

Effects of Tai Chi on Postural Stability and Balance in Parkinson's Disease

Demet Biçki, Hayriye Damla Dinçel

Abstract

Parkinson's disease is a physically restrictive and progressive disease. It challenges patients greatly due to its symptoms. It negatively affects walking, balance, and postural stability. Patients, on the other hand, turn to various treatment approaches in order to prevent this. Tai Chi exercises are a type of exercise known for their positive effects on lower extremity control and balance. Tai Chi comes to the forefront at this point. Tai Chi is a safe form of exercise that is good for Parkinson's disease, which is mostly seen in geriatric individuals, by providing the necessary flexibility and muscle strength at a moderate and light pace. In this study, we talk about the benefits of Tai Chi exercises and their effects on the restrictive symptoms of Parkinson's disease.

Keywords: Parkinson's Disease, Tai Chi, Balance, Postural Stability, Parkinson's Symptoms

INTRODUCTION

Parkinson's disease; It is a general name given to clinical syndromes in which tremor, bradykinesia, rigidity and postural balance disorders are observed in different combinations. Parkinson's disease was first described by James Parkinson in 1817. (1)(2)

The symptoms and signs of Parkinson's disease can be categorized into motor and non-motor symptoms. Motor symptoms include tremors, rigidity, slow movement, postural instability and freezing of gait. (3)

Parkinson's disease is a progressive disease that occurs as a result of dopaminergic neuron loss, usually seen between the ages of 55-65. Tremor, rigidity, akinetic syndrome, flexor posture and balance problems challenge patients greatly. Patients should be subjected to a thorough and detailed evaluation and the necessary treatment should be done. Drug treatment and, if necessary, surgical treatment should be performed. (4)(5)

Tai Chi stands out with its popularity among the elderly. Being considered slow, fluent and safe are the biggest reasons for preference. (6) There are proven studies on improving the balance and mobility of Parkinson's patients. (7)

Due to the fact that improves balance and therefore prevents falls, improves functional capacity, has positive effects on cognitive functions, sleep quality and mental health, we examined the benefits of Parkinson's disease and Tai Chi exercises on symptoms in our study accompanied by current studies. (8)

PARKINSON'S DISEASE

Parkinson is a progressive disease, with its initial symptoms manifest as motor and non-motor symptoms. Parkinson's is a disease looked by the degeneration of dopaminergic neurons in the Substantia Nigra and the accumulation of Lewy bodies. (9)

Parkinson's is a syndrome that includes symptoms such as rest tremor, flexor posture, dysarthria, dysphagia, bradykinesia, postural reflex disorders, and gear wheel rigidity. (10)

In the early years, it was referred to as tremor paralysis. It appears that this disease occurs under the influence of environmental and genetic factors. It usually occurs after the age of 40. There is no difference between male and female gender in terms of incidence. (11) It is thought that some severe head traumas may cause Parkinson's. (12)

Symptoms first begin unilaterally and then spread to both extremities. The disease process progresses slowly. The disease is staged with the Hoehn-Yahr Scale. The primary motor symptoms are bradykinesia, tremor, rigidity, postural instability and gait disturbance. Depression, anxiety and panic attacks are among the psychiatric symptoms. Masked face, loss of facial expressions, leg dystonia and bladder dysfunction are other symptoms. (13)

Usually, there is an effect on the walking patterns of these patients. Small and slow steps are seen. In the advanced stages, they may have difficulty starting to walk due to the effect of the freezing phenomenon. (14)

There are balance and postural control disorders characterized by this disease. The main reason for this is that the postural muscles cannot adapt to the variable environment and environment and cannot



novitiate appropriate responses. Decreased joint movements, loss of strength in the extensor muscles and rigidity accompanying the disease cause postural reactions to fail to function properly. (15)

In the same way, another factor that increases postural deterioration is proprioceptive losses. Verticalization leads to a change in perception and postural deterioration. Despite the impaired verticalization, the body develops compensation with the body flexion posture. (16) In the later stages, obstructive respiratory dysfunction is observed in about 80% of these patients. (17)

During performing Parkinson's rehabilitation, treatment should be designed primarily taking into account the patient's motor disorders. Firtsly, a plan should be made to ensure that patients gain independent movements and normal movement patterns again. (18)

SCALES THAT CAN BE USED IN THE EVALUATION OF PARKINSON'S

Berg Balance Scale (BBS)	MiniBESTest - BESTest	Phone-FITT
Sudden Return Test	2 Minute Step Test	Activity-Specific Balance Scale (ABC)
Functional Reach Test - Pull Test	Tinetti Balance and Gait Assessment	Non-Motor Symptoms Scale
6 minute Walking Test (6MWT)	Parkinson's Disease-Cognitive Rating Scale	Parkinson's Fatigue Scale
Parkinson's Disease Sleep Scale	Timed Up and Go Test (TUG)	Gait Freezing Scale (FOG-Q)
LASA Physical Activity Scale	Lindop Parkinson Rating Scale (LPA)	9 Hole Peg Test (NHPT)
Parkinson's Activity Scale (PAS)	Parkinson's Disease Questionnaire-39 (PDQ-39)	Physical Activity Evaluation Scale for the Elderly (PASE)
Purdue Pegboard Dexterity Test	Activities and Fear of Falling Survey in the Elderly (SAFFE)	Brief Parkinson's Disease Rating Scale (SPES-SCOPA)
Unified Parkinson's Rating Scale (MDS-UPDRS)	10 Meter Walk Test (10MWT)	Dynamic Gaul Index (DGI)
Fall Efficacy Scale International (FES-I)	5 Times Sit to Stand Test (FTSTS)	Functional Gait Assessment (FGA)
Modified Parkinson's Activity Scale (M-PAS)	New-Walking Freezing Scale (NFOG-Q)	Patient-Specific Index in Parkinson's Disease Patients (PSI-PD)

(19)

TAI CHI

These exercises, which consist of slow and controlled movements, are of Chinese origin. In addition it has many benefits, it is mainly known that it has positive effect on aerobic capacity, flexibility, balance and muscle strength. (20) It also has a meditative and psychological step. As a result of all these

effects, it is mostly preferred by the geriatric group and patients at risk of falling, especially since it is included in the scope of moderate-light exercise. (21)

These exercises contain some basic principles that should not be overlooked when applying them. These principles are: These can be listed as maintaining ideal posture, mental and physical relaxation, weight bearing exercises, breathing control, mental concentration and focus. (22) It focuses on motor control and body smoothness through slow movements. (23) Balance and coordination development is achieved through muscle control. Since the emergence of movements is based on the principle of "softness defeats hardness", the movements are performed very softly. Exercises are performed with diaphragmatic breathing in a fluid manner, avoiding difficult movements. In this type of exercise, it is tried to achieve balance and relaxation in a concentrated manner without causing fatigue. (24) In addition, slow and conscious movements minimize the risk of injury.

The origins of the movements come from the Chi philosophy, which is based on physical and spiritual balance. Chi also means energy of life and power of life. (25) While applying this exercise concept, which is done as a moving meditation, it is very important to keep the body relaxed and avoid bad thoughts. They seem to dance with trunk turns, weight transfer between extremities, and coordination of arms. However, every movement is controlled and contains intense internal power. (26)

There are different application styles. Chen is the oldest and Yang is the most widely used. Wu Hao, Wu, Sun are other Tai Chi concepts also practiced. (27) Tai Chi can be applied as a type of exercise with an aerobic effect that can be applied at low-medium intensity. (27) Tai chi exercises are performed by standing. There are studies showing that it increases muscle strength through eccentric and concentric contractions of the lower extremity during exercise. (21) (28) Mostly, practices are performed in a half-squat position with knees bent, combined with breathing. (29)

Due to the constant contact between the feet and the ground, the body always resists gravity. (30) Slow movements support balance development by making it difficult to maintain balance. (31) Balance development is also supported by increasing lower extremity strength. It has also been observed that it increases flexibility and postural control. (32) It positively improves proprioception, postural stability and balance development with mental focus and the body awareness provides as a result. (33)

Tai chi exercises are considered very suitable for the correction and control of gait and balance disorders caused by Parkinson's disease. (34) In this disease, where tremor, kyphotic posture and postural control decrease, positive results are achieved due to the body awareness and rhythmic movements provided by tai chi practices. It positively affects patients' quality of life and their fear of falling because it increases balance and focus. (7)

Tai chi is also a safe form of exercise for Parkinson's disease, which mostly occurs in geriatric individuals, by providing the necessary flexibility and muscle strength at a moderate and light pace. (35)

EFFECTS OF TAI CHI ON PARKINSON'S DISEASE

UPDRS Score is used to evaluate many symptoms together. It is used to rate Parkinson's Disease and the general condition of the Parkinson's disease. It evaluates the disease in terms of clinical features, especially motor, daily activity, emotion-thought, and treatment complications. (36) Li et al. In 2024,



they evaluated Parkinson's patients to whom they practiced Tai Chi for 3.5 years. According to their results, the rate of deterioration in the UPDRS scoring of the Tai Chi group was less observed in the annual analyzes compared to the control group. This shows that Parkinson's disease progresses faster in the control group and slower in the Tai Chi group. (37)

Medications are central to the medical treatment of Parkinson's disease. It aims to prevent the progression of the disease, relieve symptoms, and reduce the risk of complications. Due to the loss of dopaminergic neurons in the brain, the "gold standard" method is Levodopa. (38) Li et al. In their study in China, it was observed that the control group needed to increase the Levodopa dose more compared to the Tai Chi group. Other results presented from this study are in the Tai Chi applied group; Continuous improvement was observed in the BBS and TUG scales, and according to the PDCRS results, slower deterioration and continuous improvement in cognitive functions, improvement in autonomic symptoms, improvement in sleep and quality of life, and a decrease in the frequency of falls. (37)

In Italy, A wearable sensor system was used in a preliminary study by Mancioffi et al. Patients were divided into two groups, one group of Parkinson's patients received Tai Chi training and the other group received traditional physiotherapy training. All participants were evaluated with UPDRS, BBS, TUG, FRT, PDQ-39. Wearable systems recorded patients' trunk-rotation joint range of motion. As a result of the preliminary study, it was seen that planned Tai Chi training can be used as an alternative treatment method in Parkinson's patients related to back-trunk mobility. (39)

In Canada, In another study conducted by Law et al., a study was conducted on gait and posture in biomechanically early stage Parkinson's patients. The effectiveness of Tai chi was examined in these patients for 12 weeks. Obstacle overcoming, TUG, standing on one leg with eyes open and closed, SLS, dynamic postural stability, walking speed, diagonal step length, heel and toe clearance, displacement and change speed of the center of mass, and center of pressure values were recorded. As a result, although both groups showed significant improvements compared to their initial conditions, the dorsiflexion angle improved more in the Tai Chi applied group. This indicates that there is a very positive development in terms of overcoming obstacles. According to these results, Tai Chi practice has been shown to improve walking and dynamic postural stability in Parkinson's patients. (40)

Toloraia et al. focused on measuring the motor and cognitive functions of Parkinson's patients in his study. In this study conducted in Switzerland, patients were given a combination of Tai Chi, cognitive training and speech training. Tai Chi was not applied to the control group. A 4-week training was administered and then the participants were followed for 6 months. In the group where Tai Chi combination was applied; Positive results have emerged in terms of verbal and formal episodic memory, visual-spatial function, that is, cognitive performance. Likewise, the Tai Chi group maintained its superiority in the Tinetti Mobility Test and Epworth Sleepiness Scale. This study revealed that Tai Chi positively affects motor and non-motor symptoms in Parkinson's patients. (41)

In another study conducted in China, early stage Parkinson's patients were evaluated for 1 year. Motor symptom assessment was performed by Berg balance scale (BBS), Unified PD scale (UPDRS), Timed Up and Go test (TUG), and 3D gait analysis. In addition, magnetic resonance imaging (fMRI), plasma

cytokine, metabolomics and blood Huntingtin interaction protein 2 (HIP2) mRNA level analysis were performed. According to the results, there was a superiority in the Tai Chi practiced group compared to other groups in BBS, UPDRS, TUG and step. Long-term Tai Chi training improves motor functions such as balance and walking, and the mechanism of these improvements has also been observed. Tai Chi improves brain network functions; It shows positive results in reducing dopamine degeneration. Improvements were observed in amino acid metabolism, energy metabolism and neurotransmitter metabolism, and a decrease in inflammation was observed. (42)

Li et al. In a cohort study they conducted in 2020, significant improvements were observed in patients who practiced Tai Chi for 2 months compared to the routine exercise group. There was a decrease in levodopa use rates and a slowdown in the need for dose increases. A significant success rate was observed in the TUG test. The frequency of falls also decreased significantly compared to the routine exercise group. The Tai Chi group also showed superiority in the 50-meter fast walking and functional reach test. Routine exercise group; It consisted of treadmill, aerobic exercises and dancing. The routine exercise group also actually showed success in the evaluated parameters. However, the Tai Chi group achieved a superior success rate in parameters compared to the routine exercise group. (6)

CONCLUSION

As a result, Tai Chi exercises are a mind-body exercise method that provides postural stability, balance, walking, positive feedback on many motor and non-motor symptoms such as cognitive symptoms in Parkinson's patients. We need to support using of this treatment not only in China but also more widely around the world for the quality of life and continuity of independent lives of these patients.

SOURCES

- 1) Shao, Y. L. (2019). Recent advances and perspectives of metabolomicsbased investigations in Parkinson's disease. . *Mol Neurodegener.* (2019) 14:3.
- 2) Kalia, L. V. (2015). Parkinson's disease. *Lancet* 2015;386:896–912.
- 3) Engelender, S. I. (2017). The threshold theory for Parkinson's disease. *Trends Neurosci.* (2017) 40:4–14.
- 4) Przedborski, S. (2017). The two-century journey of Parkinson disease research. *Nat Rev Neurosci.* (2017) 18:251–9.
- 5) Macchi, Z. A. (2020). Patient and caregiver characteristics associated with caregiver burden in Parkinson's disease: a palliative care approach. . *Ann Palliat Med.* (2020) 9(Suppl. 1):S24–S33.
- 6) Li, Q. L. (2020). Tai Chi versus routine exercise in patients with early- or mild-stage Parkinson's disease: a retrospective cohort analysis. *Braz J Med Biol Res.* 2020 Feb 10;53(2):e9171.
- 7) Hackney, M. E. (2008). Tai Chi improves balance and mobility in people with Parkinson disease. *Gait Posture* 2008;28:456-60.



- 8) Winser, S. J. (2018). Does Tai Chi improve balance and reduce falls incidence in neurological disorders? A systematic review and meta-analysis. . Clin Rehabil. (2018) 32:1157– 68.
- 9) Balestrino R, S. A. (2020). Parkinson disease. Eur J Neurol. 2020;27(1):27–42.
- 10) Ayvat, E. A. (2024). Parkinson Hastalığında Gövde Bozukluğu. H.Ü. Sağlık Bilimleri Fakültesi Dergisi Cilt:11, Sayı:1, 2024.
- 11) Ertan, S. (2005). Parkinson hastalığının klinik özellikleri. Cerrahpaşa Tıp Fakültesi sürekli tıp eğitimi etkinlikleri, 2005;42: 249-254.
- 12) Koller, W. W. (1989). Posttraumatic movement disorders: a review. Mov Disord 1989;4:20-36.
- 13) Akbostancı, M. (2008). Parkinson hastalığının değerlendirilmesinde kullanılan ölçekler ve yeni UPDRS. Türkiye klinikleri nöroloji özel sayısı 1(4):115-117.
- 14) Altun, A. M. (2013). Parkinson Hastalığında Yürüme ve Dengenin Değerlendirilmesi. Parkinson Hastalığı ve Hareket Bozuklukları Dergisi 2013;16(1-2):1-8.
- 15) Göz, E. D. (2021). Erken Dönem Parkinson Hastalarında Pilates ve Elastik Bantlama Uygulamalarının Denge ve Postüral Kontrol Üzerine Etkisi: Randomize Kontrollü Pilot Çalışma. Arch Neuropsychiatry 2021;58:308–313.
- 16) Geroin, C. S. (2015). Does the Pisa syndrome affect postural control, balance, and gait in patients with Parkinson’s disease? An observational cross-sectional study. Parkinsonism Relat Disord 2015;21:736–741.
- 17) Oğuz, S. D. (2003). Parkinson Hastalarında Solunum Egzersizlerinin Etkinliği. Akciğer Arşivi: 2003; 4: 129-133.
- 18) Şahin, O. Ş. (2008). Parkinson Hastalığı Rehabilitasyonu. Turkish Journal of Geriatrics 2008; 12 (1): 36-48.
- 19) Doğan, M. C. (2019). Parkinson Hastalığında Ölçme ve Değerlendirme. P. D. Doç. Dr. Muhammed KILINÇ içinde, Nörolojik Fizyoterapi ve Rehabilitasyonda Ölçme ve Değerlendirme (s. 46-50). Ankara: 1. Baskı, Vize Yayıncılık.
- 20) Hong, Y. L. (2000). Balance control, flexibility, and cardiorespiratory fitness among older Tai Chi practitioners. Br J Sports Med. 2000 Feb;34(1):29-34.
- 21) Lan, C. J. (1998). 12-month Tai Chi training in the elderly: its effect on health fitness. Med. Sci. Sports Exerc. 30:345–351.
- 22) Tsang, W. W.-C. (2004). Tai Chi improves standing balance control under reduced or conflicting sensory conditions. Arch. Phys. Med. Rehabil. 85:129–137.
- 23) Gatts, S. (2008). A Tai Chi Chuan Training Model to Improve Balance Control in Older Adults. Curr Aging Sci 2008; 1: 68-70.
- 24) Wolf, S. L. (1996). Reducing frailty and falls in older persons: an investigation of Tai Chi and computerized balance training. J. Am. Geriatr. Soc. 44:487–497.
- 25) Klein, P. A. (2004). Comprehensive therapeutic benefits of Taiji: a critical review. . Am J Phys Med Rehabil 2004;83:735-45.

-
- 26) Tse, S. K. (1992). Tai Chi and postural control in the well elderly. . *Am. J. Occup. Ther.* 46:295–300, 1992.
 - 27) Lan, C. W. (2013). Tai chi exercise in medicine and health promotion. *Evid Based Complement Alternat Med* 2013:298768.
 - 28) Lu, X. H.-C. (2013). Effects of Tai Chi training on arterial compliance and muscle strength in female seniors: a randomized clinical trial. *Eur J Prev Cardiol* 2013;20:238-45.
 - 29) Jancewicz, A. (2001). Tai Chi Chuan's role in maintaining independence in ageing people with chronic disease. *J Bodyw Mov Ther* 2001; 5(1): 70-77.
 - 30) Wu, G. H. (2005). Ground contact characteristics of Tai Chi gait. . *Gait Posture* 2005;22: 32–39
 - 31) Jiménez-Martin, P. M.-O. (2013). A review of Tai Chi Chuan and parameters related to balance. *Eur J Integr Med* 2013, 5(6): 469-475.
 - 32) Wu, G. Z. (2002). Improvement of isokinetic knee extensor strength and reduction of postural sway in the elderly from long-term Tai Chi exercise. *Arch Phys Med Rehabil* 2002;83:1364-9.
 - 33) Gregory, H. W. (2009). The effectiveness of Tai Chi as a fall prevention intervention for older adults: A systematic review. *Int J Health Promot Educ* 2009;47:94-100.
 - 34) Onat, Ş. K. (2008). Parkinson hastalığı rehabilitasyonu. . *Turkish Journal of Geriatrics* 2008;12:36-48.
 - 35) Li, F. H. (2012). Tai chi and postural stability in patients with Parkinson's disease. *N Engl J Med* 2012;366:511-9.
 - 36) Cantürk, İ. (2020). Parkinson Hastalığının Derecesi ile Yürüyüş Değişkenliği Arasındaki İlişkinin Bulanık Tekrarlılık Grafiğine Göre Araştırılması. *Avrupa Bilim ve Teknoloji Dergisi* Sayı 19, S. 410-419, Ağustos 2020.
 - 37) Li, G. H. (2024). Effect of long-term Tai Chi training on Parkinson's disease: a 3.5-year follow-up cohort study. *J Neurol Neurosurg Psychiatry*. 2024 Feb 14;95(3):222-228.
 - 38) Karataş, Y. (2005). PARKİNSON HASTALIĞININ TEDAVİSİ. *Türkiye Klinikleri J Int Med Sci.* 2005;1(44):67-75.
 - 39) Mancioffi, G. C. (2023). A wearable inertial system to evaluate Tai Chi training motor effects in patients with Parkinson's disease. *Annu Int Conf IEEE Eng Med Biol Soc* . 2023 Jul:2023:1-4.
 - 40) Law, N. L. (2023). Effects of a 12-week online Tai Chi intervention on gait and postural stability in individuals with Parkinson's disease. *Sports Medicine and Health Science* 5 (2023) 239–244.
 - 41) Toloraia, K. G. (2024). High-frequency multimodal training with a focus on Tai Chi in people with Parkinson's disease: a pilot study. *Front. Aging Neurosci.*, Volume 16 - 2024.
 - 42) Li, G. H. (2022). Mechanisms of motor symptom improvement by long-term Tai Chi training in Parkinson's disease patients. *Translational Neurodegeneration* (2022) 11:6.