ORIGINAL ARTICLE

Effects of kinesiotherapy on muscle strengthening in patients with Parkinson disease

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ABSTRACT

Aim To investigate the effect of kinesiotherapy on muscle strengthening in patients with Parkinon's disease.

Methods This clinical retrospective – prospective study was based on collected data from medical histories and included 40 patients, who, beside medicaments, had undergone kinesiotherapy. This study analysed age, gender, duration of the rehabilitation and estimation of the gross muscle strength at admittance and discharge using Manual Muscle Test (MMT).

Results Females was slightly more represented in the total sample without significant statistical difference. After kinesiotherapy significant statistical difference in muscle strength was observed, average MMT of the upper extremities increased from 3.25±0.6 to 3.53±0.8 and on the lower extremities from 2.9±0.8 to 3.3±0.9. The analysis of the gender on the higher score of MMT showed that gender does not affect the score of MMT. Correlational analysis of the age and duration of hospitalization on the score of MMT showed that patients with longer hospitalization had better improvement.

Conclusion Results of the study showed that kinesiotherapy has positive effect on muscle strength in patients with Parkinson's disease.

Key words: rehabilitation, hospitalization, manual muscle test (MMT)

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Original submission:
08 June 2018;
Revised submission:
16 July 2018;
Accepted: 23 July 2018.
doi: 10.17392/970-18

Med Glas (Zenica) 2019; 16(1):71-76

INTRODUCTION

Morbus Parkinson - Parkinson's disease (MP) is a progressive disorder of the nervous system that affects movement, characterized by tremor, acinesia, bradykinesia, and rigidity, which create problems to patients with simple everyday activities (1). Bradykinesia is the main cause of functional disability and includes motility of the motor function, such as walking (in small steps and at reduced speed), decreasing font size during writing and problems with balance and position with bent knees and elbows with leaning forward (1,2). The face is hypomobile, like a mask, patients rarely blink and saliva leaks from the corners of their lips, the changes in a direction are very difficult to perform and the entire walk is uncertain, with a tendency to fall down (3). In the further progression of the disease anxiety, sleep disorders, feeling of fatigue, impaired intestinal peristaltic, constipation and incontinence occur (3,4).

The pharmacotherapy used in the treatment acts symptomatically, which means that a therapeutic dose must be corrected depending on the development of the disease, so it can lead to withdrawal or minimization of symptoms with minimal side effects (3).

There is also a surgical method of deep stimulation of the brain, as well as occupational therapy and physical therapy (3,5). The treatment of Parkinson's disease is aimed at preserving the patient's independence and quality of life (4). The use of Levodopa is associated with the occurrence of involuntary movements or dyskinesia, which can cause functional and social deficits, and limit the quality of life of patients (5). Kinesiotherapy is a branch of physical medicine that uses muscle movements and strength for the purpose of healing, improving the condition, preventing disability and achieving a higher degree of functionality, while preventing the occurrence of secondary complications related to the immobility or lack of movements. This method uses the resources of each individual - the strength of their own muscles and movements. It is simple because it does not need special space and equipment. It is increasingly used with success in the patients' rehabilitation (6). The exercises should be adjusted for every patient avoiding the fatigue. It is also important that patients start practicing when they are rest, appropriately trained and in an adequate space (5). Therapeutic exercises directly affect posture, walk, movements and the performance of daily life activities (7,8). Balance dysfunction and postural instability are common and can lead to increased frequency of falls and injuries that increase the chances of developing comorbidity and disability (8,9). Exercises should be carried out for the whole body: body and extremities, face, speech and breathing exercises. Another exercise benefit is a positive effect on the cardio-respiratory system (9,10). Strong and deep breathing positively influence the strength of the external core muscles. The exhaling phase must be at least twice as long as the inhaling phase (10-12). Coordination exercises are applied because of a disturbed cycle of normal walking due to the reduction and inability to bend, short and clumsy steps, and the inability to coordinate hands and feet during walking (13-15). Passive stretching exercises are performed in order to reduce the possibility of contracting, increasing the range of motion in the joints and relax muscles. By continuous preforming of stretching exercises, flexibility of the body increases and the ability to perform movements in one or more joint systems (16-18). With an appropriate intensity of exercise and a combination with medication and kinesiotehrapy, levels of dopamine may be elevated and motor disturbances may be improved (11-13). Previous research has not given precise answers how much kinesiotherapy affects the strength of the muscles individually, because opinions are divided how long, when and where to implement the kinesiotherapy program (14-16). For this reason we decided to show how much kinesiotherapy can affect muscle strength as to continue recovery with a home program after hospitalization.

The aim of study was to investigate the effects of kinesiotherapy on muscle strengthening in patients with Parkinon's disease.

PATIENTS AND METHODS

Patients and study design

This research was designed as a clinical, retrospective-prospective study conducted at the Clinic for Physiotherapy and Rehabilitation of the University Clinical Centre of Sarajevo during the period between January and December of 2016 for

the retrospective part and from January to March 2017 for the prospective part of the study. The study involved 40 patients randomly selected that meet the inclusion criteria, e.g. with the diagnosis of Parkinson's disease. The criteria for inclusion in the study were: patients with confirmed diagnosis of Parkinson's disease, patients with kinesiotherapy included as an optional treatment method, patients with complete documentation of the manual muscle test (MMT) value before and after the applied kinesiotherapy.

Patients were diagnosed by a neurologist, and all patients were treated with kinesiotherapy and medication therapy.

Methods

The age and gender, the time spent on rehabilitation were analysed, and gross muscle strength of the upper and lower extremities at the time of admittance and discharge using the manual muscle test (MMT) was assessed (8). Manual Muscle Test is a non-invasive tool used by health professionals to evaluate neuromuscular integrity, especially muscle strength (8). In performing this test, the muscle or muscle group is isolated, placing the patient in a suitable position for examination, and then applying an external force, while the examiner decides on the force of contraction of the muscle. The grading system is from 0-5: 0 - no muscular activity (preserved 0% of muscle strength); 1- muscle contraction is present in the tract, and can be palpated or visualized (preserved 15% muscle strength); 2 - muscle is capable of overcoming the full range of movement in the joint, if the force of gravity is excluded (in water, suspension, etc.) (preserved 25% muscle strength); 3 - muscular contraction overcomes the full range of motion without the exclusion of gravitational force (preserved 50% muscle strength); 4 - muscle contraction can overcome the full range of motion against gravitational force with mild resistance (preserved 75% muscle strength); 5 - muscle overcomes the full range of movement with the resistance provided by the therapist (preserved 100% muscle strength) (12, 18). We also analysed the difference in the muscle strength of the upper and lower extremities in those patients, and the impact of gender on MMT values.

Statistical analysis

The results were presented in tables and graphs by the number of cases, percentage, arithmetic mean with standard deviation, standard error of arithmetic mean and range of values. Statistical analysis was carried out using the $\chi 2$ test, Student's t test, and Pearson's linear correlation coefficient. The results of all tests were considered significant at a probability level of 95% or with $p < 0.05$.

RESULTS

Of the total sample, 25 (62.5%) were females and 15 (37.5%) males ($p > 0.05$).

Out of the total of 40 patients, one (2.5%) was younger than 50, five (12.5%) were aged 50-60 years, seven (17.5%) were aged 61-70, 18 (45%) belonged to the age group 71-80 and seven (17.5%) patients belonged to the age group 81-90 years. In the age group older than 90 years, two (5%) patients were noted. The average age of the patients was 73.9 years (range 39 to 92 years of age) ($p < 0.05$).

The largest number of patients spent 23.2 to 30.8 days in hospital ($p < 0.05$).

The average length of hospitalization was 27.1 ± 12.2 days with the shortest period of 3 days and longest period of 62 days. The length of hospitalization shorter than 10 days was recorded in three (7.5%), while 10-20 days of hospitalization were recorded in seven (17.5%) patients. The largest group of 18 (45%) patients was recorded with the duration of hospitalization of 21-30 days; six (15%) patients were hospitalized for 31-40 days, and in five (12.5%) patients the hospitalization lasted for 41-50 days. Only one (2.5%) patient was hospitalized longer than 50 days.

Comparison of MMT average values at admittance and discharge showed that there was a statistically significant increase in the MMT average measured at both the upper and lower extremities ($p < 0.05$). Thus, the average MMT score measured at the upper extremities increased from 3.25 ± 0.6 to 3.54 ± 0.8, while the increase at the lower extremities was from 2.91 ± 0.8 to 3.26 ± 0.9 (Table 1).

The MMT (MMT release) difference showed that the MMT increase was somewhat greater at the lower extremities and averaged 0.35 ± 0.41 com-

Table 1. Comparison of manual muscle test (MMT) values of the upper and lower extremities at the admittance and discharge

	MMT at admittance		MMT at discharge	
	Upper extremities	Lower extremities	Upper extremities	Lower extremities
Average	3.2500	2.9125	3.5375	3.2625
Median value	3.25	3	3.5	3.5
Standard deviation	0.62017	0.75011	0.81167	0.88425
Minimum	1.5	1.5	1.5	1
Maximum	4.5	5	4.5	5

pared MMT measured at the upper extremities with an average increase of 0.29 ± 0.43 (p> 0.05) (Table 2). Gender influence analysis on MMT suggests that the improvement was somewhat higher in females in comparison with males, as measured at the upper extremities, 0.36 ± 0.34 and 0.17±0.49, respectively, as well as measured at the lower extremities, -0.38 ± 0.36 and 0.3±0.53, respectively (p> 0.05). This indicates that gender has no influence on MMT improvement (Table 3).

Table 2. Difference of the manual muscle test (MMT) of upper and lower extremities

	MMT difference of upper extremities	MMT difference of lower extremities
Average	0.2875	0.3500
Median value	0.5	0.5
Standard deviation	0.40648	0.42667
Minimum	-1	-1
Maximum	1	1.5

p=0.524

DISCUSSION

Numerous studies have dealt with the influence of kinesiotherapy in patients with Parkinson's disease diagnosis, and most of them point out the positive consequences of using kinesiotherapy or its variants in such patients (18). Cugusi et al. conducted a study evaluating the impact of custom physical activity on motor and non-motor functions and the quality of life of patients with Parkinson's disease and have shown an increase in the distance that patients can independently cross, a significant increase in equilibrium and movement safety as well as a significant increase in muscle strength; the authors concluded that patient-specific exercise program could be effective as an additional method for conventional therapy in order to improve the daily life, motor and non-motor symptoms with a higher quality of life (19). These results are in agreement with results of our research. The effects of physical therapy in relation to placebo or in relation to non-intervention in patients with Parkinson's disease were studied by a meta-analysis whose results were published in 2012, which included 33 studies with a total of 1518 subjects (20). The results indicated a significant improvement in experimental patient groups in terms of increased stroke speed, stroke length, balance, muscle strength, functional mobility, and results on Unified Parkinson's Disease Rating Scale (20). The results obtained in our studies confirm the positive effect of kinesiotherapy, especially on the lower extremities. A study conducted by Baatile et al. who have been concerned with the impact on the quality of life of individuals with Parkinson's disease points the benefits of regular exercise in terms of improving the results measured with Unified Parkinson's Disease Rating Scale (UPDRS) and Parkinson Disease Questionnaire 39 (21). The results of our research show that prolonged use of exercise therapy by kinesiotherapy increases the possibility of prolonged walking and, therefore, more quality activities in everyday life. Traning in strength and its impact on bradykinesia and muscle strength in patients with Parkinson's disease were the subject of a 2016 study indicating a significantly reduced bradykinesia and increased muscle strength in older patients with Parkinson's disease as well as a positive effect on the physical function and quality of life (22). Our results agree with this research. Kwok et al. study suggests that exercises lead to great improvement on motor symptoms, postural stability, and

Table 3. Difference of the manual muscle test (MMT) of upper and lower extremities with regard to gender

		Manual muscle test (MMT)				
MMT difference	**Gender (No of patients)**	**Average**	**Standard deviation**	**Standard error**	**Minimum**	**Maximum**
Upper extremities	Males (15)	0.1667	0.48795	0.12599	-1.00	0.50
	Females (25)	0.3600	0.33912	0.06782	0.00	1.00
	Total (40)	0.2875	0.40648	0.06427	-1.00	1.00
Lower extremities	Males (15)	0.3000	0.52780	0.13628	-1.00	1.00
	Females (25)	0.3800	0.36171	0.07234	0.00	1.50
	Total (40)	0.3500	0.42667	0.06746	-1.00	1.50

MMT upper extremities p=0.148; MMT lower extremities p=0.573

functional mobility (23). Our research confirms the positive effects of kinesiotherapy. Lee et al. study indicated a significant difference in terms of equilibrium, daily life activities and depressive disorders between the experimental and control group in terms of the positive effect of this type of physical activity on all three examined components in patients with Parkinson's disease (24). The influence of kinesiotherapy on the executive functions of patients with Parkinson's disease in a recently published study suggested that six months of exercise improved some aspects of the executive functions in patients with Parkinson's disease, compared with the control group (25). These, like many other studies, suggest the positive effects that kinesiotherapy has on patients with Parkinson's disease.

However, there are fewer studies suggesting the absence of the effect of this treatment regimen in patients with Parkinson's disease, such as a 2011 study of 28 patients included in a 12-week exercise program where the results affected the cognitive function of the frontal lobe, but not on the quality of life (26).

There is a consensus in literature that regular exercise improves physical and functional abilities in different populations (27, 28). Practicing regular physical activity seems to act preventively on the individual before as well as after the diagnosis of Parkinson's disease (21). Some epidemiological studies suggest that there is an inverse correlation between physical activity and the risk of this disease, the mean and high levels of physical activity are associated with a reduced risk of developing the disease (28). A growing number of studies suggest that treatment with kinesiotherapy brings greater benefits in functional capacity in individuals with Parkinson's disease than isolated drug therapy (28,29). Various types of exercises were suggested by randomized controlled trials in order to minimize the negative effects of Parkinson's disease on motor and functional performance. These studies focused on different approaches to physical therapy, such as specific exercises to improve mobility (30), muscle strength (31, 32), balance (33), aerobic fitness (34), and stroke (35). Some studies are non-exclusive, without strong evidence or a sufficient number of subjects to confirm and measure the effect of kinesiotherapy on daily activities of patients with Parkinson's disease, although in most cases they all indicate the positive impact of kinesiotherapy on almost all aspects of life of these patients (19,20,23).

In this study, we analysed patients who performed kinesiotherapy treatment in hospital, but we were not able to monitor their further progress in the home program. It should be examined how often the kinesiotherapy program can be applied in the hospital conditions in order to prevent weakness in muscle strength.

In conclusion, kinesiotherapy had a positive effect on muscle strengthening for our patients with Parkinson's disease, which is in concordance with previously published results related to positive effects of kinesiotherapy. Daily use of kinesiotherapy is recommended in an individual program with regular check-ups in cooperation with neurologists that provide medication therapy.

FUNDING

No specific funding was received for this study.

TRANSPARENCY DECLARATION

Competing interests: None to declare.

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