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Feldenkrais method and functionality in Parkinson's disease: a randomized controlled clinical trial

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Abstract

Background: The second most common age-related chronic neurodegenerative disease after Alzheimer's disease is Parkinson's disease (PD).
Objective: The focus of this study was to improve the functional capabilities of the participants with PD.
Study groups: The PD participants were randomized into two groups: Feldenkrais and control.
Methods: The Feldenkrais group underwent 50 sessions of an exercise program based on the Feldenkrais method. The control group received educational lectures during this period. Unified Parkinson's Disease Rate Scale (UPDRS – session III), mini-mental state evaluation (MMSE), Hoehn and Yahr scale, and functional tests (figure-of-eight walk test, timed-up-and-go test, rollover task, 360 degrees turn-in-place, functional-reach test, sitting-and-standing test, Berg balance scale (BBS), and hip-flexion strength) were assessed in both groups. Procedures during the 50 sessions were conducted in an appropriate room, twice-a-week, on alternate days and lasted 60 min.
Results: Thirty subjects were randomly divided into two groups: the Feldenkrais (n=15) and the control (n=15) group. The Feldenkrais group presented significantly better in functional tests ($p<0.05$) when compared to the control group. The control group received lower scores after the 50-session period in the sitting/standing test ($p=0.02$), 360 degrees turn-in-place ($p=0.01$), and rollover test ($p=0.01$). Results of the BBS demonstrated significantly higher scores in the Feldenkrais group after treatment ($p=0.004$) when compared to the control group ($p=0.01$).
Conclusion: The Feldenkrais lessons produced specific changes in functional mobility in PD participants.

Keywords: Parkinson's disease (PD); postural balance; physical therapy modalities.

Introduction

Nowadays, aging has become a focus of health policies as it is seen that longevity predisposes people to emerging health problems as well as to chronic diseases [1].

Despite the fact that the aging process is not necessarily related to diseases and disabilities, chronic degenerative diseases are often found among the elderly. The current phenomenon seen is that an increasing number of elderly individuals not only live longer, but also live with more chronic conditions [2].

The second most common age-related chronic neurodegenerative disease after Alzheimer's disease is Parkinson's disease (PD) [3]. About 1% of the population aged over 60 years develops PD, but its prevalence increases up to 4% in individuals aged 80 years or more. Thus, it has become increasingly common in countries where high rates of longevity are seen in the population [2, 4–6].

In 2030, it is believed that eight to nine million people worldwide will be affected by PD. Moreover, the increase in chronic diseases is directly related to greater functional disabilities [2]. Besides, the presence of motor dysfunction in PD increases dependence, inactivity and social isolation, factors that substantially affect the quality of life of these patients [5–7].

PD motor dysfunctions have been reported as the rates of falls in this population is high, which almost always increase disability and morbidity [8].

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Fear of falling is very common in PD-patients compared with healthy subjects, and it compromises quality of life and daily activities. Moreover, a reduction in daily activities predisposes them to muscular decay and reduces body balance [9].

Traditionally, the treatment of PD focuses on pharmacological and surgical therapies. Complementary interventions also support and assist these therapies [10]. Physical therapy has substantial importance in maximizing motor skills, plus minimizing secondary complications arising from surgical and pharmacological therapies [5].

The Feldenkrais method chosen as the focus of the treatment is "awareness through movement". Moshe Feldenkrais created the method. He was the pioneer in somatic education. The spatial and kinesthetic awareness of the body segments is based on martial arts, and it contributes to an understanding of the composition of movement organization [11–13].

Knowing this, we proposed to investigate the effects of an exercise program based on Feldenkrais method to improve the quality of life and physical, mental and social well-being of PD patients, and for such, the intervention should be based on somatic education, guided by an approach that would contribute to the interaction of dynamical systems responsible not only for motor action, but also involving interconnections of the emotional condition.

The focus of this study was to propose an intervention to improve the functional capabilities of patients with PD. There is a lack of studies that promote health through holistic practices for this population.

Given the above, the present study investigated the effects of exercises based on the Feldenkrais method on the functionality of PD patients. The purpose was to highlight the effects of physiotherapy on minimizing motor and non-motor changes, especially those related to functionality and those crucial for daily activities.

Methods

Subjects and study design

This randomized controlled trial was attended by 30 subjects with a clinical diagnosis of idiopathic PD (Hoehn and Yahr stage 2 or 3) lasting less than a year, which has been treated with levodopa and stabilized with anti-Parkinsonism treatment.

The study followed the Guidelines and Standards Research on Humans of the National Health Council (item VII of Resolution 196/96), the national committee on ethics and research (CONEP), and was approved by the Research Ethics Committee of the Federal University Sergipe – Brazil (CEP/UFS), No. CAAE – 0040.0.107.000-10.

All participants signed the informed consent form and fulfilled the Unified Parkinson's Disease Rating Scale (UPDRS-session III) criteria for PD [14]. Physical or medical examination showed scores <24 on the mini-mental state examination (MMSE) [15]. Inclusion criteria for the study were either gender and aged between 50 and 70 years; presence of motor fluctuations and conventional anti-Parkinsonian therapy, excluding amantadine, clozapine, deep brain stimulation and thalamotomy, or pallidotomy history; absence of psychiatric condition, cognitive decline or dementia influencing the communication process; absence of musculoskeletal disorder, cardiopulmonary or neuromuscular disorder, recent or unresolved, which could affect their ability to walk or their mobility; ability to walk independently with or without assistive devices; not being under physical therapy during the training period [14].

Protocol

Participants were randomly divided into two groups: Feldenkrais and control. The Feldenkrais group underwent 50 sessions of a physical therapy program based on the Feldenkrais method. During this period, the control group received educational lectures. The Feldenkrais group sessions took place twice a week on alternate days for 60 min. Both groups were evaluated before and after the interventions. The assessments, reassessments and procedures were performed in a suitable place (Figure 1).

The exercises used in the sessions were based on the Feldenkrais method. The tasks focused on lessons on how to choose the best way to breathe, sit, stand, turnover, and walk, among other actions, easily and efficiently. The sessions were divided into four stages: warming, mobility and flexibility exercises, balance, and relaxation.

For the control group, lectures concerning guidelines to prevent falls, medication use, and frequent practice of physical activity were offered. All participants maintained constant use of anti-Parkinsonian medication throughout the study.

Measurements

Balance assessment was performed through functional activities which assess functional mobility: figure-of-eight walk test [16], timed-up-and-go test (TUG) [17], rollover task, 360 degree turn-in-place task, functional-reach test, sitting-and-standing test [18], Berg balance scale (BBS) [19], hip flexion strength [20]. The results of these tests were compared to the results of the Feldenkrais group and of the control subjects. All tests were performed with barefoot-individuals and, when necessary, the tests were performed with the use of appropriate corrective lenses.

Figure-of-eight walk test: This test analyzes the ability to walk in different ways. In the figure-of-eight walk test, subjects are timed walking in a figure-eight trajectory. The figure-eight trajectory was marked with a 4-cm-wide tape on the floor, each loop having an internal diameter of 163 cm. The time (in seconds) to walk two complete cycles was measured with a hand-held stopwatch. The subject started in the center of the figure-of-eight and the onset time was based on the first detectable movement of the subject following a command "go!" from

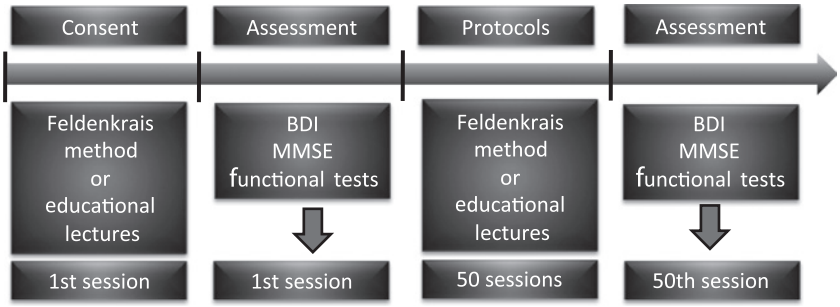

Figure 1: Timeline of the study.
BDI, Beck depression inventory; MMSE, Mini-mental state examination.

the experimenter. The task was performed twice, but the first test was considered as a training trial and was not used in the analysis [16].

Timed-up-and-go test (TUG): The TUG test assesses balance, gait velocity, stability, and direction change. In the TUG test subjects began from a seated position, rose from the chair, walked 3 m straight ahead, turned 180 degrees, returned to the chair, and sat down. The entire sequence was timed (in seconds) with a stopwatch and all subjects performed the TUG three times. The first trial was considered as a training trial and the average of the second and third trials was used for the analysis [17].

Rollover task: The rollover task evaluates mobility on the ground. This test is to verify the ability of to move in bed. It began with the subjects in a supine position on a therapy mat. The subjects were instructed to execute a 360-degree-rolling movement to the left as fast as possible after the command "go!" (stopwatch started). When the evaluator determined that the maneuver had reached a full 360 degrees, the subject immediately received a "return" command and the subject rolled 360 degrees to the right as fast as possible back to the supine position. A stopwatch was used to time (in seconds) the duration of the task. The task was performed twice, and the second trial duration was used for the analysis [18].

360-Degree turn-in-place task: A 360 degrees turn-in-place task rates mobility and balance. It was timed using the motion analysis system with reflective markers on the subjects' feet. The subjects were instructed to turn in their preferred direction 360 degrees when they were ready to do so (self-initiated). Turn duration (in seconds) was measured from the first movement of the toe or heel off the floor until the last vertical contact of the foot (toe or heel) on the floor after a full 360-degree turn [18].

Functional-reach test: This test measures balance and flexibility. The subjects stood beside a horizontally oriented measuring tape on the wall at their shoulder level. The subjects were asked to stay with their shoulders perpendicular to the measuring tape and both arms stretched out in a 90-degree shoulder flexion. They were then instructed to "reach forward as far as they could without losing balance or taking a step and the distance (in centimeters) they reached from the initial position was measured [18].

Sitting-and-standing test: Sitting-and-standing test rates ability, strength and balance. This test was performed using a firm chair without armrests. The time (in seconds) between the initial and the final seated position at the end of three repetitions was recorded at a self-selected rate. All participants performed three sets of three attempts. A total of nine replicates were recorded and the average was recorded subsequently [18].

Berg balance scale (BBS): This test analyzes balance and gait impairments and falls in the elderly. The BBS is considered the standard reference to assess balance and to determine fall risks. Scale scores were related to clinical judgments and self-perceptions of balance, laboratory measures of postural sway and external criteria reflecting balancing ability. The BBS is a 14-item test, with each item rated from 0 (signifying poor balance) to 4 (signifying better balance). A total score is 56 [19, 20].

Hip-flexion strength test: The hip-flexion strength test is crucial to evaluating how the limb performs day-to-day tasks. Hip-flexion strength was recorded in a dominant lower limb using a hand-held digital dynamometer (model: IP-90DI, Impac®, São Paulo, SP, Brazil). Participants were seated on a chair with their hips and knees flexed to 90 degrees. The thigh and knee were immobilized to avoid compensation of adductor muscles. The dynamometer was positioned perpendicular to the distal section of the femur. Normalization of the data was standardized so that the force, in Newtons (N), was multiplied by the distance between the joint axis of rotation and the point of application of force, in meters (m) and divided by the body weight (kg). Therefore, the result of muscular strength was represented as Nm/kg. The peak value was obtained from four test trials [20, 21].

Statistical analyses

All analyses were undertaken using SPSS (18.0 version, IBM®, Chicago, IL, USA). The Shapiro-Wilk test was used to evaluate data normality and homogeneity of variables within each group at each assessment interval. Demographic characteristics and baseline data were summarized by descriptive statistics using mean, standard deviation, and p. The T-test was used for dependent and independent samples. Data with $p \leq 0.05$ were considered statistically significant.

Results

The flow chart in Figure 2 shows the participants in this study. Thirty-six patients with idiopathic PD were

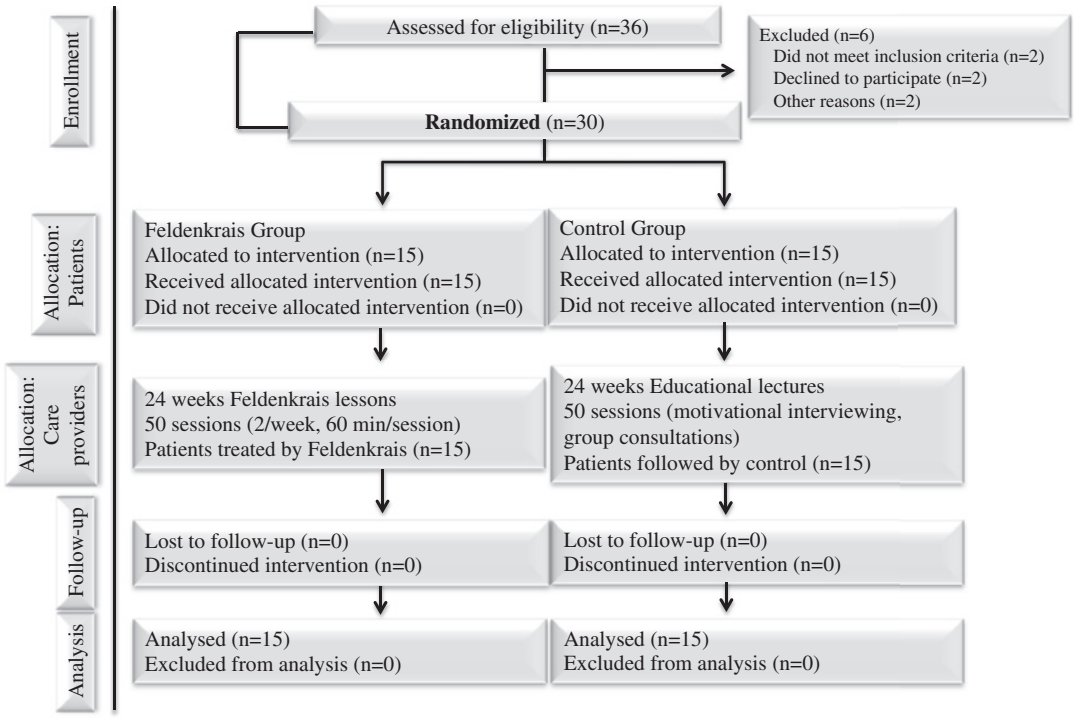

Figure 2: Flow chart of the study.

included. Meanwhile, six patients were excluded from the study, two patients were rated >3 on the Hohen and Yahar scale, one had cognitive impairment by MMSE, another had associated cardiopathy, and two participants declined to participate in the study. Thereby, 30 subjects were randomly divided into two groups: the Feldenkrais group (n=15) and the control group (n=15).

All participants had similar conditions at baseline. The Feldenkrais group was composed of 15 participants with a mean age of 61.41 (8.92) years, weight, 64.60 (2.61) kg, height, 158.24 (0.17) cm, body mass index, 25.69 (0.81) kg/m^2, UPDRS (session III), 17.44 (2.16), MMSE, 24.83 (0.69), and BDI, 13.55 (1.88); and the control group (n=15) with a mean age of 62.55 (6.29) years, weight, 63.81 (2.64) kg, height, 159.81 (0.19) cm, body mass index, 25.06 (1.10) kg/m^2, UPDRS (session III), 17.12 (1.20), MMSE, 25.06 (0.52), and BDI, 13.62 (1.37). There was no significant difference between groups for all demographic or functional variables as studied (Table 1).

The PD patients receiving Feldenkrais exercises showed significantly decreased times for performing different functional tests such as the figure-of-eight walk test (p=0.001), TUG (p≤0.003), sitting/standing (p=≤0.04), 360 degrees turn-in-place (p≤0.05), and rollover (p≤0.001) tests, when compared to before treatment, and also to the control group. The distance reached in relation to the initial position in the functional reach test was significantly higher for Feldenkrais-treated patients in comparison to pretreatment measure (p=0.0001) and control group (p=0.02). There was a significant increase in the hip-flexion strength in the Feldenkrais group in relation to the pretreatment assessment (p=0.05) and the control group (p=0.002) (Table 2).

The control group showed a significantly higher time required to perform the sitting/standing (p≤0.04),

Table 1: Baseline characteristics.

Baseline data	Feldenkrais (n=15)	Control (n=15)	p-Value
Age, years	60.70 (2.55)	61.00 (2.70)	0.91
Weight, kg	64.60 (2.61)	63.81 (2.64)	0.81
Height, cm	158.24 (0.17)	159.81 (0.19)	0.63
BMI	25.69 (0.81)	25.06 (1.10)	0.63
UPDRS (III)	17.44 (2.16)	17.12 (1.20)	0.91
MMSE	24.83 (0.69)	25.06 (0.52)	0.88
BDI	13.55 (1.88)	13.62 (1.37)	0.79

Age (years), weight (kg), height (cm), body mass index (BMI) (kg/m^2), Unified Parkinson Disease Rate Scale (UPDRS – III session) and mini mental state examination (MMSE) in both groups. Mean (PD) and p-values. T-test for independent samples. No significance between groups.

Table 2: Functional tests before and after 50 sessions in the Feldenkrais and control groups.

Variables	Functional tests	Feldenkrais (n=15)			Control (n=15)			Feldenkrais×control	
		Before	After	p-Value	Before	After	p-Value	Before (p)	After (p)
Balance and velocity	Figure-of-eight walk test	40.63 (5.73)	21.03 (1.52)	0.001[b]	40.78 (4.03)	42.72 (3.47)	0.42	0.87	0.001[b]
Balance and velocity	Timed-up-and-go	22.27 (2.93)	12.46 (0.92)	0.003[b]	22.58 (3.40)	26.19 (2.74)	0.176	0.95	0.0006[c]
Balance and velocity	Sitting/standing	11.74 (1.30)	7.92 (0.77)	0.0002[c]	11.12 (1.25)	12.44 (1.04)	0.02[a]	0.73	0.04[a]
Balance, mobility and velocity	360 degrees	8.10 (0.87)	5.14 (0.69)	0.001[b]	7.82 (0.78)	9.99 (1.24)	0.01[a]	0.91	0.05[a]
Mobility and velocity	Rollover	20.71 (2.14)	8.96 (1.39)	0.0001[c]	20.53 (2.82)	30.11 (3.41)	0.02[a]	0.64	0.001[b]
Balance and mobility	Functional-reach	19.07 (1.66)	26.54 (1.95)	0.0001[c]	19.15 (1.98)	16.32 (1.51)	0.01[a]	0.72	0.02[a]
Strength	Hip-flexion strength	3.94 (0.17)	4.93 (0.06)	0.05	3.92 (0.16)	3.90 (0.17)	1	0.79	0.002[b]

Mean (SD). T-test for dependent and independent samples. [a]$p \leq 0.05$, [b]$p \leq 0.003$, [c]$p \leq 0.0006$.

360 degrees turn-in-place ($p \leq 0.05$) and rollover ($p \leq 0.02$) tests when compared to the first assessment and Feldenkrais-treated patients, and reduced reach observed in the functional-reach test after the 50 session-period ($p=0.01$) (Table 2).

Scores from BBS were significantly higher in the Feldenkrais group when compared to before treatment ($p=0.004$) and the control group ($p=0.01$) (Figure 3).

Discussion

Before starting our study, both groups were similar in the figure-of-eight walk test performance. After 50 sessions of the Feldenkrais method, we found a significant reduction in time to complete the task, but the time increased in the control group. Although the results have not shown a significant impairment in controls, clinically we observed reduction in gait speed and difficulties to perform the tasks, such as footsteps outside and inside of the curvilinear circuit, demonstrating changes in balance and coordination during gait.

Our findings highlight the motor damage caused by PD in balance and postural stability. The reduction of these factors in the control group, and the difficulty of performing transfers and changes in different positions reflect the importance of physical therapy since early PD-stages.

Motor symptoms in PD substantially affect the subjects' lifestyle. Gait and mobility-related difficulties cause serious damage that lead to falls and immobility [5, 9]. Providing intervention to the PD patient that aims to reduce these symptoms is of fundamental importance to the quality of life of these patients.

The functional tests constitute the ability to perform day-to-day living tasks. The figure-of-eight walk test assesses the ability to walk in different paths. The curvilinear circuit requires balance and motor coordination to change the direction along pathway tasks [18, 22]. The test showed that the Feldenkrais group had dexterity to dissociate movements beside trunk rotations.

PD patients have difficulty performing tasks due to the nature of the problems related to the disease, such as difficulty in dissociation of movements and trunk-rotation deficit [22]. Whereas, in our sample, after the Feldenkrais sessions, the participants showed better body awareness that improved velocity and balance during task performance.

The circuit of the TUG test assesses functional mobility (walking, moving from sitting to standing, turning pivot), balance, stability, change of direction and gait speed

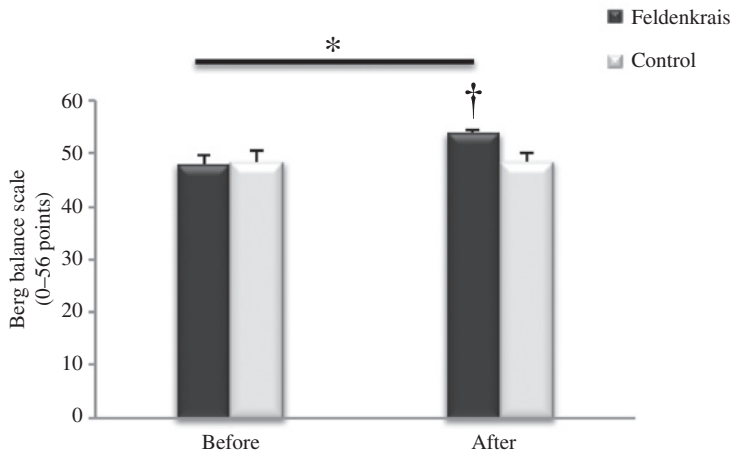

Figure 3: Scores from Berg balance scale (BBS) before and after interventions in the Feldenkrais and control groups. T-test for dependent and independent samples. *p=0.04 in relation to baseline, †p=0.01 in relation to controls.

[17, 18]. The TUG test is able to detect changes in mobility of PD patients [17]. It combines sequential motor actions that recruit components responsible for functional capacity, strength, flexibility and agility. These components are deficient in PD-patients because of rigidity, bradykinesia and akinesia [18, 22].

Similar to our study, Tomlinson et al. [5] elucidated the importance of the TUG test and functional-reach test to demonstrate the importance of physiotherapy for mobility and gait speed. The TUG test circuit showed functional mobility (like sitting/standing, walking, turn-in-place to go back to the chair) in addition to balance, body stability, direction change, gait speed.

These factors are important for performing essential tasks of daily living, such as standing up, sitting, standing, walking, and turning [23]. Furthermore, muscle strength, flexibility and agility are essential to providing better performance in day-to-day tasks, and consequently enhancing functionality [24].

The proposed activities in our study contributed exponentially to these crucial factors for everyday activities, since the Feldenkrais group demonstrated improvement in all functional analyzes.

Morris et al. [17] elucidated the importance of assessing the differences observed in the TUG-test, which is able to detect changes in gait velocity. They evaluated PD patients before and after medication, and found that the time to complete the test was higher before medication.

Another important finding was that the control group scored significantly lower on tests of sitting and standing, rollover and 360 degrees. These tasks indicate relevant changes in muscle stiffness, flexibility, mobility and transfers.

This observed decrease in the control group data showed that the clinical symptoms of PD declined due to muscle stiffness, moving in block without dissociation waists, stooped posture and reduced range of motion during postural changes, besides the absence of physical activity [17].

The Feldenkrais method may have reduced akinesia or freezing, which is defined as a sudden and abrupt loss of ability to initiate or sustain a specific motor activity [23, 24]. It was seen, for example during the slow movements of the lower limbs in the control group while performing the tasks of rollover and 360 degree turn-in-place tests.

The Berg balance scale (BBS) is widely used in the elderly population as a reliable tool for assessing functional stability [25] and has a strong association with assessment tools established for people with PD, as the sub-motor scale of the UPDRS-session III and modified H and Y scale [22]. Similar to our study, Tomlinson et al. [5] showed that physical therapy improves mobility and UPDRS scores (session III) observed by BBS assessment.

Gait and balance disorders involve a complex multifactorial phenomenon due to vestibular, musculoskeletal and proprioceptive dysfunctions [25]. Therefore, interventions that activate different components responsible for coordinated movement, in simplified form, can successfully contribute to the improvement of delay and disorders that affect PD.

Canning et al. [9] applied an exercise program in 115 PD-patients, for a period similar to the one in our study and found substantial improvement in strength, standing balance and speed in sitting and standing test.

The chosen protocol for this study covers several functional systems responsible for movement [12, 13].

Physical therapy has proved to be effective in PD patients causing changes, such as improved strength and balance, reduced gait akinesia and postural instability, and other neural-motor factors that predispose the risk of falls in this population [15].

There are few studies using the Feldenkrais method in elderly patients with PD. There was a study [11] that used the Feldenkrais method in healthy elderly people, and it was reported that the Feldenkrais method increases balance and gait speed. Another one [13] elucidated the influence of the Feldenkrais method in quality of life of PD patients. Our findings suggest that this intervention can contribute to improving the neural-motor apparatus, and thus minimize the deleterious effects of this neurodegenerative disease. The Feldenkrais method stimulates paths to allow easy and effective movements, promoting lower energy expenditure and better functionality.

Exercise for PD patients is fundamental to improving motor skills. It can also improve day-to-day functions and promote substantial gains in functional balance [13, 24, 25].

Proposing interventions that are aimed at well-being and are enjoyable and easy to perform have the potential to reduce disability and improve mobility and quality of life in PD patients. Our study proved that, as in the study of Volpe et al. [24], who compared 24 PD patients who underwent Irish dance as a form of therapy and conventional physiotherapy, the Feldenkrais method improved functionality and wellness. They found that both interventions, assessed by BBS, TUG-test and UPDRS, contribute to mobility and balance, and Irish dancing may have a predictive factor for emotional state.

Besides the motor benefits envisioned in this study, constant reports of patients in relation to the welfare obtained by the practice of the Feldenkrais method, were the goal of our perspectives. Our greatest privilege is to provide functionality for PD patients, without neglecting issues related to physical and emotional wellbeing.

Furthermore, the exercises performed during the sessions of the Feldenkrais method fostered functional movements that stimulated motor actions contrary to the clinical symptoms of PD, specifically the tasks of trunk rotation and spirals that encouraged musculoskeletal mobility.

Conclusion

The control group scored lower on tests than the group who received intervention with the Feldenkrais method. Due to absence of the Feldenkrais method's intervention. Primary care actions focused on educational lectures, motivational interviewing, or group consultations only. Although these propositions are important they did not show effectiveness in our sample.

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