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Impact of ambulatory physiotherapy on motor abilities of elderly subjects with Alzheimer's disease

Patrick Manckoundia,[1,2,3]* Michaël Taroux,[1]* Alexandre Kubicki[2] and France Mourey[2,3]

[1]*Department of Geriatrics and Internal Medicine, Hospital of Champmaillot, University Hospital,* [2]*Inserm/U1093 Motricity-Plasticity, and* [3]*Faculty of Medicine, University of Burgundy, Dijon, France*

Aim: We investigated the impact of ambulatory physiotherapy (AP) on motor abilities in elderly subjects with Alzheimer's disease (AD).

Methods: Subjects with mild to moderate AD were included and divided into "physiotherapy group" (PG) and "no physiotherapy group" (NPG) according to whether or not they received AP between inclusion (T0) and the second time of assessment, between 15 and 36 months after inclusion (T1). The follow-up duration, Mini-Mental State Examination, Tinetti and mini motor test (MMT) scores, Timed Up & Go test (TUG), gait speed (GS), one-leg balance (OLB), history of falls within the last 6 months (HF), ability to rise from the floor (RFF) and the use of a walking aid (UWA) were recorded at T0, and after at least 15 months of follow up (T1).

Results: A total of 50 subjects were included in the NPG and 20 in the PG. At baseline, these groups were not significantly different for all the parameters recorded. The ANOVA showed a progression of cognitive disorders in the two groups between T0 and T1 ($P < 0.001$), which was similar in the two groups ($P = 0.83$). For each postural and motor quantitative test (Tinetti, MMT, TUG, GS) the ANOVA showed a main effect of time of assessment (All $P < 0.05$) associated with a group × time of assessment interaction (All $P < 0.05$). The comparison between the two groups with regard to the evolution of qualitative parameters showed a significant difference for the OLB test only. No significant difference was found for RFF, HF and UWA.

Conclusions: There was a significant improvement or stability of motor abilities in the PG; while these abilities decreased in the NPG. **Geriatr Gerontol Int 2013; ••: ••–••.**

Keywords: Alzheimer's disease, balance, elderly, gait, motor physiotherapy.

Introduction

Worldwide, there are 24.3 million people with dementia, all types of dementia combined, and the number will double every 20 years to reach 81.1 million in 2040.[1] The prevalence of dementia is estimated at 8.7% in older adults aged 65 years and over, and at 17.8% in those aged 75 years and over.[2] Alzheimer's disease (AD) is the leading cause of dementia and accounts for two-thirds of cases.[3] The prevalence of balance and gait disorders in AD is 9–52%.[4–6] In addition, gait disorders appear in 50% of AD patients 3 years after the diagnosis of AD; and among these, 33% lose their ability to walk.[7] Yet, there are very few reports about the impact of physiotherapy on the maintenance of motor autonomy in demented patients, although it has been shown to have a beneficial effect.[8–14] We therefore carried out an observational study to determine the impact of individual ambulatory physiotherapy (AP) on posturo-motor abilities in non-institutionalized older adults with mild to moderate AD. In recent years, several studies have used exercise interventions to improve physical function in patients with dementia.[12,13,15,16] Among these studies, two, Rolland *et al.* and Santana-Sosa *et al.*, concerned institutionalized patients and group interventions.[13,15] The report of Tappen *et al.* only examined walking interventions combined or not with conversation.[12] Finally, the study of Ries *et al.* focused on group intervention and examined a population of fallers.[16] In contrast with these previous papers, the novelty of the present study lies in the studied population. Indeed,

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Correspondence: Professor Patrick Manckoundia MD PhD, Service de Médecine Interne Gériatrie, Hôpital de Champmaillot CHU BP 87 909, 2, rue Jules Violle, F21079 Dijon Cedex, France. Email: patrick.manckoundia@chu-dijon.fr
*Because each of these authors contributed equally, both should be considered first authors.

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our participants were not institutionalized, were not recruited on falling criteria and received individual AP. In addition, a detailed assessment of cognitive and motor abilities was carried out. We hypothesized that individual AP would have on the one hand a positive impact on balance and gait in patients with AD, despite mild or moderate cognitive disorders; and on the other hand a lesser effect on cognitive abilities. Furthermore, we wanted to show that individual AP is possible in AD patients, despite the attention and behavior disorders that characterize this disease.

Methods

Participants and protocol

Patients living at home, who were aged 70 years and older, and suffering from mild to moderate AD were recruited from a geriatric day-hospital. AD was diagnosed according to the National Institute of Neurology and Alzheimer's Disorders and Stroke-The Disease and Related Disorders Association (NINCDS-ADRDA), and the *Diagnosis and Statistical Manual-IV* Text-Revised (DSM-IV-TR) criteria.[17–19] Laboratory blood tests and magnetic resonance imaging or computed tomography brain scans were carried out during the assessment of the dementia syndrome. At inclusion (T0), these participants had a cognitive assessment, and a postural and motor evaluation carried out by the physiotherapist according to a defined protocol. In addition, all of the elderly subjects underwent a detailed medical history and physical examination before the study and during their follow up. Participants were excluded if they had severe or non-AD dementia, untreated orthopedic disease, severe malignant or non-malignant disease, neurological disorders (including polyneuropathy, stroke and Parkinson syndrome) except AD, severe muscular or rheumatological disease, severe or non-stabilized cardiovascular or respiratory disease, psychiatric diseases such as depression, a history of alcohol abuse, or a modification of their specific and symptomatic treatments of their dementia during the follow up. They were able to hear and see adequately. Participants were followed in the geriatric day-hospital, and assessed at least a second time (T1) between 15 and 36 months after inclusion. The consultation at T1 included the same cognitive and posturo-motor tests, and parameters as those during the T0 assessment.

Participants were divided into two groups. The first, "no physiotherapy group" (NPG) included those who did not receive physiotherapy between T0 and T1. The second, "physiotherapy group" (PG), comprised participants who took part in a physiotherapy program between the two assessments. The AP, initially proposed to all participants, was not carried out in some participants because of a lack of cooperation, behavioral disturbances and the absence of a physiotherapist in their area of residence. These participants constituted the NPG. The AP, based on a medical prescription at T0, was carried out by a physiotherapist. This prescription was written in the following terms: musculo-articular analytical rehabilitation of the lower limbs with a particular focus on the ankles, muscular training of the lower limbs, rehabilitation of posture, balance and coordination consisting in training to improve postural and protective reactions, and gait rehabilitation. Three sessions of 30 min were carried out per week, as is usual in the practice of physiotherapy in France. The prescription of physiotherapy was mentioned in the medical report of the patient, drafted after the assessment at T0, and sent to his/her general practitioner. If the physiotherapy was in fact carried out, it was specifically stated in the medical record at the second assessment (T1).

Because this was an observational study with no modification in the usual management of patients in our geriatric day-hospital, no written consent of the participants or their guardians was necessary.

Cognitive and motor tests

In order to assess cognitive functions, the Mini-Mental State Examination (MMSE)[20] and the usual neuropsychological tests were carried out for each AD patient at T0 (inclusion) and T1. Neuropsychological tests carried out were the Grober and Buschke test, Mattis Dementia Rating Scale, a visual recognition memory task (DMS48) Rey-Osterrieth complex figure, the five-word test, clock drawing test, frontal assessment battery, Stroop test, trail making test, and the visual object and space perception battery.[21–30] Only the MMSE scores were reported.

Postural and motor abilities were assessed at T0 and T1 using the Tinetti test (TT), mini motor test (MMT), Timed Up & Go test (TUG), measurement of gait speed (GS), one-leg balance test (OLB) and ability to rise from the floor (RFF). The TT is a reliable and validated clinical test to measure balance and gait in the elderly. It includes measurements of static, dynamic, reactive and anticipatory balance, and of ambulation and transfer ability.[31] A total maximal score of 28 indicates the best performance. The MMT is an easy direct-observation test that can be particularly useful in frail older adults. The MMT is a 20-item score that assesses abilities in bed, quality of the sitting position, abilities in the standing position and quality of gait.[32] The TUG measures the time in seconds for the subject to rise from sitting from a standard armchair, walk 3 m, turn, walk back to the chair and sit down. The cut-off point for normal mobility is 12 s, and values >30 s indicate a high level of dependence.[33,34] The GS test is carried out along a walking track of 10 m. A stopwatch is used to record the time that subjects take to finish the course. Gait speed

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has been shown to be an important predictor of disability.[35,36] The OLB test assesses the ability of the subject to remain upright on one leg without support for at least 5 s. A shorter duration is considered a failure and is associated with a twofold increase in the risk of experiencing injurious falls.[37] To carry out the RFF, the previously lying subject is instructed to stand up at a comfortable speed without using any support.[38] Finally, a history of falls within the last 6 months (HF) and the use (UWA) or not of walking aids were recorded at T0 and T1.

Data analysis

The two groups (NPG and PG) were compared at T0 for age, sex, MMSE score, TT score, MMT score, TUG, GS, success in OLB, success in RFF, HF and the UWA. Then, for each group, the assessments at T0 and T1 were also compared with regard to the same parameters. Finally, in addition to follow-up duration (FD) (difference between T1 and T0), the two groups were compared for variations (Δ) between T0 and T1 in mean scores for the cognitive and quantitative motor tests (TT, MMT, TUG and GS), percentage of success in qualitative tests (OLB and RFF), proportion of subjects with HF, and percentage of subjects using walking aids.

To further analyze our results, and to take into account the FD; that is, intervention duration, which was not the same for all patients, we calculated, for each group (NPG and PG), the normalized gain (NG) for the MMSE and quantitative motor tests (TT, MMT, TUG and GS). First, we calculated the mean gain (G), as a percentage, using the following formula: G (%) = ([T1 score – T0 score] / T0 score) × 100. Then, the NG was calculated by dividing the G by the FD in weeks: NG = G/FD. Finally, the two groups were compared for NG for cognitive and quantitative motor tests.

Statistical analysis

Quantitative parameters, including age, are presented with mean ± standard deviation (SD), and qualitative parameters, including sex, as percentages (%).

The two groups were compared at baseline using Student's *t*-test (*t*-test) and the Mann–Whitney test for quantitative variables (age, MMSE, TT, MMT, TUG and GS), and χ^2-test and Fisher's test for qualitative variables (sex, OLB, RFF, HF and UWA).

For quantitative parameters, in order to compare on the one hand, the difference between T0 and T1 for both groups, and on the other hand, the two groups according to the evolution, all dependent variables were analyzed by repeated measures analyses of variance (ANOVA) in which the factors were groups (PG and NPG) and the two assessment times (T0 and T1). This analysis was carried out for each variable independently. Levene's test for homogeneity of variance was carried out before the analysis of each variable. Post-hoc analyses included Scheffé's tests when it was necessary.

Regarding qualitative parameters, the difference between T0 and T1 in each group and the comparison between the two groups according to the evolution of these parameters were analyzed using the χ^2-test and Fisher's test.

The comparison between the two groups according to NG of MMSE, TT, MMT, TUG and GS scores was carried out using a *t*-test.

Statistical significance was accepted for $P < 0.05$.

Results

Description of the overall population and the two groups

We enrolled 70 participants, 49 women and 21 men, aged 81.76 ± 5 years (from 70 to 94) and suffering from mild to moderate AD. They were divided into two groups according to whether or not they had benefited from motor AP during their follow up. The NPG comprised 50 older adults, 33 women and 17 men, with a mean age of 81.80 ± 4.80 years. Their mean FD was 17.48 ± 7.21 months. The PG included 20 participants, 16 women and 4 men, with a mean age of 81.65 ± 5.53 years. Their mean FD was 15.30 ± 5.24 months.

Comparison between the two groups at baseline

Table 1 shows that there was no baseline significant difference between the two groups for sex ratio ($P = 0.25$), age ($P = 0.91$), MMSE score ($P = 0.19$), TT score ($P = 0.59$), MMT score ($P = 0.32$), TUG ($P = 0.74$), GS ($P = 0.58$), OLB (right $P = 0.83$ and left $P = 0.76$), RFF ($P = 0.37$), HF ($P = 0.058$) and the UWA ($P = 0.76$).

Comparison between the two groups according to the follow-up duration

The present study showed no significant difference between the two groups for FD. Indeed, FD was 17.48 ± 7.21 months in the NPG and 15.3 ± 5.24 months in the PG ($P = 0.23$).

Analysis of the evolution of the cognitive state, and postural and motor abilities in each group during the follow-up period, and comparison between the two groups according to the evolution of the cognitive status, and postural and motor abilities

For cognitive status, the ANOVA showed an effect of the time of assessment ($F_{1,68} = 66.818$, $P < 0.001$), but no group × time of assessment interaction ($P = 0.83$). For both groups, MMSE scores were lower at T1

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Table 1 Comparison between the group without physiotherapy and the group with physiotherapy at inclusion

Parameter at inclusion	NPG ($n = 50$)	PG ($n = 20$)	*P*-value
Women†	66	80	0.25
Age (years)‡	81.80 ± 4.80	81.65 ± 5.53	0.91
MMSE (/30)‡	21.42 ± 3.09	22.50 ± 2.96	0.19
Tinetti test (/28)‡	24.06 ± 3.64	23.40 ± 4.32	0.59
MMT (/20)‡	19 ± 1.47	18.30 ± 2.13	0.32
TUG (s)‡	17.12 ± 6.89	17.99 ± 11.19	0.74
GS (m/s)‡	0.80 ± 0.24	0.76 ± 0.22	0.58
OLB ≥5 s			
Right†	32.70	30	0.83
Left†	28.57	25	0.76
RFF ability†	80	70	0.37
Falls within the past 6 months†	40	65	0.058
Use of walking aids†	29	25	0.76

†Percentage; ‡mean ± standard deviation; *P*-values for Student's *t*-test or Mann–Whitney test (quantitative parameters) and for χ^2-test or Fisher's test (qualitative parameters). GS, gait speed; m, meters; MMSE, Mini-Mental State Examination; MMT, mini motor test; NPG, no physiotherapy group; OLB, one-leg balance; PG, physiotherapy group; RFF, rising from the floor; TUG, Timed Up & Go test.

(18.24 ± 4.31 for the NPG and 19.15 ± 4.12 for the PG) than at T0 (21.42 ± 3.09 for the NPG and 22.50 ± 2.96 for the PG; Fig. 1).

For each postural and motor quantitative test, the ANOVA showed a main effect of the time of assessment ($P = 0.047$ for TT, $P = 0.03$ for MMT, $P = 0.005$ for TUG, $P = 0.019$ for GS) associated with a group × time of assessment interaction ($P < 0.001$ for TT, $P < 0.001$ for MMT, $P = 0.003$ for TUG, $P = 0.006$ for GS). The decomposition of these interactions showed that the scores for NPG participants were significantly lower at T1 (TT score = 21.32 ± 5.27, MMT score = 17.24 ± 2.91, TUG = 21.77 ± 10.79 s, GS = 0.64 ± 0.23 m/s) than at T0 (TT score = 24.06 ± 3.64, MMT score = 19 ± 1.47, TUG = 17.12 ± 6.88 s, GS = 0.79 ± 0.24 m/s; all $P < 0.001$), whereas the mean scores for PG participants at T1 (TT score = 24.45 ± 4.66, MMT score = 18.8 ± 1.93, TUG = 17.88 ± 9.47 s, GS = 0.78 ± 0.26 m/s) were not significantly different from those at T0 (TT score = 23.4 ± 4.32, MMT score = 18.3 ± 2.13, TUG = 18.57 ± 11.19 s, GS = 0.76 ± 0.22 m/s; all $P > 0.05$). These results are shown in Figure 1.

For the qualitative parameters, in the NPG (Table 2), only the RFF ability decreased significantly during the follow-up period. Indeed, RFF success rates were 80% and 66% at T0 and T1, respectively ($P < 0.041$). The other tests and parameters; that is, right and left OLB, HF and UWA, were unchanged between the two assessments (all $P > 0.05$). In the PG (Table 3), statistical analysis showed a significant increase in the success rate for left OLB and a decrease in the proportion of fallers during the follow-up period. Indeed, success rates for left OLB were 25% and 55% at T0 and T1, respectively ($P < 0.041$), and the proportion of fallers was 65% and 30% at T0 and T1, respectively ($P < 0.023$). The other tests and parameters; that is, right OLB, RFF and UWA, were unchanged between the two assessments (all $P > 0.05$).

The comparison between the two groups with regard to the evolution of qualitative parameters (Table 4) showed a significant difference for OLB test only; that is, ΔOLB, (right $P < 0.019$, left $P < 0.0059$). However, no significant difference was found for RFF, a HF, and the UWA (all $P > 0.05$).

Comparison between the two groups according to normalized gains for scores of cognitive and quantitative motor tests

For the MMSE NG, there was no significant difference between the two groups (t[68] = –0.369, $P = 0.712$). However, the NPG and PG were significantly different regarding NG for scores of TT (TT NG = –0.729 and 0.404, respectively, for NPG and PG, t[68] = 4.213, $P \leq 0.001$), MMT (MMT NG = –0.566 and 0.347, respectively, for NPG and PG, t[68] = 3.736, $P \leq 0.001$), TUG (TUG NG = 1.584 and –0.428, respectively, for NPG and PG, t[68] = –2.951, $P = 0.004$) and for the GS (GS NG = –1.102 and 0.176, respectively, for NPG and PG, t[68] = 2.444, $P = 0.017$).

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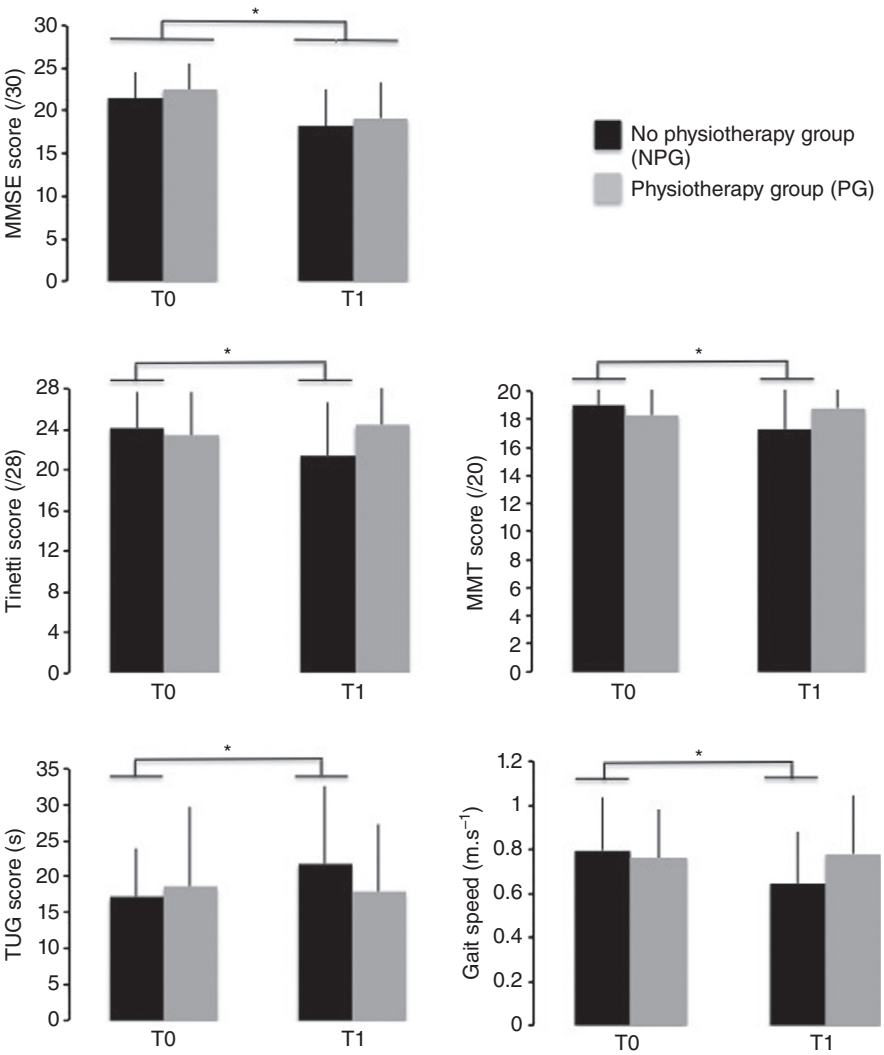

Figure 1 Comparison of evolution of Mini-Mental State Examination (MMSE) score (/30), Tinetti test score (/28), mini motor test (MMT) score (/20), Timed Up & Go test (TUG) and gait speed (GS) from T0 to T1 in each group and between the two groups; that is, no physiotherapy group (NPG) and physiotherapy group (PG). Regarding cognitive status, for both groups, the analysis of variance (ANOVA) showed that MMSE scores were lower at T1 than at T0 ($P \leq 0.001$). For each postural and motor quantitative test; that is, TT, MMT, TUG and GS, the ANOVA showed that the scores for NPG patients were significantly lower at T1 than at T0 (all $P \leq 0.001$), whereas the mean scores for PG participants at T1 were not significantly different from those at T0 (all $P \geq 0.05$).

Table 2 Group without motor physiotherapy ($n = 50$): comparisons between assessments at inclusion (T0) and at T1 regarding success rates in one-leg balance test and rising from the floor, history of falls within the past 6 months, and the use of walking aids

Qualitative parameter	T0	T1	Variation (T1 – T0)	*P*-value
OLB ≥5 s				
Right†	32.70	28.57	–4.13	NS
Left†	28.57	26.53	–2.04	NS
RFF ability†	80	66	–14	0.041
Falls within the past 6 months†	40	32	–8	NS
UWA†	28.57	33.33	+4.76	NS

†Percentage; *P*-values for χ^2-test or Fisher's test. NS, not significant difference; OLB, one-leg balance; RFF, rising from the floor; UWA, use of walking aids.

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Table 3 Group with motor physiotherapy ($n = 20$): comparisons between assessments at the times of inclusion and the second time of assessment, between 15 and 36 months after inclusion, regarding success rates in one-leg balance test and rising from the floor, history of falls within the past 6 months, and the use of walking aids

Qualitative parameter	T0	T1	Variation (T1 – T0)	*P*-value
OLB ≥5 s				
Right†	30	55	+25	NS
Left†	25	55	+30	0.041
RFF ability†	70	65	–5	NS
Falls within the past 6 months†	65	30	–35	0.023
UWA†	25	35	+10	NS

†Percentage; *P*-values for χ^2-test or Fisher's test. NS, not significant difference; OLB, one-leg balance; RFF, rising from the floor; UWA, use of walking aids. T0, at the time of inclusion; T1, the second time of assessment, between 15 and 36 months after inclusion.

Table 4 Comparison between "no physiotherapy group" and "physiotherapy group" as regarding variations between at the time of inclusion and the second time of assessment, between 15 and 36 months after inclusion, of success rates in one-leg balance test and rising from the floor, history of falls within the past 6 months, and the use of walking aids

Parameter	NPG ($n = 50$)	PG ($n = 20$)	*P*-value
ΔOLB			
Right†	–4.13	+25	<0.019
Left†	–2.04	+30	<0.0059
ΔRFF capacity†	–14	–5	0.29
ΔFalls within the past 6 months†	–8	–35	0.32
ΔUse of walking aids†	+5	+10	1

†Percentage; *P*-values for χ^2-test or Fisher's test. OLB, one-leg balance; RFF, rising from the floor.

Discussion

The present observational study consisted in the follow up of elderly outpatients suffering from mild to moderate AD. The assessment of the impact of AP in this population appears to be an original, necessary and interesting concept, especially as there is a lack of data on this topic. Indeed, only a few experimental studies have reported the positive impact of motor physiotherapy on the functional status of demented patients.[8,39] None of these studies, however, included people with dementia living at home.

The assessment of cognitive and motor abilities in the elderly population of the present study was carried out in a geriatric day-hospital during a usual standardized and programmed follow up.

With a mean age greater than 75 years and a predominance of women (70%), the epidemiological characteristics of participants included in the present study were similar to those of the geriatric population.

The initial assessment showed MMSE scores of 21.42 and 22.50 in the NPG and PG, respectively. These results correspond to cognitive disorders at a mild to moderate stage, and reflect the homogeneity of the population. The T0 mean TT scores were 24.06 and 23.40 in the NPG and PG, respectively, and were below the threshold value of 26, which defines balance impairment.[31] The balance disorders were therefore slight, as confirmed by the mean MMT score of 19 and 18.30 at T0. The TT is used for the follow up of participants who show a moderate deterioration of their functional abilities, whereas the MMT is used in participants with reduced functional abilities (i.e. frail subjects) including those with room-only autonomy.[32] Consequently, the TT is more sensitive in detecting mild balance impairment. The present results confirm this hypothesis, as

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we found that participants had abnormal TT scores, whereas the MMT scores remained normal. The mean TUG result (17.54 ± 8.24 s.) was greater than the normal threshold (12 s), but less than the average score for a high level of dependence (30 s).[34] However, because of the high SD, this result must be interpreted with caution. The mean GS (0.79 ± 0.23 m/s) shows that the included participants had postural and motor frailty. Indeed, a GS ≥1 m/s is normal, whereas a GS between 0.65 and 1 m/s indicates postural or motor frailty.[40] Additionally, a GS below 0.65 m/s is an overall frailty marker and is associated with a high risk of hospitalization.[40,41] As far as qualitative evaluation at T0 is concerned, 70% of participants failed the OLB. They therefore had a high risk of falling and of experiencing serious falls.[37] On questioning, 46% of participants said they had fallen within the past 6 months. This finding is in accordance with the studied population, as it has been established that the risk of falling is higher in patients with dementia than in those without.[42] Furthermore, falls might be underreported by patients with cognitive impairments.

Apart from the number of participants, the two groups, constituted according to whether participants received physiotherapy (PG) or not (NPG), were comparable at baseline for all of the parameters studied.

Interestingly, the observational periods were statistically the same for the two groups; the FD therefore cannot be considered a comparison bias in the progression of AD.

The present study showed a significant decline in cognitive performance over an average of 15 months between T0 and T1 in both groups. Indeed, the decrease in the MMSE score was greater than 3 in both groups. Interestingly, the progression of AD was similar in the two groups ($P = 0.93$). Thus, motor physiotherapy had no impact on cognitive function in the present study. This result might seem surprising. Indeed, it is recognized that the preservation of social relations, to which AP contributes, can slow the worsening of cognitive impairment. In the present study, the number of physiotherapy sessions per week was probably not high enough to improve the social ties of the AD patients managed.

The present results showed a significant difference between the two groups for the evolution of postural and motor abilities between T0 and T1. Indeed, postural and motor abilities deteriorated in the NPG, with a reduction in performance in the TT, MMT, TUG and RFF, and an increase in the GS. In the NPG, there was no significant difference between the two assessments for the UWA (although slightly higher), success at the OLB (although slightly lower) and a HF. In contrast, in the PG, postural and motor abilities improved or remained stable. In this group, the TT score increased by 1.05 ($P < 0.027$), success at the OLB increased by 30% ($P < 0.041$) and a HF decreased by 35% ($P < 0.023$). The MMT score, the TUG, GS, RFF ability, and the UWA at T0 and T1 were statistically similar. It is important to note that the frequency of falls decreased in participants who benefited from an AP program.

Comparison between the NPG and PG, regarding variations in motor abilities between T0 and T1, showed a significant difference for the TT, MMT, TUG, GS and OLB. Thus, the present study confirmed the feasibility and the positive impact of AP on postural and motor abilities in older adults suffering from mild to moderate AD, during a minimum 15-month period. Indeed, AP stabilized the negative motor effect of AD. The feasibility and the positive impact of physiotherapy in dementia, particularly in AD, has already been shown.[9,43] However, the number of studies was small and they mainly included institutionalized patients,[8,10–13] who probably had more advanced AD and a greater decline in autonomy than our patients, who were still living at home. Other studies involved very frail patients,[14] or those with severe AD.[44] Furthermore, very few studies in AD patient evaluated the impact of physiotherapy on falls, and to our knowledge none of these studies included either the RFF, or OLB or the UWA, which we believe is important in the assessment of autonomy. Finally, the duration of physiotherapy in some of these studies was shorter than in ours.[8,14]

Currently, there is no consensus about motor physiotherapy programs for demented patients. However, the following characteristics are recommended: personalization of physiotherapy; targeting of objectives; combination of strength and balance exercises; association with tasks to attract attention; to work on immediate memory, working memory and praxis; and dual-task work.[45] In practice, a 12-week or more rehabilitation program at a rate of three sessions of 45–60 min per week would provide a significant benefit in demented people regardless of the stage of the disease.[9] In the present study, the positive impact of physiotherapy was observed in participants suffering from mild to moderate AD, and therefore still able to live at home. Our AP program is original, because it focused especially on balance and posture training, particularly postural reactions and RFF. Motor physiotherapy at home, carried out in the patient's usual environment and living conditions, could contribute to maintaining autonomy and to delaying institutionalization in this elderly population. Finally, the present results show the need to include motor physiotherapy within the care and support plan for patients suffering from AD.

The present study had a few limitations. First, it did not assess the impact of motor physiotherapy on the autonomy of AD patients.[46,47] However, other studies have shown that physiotherapy has a positive impact on activities of daily living and the autonomy of AD patients.[15,44] The second limitation is linked to the

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sample size difference between the two groups, and the lack of a random control group with a volunteer bias regarding the NPG. The method used is explained by the lack of cooperation of some participants, and differences in the lifestyle of the studied population; that is, no physiotherapist close to home. The third limitation was the absence of any control with regard to the FD, and the intervals between the first and the second assessment. The latter is linked to the lack of adherence of these participants to the AP program, and the difficulty for some AD patients to extend it. However, statistical analysis showed no significant difference between the two groups for the FD. In addition, the comparison between the two groups according to NG for scores of cognitive and quantitative motor tests confirmed the previous results; that is, no significant difference for the FD, thus showing the efficacy of the intervention, despite variations in FD.

The present study confirmed the feasibility of a motor AP program, and showed its positive impact on postural and motor abilities in older adults suffering from mild to moderate AD. These results illustrate the need to include physiotherapy in the overall and multidisciplinary care plan of these patients. This is all the more essential, because AD is a major public health issue. Finally, further studies are required in order to confirm the present results and to assess the impact of physiotherapy on autonomy. Thus, motor rehabilitation programs adapted to demented older adults might be offered.

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Disclosure statement

The authors declare no financial disclosures. The authors declare no conflict of interest.

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