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Mini Review

# Mental Practice Combined with Motor Rehabilitation to Treat Sensorimotor Deficits in Upper Limbs of Post-Stroke Patients: Clinical and Experimental Evidence

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## Abstract

**Background:** Motor imagery and mental practice are getting increased attention in stroke rehabilitation. Many clinical studies have investigated the use of Mental Practice (MP) through Motor Imagery (MI) to enhance functional recovery of patients with diverse physical disabilities.

**Objetive:** The purpose of this short update is to synthesize the relevant literature about motor imagery and mental practice, in order to facilitate its integration into physical therapist approach after stroke.

**Method:** Update of articles about (MP), (MI) and stroke rehabilitation, on the last years of the data bases Bireme, ScienceDirect, PubMed and SciELO.

**Discussion:** (MI) has become a very popular intervention modality for clinicians but there is insufficient information available on how to administer it in clinical practice and make deliberate decisions during its application. Understanding brain plasticity after stroke is important in developing rehabilitation strategies. MP is effective when used in conjunction with conventional physical therapy for functional rehabilitation of upper limbs, as well as for the recovery of daily activities and skills.

**Conclusion:** MP is an easy to use, cost-effective strategy that was again shown to improve affected arm outcomes after stroke. Studies are needed in order to determine the optimal treatment protocol and patient profile.

**Keywords:** Motor imagery; Mental practice, Rehabilitation, Stroke

## Introduction

Stroke is one of the major causes of disability in the world [1]. Due to the increase in lifetime of the world population, the number of people affected by stroke has increased substantially over the last years [2]. Stroke may lead to sensorimotor deficits, usually causing hemiplegia or hemiparesis [2]. Thus, in order to reduce motor deficits and accelerate the functional recovery, some researchers began to investigate the effects of mental practice combined to motor rehabilitation for motor recovery of upper limbs in post-stroke patients [3-7].

Mental Practice (MP) consists of a method of training whereby the internal reproduction of a given motor act (mental simulation) is repeated extensively with the intention of promoting learning or improvement of motor skills [8]. This mental simulation (motor imagery) corresponds to a dynamic state during the performance of a specific action internally reactivated in working memory in the absence of any movement [9]. MP results of a conscious access to motor intention, which is usually performed unconsciously during motor preparation [8,9], establishing a relationship between motor events and cognitive perceptions [4].

Studies have shown that there is similarity in psychophysical and physiological functions between executed and imagined movements, suggesting that they are based on the same processes [10,11]. Experiments using functional Magnetic Resonance Imaging (fMRI) showed that not only the supplementary and premotor motor areas and cerebellum were activated during imagined movements of the hand and fingers, but also the contralateral primary Motor cortex (cM1) [5,12,13]. fMRI and Transcranial Magnetic Stimulation (TMS) studies indicated that the contralateral side of the primary motor area is activated during the imagination of complex movements, confirming previous findings that showed a more prominent involvement of the primary motor area in the performance of complex motor sequences [14,15].

Regarding the similarity of cortical areas activated and engaged in the execution and imagination of a movement, it was found that such similarities in brain activity occurred during finger movements [16]. Within this context, several investigations attempt to apply these findings in the motor rehabilitation process, especially in cases that concern the recovery of areas involved in motor function, after lesion in the Central Nervous System (CNS) [3,6]. MP applied alone achieves less interesting results than motor rehabilitation alone in patients with neurological disorders. Nevertheless, the combination of both techniques (MP and motor rehabilitation) towards more effective than the two techniques applied alone [17-20].

Since its first applications in the context of neurological recovery, only eleven experiments were conducted combining these techniques


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in order to investigate whether this combination is really effective [21-31]. Thus, it was not possible to standardize the use of MP as a rehabilitation practice in neurological recovery in post-stroke patients. In this sense, there is no consensus on the frequency (how many days per week and how many weeks), duration (minutes per session), type (visual or kinesthetic) and the appropriate time of application of MP (phase recovery of the pathology). However, such investigations have shown evidence that MP associated with motor rehabilitation based on activities of daily living was more effective than conventional motor rehabilitation used per se [21-31].

MP demands a conscious engagement of certain brain regions often activated unconsciously during motor preparation. However, movement imagination is not dependent on motor execution skills, but it is quite a lot of dependent on processing of central mechanisms [9,11]. With this in mind, it may be possible that the frequent use of MP facilitate the central motor commands organization. Based on the "neural networks" theory, which underlines that they are previously established for certain motor acts, studies have been reported that those neural networks involved in motor gesture execution are rehearsal during MP [6]. Thus, the improvement in performance of the executed motor gesture occurs by coordination of motor patterns responsible for its development. It is based on the theory that "neural networks" remain intact despite the physical damages, which suggest that post stroke patients could benefit of mental practice use activating the partially damaged "neural networks". Those findings are in agreed with previous studies of mental practice, despite the lack of neuroimaging data to reinforce this idea [21-26]. Moreover, those findings are also in agreed with studies that relate changes in motor functions to cortical functions when several specific protocols of motor tasks were used [32], including MP [27]. Such theory is attributed to a mechanism cerebral reorganization, where new areas are recruited to assist the movements of the affected arm [32].

Jeannerod[9] pointed out the importance of the role of MP prior to motor execution. It would represent an additional or complementary technique to motor execution, but do not replace it [11]. Since the patients' ability to perform the MP is evaluated, the focus can then be directed on the severity of the injury and the moment when the MP should be introduced to the treatment. When the neurological condition does not allow patients to perform movements, MP is needed in order to keep the neural networks active [21-26] and also to promote cortical reorganization [27], so that the motor preparation facilitates future executions of specific movements during the rehabilitation program.

MP represents an intriguing "backdoor" approach to access the motor rehabilitation at all stages of stroke recovery. Unlike active and passive motor therapies, MP, in principle, is not dependent on residual function but still incorporates voluntary drive. In stroke patients, MP may then provide a substitute for executed movement as a means to activate the motor network. Thus, MP is most effective when the skills being mentally rehearsed are also physically practiced. This is due to motor rehabilitation component, which is believed to create a motor program or "motor schema" that MP reinforce.

MP when combined with motor rehabilitation, proved very useful and effective, with significant results in improvement of motor deficits in post-stroke patients. Thus, it is recommended that further studies must be conducted to determine specific parameters such as number and weekly frequency, duration (minutes per session), type (visual or kinesthetic) and the appropriate moment to apply mental practice (phases recovery of pathology), in order to create specific protocols for each treatment phase. In addition, it is also necessary further studies with this same design using neuroimaging techniques in order to obtain more information about the patterns of brain activation and reorganization.

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