the sensory and motor functions of SCI. However, the current high-quality research evidence for BCI treatment of SCI is insufficient, so this review aims to evaluate the effectiveness and feasibility of non-invasive BCI training for improving motor, sensory, and activities of daily living in patients with SCI.

**Condition being studied** Spinal cord injury (SCI) is a devastating disease, with about 180,000 new cases of SCI in worldwide each year, most of which occur in the ages of 15-29 years, 40-49 years, and over 50 years. Both traumatic and non-traumatic SCI may lead to severe limb motor, sensory and autonomic dysfunction below the injury plane, significantly reducing the patient's ability to perform activities of daily living (ADL) and quality of life.

**METHODS**

**Participant or population** Adult SCI.

**Intervention** The intervention measures were BCI with external equipment training.

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**Comparator** the intervention group received BCI treatment alone or in combination, while the control group received sham BCI treatment or no BCI treatment.

**Study designs to be included** self-control study/ Controlled trial.

**Eligibility criteria** The inclusion criteria included: (I) Adult SCI, (II) The intervention measures were BCI with external equipment training; (III) Comparison: (i) the intervention group received BCI treatment alone or in combination, while the control group received sham BCI treatment or no BCI treatment; (ii) when the study was a self-control study, the intervention group received BCI treatment alone; (IV) Results related to SCI function recovery, such as motor function, sensory function, ADL, quality of life.

**Information sources** PubMed, Cochrane Library, Embase, Web of Science, CNKI, WanFang, and VIP.

**Main outcome(s)** (1) Effect of BCI on motor function recovery in patients with SCI; (2) Effect of BCI on recovery of sensory function in patients with SCI; (3) Effect of BCI on recovery of daily activity ability and quality of life in patients with SCI.

**Quality assessment / Risk of bias analysis** Sensitivity analysis to evaluate the stability of the system research.

**Strategy of data synthesis** All statistical analyses were performed using Stata14.0 software. standard mean difference (SMDs) was used to study different scoring systems and aggregate continuous data. And these data are summarized. For studies designed as RCTS, effects were summarized with the use of the standardized mean difference in the change score (score from endpoint to baseline) and its corresponding 95% CI. For studies designed to be self-controlled, effects were summarized using standardized mean differences between pre-and post-intervention and their corresponding 95% CI. Heterogeneity was quantified using Cochrane's Q test and I<sup>2</sup>. If I<sup>2</sup> > 50% and p-value < 0.05, then the study is heterogeneous and the random effects model is used. Otherwise use fixed effects model. p < 0.05 was considered as a statistically significant difference.

**Subgroup analysis** Different onset periods (subacute phase Vs. Chronic phase), number of treatments (< 30 Vs. > 30), duration of a single

treatment (< 60min Vs. ≥60min), and comparison of RCT and non-RCT studies.

**Sensitivity analysis** Sensitivity analysis to evaluate the stability of the system research.

**Country(ies) involved** China.

**Keywords** Meta-analysis; Spinal cord injury; Brain-computer interface; Motorfunction.

#### **Contributions of each author**

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