EFFICIENCY OF TAI CHI FOR PATIENTS WITH PARKINSON’S DISEASE

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Abstract

Frequent limb tremor, body immobilization and imbalance limit human mobility, increase fatigue, cause emotional stress and recurrent depression. Physical exercises do not directly reduce bradykinesia, tremor or rigidity, they help patients improve their functional activity, increase their mobility and improve mood (Budrys, 2009). The method is beneficial to Parkinson’s disease (PD) patients because it involves such movements as weight transfer from one leg to another, slow and controlled movements, and waist rotation (Borrione et al, 2014). The purpose of the study was to investigate the effects of a 15-session program of therapeutic Tai Chi. All participants were examined twice - before and after the Tai Chi programme. The study was conducted with patients at stages I-III of Parkinson’s disease at VĮKlaipėdaSeamen’s hospital in Lithuania. A total of 16 participants were enrolled: 9 females and 7 males. The research methods are: the evaluation of balance and gait according to Mary Tinetti (1986), fatigue evaluation by means of the Multidimensional Fatigue Inventory. The research findings showed that the patients demonstrated better results during the application of the Tai Chi programme. Their mobility improved to such a degree that research subjects showed the decrease in fatigue indices.

Keywords: Parkinson’s disease, physical therapy, Tai Chi, physical activity, fatigue, rehabilitation, physical exercise

Relevance

The Parkinson’s disease (PD) is known to be diagnosed in 1-2 % of people over 65 years. Among those over 85 years, the number increases up to 4 % of the overall

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population. Due to the increase in life expectancy in Lithuania and throughout the world, cases of neurodegenerative diseases, including PD, are becoming more common (Nuytemans et al., 2010). The disease is spread throughout the world and evenly among all ethnic groups. Difference in morbidity is notable in reference to the gender (Budrys, 2009). Tremor is one of the most common PD symptoms diagnosed in 90% of the patients of the patients. The most common form is 4-6Hz frequency distal low-amplitude resting tremor, which usually starts on one side of the body (arm or leg tremor) and spreads to other limbs later on (Kriščiūnas et al., 2008). Arm tremor is defined as pill-rolling trembling. Some patients claim they feel “internal shaking” which can not be observed externally (Jankovic, 2008). Common resting tremor temporarily disappears during movement. For example, when holding one's arm stretched to the front, the tremor disappears (in the stretched arm), but after the movement is done, the tremor reappears (Traill et al., 2008). During mental strain, when fear or stress is present, there is notable increase in tremor, which disappears when sleeping (Subačiūtė et al., 2009). Common convulsive seizures are: eye seizures (eyes shifting up or down involuntarily for several minutes), hiccup (due to phrenic spasm) and yawning (due to a spasm in muscles of respiration) (Subačiūtė et al., 2009). Another common PD symptom is extrapyramidal rigidity (stupor, immobility) diagnosed in 89-99% of PD cases (Kazlauskas et al., 2009). Muscle stiffness occurs due to simultaneous increase in muscle tone of agonist, antagonist and synergist muscles. Leading to movement control impairment, motor symptoms are considered cardinal in PD. Consequently, they are the primary focus (Li, Dong, Cheng, & Le, 2016; Glickman-Simon, Karp, & Sethi, 2015; Yang, Qiu, Hao, Lv, Jiao, & Teng, 2015; Yang, Hao, Tian, Gong, Zhang, Shi, Zhao, 2015).

However, there are quite a lot of non-motor symptoms common to PD, including autonomic, cognitive and emotional disorders (Traill et al, 2008). Non-medical Parkinson’s disease treatment includes ergotherapy, psychotherapy, physical exercises, individual physical therapy and, if necessary, speech therapy (Zhou, Yin, Gao, & Yang, 2015; Elkins, 2015; Zhang, Hu, Nie, Jin, Chen, Guan, Jin, 2015; Li, & Harmer, 2015; Gavrikova, Masuda, Murakami, Hasegawa, Koike, Kuroha, & Uchiyama, 2011). Medical and surgical treatment helps to reduce Parkinson’s disease symptoms, but does not help to restore freedom of
movement (Budrys, 2009). Physical exercises are concurrent in PD treatment (Li et al., 2012). It is worth noting that the majority of authors claim that application of physical exercises does not directly reduce the triad of cardinal PD symptoms, but improves functional activity, locomotion and facilitates adaptation to social life (Ebersbach et al., 2010). As it has been stressed by Kriščiūnas (Kriščiūnas et al., 2008), a physical therapist addresses two main problems in the course of work with a PD patient. The first one is related to development of the motor apparatus (the locomotor system) and encouragement of physical activity. The second one is referred to the patient’s safety, including teaching to stand up and sit down safely from various positions, walk on different surfaces etc. Tai Chi is the Chinese art of movement (a form of physical exercises) which is popular not only in China, but worldwide and mainly due to its multitudinal applicability. Tai Chi is the short form of Tai Chi Chuan accepted in the West (only the full form is used in China). Health, self-defence, and meditation are three main aspects of Tai Chi. Consecutive movements based on self-defence methods have positive effect on health and create favorable conditions for meditation (Toyo et al., 2006).

**State of the problem**

Foreign literature suggests that problems of mobility and postural instability are particularly noticeable when performing motoric tasks under changing conditions. During Tai Chi practice, slow multidirectional movements and attention focused on performance and release of qi (chi) energy may help to increase lower extremity strength due to focusing on transferring body weight from one leg to another at the time of movement (Yang et al., 2014). Patients with Parkinson’s disease and other people are recommended to receive Tai Chi exercise therapy in order to improve quality of life, reduce disability and postural instability disorders. At the end of the program, overall body flexibility and lower extremity strength increase are significant, which is beneficial to PD patients’ gait development and reduction of risk of falling (Kim et al, 2014). It is also noticeable that the function of internal organs improves after the Tai Chi programme and patients’ complaints of constipation and intestine pain become less frequent. The quality of sleep improves and the drowse during daytime reduces (Borrione et al., 2014). Fisher et al. recommend a single Tai Chi session for elder
people to be as long as 40-45 minutes with 10 minutes spent on warming up, 25-30 minutes on the main part (formations), and 5 minutes on warming-down (meditation). It is also recommended to take five minute breaks between repeating the formations and performing new positions. It is advisable to allow the patients to interact socially during rest periods (Fisher et al., 2004).

The efficiency of Tai Chi as a rehabilitation module in patients with Parkinson’s disease (Malinovskaya, Salmina, Prokopenko, Komleva, Morozova, Panina, & Gasymly, 2014).

**Materials and methods**

Prior to the research, Klaipeda University Faculty of Health Sciences Rehabilitation Department Bioethics Committee granted a permission to conduct the research (2014 10 01 No RE-BK-057), and the participants were familiarized with the research, its purpose and objectives. Also, prior to the research, the participants were informed about anonymity of the research and that they could withdraw from it at any time, that the participation was voluntary. All research participants had to fill in the informed consent form to verify their participation. The participants were 45-75 years old. They had stages I-III of Parkinson’s disease, according to modified Hoehn and Yahr Staging Scale. Among the inclusion criteria there also was the presence of at least two PD symptoms (postural instability, bradykinesia, tremor, rigidity) and the absence of any additional disorders or pathologies that would limit the patients’ gait capabilities (for example, joint endoprosthesis or other orthopaedic injuries). A total of 16 subjects with Parkinson’s disease participated in the research. There were 56.25% of females (n=9) and 43.75% of males (n=7). The age varied from 48 to 72 years with the average of 61.63±8.13 (the average ±standard bias). The clinical condition was evaluated before the first Tai Chi session and after the last one. The results were compared in order to analyse efficiency of the method.

Mary Tinetti Performance-Oriented Mobility Assessment Scale (1986) to evaluate the participants’ balance and gait indices, the performance-oriented mobility assessment scale – the Tinetti test (1986) – was used. The test consists of two parts that evaluate balance and gait. The test was employed due to its multiple applications in evaluating general performance-oriented mobility of adult and elderly people. The test is easily applied and
lasts for only approximately 10-15 minutes. It does not require special tools or preparations. During this simple and easy test, performance of specific tasks is appraised by points. Reliability of the performance-oriented mobility assessment scale is 85%.

The Multidimensional Fatigue Inventory (MFI) Participants’ fatigue was evaluated using the Multidimensional Fatigue Inventory, MFI-20. MFI-20 covers 5 scales: general fatigue, physical fatigue, activity, reduced motivation and mental fatigue. The inventory consists of 20 questions. The fatigue scales are measured in percentage. Higher values indicate greater disorder (Stankus, 2007).

Tai Chi Protocol. During physical therapy, Tai Chi method was applied. The research included 15 Tai Chi sessions held four to five times a week. The first physical therapy procedure (instruction/briefing) was performed before the patients were discharged from Klaipėda Seamen’s hospital Neurology department. The patients continued the remaining procedures at home or as outpatients. Every patient was treated individually or in small groups (two or three patients). Procedure length and selection of warm-up and formation exercises (program planning) was based on foreign authors’ works. Fisher et al. (2004) suggested mild Tai Chi exercises, Shou-Yu et al. (2014) suggested warm-up exercises, while Toyo et al. (2006) set guidelines for the practitioners of short Tai Chi formation. The length of the session was 40-45 minutes. The structure of the session was composed of the following parts: 10 minutes for the introductory (preparation) part, 25-30 minutes for the main part (Tai Chi formations), and 5 minutes for Tai Chi meditation and relaxation exercises.

Mathematical statistics and data analysis. The received data was processed and statistical data analysis was conducted using SPSS 17.0 statistics package and Microsoft Excel 2008 computer software. To analyse the results of the participants, the arithmetic means, standard deviation and representative bias were calculated. The difference significance of the means of independent and dependent variables was calculated by means of Student’s T-test. The difference meeting the p<0.05 level was considered statistically significant.

Results and their discussion

General Performance-Oriented Mobility Impairment Assessment by Mary Tinetti test (1986) was used in order to evaluate the level of general performance-oriented mobility
impairment in participants with Parkinson’s disease. The results are shown in Figure 1. After application of the Tai Chi method 15 participants (93.75%) have shown better results. During the first examination, the mean of the general performance-oriented mobility assessment was 20.81±6.23 (the lowest value between severe and slight impairment was 14 points, the highest totalled 36 points). Nine participants were evaluated as having severe, five – mild, and two – slight general performance-oriented mobility impairment. After application of the programme, during the second examination, an increase in the sum total of the means was revealed: 23.44±5.85 (the lowest value was 16 points, the highest – 36 points, which is mild general performance-oriented mobility impairment). The most significant change was observed in the sum total of participants No. 12 and No. 15 (which increased by five points). No change was observed in the sum total of participant No. 7. Three participants’ (No. 4, No. 8 and No. 15) demonstrated general performance-oriented mobility impairment change from severe to mild.

Figure 1. Results of general performance-oriented mobility impairment assessment in participants No. 1-16 before and after application of the Tai Chi method

*Note:* The difference between the indices before and after application of the Tai Chi method is reliable (p<0.05)

When evaluating general performance-oriented mobility impairment in the participants, we noticed that it changed during the application of Tai Chi method. The main
The purpose of the research was to evaluate the efficiency of Tai Chi as a rehabilitation method for patients with Parkinson's disease. A total of 16 PD patients took part in the program consisting of 15 Tai Chi sessions. The research results showed that the application of Tai Chi exercises is efficient in improving patients' gait and general stability. The Tai Chi method proved to be a factor of reduction of the physical fatigue component, which in turn has a positive effect on the mental fatigue component. Currently, there is an increase in number of research regarding the benefits of Tai Chi to elderly people that have mobility and balance disorders (Kim et al., 2014). Recent research shows that application of Tai Chi is very efficient and safe for PD patients in improving the freedom of movement (Hackney et al., 2008; Yang et al., 2014). Authors who analyze Tai Chi efficiency for PD patients usually study this method's effect on patients' gait and balance stability. In the course of analysis of gait indices, the largest challenge is associated with the step length. To feel more secure and to maintain their centre of mass, PD patients make short, quick and low steps. After the Tai Chi programme and the second examination, a statistically significant improvement \((p<0.05)\) of the participants' gait was registered. After application of the method, the participants' step increased in length; a higher step was also noticeable. A small but statistically significant \((p<0.05)\) result improvement was revealed in step symmetry, straightness of gait line and walking pace. Our research results match the results of the research conducted by Hackney et al. (2008). The researchers revealed a statistically significant \((p<0.05)\) change in the results of the tasks of making a longer step and standing on one leg.

Fatigue evaluation was made based on the Multidimensional Fatigue Inventory (MFI—20L). In the course of analysing and evaluating general fatigue indices (Figure 2) in the periods before and after the application of Tai Chi, we noticed that 68.75% \((n=11)\) of the results did not change (by comparison of the data from the first and the second examinations). Rest of the participants showed improvement in the general fatigue component with a statistically significant difference between the results \((p<0.05)\). The biggest decline is noticeable in results of participant No. 8 (decreased by 6.25%). The results of participants No. 7 and No. 16 also worsened by 6.25%. Only one participant's (No. 1) results improved by 6.25%. After the evaluation of general and physical fatigue of the participants, a statistically insignificant difference was noticeable.
between male and female results (p<0.05). During the literature review, we could not find any other accessible research on Tai Chi effects on PD patients’ sense of general and physical fatigue. Therefore we could not compare results. Parkinson’s disease is the second most common chronic neurodegenerative disease after Alzheimer disease (Valeikiene et al., 2004). During the disease, a lesion in basal ganglia, especially substantianigra, starts to develop. Dopamine neurons deteriorate in the substantianigra of brainstem; dopamine and acetylcholine levels become imbalanced, which causes main PD symptoms: deficiency of motor activity causes rigidity, rest tremor and postural instability (Subačiūtė et al., 2009). Symptoms of the disease inevitably disorganise patients’ work and daily activities. Frequent limb tremor, body immobilization and imbalance limit a person’s mobility, increase fatigue, cause emotional stress and recurrent depression. From the perspective of the modern medicine, physical activity is a great non-pharmacological method of PD treatment.

Although physical exercises do not directly reduce bradykinesia, tremor or rigidity, they help to improve patients’ functional activity, improve their mobility and mood (Budrys, 2009). Properly applied, medications and physical activity is the best combination to improve the patients’ functional condition, sense of well-being and self-efficacy.

Figure 2. Results of general fatigue assessment in participants No. 1-16 before and after application of the Tai Chi therapy (in percentage).

*The difference between the indices before and after application of the Tai Chi method is reliable (p<0.05)
One of the research aims was to evaluate the efficiency of fatigue tolerance development by the Tai Chi method in PD patients. During the first examination and after the assessment of the general fatigue of the participants, it was revealed that the mean value of the results was 49.22%. After application of the method, a statistically significant (p<0.05) increase in the mean value is noticeable (up to 51.17 %), which suggests that the participants had greater general fatigue. In Figure 3, it can be seen that the physical fatigue component of 13 participants (81.25 %) did not change. The data is not statistically significant (p<0.05). The change and improvement of the results is noticeable in participants №3, №4 and №8. The results are validated by a statistically significant reliability (p<0.05). The results of the before-mentioned participants changed by 6.25 %.

![Figure 3. Results of physical fatigue assessment in participants No. 1-16 before and after application of the Tai Chi therapy (in percentage).](image)

*Note:* The difference between the indices before and after application of the Tai Chi method is reliable (p< 0.05)

When analysing physical fatigue results, a positive effect of the Tai Chi method is evident. Before the programme implementation, the sum total of the means of the results was 52.34 %. After the program implementation, a statistically significant improvement of the results was registered - 51.17%. After the evaluation of primary results and those obtained after the program, it could be noticed that the majority of the participants felt slight above-average physical and
general fatigue (greater value in percent for greater impairment severity). During the literature review, it appeared impossible to find any other accessible research on Tai Chi effects on PD patients’ sense of general and physical fatigue, therefore it was impossible to compare the results as well. The research results showed that PD patients that took part in 15 Tai Chi sessions showed better results in the indices of gait and balance. According to our findings, Tai Chi is beneficial to reduction PD patients’ physical fatigue. However, the method does not seem to have a positive effect on the general fatigue component. Although the research is relatively short and of a small scope, the results allow considering the Tai Chi method to be efficient and safe rehabilitation method to improve PD patients’ freedom of movement and reduce physical fatigue caused by symptoms of the disease.

Conclusion

The research results demonstrated that Tai Chi sessions had been efficient in improving PD patients’ gait, postural stability and tolerance to physical fatigue.

1. When applying Tai Chi as a rehabilitation module, the improvement of the results of the participants’ gait indices was statistically significant (p<0.05). The most considerable change was observed concerning the tasks that require making a longer and higher step. A positive effect was observed in step symmetry, gait line straightness and walking pace.

2. When analysing the results of physical fatigue evaluation, a statistically insignificant (p>0.05) positive improvement of the results was revealed. The improvement in the general fatigue evaluation results was statistically significant (p<0.05).

References


