The Effect of Balance Training by Tetraks Interactive Balance System on Balance and Fall Risk in Parkinson’s Patients: A Report of Four Cases

Parkinson Hastalarında Tetraks İnteraktif Denge Sistemi ile Denge Eğitiminin Denge ve Düşme Riski Üzerine Olan Etkisi: 4 Vaka Raporu

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ABSTRACT

This pilot study aimed to investigate the effect of balance training by Tetraks Interactive Balance System (TIBS) on balance and fall risk in patients with mild to moderate Parkinson’s disease. Four patients with Parkinson’s disease between the ages of 56 and 70 years (61.25±6.70) were applied balance training for 3 weeks by TIBS. Sociodemographic features and physical properties of the subjects were recorded. Their motor performance was evaluated by the Unified Parkinson’s Disease Rating Scale (UPDRS), balance was measured using the Berg Balance Scale (BBS), Functional Reach Test (FRT), Timed Up and Go Test (TUG), and the Standing on One Leg Balance Test (SOL) and, their fall risks were evaluated by TIBS. Evaluations were performed twice, before and after treatment. Following training, Parkinson’s patients showed improvements in UPDRS, TUG, BBS, FRT, SOL and fall risk. Balance training by TIBS has positive effects on balance and decreases fall risk in Parkinson’s disease patients. (Archives of Neuropsychiatry 2014; 51: 283-287)

Key words: Parkinson’s disease, balance, balance tests, fall risk

ÖZET


Anahtar kelimeler: Parkinson Hastalığı, denge, denge testleri, düşme riski

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Introduction

Parkinson’s disease (PH) is a progressive, neurodegenerative, chronic disease manifested by cardinal signs including bradykinesia, rest tremor, rigidity and postural instability. A progressive decrease in the speed of movement and disruption in balance and postural control are observed in time because of damage of dopaminergic neurons in basal ganglia. Imbalance in Parkinson’s disease occurs by combination of many disorders including loss of postural reflexes, insufficiency in postural adjustments, rigidity in the trunk and extremities and akinesia. Falls begin to be observed, when the patients start to lose their ability to perform rapid postural correction (1,2). Imbalance which is one of the most important findings of PD causes to dependence in activities of daily living and physical disability. Many methods are used to evaluate balance in PD. Although there are many balance tests which are used widely in neurological conditions, it is observed that there are no tests which can be accepted as gold standard when the literature related with evaluation of balance in PD is examined (2,3).

Although it is widely accepted that exercises are beneficial in PD, there is no consensus on the type of exercise and the amount of exercise needed. The lack of data and conflicting results make it difficult to determine optimal treatment regimens. There is growing evidence that balance training has positive effects on balance and decreases fall risk in Parkinson’s disease patients. (Archives of Neuropsychiatry 2014; 51: 283-287)
The right side in all patients. Information was given to the patients about the study.

Evaluations

Evaluations were performed for two times at the beginning and end of treatment by the same investigator. Measurements were performed in the “open” period of the patients.

Unified Parkinson’s Disease Rating Scale (UPDRS)

UPDRS evaluates mental and psychological state, activities of daily living, motor performance and complications of levodopa treatment in PD. Since it gives accurate and comprehensive information in many aspects, it is the most commonly preferred scale in PD. The motor evaluation part of UPDRS was used in our study. In this part 14 motor findings were scored between 0 (no disruption) and 4 (disruption with the greatest severity or the patient is not able to perform the movement) according to severity (20).

Berg Balance Scale (BBS)

It is a scale composed of 14 tests which measures different positions, postural changes and the ability to maintain balance during movement. Grading is done by scoring between 0 (not able to perform) and 4 (normal performance) and the total score ranges between 0 (dependent) and 56 (independent) (21).

Functional Reach Test (FRT)

The patient was instructed to elevate his dominant arm 90 degrees, to place his/her hand on the level of the shoulder by making a fist and to reach forward as much as possible such as no movement or imbalance occurs in the foot following the meter placed on the wall. The length reached was recorded as centimeter (cm) (6).

Timed Up and Go Test (TUG)

In this test, the patient was instructed to stand up from the chair, walk for 3 meters (m), turn around himself/herself, walk back to the chair and sit. The time passed during these activities was recorded as seconds (s) (6).

Standing on One Leg Balance Test (SOL)

The patient was instructed to stand on his/her right and left foot one by one with the eyes open and arms by the body and the time was recorded as seconds (6).

Method

Patients

Four male patients with a diagnosis of idiopathic PD with a mean age of 61.25±6.70 (56-70) who presented to Başkent University Hospital Ümitköy Outpatient Clinic, Division of Physical Therapy and Rehabilitation between January 2010 and January 2011 and who were below the 4th stage according to the modified Hoehn-Yahr staging and who had stabile drug (levodopa) usage were included in the study. The physical properties of the patients are shown in (Table 1). Patients who had another neurological disorder other than PD, who had postural hypotension, visual and vestibular disorder which could affect balance, cardiovascular or musculoskeletal system problem which could affect locomotion and who were using antihypertensive, antiarrhythmic and antidepressant drugs were excluded from the study. The dominant side was way of performance and there is no standardized exercise approach established for this disease group (4,5). Exercise approaches directed to develop balance should base on a correct evaluation and focus on the disrupted parameters of balance. The aims in balance training in PD include development of postural sway regularity and appropriate weight distribution, functional balance responses and emotional regulation, prevention of falls and development of gait (6,7). Rehabilitation studies in PD are mostly directed to bradykinesia (8,9,10). A few recent studies have evaluated the effects of balance rehabilitation (11,12,13,14,15,16). In the literature, there is limited number of studies related with balance training performed with computerized systems (15). Tetraks Interactive Balance System (TIBS) has been used clinically for the aim of evaluation and training in recent years. Studies have shown that TIBS is a valid and reliable method for evaluation of balance (17,18,19). However, there are no validity and reliability studies in different diseases and studies related with the effects of balance training. This pilot study was conducted to examine the effect of balance training with TIBS on the balance and fall risks of patients.

Table 1. Values of the the patients with Parkinson's disease before and after treatment

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years)</th>
<th>Disease time (years)</th>
<th>MHYS</th>
<th>Body weight (kg)</th>
<th>Height (cm)</th>
<th>Body Mass Index (kg/m²)</th>
<th>UPDRS</th>
<th>BBT</th>
<th>SOL (right) (s)</th>
<th>SOL (left) (s)</th>
<th>TUG (s)</th>
<th>FRT (cm)</th>
<th>Fall risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63</td>
<td>5</td>
<td>2.5</td>
<td>81</td>
<td>175</td>
<td>26.7</td>
<td>20.15</td>
<td>53</td>
<td>18.45</td>
<td>13.89</td>
<td>08.69</td>
<td>29.50</td>
<td>100 70</td>
</tr>
<tr>
<td>2</td>
<td>56</td>
<td>6</td>
<td>1</td>
<td>74</td>
<td>168</td>
<td>26.24</td>
<td>10.8</td>
<td>54</td>
<td>18.00</td>
<td>22.05</td>
<td>09.72</td>
<td>41.50</td>
<td>84 58</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>9</td>
<td>3</td>
<td>70</td>
<td>160</td>
<td>27.34</td>
<td>25.20</td>
<td>48</td>
<td>10.40</td>
<td>12.37</td>
<td>20.79</td>
<td>27.00</td>
<td>70 46</td>
</tr>
<tr>
<td>4</td>
<td>56</td>
<td>9</td>
<td>2</td>
<td>88</td>
<td>170</td>
<td>30.44</td>
<td>18.11</td>
<td>54</td>
<td>12.00</td>
<td>4.00</td>
<td>08.50</td>
<td>35.50</td>
<td>50 28</td>
</tr>
</tbody>
</table>

BT: Before treatment, AT: After treatment, s: second, cm: centimeter, kg: kilogram, m: meter, MHYS: Modified Hoehn and Yahr Scale, BBT: Berg Balance Test, SOL: Standing on One Leg Balance Test, TUG: Timed Up and Go Test, FRT: Functional Reach Test, UPDRS: Unified Parkinson’s Disease Rating Scale
Modified Hoehn and Yahr Scale (MHYS)

It is widely used in PD to determine clinical state and symptoms of the patient in a short time. The severity of the disease is scored between 1 and 5.

- Stage 0: No signs of disease
- Stage 1: Unilateral involvement
- Stage 2: Axial involvement in addition to unilateral involvement.
- Stage 2.5: Mild bilateral disease, the patient can collect himself/herself together in the balance test.
- Stage 3: Mild-moderate bilateral disease, some imbalance is present, but physically independent.
- Stage 4: Severe disability present, the patient can still walk, but cannot stand up without assistance.
- Stage 5: Dependent to wheelchair or bedridden (22,23).

Evaluation of Fall Risk by Tetraks Interactive Balance System

Tetraks Interactive Balance System (Tetraks Ltd., 56 Miryam st., Ramat Gan, Israel) is a valid and reliable method to evaluate balance and fall risk. The system obtains data by using 4 different platforms which measure vertical pressure fluctuations arising from two heels and two fingertips. It can record the data coming from four different measurement platforms in a certain time period digitally and document them as visual and numerical data. The fall risks of the patients were calculated as percentage (%) by a posturographic program considering the oscillation rates (17).

Balance Training

The patients received balance training with TIBS for 5 weeks 25 minutes a day and 3 days a week (a total of 15 sessions) (Figure 1). After the operation to be performed was demonstrated for three times, evaluations and training were realized in a room isolated form visual and auditory stimuli in the “open” period of the patients. The open period of the patients was considered as the period during which findings related with PD including rigidity, tremor and bradykinesia were decreased approximately one hour after ingestion of the morning drug, more free, easy and rapid movement was possible and the patient also felt improvement subjectively (24,25,26).

Results

The mean ages, demographic and physical properties and evaluation results related with pre- and post-training periods are presented in (Table 1). According to our findings, improvements were found in TUG, BBT, FRT, SOL and fall risks after balance training in patients with Parkinson’s disease compared to the pre-training period.

Discussion

Imbalance which is observed frequently in PD is a severe problem leading to functional limitation. It is generally accepted that exercises are beneficial in this disease (13). Straining, posture correction, joint movement exercises and balance, walking and coordination exercises are recommended in the scope of exercise programs. Balance and strengthening exercises show curative effect on the abilities of balance, posture and walking (13).

In the literature, many scales and methods have been used and investigated to evaluate balance in PD. Visser et al. (3) proposed that the most valid test which evaluates balance in PD was retropulsive test (pulling backward on the shoulders unexpectedly). Qutubuddin et al. (21) stated that the retropulsive test did not evaluate balance in all aspects, though it was an easy method in evaluation of balance in PD. Gündüz et al. (27) compared different balance scales in PD (Berg balance Test, Tinetti Performance Oriented Balance and Gait Scale, Standing on One Leg Balance Test, Functional Reach test). Conclusively, they found that all balance evaluation tests were reliable and valid for patients with PD and Berg Balance test was a more reliable test.

In our study, the balance of the patients were evaluated with Berg Balance Test, Functional Reach test, Timed Up and Go Test, and Standing on One Leg Balance Test. Application of evaluations was easy and understandable.

In some studies performed recently, the effect of balance rehabilitation programs in PD has been examined (11,12,13,1,4,15,16,28,29). Samnia et al. (30) examined the effects of balance training in PD on postural instability (they used physical balance training as balance training). Conclusively, balance values improved in PD patients who were trained compared to the control patients with PD. Kadivar et al. (31) examined the effects of step exercises and rhythmic auditory stimulus on functional performance.
and recorded improvement in functional balance and gait. In the study performed by Balci et al. (32) in which the effects of a home program including balance, postural control, coordination and strengthening exercises on balance and functional capacity were examined, improvement was found in balance and participation in daily activities of living.

Qutubuddin et al. (15) performed balance training with computerized dynamic posturography for 8 weeks in patients with PD and compared them with the patients who received classical physiotherapy-rehabilitation. Conclusively, they did not observe any difference between the two groups.

In the literature, there are studies related with TIBS used in different diseases. Adam et al. (33) used TIBS to evaluate balance in patients with ankylosing spondylitis. Arce et al. (34) examined postural adjustment in patients with head trauma using TIBS. Oppenheim et al. (35) examined postural characteristics of patients with diabetic neuropathy using TIBS.

Baszczynski et al. (36) examined the postural oscillation changes (open and closed) in static position and the effects of these postural oscillation increases on fall risk in the study they performed in which they evaluated postural instability and fall risk in patients with idiopathic Parkinson’s disease. They stated that especially medio-lateral balance loss occurred in the static standing position with the eyes closed and this increased the fall risk, when patients with stage 1-3 PD according to MHYS were compared with healthy individuals in the same age group. It has been emphasized that this balance problem and the severity of fall risk increases as the MHYS score of the individual increases and it has been reported that increase in postural oscillation in patients with PD would be a risk factor for fall. TIBS measures the change of place of the center of gravity in a total of 4 platforms dividing one foot to two and provides weight transfer to the right and left foot one by one and to the anterior and posterior parts of each foot with the plays it contains. TIBS used in our study gives training to develop antero-posterior and medio-lateral oscillation characteristics. We think that postural control increased and fall risk decreased with development of postural oscillation characteristics in 4 patients in our study. Improvement in the values of BBT and SOL which evaluated balance and TUG and FRT which evaluated functional balance in TIBS and improvement in fall risks might be related with increased postural control.

In the literature, there is no study examining the effects of balance training with TIBS in patients with PD. Our study was planned as a pilot study as a result of recognition of the clinical benefits of balance training with TIBS in patients with PD and the patients’ satisfaction. Balance training with TIBS is a rehabilitation in which patients participate easily and fondly, since it provides visual feedback and applies balance training with different plays. The most important advantage of balance training with TIBS is that participation of patients in balance training is well and they are satisfied with the training.

We think that balance training with TBS in patients with PD will have positive effects on the balances of these patients and may decrease the fall risk. The most important limitation of our study is the limited number of the patients included. This arisen from the fact that we wished to interpret the results by including patients with PD who had similar properties and who had the functional capacity to work with TIBS. According to our study, it can be concluded that balance training with TIBS improve balance abilities of patients and decrease the fall risk in patients with mild-moderate PD. We think that TIBS is a beneficial system which can be used in balance training and rehabilitation in PD by physiotherapists.

The validity and reliability of evaluation of balance and fall risk by TIBS in patients with PD and the differences in balance and development of fall risk between patients who receive classical balance training and patients who receive balance training with TIBS should be investigated in future studies.

References


