REVIEW ARTICLE

Practice of mental protocols used in rehabilitation of patients with Parkinson's disease: a systematic review

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ABSTRACT

The Mental Practice (MP) consists of a training method by which a given specific motor act is cognitively reproduced internally and repeated with the intention of promoting learning or improvement of motor skills, without inducing any real movement. The results of MP to research in Parkinson's disease are still ambiguous due to various reasons such as the diversity of the intervention protocols. The MP with intervention protocols are cognitively complex and challenging presenting variations in its application concerning the type of PM, task/movement to be imagined and type of instruction. **Objective:** The study aimed to investigate the literature MPs protocols used for motor rehabilitation of individuals with Parkinson's disease. **Methods:** The searches of this systematic review was performed on the portals databases: PubMed, Scopus, Web of Science and Medicine. The descriptors were: ("mental practice" or "engine imagery" or "imagery training" and "Parkinson"). **Results:** 128 articles were found, of which only 4 were included according to the eligibility criteria. **Conclusion:** The protocols that have proven to be effective for reducing bradykinesia, improving mobility and gait speed used the MP combined with physical practice in 12 sessions, of 5 to 30 minutes, visual or visual and kinesthetic imagery of specific activities and used gait videos of patients or healthy subjects promote familiarization and identification of kinematic components of the movement.

Keywords: Parkinson Disease, Rehabilitation, Physical Therapy Modalities, Imagination

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Received on October 19, 2016.
Accepted on November 7, 2016.

DOI: 10.5935/0104-7795.20160030

INTRODUCTION

The use of Mental Practice (MP) in rehabilitation of neurologic patients is relatively new, however it has been used in sports for some years, once evidences suggest benefits in the motor performance and postural control of athletes.[1-3]

There are evidences that the cognitive review of motor events recruits neural structures similarly to those involved during the planning, control, and execution of the active movements.[2,4]

The MP consists of a training method by which a given specific motor action is cognitively and internally reproduced (mental simulation) and extensively repeated as to promote the learning or the perfection of a motor ability, without inducing any real movement.[5-7]

The MP can be performed with internal images, therefore proposing a kinesthetic characteristic with a first-person perspective, where the individual performs a mental simulation of his own, trying to feel the movement without executing it. It can also be performed with external images, which is predominantly visual, with either a first-person or a third-person perspective, through which the individual visualizes the movements being executed by another person or by parts of his own body.[6,8,9]

The fundamental investigation of the MP effects lie on patients with stroke, who achieve gains as improvements in the arm function, in the activities of daily living, gait and movement coordination.[1,8]

Although these studies on patients with Parkinson Disease (PD) is scarce, some evidences show the MP can reduce the bradykinesia. Moreover, most of the PD patients in the initial stages preserve the vivacity and the precision of the motor image.[1,10,11]

The result of the researches with MP are still controversial, due to many reasons, like small sample sizes, sample heterogeneity, and mainly the diversity of study protocols. The MP interventional protocols are cognitively complex and challenging, proposing variations in their application concerning the MP type, tasks/movements to be imagined, and instruction type.[12,13]

OBJECTIVE

The objective of this study is to investigate the literature concerning the MP protocols used in the rehabilitation of patients with Parkinson Disease.

METHODS

This systematic review was performed by two researchers (DM and JGFM) who searched for the data in an independent and blind fashion. Other three researchers (MGWSC, LPS and OGL) were reviewers, being inquired in case of doubts.

This review article aims to answer the question: what are the mental practice protocols applied in clinical research for motor rehabilitation of patients with Parkinson Disease? The primary outcome is the description of the protocols applied in clinical research of motor rehabilitation. The secondary outcome concerns the most efficient protocols for motor rehabilitation.

The search for data was done between October 2015 and January 2016, and the databases accessed were: PubMed, Scopus, Web of Schience and Bireme (including Medline, Lilacs, Ibecs, Scielo, Cochrane Library, among others). No filters were used, nor any restrictions on publication year and language. The descriptors were: "mental practice" or "motor imagery" or "imagery training" and "Parkinson". The bold descriptors were chosen according to the DeSC and MeSH lists. The others are keywords to expand the search.

Once an article was selected with the descriptors/keywords above, its references were analyzed as to verify relevant studies that may have been omitted in the electronic search.

The articles included were those reporting clinical trials whose sample contained adult subjects of both sex, with diagnosis of idiopathic PD, and who underwent MP as a treatment for the motor symptoms of the disease. Cross sectional and qualitative studies, letters to editor, case report, systematic review, and series of cases were excluded. The quality of the selected articles was evaluated by the Physiotherapy Evidence Database (PEDro) scale, whose score was not part of the eligibility criteria of this study.

RESULTS

After the selections, 4 articles were included. The references of these articles were analyzed, however there was no new inclusion (Figure 1).

The included articles report reasonably clear descriptions on how the sample was studied and the description of the MP applied. The score in the PEDro scale was: Braun[2] and Santiago[13] = 8; Tamir[10] = 6; and El-Wishy[12] = 7.

The articles reported similar sampling characteristics, however Tamir[10] better detailed the sample they studied (Table 1).

It was possible to observe that all studies applied the MP combined with physiotherapy and that most of the authors used the visual or visual and kinesthetic Motor Imagery (MI) in 12 sessions, except for Santiago.[13] The MP strategies they applied were varied (Chart 1).

It was possible to find that the main objective of the studies was to influence the mobility and gait improvement of patients with PD, and that most studies used, among their evaluation tools, the Timed up and Go test (TUG). Half of the studies have found positive results for the association of MP and physiotherapy (Chart 2).

DISCUSSION

In the last decade, the number as well as the quality of clinical trials which evaluate the efficacy of physical therapy for treating Parkinson disease (PD) have increased substantially.[14] However, recent innovations like Mental Practice (MP) should be considered as promising approaches,[15] once its use for treating PD is relatively new, for which is important to adjust and develop interventions for this population specificities and their individual abilities.[16]

Initially, the target of MP remained in the improvement of the arm-hand functions, but recently, studies have evaluated their effects on locomotor tasks.[8] Nonetheless, studies with MP in PD are still rare.[11]

The articles included in the review applied the MP as a therapeutic intervention in relatively similar samples. In three studies,[10,12,13] patients of both sex, with idiopathic PD at light to moderate degree of the disease, and balanced ages once allocated in Control Group (CG) and Experimental Group (EG) composed the sample. Another study[2] that assessed a sample of patients with degree varying from light to severe, performed intention-to-treat analysis reporting the initial mean age, but failed to inform the mean age per sex group of the patients who completed all the steps of the study. For Baun,[2] the degree differences in of PD in their sample may have influenced the results, once the MP may be an adequate treatment only for those in the least severe degrees of PD, given they better comprehend the technique application, agreeing with the statement that the PD patients in their initial and secondary stages of the disease are

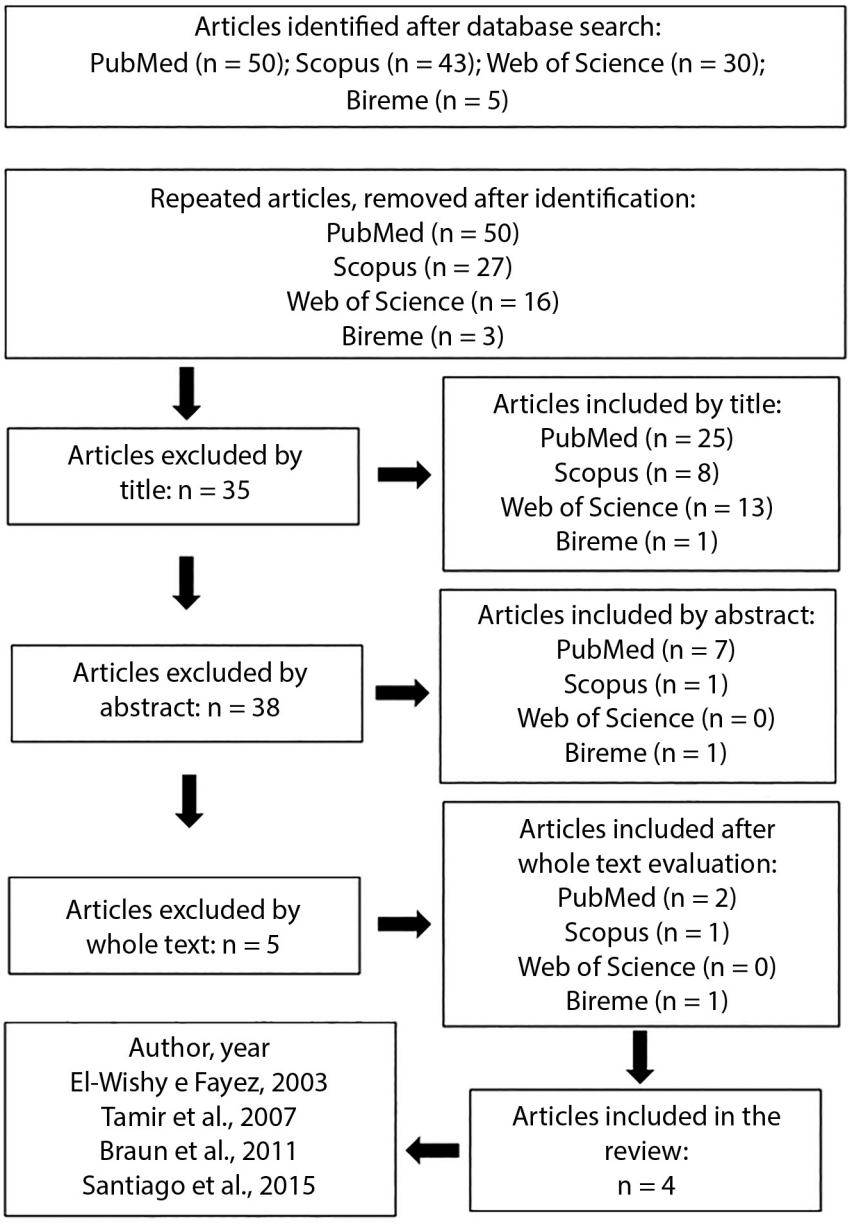

Figure 1. Flowchart of search and selection of articles

Table 1. General sample characteristics regarding age, sex and stage of PD

Author	Total N/Age: X (±)	N CG/Age: X (±)	N EG/Age: X (±)	Sex (M/F)	Stage PD
Braun[2]	N = 33/Age: NI	N: 15/Age: NI	N: 18/Age: NI	NI	HY: 1-4
Tamir[10]	N = 23/Age: NI	N: 11/Age: 67 (9)	N:12/Age: 67 (10)	CG: (4/7) EG: (4/8)	HY: 1.5 - 3 CG: 2.31 (0.4) EG: 2.29 (0.4)
El-Wishy[12]	N = 26/Age: NI	N: 13/Age: 71 (4)	N: 13/Age: 72 (4)	Total (11/15) CG: NI EG: NI	HY: 1.5-3 CG: 2.3 (0.3) EG: 2.2 (0.3)
Santiago[13]	N: 20/Age: 61 (9)	N: 10/Age: 61 (9)	N: 10/Age: 61 (10)	Total (6/14) CG: NI EG: NI	HY: 2-3 CG: 2.25 EG: 2.75

EG: Experimental group; CG: Control Group; M: Male; F: Female; PD: Parkinson disease; N: Sample size; X (±): Mean (Standard deviation); HY: Stage scale of Hoenh Yahn; NI: Not informed.

capable to more precisely imagine the movements, even though they possess an important slowness during the imagination process.[1,17]

Some studies[3,18] emphasize that for the MP approach it is to elaborate a fine screening, once not all individuals are able to imagine motor tasks. Significant individual differences in the imagination capacity between healthy individuals and neurologic patients are not only due to motivation or concentration differences, but are also due to different neurological processing characteristics.[11]

The type of imagery used by the studies[2,10,12,13] varied. Most studies used motor imagery (MI), except for two studies. One of them[10] used visual and kinesthetic MI and the other[12] used only the kinesthetic MI.

Nevertheless, it is possible to verify that the visual image is considered easier than the kinesthetic images, either with patients with PD or with controls.[11] It suggests that it could be easier to learn and use the visual MI, followed by the application of the kinesthetic MI. the choice for the MI type may also depend on the task to be learned. The visual MI is the best for tasks that emphasizes the form, whereas the kinesthetic MI is better for tasks that emphasizes the time or coordination of both hands.[19]

There is a considerable variety of strategies for MP applied in the studies included in this review, what may have contributed to the diversity of findings. Some studies,[10,12] obtained positive results, whilst others,[2,13] did not find positive results in the use of MP.

The absence of positive results after the use of MP may have occurred due to the small sample sizes, difficulties to monitor the patients in the execution of MP in their homes according to the requirements, the use of limited objective measurements to assess the cognitive capacity of the patients, and the inclusion of patients in stage 4 of DP.[2] These negative results agree with the statement that it is not surprising that the MI seems to be affected in PD, being reported, for example, the slow decomposition of motricity related potentials during MI of late stages of PD. The MI, as well as the executed motor tasks, depend on supplementary motor area, which is the primary target of the basal ganglia output, being less activated in patients with PD.[18,20]

The physical fatigue and the reduction of the effects of parkinsonian medication can also explain the results, once the complete protocol used was long, of approximately 2 hours.[13] It is important to reiterate that it is not only the experience and the individual behavior that may facilitate the neuroplasticity

Chart 1. Description of the mental practice protocol used in the included articles

Author	Total number of sessions	Weekly sessions	Session duration	MI type	MP strategies
Braun[2]	12 or 6	1 or 2	CG: 20 min physiotherapy + 10 min relaxation; EG: 20 min physiotherapy + 20 min MP	Visual (1st or 3rd person, per patient choice)	Group physiotherapy weekly sessions of 1 hour or, 30-min sessions twice a week of individual physiotherapy. Both groups performed physiotherapy sessions according to the Guidelines for physical therapy in patients with Parkinson's disease of the Royal Dutch Society for Physical and homebased designed activities. CG: They were encouraged to perform the home relaxation, by progressive muscle relaxation or listening to a relaxing CD. EG: The MP was taught in four stages: explanation of the concept, development of imagination techniques, application, and consolidation. The main objective was to improve tasks like walk and stand up form a chair or from the ground.
Tamir[10]	12	2	CG: 40 min physical practice followed by relaxation; EG: 45 min physical practice + 5 min MP	Visual and kinesthetic	Both groups performed physical practice in 3 stages: Callisthenic exercises (15-20min), ADL practice (15-20min) and relaxation (NI). External stimuli were used, such as bars on the ground and rhythmic auditory stimulation with music or metronome, and cognitive strategies. CG: The patients physically rehearsed the tasks. EG: The patients watched a video of themselves walking, and attempted to improve with MP. ADL tasks were practiced either physically and by MP. The MP was alternated before and after the physical practice, followed by relaxation.
El-Wishy[12]	12	3	CG: 25-30 min watching documentary videos + 30-40 min de physical therapy + relaxation; EG: 25-30 min of MP + 30-40 min physical therapy + relaxation	Visual	Both groups performed physical therapy of three parts: 1- Callisthenic exercises for improving the performance of trunk movements, flexibility, muscle strength, balance, and coordination (15-20 min); 2- Practice of specific functions for improving the crucial motor tasks, such as transfers, gait, and instrumental abilities for upper limbs (15-20 min); e 3- relaxation exercises (NI). CG: Watched documentary videos regarding health topics along the period the EG were provided with MP. EG: In the first week, the patients watched a video of an adult with normal gait (10m) and the gait kinematic was explained by a therapist. A second video showed the patient walking over 10-meter a straight line at a comfortable speed. The 1st training week was designed for the patient familiarize with the gait kinematic and to identify his/her own issues. Along the last three weeks, the patients performed the MP according to a 5-stage protocol: progressive relaxation, external imaging (analysis of sequence of tasks), the identification of the problem, internal imaging, and mental rehearsal.
Santiago[13]	1	1	NI	Kinesthetic	The therapeutic intervention was divided in 7 steps: 1st step: patients from both groups identified their gait changes and a researcher explained the difference between a normal gait and a Parkinson gait; 2nd step: both groups memorized the normal gait phases with the aid of cards (with images of elderlies performing normal movement), then they executed the gait sequences for 5 consecutive times; 3rd step: keywords were created for each card where the patients reported the gait stages, ordering the cards without help for three times; 4th step: Performed only by the EG, the patients used the MP in first-person (closed eyes) and were encouraged to feel the movement, reporting the keywords of the previous step. The researcher counted the number of imagined steps up to a total of 240 steps, divided in three series; 5th step: both groups performed the physical practice of the gait, walked 3 series of 10 repetitions, and 8 steps per repetition, totaling 240 steps; 6th step: The EG group performed gait MP as if in a busy street, with a supermarket and stores. A series of 10 repetitions, 8 steps per repetition, totaling 160 steps were imagined; 7th step: both groups performed a physical practice of gait in a busy street simulated with progressive obstacles. The patients were required to walk 1 series along a corridor, with 10 repetitions and 8 steps per repetition, totaling 160 steps.

PD: Parkinson disease; EG: Experimental group; CG: Control group; NI: Not informed; MP: Mental practice; ADL: Activities of Daily Living; MI: Motor Imagery; Min: Minutes.

of patients with PD, but some practice variables like intensity, specificity, and complexity also need to be considered for achieving better results for these patients.[15]

Other variable that may influence the results is the fact that PD is characterized by a wide phenotypical heterogenicity, whilst it is not clear whether the specific clinical subtypes of PD may adapt differently to this intervention, for which there is no reports on the different clinical evaluation of trembling and rigid-akinetic after the rehabilitation.[15]

Although it has not been considered a key element, it is important to emphasize that the introduction and familiarization processes concerning the MP concept before the intervention is relevant and may improve, in the long term, the encouragement for adhering, even though this hypothesis has not been confirmed.[21] The temporal characteristics of the imagined movement may influence the capacity of the MI in PD patients, therefore this aspect must be carefully approached in its design for motor rehabilitation.[22] Patients with PD have shown to be significantly slower in the elaboration of the mental images than healthy subjects. This slowness of imagination reveals temporal problems in MI that are reflected in the same proportion during the physical execution, leading to bradykinesia.[1]

One study,[23] reported that when the observed actions represent daily living activities performed by the observer, there is a stronger activation of the mirror neurons system. Moreover, the observation of the action plays an important role in the miming and

Chart 2. Description of the objectives, evaluation tools for measuring the outcome and main findings of the studies

Author	Objective	Evaluation tools	Main findings
Braun[2]	Establish whether the rehabilitation with MP combined with PP is more efficient when compared to rehabilitation with relaxation combined with PP for improving the mobility of patients with PD.	Gait improvement: Visual analogue scale; Functional mobility: TUG; Gait Evaluation: 10MWT.	No difference was found between rehabilitation combined with MP or with relaxation. Other investigations are suggested as to study the underlying mechanisms of the responders and non-responders to MP, as well as the establishment of the PM dose and content.
Tamir[10]	Evaluate the benefits of MP combined with PP compared to PP isolated.	Sequential movement performance: TUG, get up and lie down with 360° turn. Balance: trunk control (Tandem posture, functional reach and retropulsion test). Neurologic functional deficits: UPDRS; Cognitive disorders: Clock drawing and Stroop test.	The combination of MP with the physical practice for patients with PD may cause the reduction of bradykinesia. The combination seems to have positive effects on the motor performance and functional tasks of these patients. A significant improvement was evidenced in the tests: TUG and get up and lie down with 360° turn.
El-Wishy[12]	Evaluate whether the MP combined with PP can improve the kinematic parameters and clinical measures of gait of patients with PD.	System of kinematic analysis of gait (step length, gait speed, and excursions in the sagittal plane of the ankle, knee and hip joints); Gait evaluation: FGA.	The MP added to the physiotherapy program brings rehabilitation approach for the motor issues of PD. The ideal treatment and the long and short terms benefits must be investigated in future studies. Significant difference was found when comparing the CG and EG. The EG had more effecient results in the step length, lower limb execution, FGA score and gait speed improvement.
Santiago[13]	Determine the immediate effects of MP combined with PP of patients with PD	Cognition: MoCA; Gait evaluation: FAC; Evaluation of the motor imagination: MIQ-R; Clinical and motor evaluation and ADL: UPDRS; Functional Mobility: TUG; Postural instability evaluation: FGA; Kinematic gait evaluation: Qualisys Motion Capture Systems.	The MP did not show improvements when compared to the physical practice of gait after a single session. There were no statistical differences between the groups. There was intragroup difference in both groups after the first evaluation (after 10 min.) in the balance time and in the total supported time. After the second re-evaluation (after 1 day): significant (for both) in speed, step length, decrease of TUG time, and hip mobility. Follow up (after 7 days): significant in both groups concerning speed, step length, decrease in TUG time, and hip mobility.

PD: Parkinson disease; EG: Experimental group; CG: Control Group; NI: Not informed; MP: Mental practice; PP: Physical practice; ADL: Activities of daily living; UPDRS: Unified Parkinson's Disease Rating Scale; TUG: Timed Up Go; FGA: Functional Gait Assessment; 10MWT: 10-meter walking test. MoCA: Montreau Cognitive Assessment; FAC: Functional Ambulatory Category; MIQ-R: Movement Imagery Questionnaire - revised.

learning, as well as in the acquisition of new motor abilities, even in elderlies who seem to have a reduced capacity to gather new motor memories.[24]

It is clear, in this systematic review, that different aspects must be considered in the conception of a MP protocol. Other studies which use this method for treating the PD are still scarce as well as heterogeneous in their methodologies. There are some evidences that different MP interventions could be fruitful. It seems important, however, to adapt the PM content for the capacities of the patients with neurologic diseases influencing their ability to generate vivid images (at a cognitive stance) decreasing the kinetic input and limiting their physical performance.

CONCLUSION

The protocols that were efficient to reduce the bradykinesia, to improve the mobility and gait speed used the MP combined with physical practice in 12 sessions of 5 to 30 minutes, visual or visual and kinesthetic imagery of specific activities. They also used videos with gaits of the patients or healthy subjects for familiarization and identification of the kinematic components of the movement, as well as for identifying the problems of the patients.

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