AIMS 2023
1st International Congress of Artificial Intelligence in Medical Sciences
17-19 May 2023 - Kish
اولین کنگره بین‌المللی هوش مصنوعی در علوم پزشکی
27 الی 29 اردیبهشت 1402 - کیش

Non-invasive Brain-Computer Interfaces (BCIs) for the Treatment of Neurological Disorders

Hamidreza Riasi[1], Ali Rajabpour-Sanati[1], Fariba Nakhaei[1]
1. Faculty of Medicine, Birjand University of Medical Sciences, Birjand, Iran

Introduction:

Neurological disorders such as stroke, spinal cord injury, and cerebral palsy can severely affect a person's quality of life. Brain-computer interfaces (BCIs) have emerged as a promising therapeutic tool for treating these conditions. However, invasive BCIs carry risks and are often impractical for long-term use. This systematic review aims to evaluate the effectiveness of non-invasive BCIs for the treatment of neurological disorders.

Methods:

We conducted a systematic review of the literature using electronic databases such as PubMed, Embase, and the Cochrane Library. Studies that investigated the use of non-invasive BCIs for the treatment of neurological disorders in humans were included. The primary outcome measures were improvement in motor function, cognitive function, and quality of life.

Results:

Our systematic review found 25 studies that met the inclusion criteria and included 347 patients with various neurological disorders. The majority of the studies used electroencephalography (EEG) based BCIs, while a few used functional near-infrared spectroscopy (fNIRS) based BCIs.

Motor Function:

Ten studies found that non-invasive BCIs improved motor function significantly. These enhancements were observed in patients suffering from stroke, spinal cord injury, and cerebral palsy. Exoskeletons, prosthetic arms, and wheelchairs were all controlled using non-invasive BCIs. Motor function improvement was assessed using a variety of scales, including the Fugl-Meyer Assessment, the Action Research Arm Test, and the 10-meter walk test.

Cognitive Function:

Seven studies found that non-invasive BCIs improved cognitive function significantly. These improvements were observed in stroke and traumatic brain injury patients. Non-invasive brain-computer interfaces (BCIs) were used to provide cognitive training and improve attention, memory, and executive function. Various assessment scales, such as the Stroop test, the Trail Making Test, and the Digit Span test, were used to assess cognitive function improvement.

Quality of Life:

Eight studies found that non-invasive BCIs improved quality of life significantly. These improvements were observed in stroke and spinal cord injury patients. Non-invasive BCIs were used to improve communication and environmental control. Various assessment scales, such as the Stroke Impact Scale and the Spinal Cord Injury Quality of Life Questionnaire, were used to assess the improvement in quality of life.

Conclusion:

Non-invasive BCIs have the potential to provide safe and effective therapeutic options for patients with neurological disorders. EEG-based BCIs show promise for motor rehabilitation, while fNIRS and TMS-based BCIs hold potential for cognitive rehabilitation. However, larger randomized controlled trials are needed to establish the long-term efficacy and safety of these interventions.

Keywords:
artificial intelligence, cerebral palsy, cognitive development