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Effects of motor imagery on walking function and balance in patients after stroke: A quantitative synthesis of randomized controlled trials

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ABSTRACT

Objective: This study aimed to evaluate the effects of motor imagery (MI) on walking function and balance in patients after stroke.
Methods: Related randomized controlled trials (RCTs) were searched in 12 electronic databases (Cochrane Central Register of Controlled Trials, PubMed, Science Direct, Web of Science, Allied and Complementary Medicine, Embase, Cumulative Index to Nursing and Allied Health Literature, PsycINFO, China National Knowledge Infrastructure, Chinese Biomedical Literature Database, WanFang, and VIP) from inception to November 30, 2016, and Review Manager 5.3 was used for meta-analysis. References listed in included papers and other related systematic reviews on MI were also screened for further consideration.
Results: A total of 17 studies were included. When compared with "routine methods of treatment or training", meta-analyses showed that MI was more effective in improving walking abilities (standardized mean difference [SMD] = 0.69, random effect model, 95% confidence interval [CI] = 0.38 to 1.00, $P < 0.0001$) and motor function in stroke patients (SMD = 0.84, random effect model, 95% CI = 0.45 to 1.22, $P < 0.0001$), but no statistical difference was noted in balance (SMD = 0.81, random effect model, 95% CI = −0.03 to 1.65, $P = 0.06$). Statistically significant improvement in walking abilities was noted at short-term (0 to < six weeks) (SMD = 0.83, fixed effect model, 95% CI = 0.24 to 1.42, $P = 0.006$) and long-term (≥six weeks) assessments (SMD = 0.45, fixed effect model, 95% CI = 0.25 to 0.64, $P < 0.00001$). Subgroup analyses suggested that MI had a positive effect on balance with short-term duration (0 to < six weeks) (SMD = 4.67, fixed effect model, 95% CI = 2.89 to 6.46, $P < 0.00001$), but failed to improve balance (SMD = 0.82, random effect model, 95% CI = −0.27 to 1.90, $P = 0.14$) with long-term (≥six weeks) duration.
Conclusion: MI appears to be a beneficial intervention for stroke rehabilitation. Nonetheless, existing evidence regarding the effects of MI in patients after stroke remains inconclusive because of significantly statistical heterogeneity and methodological flaws identified in the included studies. More large-scale and rigorously designed RCTs in future research with sufficient follow-up periods are needed to provide more reliable evidence on the effects of MI in post-stroke patients.

Contents

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1. Introduction

Stroke patients may experience some degree of physiological dysfunctions, such as motor, sensory, and cognitive, and psychological disorders [1]. Motor impairment of hemiparesis is commonly identified as the major cause of disability in people with stroke, and such impairment can persist for years, limiting functional performance and affecting quality of life (QoL) [2,3]. Balance ability of stroke patients usually decreases, and accidental falls and injuries may frequently occur [4]. Previous studies [5,6] indicated that muscle weakness contributes to motor impairments in post-stroke patients with hemiparesis, further leading to loss or limitation in mobility functions. Recently, therapeutic management for stroke patients has been significantly improved with an increasing trend in survival rates [7]. Therefore, stroke rehabilitation ultimately aims to improve patients' motor function, balance, and enhance functional status.

Motor imagery (MI) is one approach of mental practices (MPs) that motor acts are practiced without any body movements [8]. Essential components of MI include visual imagery (VI) and kinesthetic imagery [9]. MI can also be described as one person seeing another individual moving the whole or parts of body in mind without any physical movement [1]. MI and MP are considered synonymous because they are usually used interchangeably in practice or research [10]; thus, in this study, MI and MP are both used to describe MI intervention. MI includes repetition of imagined body movements or rehearsing imagined gestures to facilitate motor performance [7]. According to Sharma and colleagues [11], MI was characterized as a novel “backdoor” method for stroke patients owing to its independent motor performance without residual function; this method can access motor system and promote rehabilitation during stroke recovery.

Some research implied that MI contributes to recovery from paralysis and also helps reduce physical dysfunctions in post-stroke hemiparesis when accompanied with physical practice [12,13]. Previous systematic reviews demonstrated that MI effectively improves upper extremity functions in hemiplegic patients [14,15]. Recently, MI has also been observed to improve motor functions of lower limbs in stroke patients [16,17]. However, limited systematic reviews focused on the effects of MI on lower limb functions. A systematic review [18] that evaluated the effects of MI on walking function in stroke patients was published in 2014, but it presented inadequate methodological quality of the included studies. A few latest studies have also been conducted after the publication of this systematic review. Hence, more rigorously designed systematic reviews are needed to further analyze the effects of MI as part of rehabilitation programs on walking function and balance in patients after stroke.

2. Methods

2.1. Inclusion criteria

Types of participants: Participants in the included studies were male or female adults (aged 18 years or above) diagnosed with stroke regardless of race and nationality.

Types of interventions: Randomized controlled trials (RCTs) designed to investigate the effects of MI on walking abilities and balance in patients after stroke. Both MI and MP were included as the MI intervention in this review.

Types of comparisons: RCTs compared MI with “routine methods of treatment or training” or other active comparisons. In this study, “routine methods of treatment or training” included the same standard methods of rehabilitation training or medical treatment utilized in all groups; for studies included the same co-interventions (e.g. gait training, physical training, task orientated training, multi professional therapy or proprioceptive training) in both groups, the “co-interventions” were also described as the “routine methods of treatment or training in the study site” and the only difference between intervention and control groups was the inclusion or exclusion of MI. Placement on where or who delivered the therapy was not restricted.

Types of outcomes: Primary outcomes for this meta-analysis comprised walking abilities and balance, which were measured through clinical tools, such as Timed Up and Go Test (TUG), Functional Ambulation Categories (FAC), Functional Reach Test (FRT), maximal percentage in limb loading on affected limb (MPL), 10 m maximum walking speed (10mMWS), 5 m maximum back-and-forth walking speed (5mMBFWS), 6 min walking test (6MWT), Berg Balance Scale (BBS), the Korean version of Berg Balance Scale (K-BBS), and balance subscale of Fugl–Meyer (FM-B). Secondary outcome was motor function of lower extremities in patients with stroke, which was measured by lower-extremity Fugl–Meyer (FMA-L) and Fugl–Meyer assessment (FMA).

2.2. Search methods and selection of studies

The reviewers searched the following 12 online databases from inception to November 30, 2016: Cochrane Central Register of Controlled Trials (CENTRAL), PubMed, Science Direct, Web of