Rehabilitation with mental practice has similar effects on mobility as rehabilitation with relaxation in people with Parkinson's disease: a multicentre randomised trial

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Questions: Is mental practice embedded in standard physiotherapy compared with relaxation embedded in standard physiotherapy more effective at improving mobility tasks in people with Parkinson's disease in the community? Does disease severity influence the treatment effect? **Design**: A multicentre randomised controlled trial. **Participants**: People with Parkinson's disease. **Intervention**: During a six-week intervention period, both groups received physiotherapy as usual with the addition of either mental practice (experimental group) or relaxation (control group). Imagery skills were taught using a four-step protocol. Movement imagery (in thought) and the performance of motor activities were combined. **Outcome measures**: Outcomes were assessed at six weeks and three months with: the patient- and therapist-perceived effect on walking performance (visual analogue scale), the Timed Up and Go test, and the 10 m Walk test. Primary analysis was performed using intention-to-treat and was repeated as a per-protocol analysis, and as a sub-group analysis of participants with Hoehn and Yahr stage of less than 3. Generalised estimating equations were used to analyse effects. **Results**: 47 participants were assigned to the control (n = 22) and experimental (n = 25) groups. No effect in favour of the mental practice intervention on any outcome measure could be detected at any of the measurement points. In the sub-group analysis of participants with milder disease, the experimental group improved more than the control group but this was not statistically significant. **Conclusion**: In this study, we did not find differences between embedded mental practice and relaxation with current standard of care. **Trial registration**: Nederlands Trial Register: NTR1735. **[Braun S, Beurskens A, Kleynen M, Schols J, Wade D (2011) Rehabilitation with mental practice has similar effects on mobility as rehabilitation with relaxation in people with Parkinson's disease: a multicentre randomised trial. *Journal of Physiotherapy* 57: 27–34]**

Key words: Parkinson's disease, Mental practice, Randomized controlled trial, Physiotherapy

Introduction

Patients with Parkinson's disease are usually treated with dopaminergic medication. To cope with motor control problems many patients are also treated by a physiotherapist, even in early stages of the disease. The therapy is targeted at improving, maintaining, or delaying problems with gait, transfers, posture, balance, and general physical condition (Kwakkel et al 2007). Cognitive deficits (eg, problems concentrating, attention problems) are also common in patients with Parkinson's disease (Hoehn and Yahr 1967, Sammer et al 2006). Physiotherapy helps to improve, maintain, or delay problems with motor control (Dibble et al 2009, Kwakkel et al 2007). It has been hypothesised that movement imagery might have additional value in patients with Parkinson's disease because it targets the conscious control of movement through cognitive strategies, which is generally recommended in national guidelines (Keus et al 2004).

Athletes have used all sorts of cognitive skills to improve motor performance and the use of mental practice in athletes has been the subject of research for several decades (Feltz and Landers 1988). Recently mental practice has been used in different patient populations as an additional therapy (Dickstein and Deutsch 2007), on the understanding that it increases practice of skilled movements. Mental practice is generally described as repeated mental simulation of the execution of a target movement in the absence of bodily activity for the purpose of improving a given movement. This movement imagery technique can be described to patients as imagining oneself undertaking the skilled movement without actually doing the movement.

Brain imaging research in healthy subjects has shown that during vivid imagery of a specific movement almost the same brain areas are active as during overt movement (Milton et al 2008). Fundamental research in patients has mainly been done with patients suffering from stroke (Sharma et al 2006) and this kind of research with patients with Parkinson's disease shows that some but not all are able to perform mental imagery (Cunnington et al 2001, Frak et al 2004).

Clinical studies of mental practice have been performed in various patient populations. There is some evidence that mental practice might help patients with conditions such as chronic pain, cancer, and orthopaedic pathologies (Dickstein and Deutsch 2007). However, the majority of clinical research has been performed in stroke patients (Braun et al 2006). Initially the focus of mental practice was on the improvement of arm-hand functions, but recently more studies have been performed to assess possible effects on locomotor tasks (Malouin and Richards 2009). There is also some evidence that several different mental practice interventions might work. It seems important, however, to

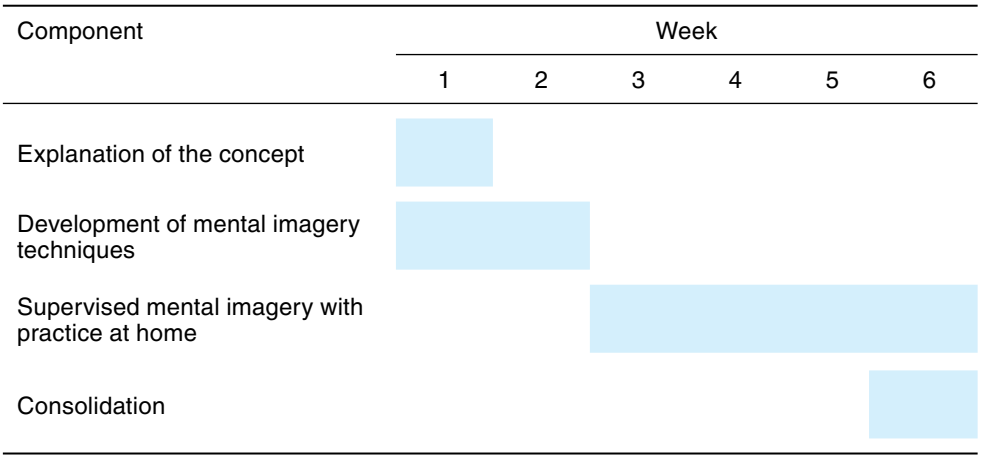

Figure 1. Overview of the components of the 6-week mental practice training.

tailor the content of the mental practice to the abilities of the patient, as neurological conditions can influence the ability of patients to generate vivid images (cognitive level), decrease kinesthetic input, and limit physical performance (Braun et al 2008).

Only a few clinical studies have been conducted in patients with Parkinson's disease (Tamir et al 2007, Yaguez et al 1999) and results show some controversy on what effects a mental practice intervention might have. Mental practice should have the greatest effects on the movement that is actually mentally rehearsed (Feltz and Landers 1988). Recently, however, promising results on mobility tasks in a randomised clinical trial of reasonable size and duration have been published (Tamir et al 2007). It seems that mental practice might have a positive effect, but more research is needed to determine the effects with more certainty. We therefore performed a randomised controlled trial of a mental practice framework that is tailored to the patients' abilities, in which patients with a wide range of disease severity were eligible. In this study, relaxation was treated as a sham intervention and only used to control for attention. Therefore the research questions for this study were:

1. Is mental practice embedded in physiotherapy according to the National Dutch guidelines compared with relaxation embedded in the same physiotherapy more effective at improving mobility in people with Parkinson's disease in the community?
2. Does disease severity influence the treatment effect?

Method

Design

A multicentre randomised controlled trial was conducted over a one-year period. Participants were recruited from one of five locations at which they were receiving treatment: three community practices, and rehabilitation day treatment in a nursing home and hospital. All were outpatients.

Randomisation for all sites was conducted by an independent third party who was blinded to the potential participant's characteristics. The randomisation schedule consisted of a random allocation list for each site. Each list had block sizes of four (Altman et al 2001). No other stratification took place. After baseline measurement, the therapists were notified to which group the participant was assigned. The participants were not blinded to the treatment they were allocated because they were aware of the content of the treatment they received. Therapists were not blinded because they taught the participant the imagery or relaxation techniques.

Participants

People entering the trial had to meet the following inclusion criteria: clinically diagnosed adults with Parkinson's disease, and sufficient cognitive level and communication skills to engage in mental practice. The latter was determined by taking into account the clinical judgment of the treating therapist, support from family and the score on the Mini-Mental State Examination (Tombaugh and McIntyre 1992). Patients who had other conditions such as stroke, rheumatic diseases, or dementia prior to the onset of Parkinson's disease and sufficient to cause persistent premorbid disability were excluded.

At baseline, the following participant characteristics were recorded: age, gender, time since diagnosis of Parkinson's disease, cognitive level assessed with the Mini-Mental State Examination (Tombaugh and McIntyre 1992), Hoehn and Yahr stage (Hoehn and Yahr 1967), and the use of walking aids.

Intervention

The participants recruited were already receiving physiotherapy according to the Dutch guidelines for patients with Parkinson's disease (Keus et al 2004), some on a one-to-one basis and some in groups. This pre-existing treatment was continued. The randomly allocated 'new' treatment was incorporated into the participant's program. All participants received six weeks of physiotherapy, leaving their own therapy frequency and organisation unchanged. Participants received either one hour of physiotherapy per week (groups) or two sessions of half an hour per week (individuals). Thus, in both cases, participants continued to receive six hours and did not increase their contact time with the therapist. If participants were treated on an individual basis for half an hour, 10 minutes were spent on mental practice or relaxation. In group sessions of one hour, the time was increased to 20 minutes. Therapy with the therapist was recorded in pre-structured files, which detailed content and duration. As soon as the therapists thought participants were able to perform imagery or relaxation outside of therapy they encouraged unguided mental practice. Logs (one per week) were handed to the participants to record unguided mental practice behaviour. In principle, a maximum of six logs could be completed.

The main goal of the mental practice intervention was to improve locomotor tasks like walking, standing up from a chair or the floor. Therapists were trained to teach and monitor mental practice according to the framework in which four steps are distinguished: explaining the concept, developing imagery techniques, applying mental practice, and consolidating (Braun et al 2008). Figure 1 presents the time frame over which these four stages were utilised.

Unlike a fixed treatment regimen, the mental imagery framework allowed the physiotherapist to tailor the content to each participant's abilities and preferences. Examples of tailoring are the chosen view and the ratio of actual to imagined attempts at movements. Participants were told that imagery inherently involved a point of view. They were advised to try first person (as if looking through their own eyes) and third person (as if looking at oneself from a distance), and were then allowed to choose whichever view they preferred (Milton et al 2008). During therapy, imagery attempts and overt movements were combined, ie, movements were performed to generate sensory information. This information was then embedded in the imagery attempts to make them as vivid as possible. The proportions of actual movements and imagery attempts were based on individual preferences (Malouin et al 2004). The ratio of actual to imagined attempts could change over time or differ depending on the task or its difficulty. The success of a participant in imagining the actions correctly and vividly was judged by the therapist in several ways: self-report by the participant, comparing the time taken to perform a task mentally against the time in reality, and by checking that the participant could recite the order of actions correctly.

The control therapy was used to control for attention and consisted of treatment according to the national Dutch guidelines (Keus et al 2004) with relaxation therapy being incorporated into each session. The amount of relaxation incorporated matched the amount of mental practice in the experimental group. Relaxation was chosen to enable comparison with the trial by Tamir and colleagues and followed the principles of progressive muscle relaxation according to Jacobson (Gessel 1989). Participants were encouraged to do relaxation homework outside of therapy as well, using unguided progressive muscle relaxation or by listening to a relaxation CD.

Outcome measures

Improvement in walking was assessed with a visual analogue scale (Donnelly and Carswell 2002, Stratford et al 1995, Wewers and Lowe 1990). Participants and therapists were asked to score on a scale from 0 to 10 how well they thought the participant walked with 0 being 'poor' and 10 being 'excellent'.

Data from two measures from the Dutch guidelines were used: the Timed Up and Go test and the 10 m Walk test. The Timed Up and Go test measures the time a person needs to stand up from a chair, walk 3 m at a comfortable speed, turn around, walk back, and sit down. The test is internally consistent, reliable, valid, and responsive (Lin et al 2004, Mathias et al 1986, Morris et al 2001). The 10 m Walk test can be used in people able to walk independently with or without walking aids and/or orthoses. The test is reliable, valid and responsive (Garraway et al 1980).

The data on outcome measures were collected by an independent, blinded assessor. Data were collected at three assessment points: at baseline, after the 6-week intervention period, and at a follow-up assessment 3 months after randomisation. In order to reduce the influence of fluctuating performance associated with the on/off periods that characterise Parkinson's disease, data were collected on three separate days for each of the three assessment points and on each day each test was performed three times. At each assessment point, the three days of data collection were scheduled within a 2-week period: during the two weeks before the intervention started (Week –1 to 0), after the intervention period (Week 7–8) and at the follow-up assessment (Week 12–13). For each patient we used the mean score on each measure for the measurement period. Potentially this was the mean of nine values although some patients completed fewer measures. The visual analogue scale was measured only once in each assessment period.

Data analysis

The calculation of the sample size was based on the visual analogue scale outcome. We sought a difference between the two groups of 2 cm on the 0 to 10 cm visual analogue scale. In this sample size calculation, we used a standard deviation of 2.25 cm and assumed a 50:50 random allocation. There is no literature available on the minimum clinically important difference between groups or the standard deviation in a population with Parkinson's disease. In pain patients, however, the minimum clinically important change is set at 1.5 cm (Ostelo et al 2008). Since we hypothesised that participants in the control group would not improve we aimed for a 2-cm difference between groups. In other populations the standard deviation on a visual analogue scale is somewhere between 1.5 and 3.0 (Donnelly and Carswell 2002). With the power of this study set at 90% and the level of significance set at 5%, 19 patients in each group were needed to identify a 2-cm difference between groups as statistically significant.

Group characteristics at baseline were presented using descriptive statistics: means and standard deviations for continuous variables, and absolute numbers of participants and percentages for categorical variables. Differences between groups with regard to baseline characteristics were judged on clinical relevance (Assmann et al 2000).

To account for the dependency of the observations in time generalised estimating equations, a longitudinal linear regression technique, were used to analyse the treatment effects at the end of the intervention and at follow-up. Generalised estimating equations were used because of the dependency of observations across time within participants and because the time frames between the baseline and post-intervention and between post-intervention and follow-up were not equal. As the level 1 variable we used the PARTICIPANT and as the level 2 variable we used TIME.

For the outcome measures, we report percentage change scores, to correct for differences between groups at baseline on outcome measures. As independent variables we included TIME, INTERVENTION and the interaction TIME × INTERVENTION. Mean difference in difference of percentage change scores was estimated by the model and the confidence interval (95% CI) given. Normal distribution of the data on the calculated change scores of the outcome measures was checked visually (Q-Q Plot).

Table 1. Characteristics of participants.

Characteristic	Participants			
	All participants (n = 47)		Participants with Hoehn and Yahr stage < 3 (n = 36)	
	Exp (n = 25)	Con (n = 22)	Exp (n = 19)	Con (n = 17)
Gender, n male (%)	17 (68)	15 (68)	12 (63)	11 (65)
Age *(yr)*, mean (SD)	70 (8)	69 (8)	69 (8)	68 (8)
Time since diagnosis (*yr*), mean (SD)	5.2 (5.0)	6.6 (7.8)	4.6 (4.1)	5.0 (7.1)
MMSE *(yr)*, mean (SD)	27 (3)	27 (2)	28 (3)	27 (2)
Treated individually, n (%)	12 (48)	12 (55)	11 (58)	10 (59)
Treated in a group, n (%)	13 (52)	10 (45)	8 (42)	7 (41)
Hoehn and Yahr stage, n (%)				
1	6 (24)	3 (14)	6 (32)	3 (18)
1–2	1 (4)	5 (23)	1 (5)	5 (29)
2	8 (32)	6 (27)	8 (42)	6 (35)
2–3	4 (16)	3 (14)	4 (21)	3 (18)
3	3 (12)	4 (18)	0 (0)	0 (0)
3–4	0 (0)	0 (0)	0 (0)	0 (0)
4	3 (12)	1 (4)	0 (0)	0 (0)
Walking aid, n (%)				
none	22 (88)	19 (86)	18 (95)	16 (94)
cane	2 (8)	2 (9)	1 (5)	1 (6)
rollator	1 (4)	1 (5)	0 (0)	0 (0)

Exp = experimental group, Con = control group, MMSE = mini-mental state examination

Table 2. Mean (SD) of the amounts of physiotherapist contact and independent practice of the allocated intervention and the average duration of independent practice per session.

Therapy	Groups	
	Exp	Con
Supervised physiotherapy		
Treatments *(number/participant)*	7.7 (3.5)	7.7 (3.4)
Duration *(hr)*	5.2 (1.3)	5.3 (1.1)
Independent practice		
Sessions *(number/participant)*	55 (53)	22 (44)
Total duration *(min)*	271 (257)	268 (449)
Duration per session *(min)*	5	12

SD = standard deviation

Three analyses with generalised estimating equations were conducted. The primary analysis of the effect of intervention was performed on the entire research population on an intention-to-treat basis. The second analysis was a per-protocol analysis; from the entire population, only participants who received 60% of the guided therapy (and reached at least Step 2 of the mental practice framework) and had practised unguided were included. The third analysis was a subgroup analysis of the initial population, performed on participants with a Hoehn and Yahr stage below 3, who were hypothesised to be more able to perform mental practice (Sammer et al 2006).

Results

Flow of participants through the trial

Forty-seven participants were recruited to the study between February and April 2009. The baseline characteristics of the participants, and the characteristics of those included in the subgroup analysis (Hoehn and Yahr stage < 3), are presented in Table 1. Three participants in the experimental group and four in the control group withdrew from the study before the Week 7–8 assessment, with a further four experimental and three control group participants lost before the Week 12–13 assessment. The flow of participants through the trial and the reasons for loss to follow-up are presented in Figure 2.

Compliance with the trial method

The amount of treatment received and compliance with the experimental and control interventions are summarised in Table 2. Data provided by the participants in their treatment logs confirmed that therapists delivered the appropriate therapy in each case. Only two of the withdrawals appeared to be directly related to the intervention. One participant stopped because of the intervention (too much effort), and another stopped because she found thinking about motor actions was too confronting.

Table 3 shows the results from the intention-to-treat analysis, while individual data are presented in Table 4 (see eAddenda for Table 4). No significant differences were found between the two groups on any outcome measure at any point.

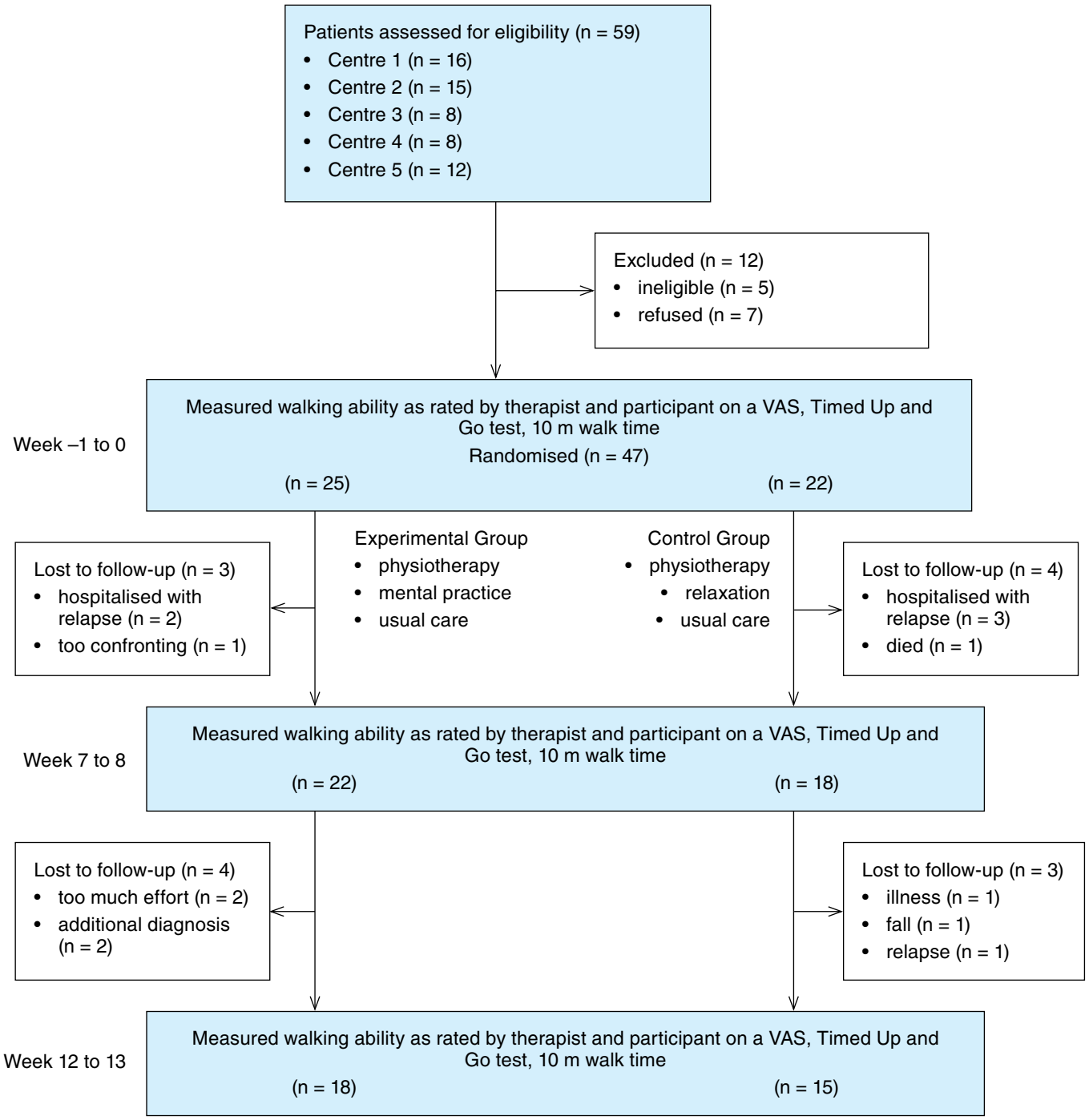

Figure 2. Design and flow of participants through the trial. VAS = visual analogue scale

For the per-protocol analysis, seven participants from the experimental group and five from the control group were excluded from the entire research population. In ten of these twelve participants the treatment amount was insufficient (below 60%). One participant from the experimental group was excluded because he used mental practice to relax and one because he did not reach Stage 2 of the mental practice framework. The results were similar to the intention-to-treat analysis (data not shown).

For the subgroup analyses, from the entire research population six participants in the mental practice group and five in the control group were excluded because they were Stage 3 or higher on the Hoehn and Yahr classification (see Table 1). Table 5 presents the results of the subgroup analysis. No significant differences were found between the two groups on any outcome measure at any point. However, except for the results of the difference score of the Timed Up and Go test at follow-up, all measures showed more average improvement compared with baseline for the mental practice group at both measurement points. These differences were not significant.

Table 3. Mean (SD) of groups, percentage change (SD) from baseline, and mean (95% CI) difference between groups in percentage change from baseline for all outcomes, for all patients (intention-to-treat analysis). Generalised estimating equations (GEE) were used to estimate changes in scores from baseline between subjects and over time as a difference in difference score in percent.

Outcome	Groups						Percentage change from baseline (SD), estimated from GEE				Difference in percentage change from baseline between groups (95% CI), estimated from GEE	
	Week –1 to 0		Week 7 to 8		Week 12 to 13		Week 7 to 8		Week 12 to 13		Week 7 to 8	Week 12 to 13
	Exp	Con	Exp	Con	Exp	Con	Exp	Con	Exp	Con	Exp minus con	Exp minus con
VAS walking *(cm)*												
Participant rated	5.0 (2.2) n = 25	6.5 (2.1) n = 19	5.6 (1.3) n = 21	6.6 (1.1) n = 17	5.5 (2.1) n = 17	6.9 (1.7) n = 13	45 (102) n = 21	6 (43) n = 16	36 (116) n = 17	9 (40) n = 13	35 (–11 to 80)	21 (–25 to 68)
Therapist rated	6.0 (2.1) n = 25	7.2 (1.8) n = 21	6.1 (1.7) n = 21	7.5 (1.0) n = 16	6.4 (2.4) n = 17	7.8 (0.7) n = 13	22 (63) n = 21	3 (24) n = 16	19 (39) n = 17	5 (28) n = 14	19 (–10 to 47)	2 (–19 to 23)
Timed Up and Go test *(sec)*	14.6 (9.6) n = 25	15.7 (16.5) n = 21	13.1 (10.6) n = 22	12.3 (6.6) n = 18	18.1 (31.6) n = 19	9.5 (1.5) n = 15	–11 (18) n = 22	–5 (20) n = 18	2 (51) n = 19	–18 (20) n = 16	–5 (–17 to 7)	19 (–5 to 43)
10 m Walk test *(sec)*	10.3 (3.6) n = 17	11.0 (5.1) n = 13	10.0 (6.3) n = 14	9.5 (3.8) n = 11	11.8 (12.6) n = 15	8.3 (1.5) n = 11	–4 (23) n = 14	–7 (8) n = 11	10 (57) n = 13	–11 (6) n = 8	3 (–10 to 15)	20 (–10 to 49)

Shaded row = primary outcome measure. Exp = experimental group, Con = control group, GEE = generalised estimating equations, VAS = visual analogue scale

Table 5. Mean (SD) of groups, percentage change (SD) from baseline, and mean (95% CI) difference between groups in percentage change from baseline for all outcomes, for patients with Hoehn and Yahr stage < 3 (subgroup analysis). Generalised estimating equations (GEE) were used to estimate changes in scores from baseline between subjects and over time as a difference in difference score in percent.

Outcome	Groups						Percentage change from baseline (SD), estimated from GEE				Difference in percentage change from baseline between groups (95% CI), estimated from GEE	
	Week –1 to 0		Week 7 to 8		Week 12 to 13		Week 7 to 8		Week 12 to13		Week 7 to 8	Week 12 to 13
	Exp	Con	Exp	Con	Exp	Con	Exp	Con	Exp	Con	Exp minus con	Exp minus con
VAS walking *(cm)*												
Participant rated	5.0 (2.3) n = 19	6.9 (2.0) n = 16	5.7 (1.3) n = 16	6.6 (1.1) n = 14	5.4 (2.0) n = 13	6.9 (1.7) n = 12	53 (116) n = 16	–6 (31) n = 13	45 (133) n = 13	–3 (29) n = 11	52 (–2 to 107)	33 (–25 to 91)
Therapist rated	6.3 (1.8) n = 19	7.4 (2.0) n = 17	6.5 (1.5) n = 16	7.5 (0.8) n = 14	7.0 (1.9) n = 13	7.7 (0.8) n = 12	16 (54) n = 16	0 (22) n = 14	18 (36) n = 13	3 (29) n = 12	16 (–12 to 43)	4 (–19 to 27)
Timed Up and Go test *(sec)*	11.4 (3.6) n = 19	11.5 (3.5) n = 17	10.1 (2.4) n = 17	10.5 (2.0) n = 15	10.4 (3.4) n = 15	9.3 (1.4) n = 14	–8 (13) n = 17	–3 (10) n = 15	–7 (12) n = 15	–12 (8) n = 14	–6 (–13 to 2)	6 (–1 to 13)
10 m Walk test *(sec)*	9.7 (2.6) n = 12	10.5 (4.2) n = 10	8.1 (2.2) n = 10	8.8 (2.7) n = 9	7.9 (2.2) n = 11	8.1 (1.5) n = 10	–12 (10) n = 10	–7 (8) n = 9	–12 (4) n = 9	–11 (6) n = 8	–5 (–13 to 2)	–1 (–6 to 3)

Exp = experimental group, Con = control group, GEE = generalised estimating equations, VAS = visual analogue scale

Discussion

In this study, groups were comparable at baseline, but neither the intention-to-treat analysis nor the per-protocol analysis revealed any effects of mental practice on walking performance by patients with Parkinson's disease. In the subgroup analysis of those participants with Hoehn and Yahr stages below 3, the experimental and control groups were again comparable at baseline. Although a general trend in favour of the mental practice group was revealed, it was not statistically significant.

Based on our power calculation, the group sizes should have been sufficient to reveal differences. Perhaps our assumptions were too optimistic or it may have been unrealistic to expect an additional therapy incorporated into an existing treatment program to have as large an effect as we sought. Therefore the group sizes may have been too small. However, the study by Tamir and co-workers (2007) did reveal significant effects on the Timed Up and Go test in a smaller research population (n = 23) than our total population (n = 47). The research populations were quite similar except for severity of the disease. Patients with Hoehn and Yahr stages of 3 and higher were included in our trial and may have been unable to use the techniques adequately, which might have influenced the results of the entire group. Results from the analysis of the subgroup (n = 36), whose characteristics were almost like those from the patients from the other trial, did show a general but non-significant trend in favour of the mental practice group.

In two recent reviews there has been a call for distinction between treatments for moderately and severely affected patients (Dibble et al 2009, Kwakkel et al 2007). Mental practice might well be a treatment suitable only for patients in less severe stages of Parkinson's disease, who are perhaps better at applying the technique. Our subgroup analysis and the study by Tamir and colleagues suggest that this may be the case. This hypothesis is also supported by other literature (Sammer et al 2006).

The improvement in both groups in this study was remarkable given that the disease is generally progressive, and given that all participants had already received therapy and were still receiving it. One might speculate that both mental practice and relaxation had a beneficial effect, especially because both groups had similar amounts of treatment and compliance with the new therapies. Because both groups improved, maybe the contrast between the two interventions was not large enough or the groups were too small to detect possible effects. A control group with an incorporated therapy was needed, however, to control and compensate for additional attention. Apart from the study by Tamir and colleagues, relaxation has been part of the control intervention in other studies (Kamsma et al 1995) with significant effects in favour of the experimental treatment. However, there is also some evidence that relaxation as part of a treatment package might help patients with Parkinson's disease (Kwakkel et al 2007), but at this point there is no evidence that relaxation as a single intervention improves locomotor tasks like walking. Effects of both mental practice and relaxation in this study could only have been revealed with a third, regular-therapy-only group, but this was not incorporated.

Participants in this trial may not have practised enough under the supervision of a physiotherapist. We taught the participants mental practice for a total of six hours, whereas a total of 12 hours was used in the study by Tamir and colleagues. Partly this was compensated for by the unsupervised imagery in our study. As all participants were community-dwelling people, we assumed that they would be able to fill in the patient-completed logs correctly after receiving instruction, although this was not assessed. It is difficult to know to what extent the mental practice therapy was actually used by the participants at home. Some participants reported an additional 15 hours of unguided mental practice, but the average of 3 hours and 50 minutes might still have been too small because some participants did not practise unsupervised at all. On the other hand, if the variation in dose was an important factor in this study, the per-protocol analysis should have revealed a benefit in compliant participants, but it did not.

More objective measures could have been used to select patients whose cognitive abilities might allow them to better engage in mental practice (other than the Mini-Mental State Examination, which was not developed to evaluate imagery ability). Recently ways of measuring the imagery ability, like the hand-rotation test and the Kinaesthetic and Visual Imagery Questionnaire (Malouin et al 2007, Simmons et al 2008), have been introduced. At this point, however, it is not known if being able to perform mental imagery necessarily equates to benefiting from it in clinical practice. In addition, we do not know if people who are unable to perform imagery at baseline are able to learn to do so.

In this study, we did not find differences between embedded mental practice and current standard of care with relaxation. The working mechanisms for mental practice interventions in Parkinson's disease are based on evidence from sports and fundamental clinical research performed over the last 10 years in patients with different pathologies, mainly stroke (Dickstein and Deutsch 2007, Feltz and Landers 1988). Since mental practice is a relatively new treatment in patients with Parkinson's disease, it seems important to adjust and develop the intervention to the specifics of this population and the individual abilities (Craig et al 2008). Further research is needed to study underlying mechanisms of why mental practice works in some patients and does not in others. The mental practice intervention should be tested to determine the optimal content and dose. ■

eAddenda: Available at jop.physiotherapy.asn.au
Table 4.

Ethics: The Atrium, Orbis medical concern, HsZuyd (The Netherlands) Ethics Committee approved this study. All participants gave written informed consent before data collection began.

Acknowledgements: We thank all involved therapists and patients for participating in the trial. We appreciate the help of Marieke Spreeuwenberg, PhD, Zuyd University of Applied Sciences, with the statistical analysis.

Competing interests: None declared.

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References

Altman DG, Schulz KF, Moher D, Egger M, Davidoff F, Elbourne D, et al (2001) The revised CONSORT statement for reporting randomized trials: explanation and elaboration. *Annals of Internal Medicine* 134: 663–694.

Assmann SF, Pocock SJ, Enos LE, Kasten LE (2000) Subgroup analysis and other (mis)uses of baseline data in clinical trials. *Lancet* 355: 1064–1069.

Braun SM, Kleynen M, Schols JM, Schack T, Beurskens AJ, Wade DT (2008) Using mental practice in stroke rehabilitation: a framework. *Clinical Rehabilitation* 22: 579–591.

Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M (2008) Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ* 337: a1655.

Cunnington R, Egan GF, O'Sullivan JD, Hughes AJ, Bradshaw JL, Colebatch JG (2001) Motor imagery in Parkinson's disease: a PET study. *Movement Disorders* 16: 849–857.

Dibble LE, Addison O, Papa E (2009) The effects of exercise on balance in persons with Parkinson's disease: a systematic review across the disability spectrum. *Journal of Neurologic Physical Therapy* 33: 14–26.

Dickstein R, Deutsch JE (2007) Motor imagery in physical therapist practice. *Physical Therapy* 87: 942–953.

Donnelly C, Carswell A (2002) Individualized outcome measures: a review of the literature. *Canadian Journal of Occupational Therapy* 69: 84–94.

Feltz D, Landers D (1988) A revised meta-analysis of the mental practise literature on motor skill learning and performance. In Druckman D, Swets J (Eds) Enhancing Human Performance: Issues, theories and techniques (2nd edn). Washington DC: National Academy of Science, pp 1–65.

Frak V, Cohen H, Pourcher E (2004) A dissociation between real and simulated movements in Parkinson's disease. *NeuroReport* 15: 1489–1492.

Garraway WM, Akhtar AJ, Prescott RJ, Hockey L (1980) Management of acute stroke in the elderly: preliminary results of a controlled trial. *BMJ* 280: 1040–1043.

Gessel AH (1989) Edmund Jacobson, M.D., Ph.D.: the founder of scientific relaxation. *International Journal of Psychosomatics* 36: 5–14.

Hankey GJ, Deleo D, Stewart-Wynne EG (1997) Stroke units: an Australian perspective. *Australian and New Zealand Journal of Medicine* 27: 437–438.

Hoehn MM, Yahr MD (1967) Parkinsonism: onset, progression and mortality. *Neurology* 17: 427–442.

Kamsma YPT, Brouwer WH, Lakke JPWF (1995) Training of compensational strategies for impaired gross motor skills in Parkinson's disease. *Physiotherapy Theory and Practice* 11: 209–229.

Keus SHJ, Hendriks HJM, Bloem BR, Bredero-Cohen AB, de Goede CJT, van Haaren M, et al (2004) KNGF-Richtlijn 'Parkinson'. *Nederlands Tijdschrift voor Fysiotherapie* 114: Supplement.

Kwakkel G, de Goede CJ, van Wegen EE (2007) Impact of physical therapy for Parkinson's disease: a critical review of the literature. *Parkinsonism and Related Disorders* 13 Suppl 3: S478–487.

Lin MR, Hwang HF, Hu MH, Wu HD, Wang YW, Huang FC (2004) Psychometric comparisons of the timed up and go, one-leg stand, functional reach, and Tinetti balance measures in community-dwelling older people. *Journal of the American Geriatrics Society* 52: 1343–1348.

Malouin F, Richards CL (2010) Mental practice for relearning locomotor skills. *Physical Therapy* 90: 240–251.

Malouin F, Richards CL, Doyon J, Desrosiers J, Belleville S (2004) Training mobility tasks after stroke with combined mental and physical practice: a feasibility study. *Neurorehabilitation and Neural Repair* 18: 66–75.

Malouin F, Richards CL, Jackson PL, Lafleur MF, Durand A, Doyon J (2007) The Kinesthetic and Visual Imagery Questionnaire (KVIQ) for assessing motor imagery in persons with physical disabilities: a reliability and construct validity study. *Journal of Neurologic Physical Therapy* 31: 20–29.

Mathias S, Nayak US, Isaacs B (1986) Balance in elderly patients: the 'get-up and go' test. *Archives of Physical Medicine and Rehabilitation* 67: 387–389.

Milton J, Small SL, Solodkin A (2008) Imaging motor imagery: methodological issues related to expertise. *Methods* 45: 336–341.

Morris S, Morris ME, Iansek R (2001) Reliability of measurements obtained with the Timed 'Up & Go' test in people with Parkinson disease. *Physical Therapy* 81: 810–818.

Ostelo RWJG, Deyo RA, Waddell G, Croft P, von Korff M, Bouter LM, et al (2008) Interpreting change scores for pain and functional status in low back pain. *Spine* 33: 90–94.

Sammer G, Reuter I, Hullmann K, Kaps M, Vaitl D (2006) Training of executive functions in Parkinson's disease. *Journal of the Neurological Sciences* 248: 115–119.

Sharma N, Pomeroy VM, Baron JC (2006) Motor imagery: a backdoor to the motor system after stroke? *Stroke* 37: 1941–1952.

Simmons L, Sharma N, Baron JC, Pomeroy VM (2008) Motor imagery to enhance recovery after subcortical stroke: who might benefit, daily dose, and potential effects. *Neurorehabilitation and Neural Repair* 22: 458–467.

Stratford P, Gill C, Westaway M, Binkley J (1995) Assessing disability and change on individual patients: a report of patient specific measure. *Physiotherapy Canada* 47: 258–263.

Tamir R, Dickstein R, Huberman M (2007) Integration of motor imagery and physical practice in group treatment applied to subjects with Parkinson's disease. *Neurorehabilitation and Neural Repair* 21: 68–75.

Tombaugh TN, McIntyre NJ (1992) The mini-mental state examination: a comprehensive review. *Journal of the American Geriatrics Society* 40: 922–935.

Wewers ME, Lowe NK (1990) A critical review of visual analogue scales in the measurement of clinical phenomena. *Research in Nursing & Health* 13: 227–236.

Yaguez L, Canavan AG, Lange HW, Homberg V (1999) Motor learning by imagery is differentially affected in Parkinson's and Huntington's diseases. *Behavioural Brain Research* 102: 115–127.