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ORIGINAL ARTICLE

Dance training and performance in patients with Parkinson disease: Effects on motor functions and patients' well-being

Développement d'un spectacle de danse chez les patients atteints de la maladie de Parkinson : effets sur les fonctions motrices et le bien-être des patients

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KEYWORDS
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Well-being

Summary
Objective. — Evaluate the effects of a 16-week a specific dance training program on motor function and well-being in patients with Parkinson Disease (PD).
Methods. — Patients were allocated either to the experimental group or to the control group (no intervention). In the experimental group, patients practiced dance once a week for a total of 16 sessions. Dance sessions consisted of a choreography with the aim of performing a dance performance at the end of the 16-week dance program. At baseline and after 16 weeks, motor functions, patients' feeling of happiness and cognitive functions were collected. Differences between the two groups were calculated for each tested measure.

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Results. — Eight patients in the experimental group and 6 in the control group completed the study. A significant difference between the two groups was found for the 10-meter test as well as for the feeling of happiness. No differences were found for the other outcomes. In conclusion, weekly sessions of dance improve motors capacities and the feeling of happiness in patients with PD. The motivational aspect of learning a choreography and presenting a dance performance may have induced additional benefits of the training program.

MOTS CLÉS
Parkinson ;
Danse ;
Performance ;
Entraînement physique ;
Musique ;
Bien-être

Résumé
Objectif. — Évaluer les effets d'un programme de danse de 16 semaines sur la fonction motrice et le bien-être des patients atteints de la maladie de Parkinson.
Méthodes. — Les patients ont été répartis soit dans un groupe expérimental, soit dans un groupe contrôle (pas d'intervention). Dans le groupe expérimental, les patients ont participé à des cours de danse hebdomadaire pour un total de 16 séances. Les séances de danse consistaient en une chorégraphie dont le but final était la présentation d'un spectacle de danse à la fin du programme. Au départ et après 16 semaines, les fonctions motrices, le sentiment de bonheur des patients et les fonctions cognitives ont été évaluées. Les différences entre les deux groupes ont été calculées pour chaque mesure testée.
Résultats. — Huit patients dans le groupe expérimental et 6 dans le groupe de contrôle ont été inclus dans cette étude. Une différence significative entre les deux groupes a été constatée pour le test de 10 mètres ainsi que pour le sentiment de bonheur. Aucune différence n'a été constatée pour les autres résultats. En conclusion, les séances hebdomadaires de danse améliorent les capacités motrices et le sentiment de bonheur chez les patients atteints de la maladie de Parkinson. L'aspect motivationnel de l'apprentissage d'une chorégraphie et de la présentation d'un spectacle de danse peut avoir induit des bénéfices supplémentaires sur l'impact des cours de danse.

1. Introduction

Parkinson disease (PD) is a neurodegenerative condition caused by a depletion of dopamine in the substantia nigra which in turn alter the basal ganglia circuit, resulting in multiple sensorimotor impairment and non-motor disturbances (e.g., depression, cognitive decline or apathy) [1]. Promising therapeutic strategies, pharmacological, surgical and genetic, have been developed; however, to date, there is no cure to stop the evolution of the disease [2]. In this context, it is important to develop non-medical approaches aiming at improving patients' daily functioning and quality of life, in order to help them cope with the progression of the disease.

In the recent years, dance has become an attractive strategy to promote motor and non-motor functions in PD, as highlighted in a recent review [3]. Even if most trials available so far report preliminary findings, such pilot studies are mandatory to define the most appropriate protocol to conduct a large sample randomized controlled trial. More than being a rehabilitative strategy, dance seems to be an optimal approach to promote functional outcomes of patients suffering from this neurodegenerative disease. It offers a multidimensional approach acting at various levels to promote patients' functional and emotional status. Indeed, dance combines physical, rhythmic, cognitive, emotional and social elements which could positively impact multiple impairments in patients with PD.

Physical activity is especially important for PD as, beside strengthening motor functions, it promotes dopamine release and may offer neuroprotection [4]. However, people with PD are often less active[5], and patients' adherence to physical training may be challenged by their loss of motivation, mood disturbances or fatigue [6]. Therefore, it is even more important to make physical activities enjoyable and fun, while including rehabilitation objectives, in order to motivate people with PD to engage in physical activities. In this context, it has been shown in a previous review that dance trainings have good adherence rates in people with PD [7], suggesting that longstanding participation may be more feasible for dance than other forms of physical trainings. In addition, having a common goal might also enhance patients' participation and adherence, which in turn may lead to stronger impact of the training on patients' functional, emotional or cognitive abilities. In this context, in the present study, we aimed to evaluate the effects of a 16-week dance training with the aim to present a dance performance at the end of the 16-week training.

Our primary aims were to evaluate the impact of this specific training on patients' walking speed and balance as measured with the 10-meter test and the Tinetti test compared to a control group who did not receive any dance training.

Our secondary outcomes were patients' endurance measured with the 6-minute test, mobility tested with the fingertip-to-floor test, cognitive functions evaluated with the Montreal Cognitive Assessment (MoCA) and level of happiness measured with the VAS happiness.

2. Method

2.1. Participants

Inclusion criteria were: diagnosis of PD, being able to stand and walk for a minimum of 6 minutes without any help. Exclusion criteria were: premorbid neurological disorders, cardiovascular disorders, psychological disorders, vision problems that cannot be corrected with glasses, hearing problems that do not allow to hear music, surgery that interferes with motor function in the 6 months prior to the study. During the study protocol, patients in the experimental group were asked to attend to a minimum of 80% of the planned sessions, otherwise they would be excluded from the study.

2.2. Intervention

Each session consisted of 60 minutes of a dance training provided by a professional dancer. The dance classes started with a sit warm-up with different exercises of rhythm, memorization, and coordination in order to progressively introduce the movements of the choreography. The level of difficulty of the exercises increased as the sessions progressed. Each week, the participants learned new steps which they integrated into the choreography. In addition, adaptations were made so that everyone could dance; for example, chairs were included and the music was slowed down at certain times. Finally, the hour ended with stretching in a seated position. Patients could attend the session with a relative, and were supervised by volunteer nurses, physiotherapists or occupational therapists. 16 sessions of dance were given over a 4-month period, each session lasted around 60 minutes. A show was organized at the end of 16 sessions.

2.3. Study protocol

In this controlled open-label study, based on their wiliness to participate to the dance session, patients were allocated to the experimental (dance sessions) or the control (no dance sessions) groups. Before (T0) and after the 16 sessions of dance (T1), motor, cognitive and emotional outcomes were collected.

The study was approved by the local Ethical Committee and signed informed consent was obtained for all patients.

2.4. Outcomes

Primary outcome measures were the Tinetti test to assess dynamic balance and gait [8] and the 10-meter test to assess walking speed [9].

Secondary outcome measures were the 6-minute test to evaluate the endurance [10] and the fingertip-to-floor test to assess patients' flexibility [11]. The Montreal Cognitive Assessment (MoCA) was used to measure patients' cognitive functions [12] and the visual analogue scale (VAS) for happiness was collected.

2.5. Statistical analyses

Given the small sample size, we used non-parametric tests for our analyses and all data are presented as medians and interquartile range (IQR) 25 and 75. Patients' baseline characteristics were compared between the two groups using a Mann-Whitney test for age and time to diagnosis, and a Chi^2 test for gender. For each test, baseline values were compared with a Mann-Whitney test. The treatment effect [(post-control minus pre-control) versus (post-experimental minus pre-experimental)] was calculated with a Mann-Whitney test. If the treatment effect was found to be significant, a Wilcoxon signed-rank test was used to compare the changes in the control group and in the experimental group (pre versus post intervention). Significance was set at $P < 0.05$. All statistical analyses were performed using STATA (StataCorp 2013. StataCorp LP, College Station, TX).

3. Results

Out of the 20 patients, 16 met the inclusion criteria. 10 patients participated to the dance sessions (experimental group) and 6 patients did not (control group). Two patients were excluded from the experimental group during the study period (<80% of attendance and misdiagnosis). Baselines characteristics were similar between the two groups for age ($P = 0.683$), time to diagnosis and gender ($P = 0.53$) (Table 1).

At baseline, there was no difference between the two groups for any of the tested outcomes (all ps >0.05).

Primary outcomes: No significant treatment effect was found for balance ($P = 0.200$), while a significant effect was identified for walking speed ($P = 0.009$). The control group did not show any improvement ($P = 1$), while the experimental group improved from 8 seconds to 6 seconds at the 10-meter test ($P = 0.009$).

Secondary outcome: The only significant difference was found for the happiness VAS ($P = 0.015$). The experimental group improved from 6 (5—7) to 7.75 (7.375—8.125; $P = 0.028$), while the control group did not show any changes ($P = 1$).

All results are presented in Table 2.

4. Discussion

The objective of this pilot study was to evaluate the effects of a dance program, including the common goal of presenting a dance performance at the end of the training, on motor and cognitive functions as well as well-being in patients with PD. Despite the relatively small number of participants included in our study, the results showed that walking speed and the feeling of happiness had significantly increased in the experimental group compared to the control group, which demonstrates the promising effects of dance in this population of patients. On the other hand, the results of the other tests, namely the Tinetti test, the 6-minute test, the MoCA and the finger-to-ground distance, did not show any significant difference between the two groups.

Following a 16-week dance program, patients in the experimental group significantly increased their walking speed (from 8 to 6 seconds to walk 10 meters), while the control group did not present any improvement. Our

Table 1 Baseline characteristics differences between the control and the experimental groups expressed in median and interquartile range for age and time from diagnosis.

	Gender	Age (years)	Time from diagnosis (years)
Control group ($n = 6$)	2 women	68 (62.5—70.5)	4 (3.25—7)
Experimental group ($n = 8$)	4 women	65 (56.75—75.25)	9.5 (6.75—11.75)
	$P = 0.533$	$P = 0.750$	$P = 0.082$

Table 2 Scores for all test, presented as median and interquartile range (IQR) at baseline (T0) and at the end of the 16-week study period (T1).

Tests	Control group ($n = 6$)	Experimental group ($n = 8$)	Results
	Median (IQR25—75)	Median (IQR25—75)	
Tinetti (seconds)	T0: 28 (26.5—28) T1: 28 (27.25—28) Δ: 0 (0—0)	T0: 27.5 (25.5—28) T1: 28 (27—28) Δ: 0 (0—1.25)	Treatment effect: Z = −1.281; $P = 0.200$
10-meter (seconds)	T0: 7 (6.25—7) T1: 7 (6.25—7) Δ: 0 (−0.75—0.75)	T0: 8 (6—9.25) T1: 6 (4.75—8.25) Δ: −1 (−2—−1)	Treatment effect: Z = −2.629; $P = 0.009$* Control: z = 0; $P = 1$ Experimental z = 2.588; $P = 0.009$*
6-minute (meters)	T0: 413.5 (319.75—487.75) T1: 414.5 (395.5—45.25) Δ: 1 (−35.5—30.75)	T0: 398(298—4.45.5) T1: 417(317.25—485.375) Δ: 16.5 (−4—45.875)	Treatment effect: Z = −0.714; $P = 0.475$
Fingertip-to-flor (cm)	T0: 16.5 (15—20.25) T1: 17 (15.25—21.75) Δ: 0.5 (0—17.5)	T0: 12 (9—19.25) T1: 8.5 (4.5—17) Δ: −3.5 (−6.25—0)	Treatment effect: Z = −1.372; $P = 0.170$
MoCA	T0: 25 (24.25—25.75) T1: 26.5 (25—28.75) Δ: 2.5 (0.5—3)	T0: 22.5 (19.75—26.25) T1: 26 (25.75—26.75) Δ: 3.5 (2.5—6)	Treatment effect: Z = −1.247; $P = 0.212$
VAS Happiness (cm)	T0: 7.25 (6.625—7.875) T1: 7.25 (6.625—7.875) Δ: 0 (0—0)	T0: 6 (5—7) T1: 7.75 (7.375—8.125) Δ: 1.25 (1—2.5)	Treatment effect: Z = −2.433; $P = 0.015$* Control: Z = 0; $P = 1$ Experimental Z = −2.200; $P = 0.028$*

Δ: scores at T1 minus scores at T0.
* Denotes for a significant result.

findings are consistent with previous studies in PD showing improved gait velocity following dance training [13—15]. Beside, a meta-analysis concluded that in comparison to the absence of intervention, dance training induced significant improvements in motor scores [16]. However, for gait velocity specifically a recent review showed that the results remain mixed [3]. Dance is a multidimensional approach which encompasses a broad range of styles involving various rhythms, types and speed of movements. Such heterogeneity may explain such inconsistency results for the impact on dance on gait velocity.

From a neurophysiological point of view, it is now admitted that, as a rehabilitative strategy, dance has the potential to promote neuroplasticity in healthy [17] and elderly subjects [18,19], especially in the motor domain. Such neuroplasticity effects related to a dance training need to be investigated in patients with PD to better understand the underlying neuronal correlates of dance and its impact on motor functions in this specific population of patients.

Beside the physical training induced by dancing, music is also said to play an important role in improving physical abilities of patients with PD. Indeed, a study aimed at evaluating the effectiveness of music therapy on the motor symptoms of PD shows that music therapy, which includes dance, significantly reduces bradykinesia and rigidity [20]. As for other pathologies, it has been shown that a musical background is an asset to provide an effective walking rhythm throughout the therapy session [21]. In addition, rhythmic music is believed to activate the basal ganglia, which improves motor control in patients with PD [22] and facilitates the execution and movements' synchronization [23]. In this context, dance training may have improved patients' movement synchronization, which in turn could have enhance walking speed.

Fatigue is an important component of PD, which affects 30% to 56% of patients and is thought to be responsible for a decrease in physical performance [24], which induces a vicious circle for patients who are even less willing to be

active. Music activates the release of endorphins, which causes a sensation of pleasure [25] and reduces the feeling of fatigue [26]. Reduced fatigue due to music, could also explain the significant improvement in gait velocity observed in this study. A better understanding of the effect of dance on fatigue in PD should be explored in future research.

In the present study, patient's feelings were assessed using the happiness visual analog scale, which showed that the 16-week dance training program had a beneficial effect on this outcome. Indeed, the results showed a significant improvement in the experimental group compared to the control group (patients in the active group improved from 6 to 7.75 on the VAS). This could be explained by the fact that dancing with others is a social activity in addition to being a physical activity [27]. Supporting this finding, a previous study in PD, showed that patients can be more interested and motivated by being physically active during an activity encompassing a social component than with traditional general exercises [14]. Previous studies evaluating the effects of dance in PD also found an improvement of patients' quality of life following a dance training program [15,22,27—31]; however, the effect of dance on the feeling of happiness *per se* has not yet been tested in the current literature. Similar to gait velocity, the positive impact of dance on patients' quality of life is not consistent among studies [3].

Motivation might have played a critical role in the present study on both motor function and patients' well-being. Indeed, all patients had a common goal as they had to practice a choreography with the aim to present a spectacle at the end of the 16-week training period. The enthusiasm of the dance performance may also have given them this feeling of happiness. In addition, it may also have induced greater involvement during the dance program, which in turn may have had a stronger impact on the improvement of motor skills related to the dance training. Indeed, in a previous review, it has been shown that dance is emotionally, mentally, physically and socially beneficial and that these are important aspects to address in the therapeutic management of illness [32]. Adding a spectacle as the final goal of the dance training session, may have added more motivation and induce a strong effect on happiness in the experimental group, as suggested in a previous review investigating the effects of goal setting on health outcomes in patients with various disabilities [33].

4.1. Limitations

Some caveats need to be acknowledged. First, this is not a randomized study as patients were allocated to one or the other group based on their willingness to participate to the dance training. This might have affected their motivation which could have influenced the results. Second, our sample size is small and lack of statistical power, which may partially explain why other aspects, such as balance, flexibility or cognitive functions were not significantly impacted, as shown in previous studies [3]. Third, the population included in this study is rather heterogeneous (e.g., wide range of time since the diagnosis and unbalanced proportion of men and women). Indeed, the fact that the control group was in a less advanced stage of the disease could have biased the results as the improvement observed in the experimental group could be interpreted as a regression to the mean. Moreover, more women were included in the experimental group compared to the control group, which could reflect that women are more motivated than men to practice dance, and therefore the effects of dance might be stronger in women. Large sample randomized controlled trial should provide more robust findings and allow subgroup analyses to better determine if dance is more efficient for a subgroup of patients (e.g., duration or severity of the disease or gender).

5. Conclusions

The results of this study show that a dance training over a 16-week period, improves walking speed and feelings of happiness in patients with PD. The originality of the study is the creation of choreography and a dance performance that was achieved at the end of the training. This additional common goal may have enhance patients' motivation and positively impacted their gait and sensation of happiness. Movement therapy with dance is promising, which is why there is a need to raise awareness among patients with PD and therapists to promote and include dance in rehabilitation programs. Dance has the advantage to offers a multidimensional approach and allows to provide a specific training acting on physical, social and artistic aspects. Larger sample are needed in order to investigate the beneficial effects of dance and performance on patients with PD.

Disclosure of interest

The authors declare that they have no competing interest.

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