Original Paper

Kinetic Program and Functional Status in Patients with Parkinson's Disease

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ABSTRACT: The main purpose of kinetic program integrated in complex medical assistance of PD patients is the improvement of life quality, through amelioration of self-care activities, and possibility of making various activities in stability, balance and coordination conditions. We choose the kinetics techniques according to the clinical form and the gravity of the functional deficit. Taking into consideration the locomotors dysfunctional status, almost patients were included in the second and third evolutional stages. For quantize the results and monitories the patients with assessment of the kinetic program benefits we have use different scales and questionnaires. The age of the patients was over 45 years and more patients were male then women; this aspect confirm the increase frequency of disease in the male subjects. The individual and global clinical motor aspects were been influenced by the kinetic program. The global functional impact upon the individual general state was appreciated with scale FIM scale (Functional Independence Measure). Each patient and the entire studied group had presented an increase of the final motor score; this evolution mode proved the important of the kinetic program in the management of the Parkinsonism patient global state. "The PD patients have not be help" in the quotidian activities performance – is one of the kinetic rules that has be respected by all the family patient members.

KEYWORDS: *Parkinson disease, rehabilitation program, kinetic exercise*

Introduction

In complex and variable neurological pathology, Parkinson's disorder is defined as the most common movement disease and the second most common neurodegenerative disorder which leads to progressive deterioration of motor function due to loss of dopamine-producing brain cells. Parkinson's disease is often defined as a parkinsonian syndrome that is idiopathic (having no known cause) or the most common form of parkinsonism and is usually defined as "primary" parkinsonism, meaning parkinsonism with no external identifiable cause, although some atypical cases have a genetic origin [1, 2].

Parkinson's disease (PD) - one of the entities of basal motor disease group of basal ganglions - is characterized by:

- primary functional deficits (negative symptoms) – bradykinesia, hypokinesia, akinesia, postural instability, progressive loss of muscle control and impaired balance;
- secondary effects (positive symptoms) – tremor trembling of the limbs and head while at rest, rigidity, involuntary movements (chorea, athetosis, balism, distony).

Supplementary there are associated others signs and symptoms (disturbance of comportment - anxiety or depression, of intellect function - dementia, ocular motor control perturbation, autonyms functions and/or of the sensorial system). As symptoms worsen, it may become difficult to walk, talk, and complete simple tasks. The progression of Parkinson's disease and the level of impairment and disability vary from patient to patient.

Early after the turn of the century, much excitement was generated by the reports of Tillerson et al. [3, 4] that exercise appeared to protect against neuronal degeneration in rodent models of toxin-induced Parkinsonism.

Although results from studies of the neuroprotective effects of exercise are mixed, one consistent finding from animal models and human trials is the lack of adverse effects of exercise and physical activity on anatomic and behavioral outcomes.

The adverse side-effect profile of exercise as an intervention for those with PD appears to be minimal. As such, we think there is no reason to wait for confirmation of neuroprotection. Rather, evidence is accumulating that exercise and physical activity should be utilized as key tools in the management of PD across the spectrum of disease [5].

The main objective of the rehabilitation programme is deferred as much time as possible the evolution of the disease and ensure as much time as possible an acceptable functionality status for the PD patients.

The current study starts from one of the main aspects regarding the rehabilitation of the PD patients, pursuant to that the motional function

could be preserved at parameters very close to those physiological ones thru a kinetically program made early. The most individuals with PD are only referred to rehabilitation after the onset of reduced mobility and an increase in falls. As such, the majority of PD rehabilitation care is provided in a tertiary prevention model of care [5].

Thru this it is ensuring the maintenance and improvement of life quality.

Patients and Methods

We made a prospective study with 26 patients (2012-2013) in the Rehabilitation Departments of Filantropia Hospital and No.1 Hospital, from Craiova. The Ethical Committee of the Hospitals approved all the procedures of this study and all patients signed a consent form.

All patients were diagnosed with PD and received a complex medical assistance (anti-Parkinson medication and rehabilitation program). The disease stage was established in accordance with the Hoehn and Yahr classification.

The biographic data of our patients are showed in Table 1. Only 1 patient was professional active (office work), the others were retired.

Table 1. Patients distribution

Total = 26 patients		Own place		Age intervals (years)		
		Urban	Rural	45 - 55	56 - 65	66 – 75
Sex	Female - 11 F	4 F	7 F	1	2	8
	Male – 15 M	4 M	11 M	2	5	8
Disease stage		Stage 1		3	2	-
		Stage 2		2	4	4
		Stage 3		-	4	5
		Stage 4		-	-	2

Each patient was complete evaluated in two moments: T1 – initial, at the including in the study group and after a medium 3 month interval – moment T2. During the 3 month interval, the patients follow a kinetic program integrated in a complex medical assistance (pharmacotherapy, education, kinetic program); the kinetic program was learned by patient in hospital conditions (10 sessions) and continues at home, until the evaluation moment T2. None of the patients from the study group have performed before a kinetic program. It is recommended that patient should perform exercises 45 minutes to one hour after medications.

In the initial stage we made a complete evaluation (pathogenic, clinical and functional) of the subjects included in the study with the help of multidisciplinary team which ensured the health care.

For quantize the results and monitories the patients with assessment of the kinetic program benefits we have use the following scales:

- Garden City scale for global physical deficiency of the patient (10 items evaluated with score from 0 to 3 are included - tremor, stiffness, bradykinesia, gait, posture, upper limb balance, facies, speech, vegetative disorders, self-care ability; the total score of the scale is obtained by adding the value for each item; the lower score corresponds to the better general functional status and the maximal score corresponds to multiple dysfunctions, a highly disability status).
- The Tinetti Gait and Balance Instrument (a simple, easily administered test that measures a patient's gait and balance) – this assessment tool scale is designed to determine an elders risk for falls within the next year. The test is scored on the patient's ability to perform specific tasks (the higher the score is equal with the better the performance). Scoring is done on a three point scale with a range on each item of 0-2 with 0 representing the most impairment. Individual scores are then combined to form three scales: a Gait Scale, a Balance Scale and then and overall Gait and Balance score. The maximum score for gait is 12 points while the maximum for Balance is 16 points with a total maximum for the overall Tinetti Instrument of 28 points [6].
- The Functional Independence Measure (FIM) scale for assessment of PD consequences to the general status of body. The scale contains 18 items composed of 13 motor tasks considered basic activities of daily living (eating, grooming, bathing, upper body dressing, lower body dressing, toileting, bladder management, bowel management, bed to chair transfer, toilet transfer, shower transfer, locomotion, stairs) and

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5 cognitive tasks (cognitive comprehension, expression, social interaction, problem solving, memory) and assesses physical and cognitive disability. Items are scored on the level of assistance required for an individual to perform activities of daily living. Each item is scored from 1 to 7 based on level of independence, where 1 represents total dependence and 7 indicates complete independence. Possible scores range from 18 (lowest) to 126(highest), with higher scores indicating more independence [7].

The main purpose of the study is proving of kinetic applied programme role in the complex rehabilitation of PD patients; by descriptive monitories of the 26 patients with PD we have tried to confirm the importance of kinetotherapy for regain and maintain of functional independence of the patient, in a optimum time period, so the patients have a social and even professional integration. Symmetry re-education, balance and coordination are essential aspects, indispensable to obtain for rehabilitation of the PD patients; as soon motor control is earlier as soon decrease time and risk appearance of complications in existence neuromotor deficit and mio-artro-kinetics parameters are very close to physiological values.

Applied rehabilitation assistance covers the following compartments: hygienic-dietetic and educational, medication, physical (procedures of electrotherapy and thermotherapy), kinetic, massage, individualized in relation with the clinical-functional diagnostic, adapted all time for each patient. We made a rehabilitation-kinetic program, defining the following:

- assistance rehabilitation constituent,
- optimal exercises in the kinetic program applied in relation with the evolutions condition and the global clinical-functional status,
- optimal period of treatment after it is obtained the amelioration of neuromotor status, with get back of the motor control, in possible limits,
- optimal number of rehabilitation meetings and also the rhythm of intern for as much as complete recovery of the patient.

All the patients have been daily examined, 5days/week, in the hospitalize period, and also two other weeks in ambulatory conditions. Kinetic session was about 30-40 minutes, with a break of 10 minutes. We took in consideration the next objectives for the kinetic program:

- pain reducing /avoid,
- improvement of articulation mobility, with prevent installation, correction and reduction of dysfunctional consequences of vicious attitudes,
- rigidity limitation,
- coordinate amelioration in conditions of an optimum static and dynamic balance,
- recovering the mime of the patient,
- improvement of the parameters of breathe function, with getting an economical breathe model,
- getting daily usual movements, increasing the life quality index.

The applied kinetic programme has comprised by exercises chose and performed according to the therapeutic objective (Table 2).

Postural exercises: these have been made in front of the glass with permanent self-control for preventing and improve of vicious characteristic postures (head and neck inclinable ahead, round dorsa lumbar kyphosis, knee and hips easy flexed). For postures of realignment the patient has been positioned in decubitus (especially ventral decubitus for preventing or correction the tendency of flexum to the hips), orthostatic or sitting.

Exercises for improving the mobility: we have used the technique Knott, named “pumping” or “rhythmic”, to obtain a good mobility (passive move of a segment on all amplitude, and after that the patient active, rhythmic execute the same movement faster and faster), with significant improvement of hypokinesia for these segments.

Cervical and trunk rotations start in the morning in bed, with rolling on one side, then in the other side, repeating several times. These rolling are preceded of head rotations, into right and left sides (increase the limb mobility and improve balance when patient intends to elevate in stand up position). These exercises had been made in both sit down and stand up positions.

The exercises for active mobilization were represented through Kabat diagonals (flexion and extension first diagonals, flexion and extension second diagonals for each side and both sides); each patient performed 10 exercises without resistance in the first two sessions and then with resistance; the breath was been synchronized with the Kabat diagonal. The patient posture was line in bed and in sitting position. In the last position, the patient has been performed exercises for scapulae-humeral joint and elbow joint, for trunk and entire upper limbs, and trunk and lower limbs, finally.

Table 2. Kinetic program

Rehabilitation kinetic objective	Examples of exercises and other technique modalities
Vicious postures correction	Corrective postures Self-control of various postures
Range of motion improvement	Global sedative massage Rotations of cervical spine and trunk Stretching of the flexor muscles Rhythmic rotation, rhythmic initiation Global mobilizations Knott exercises
Coordinate / balance improvement	Occupational therapy exercises for upper limbs Facility exercises for stabilization and balance reaction stimulations Walking exercises
Mimic improvement	Mimic exercises
Breathing improvement	Relaxation exercises Breathing exercises (thorax and abdomen exercises)

Exercises for corrective walking: these types of exercises were been necessary for the balance movements promotion (the upper limbs near the trunk associated with the twist motion of the trunk). In the first step, we applied the lower limb joint mobilizations, especially for the hip level; for examples:

• walking in straight line, with the foot places in the previous marked traces (established through the normal walking scheme); after 3 – 4 sessions of walking training, we placed sticks and carton boxes, with height of 10 – 15 cm, for training patients to walk with small steps and to break through fear of obstacles;

• command sudden change of the walking sense;

• stepping front and back;

• making of sudden stop and beginning the walking scheme;

• lateral moving with crossing steps, patient eyes moving in the different points of the kinetic room;

• zigzag walking in the finger tips.

Exercises for mimic rehabilitation: all patients performed these exercises in the front of the mirror, for visual self-control. In the first time, we applied analytic training for frontal parts, eyes, eyebrows cheeks; then, we indicated the global training – the mimicry of the different psychological phases (tearfulness, chink, surprise, anger).

Exercises for breath function: we recommended the following exercises for physiological maintain of respiratory parameters and an efficacy respirator pattern:

• before the other kinetic respiratory exercises, all patients have been awaked to biodynamic image of thorax, 3 – 4 times in the each session;

• respiratory techniques for the dyspnoea reducing and breath helping; the patient was learned with the optimal walking pattern into the difference distances; the patient attained to up stairs without dyspnoea and to have a self confidence in the exhausted efforts performance;

• respiratory adapted pattern approach.

The following educational aspects has added in kinetic program:

• continuity of the program;

• the patient, alone or helped by some family member, continues the quotidian activities after the kinetic program; a hot bath is also indicated; the accented rigid status in the morning, when patient wakes up, don't represents an impediment for the quotidian activities;

• the patient silks have to spread abroad around the place of dressing, so the patient must to bend or twist in different parts to take his cloths;

• the simple closing systems for the dressing (without a lot of buttoned or clasp systems);

• stand up after a few rotations of the trunk;

• change the type of the quotidian activities sometime in the day;

• balance the upper limb in the walking scheme (patient has been consciously);

• the family members have not consider the patient status as elderly result, so the patient has not to be protected; he / she has to perform activities as much as possible. This is one the

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most important educational aspects in the management of PD patients.

The statistical analysis was performed with the use of a SPSS (Windows version 6.1). The standard statistical methods were used to compute the means and standard deviations. We used the Pearson's product moment to establish the correlation between the average values of studied parameters and regression curve. Statistical significance was accepted at the level of $p<0.05$.

Results

The age of the patients was over 45 years (the mean value of studied group was 64,77 years) and more patients were male then women; this aspect confirm the increased frequency of disease in the male subjects.

The own place of our patients was dominant in rural than urban provenience; we could explained that rapport through the increase accessibility of all persons to specialist medical services.

Table 3.Scales regression analysis

Scale	**Model**	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
GC Scale	1	.934	.872	.867	1.504
	a Predictors: (Constant), GCI; b Dependent Variable: GCF				
	1	.939	.882	.853	1.581
	a Predictors: (Constant), GCI, SEX, MEDIU, STADIU, VARSTA b Dependent Variable: GCF				
FIMM Scale	1	.937	.878	.873	3.950
	a Predictors: (Constant), FIMMI; b Dependent Variable: FIMMF				
	1	.961	.924	.905	3.404
	a Predictors: (Constant), FIMMI, SEX, MEDIU, VARSTA, STADIU b Dependent Variable: FIMMF				
FIMC Scale	1	.800	.640	.625	2.322
	a Predictors: (Constant), FIMCI; b Dependent Variable: FIMCF				
	1	.891	.794	.743	1.923
	a Predictors: (Constant), STADIU, SEX, MEDIU, VARSTA, FIMCI b Dependent Variable: FIMCF				
FIM Scale	1	.911	.829	.822	6.070
	a Predictors: (Constant), FIMI; b Dependent Variable: FIMF				
	1	.944	.891	.864	5.306
	a Predictors: (Constant), FIMI, SEX, MEDIU, STADIU, VARSTA b Dependent Variable: FIMF				
TinettiM Scale	1	.873	.762	.753	.657
	a Predictors: (Constant), TimettiMi; b Dependent Variable: TinettiMf				
	1	.906	.821	.777	.624
	a Predictors: (Constant), TimettiMi, SEX, MEDIU, VARSTA, STADIU b Dependent Variable: TinettiMf				
TinettiE Scale	1	.942	.887	.882	.656
	a Predictors: (Constant), TinettiEi; b Dependent Variable: TinettiEf				
	1	.948	.899	.873	.681
	a Predictors: (Constant), TinettiEi, SEX, MEDIU, VARSTA, STADIU b Dependent Variable: TinettiEf				
Tinetti Scale	1	.939	.882	.878	1.029
	a Predictors: (Constant), TinettiTi; b Dependent Variable: TinettiTf				
	1	.957	.915	.894	.958
	a Predictors: (Constant), TinettiTi, SEX, MEDIU, VARSTA, STADIU b Dependent Variable: TinettiTf				

Taking into consideration the locomotors dysfunctional status, almost patients were included in the second and third evolutional stages. The subjects placed into the initial stage

were younger that the other patients; the patients over 56 years old presented the intermediary stages and the patients with the fourth stage were the oldest studied subjects (all of them had the age over the 69 years).

There were statistically significant correlations between initial and final mean values of the scales used ($p \leq 0.05$, Pearson correlation).

The items of the Garden City scale had a favorable evolution; the increase of each mean value parameter scale was minimal or had a stationary evolution. The mean score was ameliorated with 28 percentages (the final mean value was 15.04±4.12 compared with the initial mean value of 20.96±4.53). The frequencies graphic is expressed in the curves shown in Fig.1. When we performed the linear regression equation for the mean initial values and the final values of the scale, we found the following: the value of R (correlation) was 0.934 for the mean GCS. R-squared (predictivity) was over 0867, so over 85% of the cases studied follow the model of linear regression equations also confirmed by ANOVA. When we performed the regression equation, taking into account the parameters of age, gender, origin and stage of disease, the results were similar (Table 3).

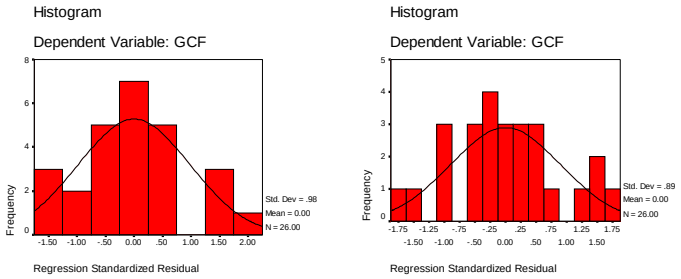

Fig.1.Garden City scale frequencies

The mean value of Tinetti Balance scale was increased with 18% (the final mean value was 11.15±1.91 compared with the initial mean value of 9.23±2.04). The mean value of Tinetti Gait scale was increased also with 17% (the final mean value was 9.31±1.32 compared with the initial mean value of 7.73±1.84). These minimal percentages proved the essential role of kinetic program in the complexity of the medical management of the PD patients; it is not described a drug with direct action upon the balance and walking. The values of the two percentages were almost equally; this result could be explained through the direct correlation between normal walking and static balance; any rehabilitation program takes into consideration this kinetic fundamental principle. The mean value of total Tinetti scale was increased with 18% (the final mean value was 20.46±2.94 compared with the initial mean value of 16.96±3.68). The graph spectrum is expressed in the curves shown in Fig.2. When we performed linear regression equation for the mean initial values and final values for the Tinetti Gait scale, we found the following: the value of R (correlation) was 0.873 for the mean values. R-squared (predictivity) was over 0762, so over 75% of the cases studied follow the model of linear regression equations also confirmed by ANOVA. When we performed the regression equation, taking into account the parameters of age, gender, origin and stage of disease, the results were higher (Table 3).

When we performed linear regression equation for the mean initial values and final values of the Tinetti Balance scale, we found the following: the value of R (correlation) was 0.942 for the mean. R-squared (predictivity) was over 0.821, so over 80% of the cases studied follow the model of linear regression equations also confirmed by ANOVA. When we performed the regression equation, taking into account the parameters of age, gender, origin and stage of disease, the results were similar (Table 3).

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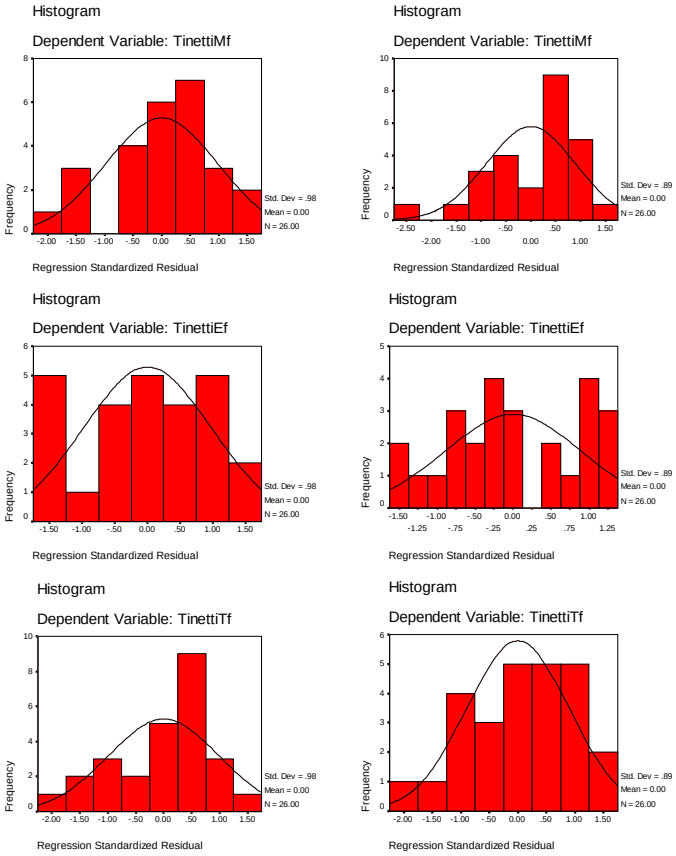

Fig.2.Tinetti scale values

The individual and global clinical motor aspects were been influenced by the kinetic program. Each patient and the entire studied group had presented an increase of the final motor score (the final mean value of the motor subscale was 52.88±11.06 and the initial mean value was 40.42±10.35; the increase was 24%); this evolution mode proved the important of the kinetic program in the management of the PD patient global state. The cognitive mean score had increased with 18 percentages (the final mean value was 27.92±3.79 compared with the initial mean value of 22.73±3.74). The increase of the total mean score of FIM scale was 23% (the final mean value was 80.81±14.32 compared with the initial mean value of 62.38±13.12).

Graph spectrum is expressed in the curves shown in Fig.3. When we performed linear regression equation for the mean initial values and final values for the FIMM scale (motor tasks), we found the following: the value of R (correlation) was 0.937 for the mean. R-squared (predictivity) was over 0.878, so over 75% of the cases studied follow the model of linear regression equations also confirmed by ANOVA. When we performed the regression equation, taking into account the parameters of age, gender, origin and stage of disease, the results were higher (Table 3).

When we performed linear regression equation for the mean initial values and final values for the FIMC scale (cognitive tasks), we found the following: the value of R (correlation) was 0.800 for the mean. R-squared (predictivity) was over 0.640, so over 60% of the cases studied follow the model of linear regression equations also confirmed by ANOVA. When we performed the regression equation, taking into account the parameters of age, gender, origin and stage of disease, the results were higher (Table 3).

When we performed linear regression equation for the mean initial values and final values for the total of the FIM scale, we found the following: the value of R (correlation) was 0.911 for the mean. R-squared (predictivity) was over 0.829, so over 80% of the cases studied follow the model of linear regression equations also confirmed by ANOVA. When we performed the regression equation, taking into account the parameters of age, gender, origin and stage of disease, the results were similar (Table 3).

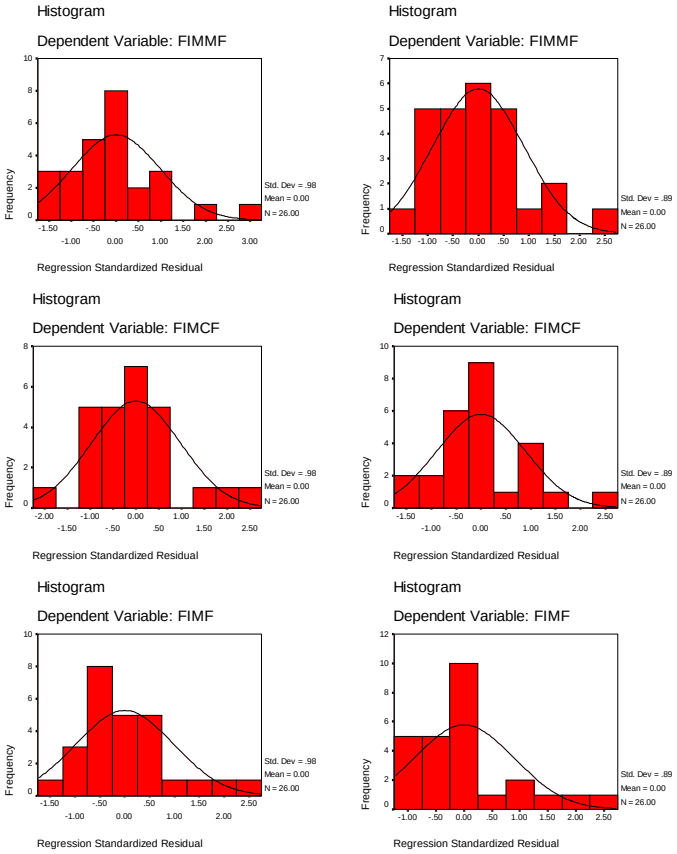

Fig.3.Functional Independence Measure scale spectrum

Discussions

The studied patients had a biological age between 49 and 73 years. This aspect is in accordance with the medical literature data – the Parkinson's disease with functional and clinical status is more frequent after 50 years. Most individuals with Parkinson's disease are diagnosed when they are 60 years old or older, but early-onset Parkinson's disease also occurs, as was the case with the patients studied (6 of the 26 patients included were age below 60 years) [8, 9, 10]. The duration of the disease was variable from 2 to 17 years, indicating that none of the patients did benefit from a rehabilitation program previously, based on a correct kinetic program.

The kinetic measures were individual applied and we respected the progressively criteria of all exercises. The physical methods and measures – electrotherapy measures with no pain and decontracture effects were been integrated into the global rehabilitation program. Evidence-based approaches to rehabilitation are known to improve physical functioning, strength, balance, gait, and health-related quality of life among people with PD [11, 12].

The Functional Independence Measure (FIM) is a widely accepted scale used to measure the functional abilities of patients undergoing rehabilitation.

FIMM scale score improvement in the study conducted was relatively lower than in other studies (Ellis et al, 2008, Marciniak et al, 2011) a pertinent explanation being that none of the patients did not follow such a kinetic program before, and most patients in rural areas were not consistently looked after during home-training program until the final evaluation. It should be noted that the motor status of the patients included in our study was higher than those in other studies, motor gain rehabilitation being dependent on the initial status.

It is worth mentioning the favorable effect of the kinetic program on the cognitive component, with significant and predictive improvement of the FIMC score (cognitive tasks).

The physical and kinetic rehabilitation program performed to all our subjects had the following important aspects, in accordance with other studies [13,14]:

- the kinetotherapy program was daily applied;
- the patient attention was asked to any voluntary gestures, so the cortical structures are informed and it is established a pathogenic

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interference between pyramidal and extrapyramidal systems;

- relaxation and posture were initial and obligatory steps of the kinetic program;
- passive mobilizations had the complex role of maintenance and correction the range of motion in the conditions of joint soft structure proprieties; these structures have a pregnant tendency of stiffness and retrain to all PD patients;
- the facilitate proprioceptive techniques – rhythmic rotation, rhythmic initiation, stretching, Kabat diagonals – are essential kinetic aspects through can be done all muscles to attain the proposal rehabilitation objects;
- motor control and supply motions are the fundamental aspects for the choice of the physical training in the different evolutionist stages and clinic-functional status;
- the exercises have to perform in the conditions without pain or fatigue – the two of the more frequent symptoms of the PD inpatients;
- the execution rhythm of the exercises has to be sustained;
- the used commands in the exercise sessions are firmly, precise, clear, to maintain wake up the patient attention and to stimulate him in the exercises;
- the kinetic rules have to be respected at home and have to explain and demonstrate by the physical therapist to all family members of the patient.

The visual information and the experimentation of mental reproduction are previously of any exercise in the rehabilitation program.

The favorable Tinetti scale score for both walking and equilibrium justifies the importance of kinetic measurements and the interest in gait during rehabilitation programs focus on but are not limited to improving gait speed, base of support, stride length, trunk and arm swing movement. Strategies include utilizing assistive equipment (pole walking and treadmill walking), verbal cueing (manual, visual and auditory), exercises (marching and PNF patterns) and altering environments (surfaces, inputs, open vs. closed) [15].

The limitations of the study are represented by the limited number of kinetic compliant patients, the lack of association with other means physiotherapeutic means (regular physical exercise with physiotherapy can be beneficial to maintain and improve mobility, flexibility, strength, gait speed, and quality of life [15]) and the impossibility of permanent control of the program by a physiotherapist (medical deficit of professionals for home assistance). It is noted in the medical literature that when an exercise program is performed under the supervision of a physiotherapist, there are more improvements in motor symptoms, mental and emotional functions, daily living activities, and quality of life compared to a self-supervised exercise program at home [16].

Conclusions

To conserve as much as possible the optimal motor function in PD patients (posture, balance and walking, especially) it must associate the pharmacology measures with kinetic programs.

The choice of the kinetic techniques is made in accordance with the clinic form and the gravity of functional deficits; the rehabilitation program cannot be standardized.

The fundamental role of the kinetic program, integrated in the complex medical assistance of the PD patients, is to enhance the quality of life – to ameliorate the self-care modalities, to safely perform the quotidian activities; the patients have an adequate motor control.

The analytic exercises are preferred and these exercises have to perform for all muscle groups, at the maxim range of motion.

The kinetic sessions are daily performed, the execution rhythm is sustained and the used commands are clear, precise and firmly.

"The PD patients have not be help" in the quotidian activities performance – is one of the kinetic rules that has to be respected by all the family patient members.

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