The Effect of Standing Posture-enhancing Exercise on Parkinson’s Disease Patients’ Turning Around Motion

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Abstract. [Purpose] The aim of the present study was to evaluate the effects of shoulder external rotation and trunk extension exercises on standing posture improvement using the turning around motion of patients with Parkinson’s disease. [Methods] Sixteen patients with Parkinson’s disease performed shoulder external rotation and trunk extension exercises in three sets of ten times a set, three days a week, for twelve weeks. To measure turning around, the ink footprint method was used. The number of steps and the time taken were measured every week from before until the end of the study. [Results] The number of steps and time taken on each week over the twelve weeks significantly decreased compared with their values before the exercise. [Conclusion] Standing posture improvement exercises can partially help patients with Parkinson’s disease perform the turning around motion in activities of daily living.

Key words: Parkinson’s disease, Standing posture, Exercise

(INTRODUCTION)

Parkinson’s disease occurs in around 1% of those aged 50 years old or older and increases with age, occurring in 2.6% of those aged 85 years old or older. The ratio of male patients to female patients is 3:2\textsuperscript{1), 2). Gait and postural problems are characteristic of Parkinson’s disease. Due to a progressive loss of substantia nigra neurons, which produce dopamine, neurotransmitter imbalances occur in the basal ganglia. Once around 80% of the neurons have been lost, Parkinson’s disease becomes evident and sufferers begin to experience difficulties with motor skills, cognition, and autonomic function\textsuperscript{1}). Parkinson’s disease patients walk with a stooped posture, festinating gait, and rigidity. In the first ten years of the disease, it is more common for people to exhibit slowness of movement, mild gait hypokinesia, resting tremor, and reduced speech volume. In the latter ten years, festination, dyskinesia, akinesia, marked hypokinesia, postural instability, and falls are thought to be more of a problem. There is considerable variation across individuals in the manifestation of their movement disorders as well as variations in motor performance over time\textsuperscript{1–9). The clinical characteristics of Parkinson’s disease can be largely divided into motor symptoms and non-motor symptoms. The motor symptoms include tremors, bradykinesia, tetany, postural unstability, and gait disturbance; the non-motor symptoms are diverse and include cognitive functional disorder, psychiatric symptoms, sleep disorders, autonomic nervous system symptoms, and sensory symptoms. Parkinson’s disease patients generally present bent necks and trunks\textsuperscript{7–9). Changes of muscle tension and excessive forward bending cause damage to the range of rotation, which impairs functional activities, such as getting up from bed and turning over in bed\textsuperscript{3). Parkinson’s disease patients maintain standing posture well in the early stage of the disease. However, as the disease progresses, step length and arm movements decrease because trunk and pelvic movements decrease, resulting in secondary injuries, and disabilities cause poor balance and falls\textsuperscript{10). Parkinson’s disease patients’ standing postures are characterized by the trunk bending forward. This causes an increase in the internal rotation of the humerus\textsuperscript{11). Increased internal rotation of the humerus causes muscle shortening in regions such as the adductor of the shoulder joint and the latissimus dorsi muscle, which limit the motions of the upper extremities and trunk\textsuperscript{12). These limited motions of the shoulder joint and trunk reduce the limit of stability, causing declines in balance ability\textsuperscript{10, 13). For this reason, Parkinson’s disease patients exert excessive energy because of their reduced efficiency of motion in the standing posture during activities of daily living\textsuperscript{4). Parkinson’s disease patients show characteristics such as a shuffling gait with small steps, increased forward bending of the trunk, and decreased trunk rotation. To combat this, Parkinson’s disease patients should strengthen shoulder external rotation and trunk extension. Turning can be promoted when it is supported by the appropriate interactions between trunk flexion and extension\textsuperscript{15).
In most previous studies, external sensory input was used to examine the effects of functional movement. However, there have been no studies of the cause of the reduction in extensor muscle activity. Therefore, this study asked Parkinson’s disease patients to perform shoulder external rotation exercises and trunk extension exercises for 12 weeks, as exercises for enhancing standing posture and examined the effects of these exercise programs on turning around motion.

**SUBJECTS AND METHODS**

This study was conducted with twenty patients (twelve male, nine female) who had been diagnosed with Parkinson’s disease and hospitalized in H hospital, which is dedicated to elderly persons, located in Yongin-si, Korea. The study took place from January, 2007 to April, 2007 in the physical therapy room of H hospital. Four patients (two male, two female) were excluded from the study (Table 1). The selection criteria were as follows; patients who agreed to the content of this study and voluntarily participated; patients who could walk at least 10 m without using any walking aids; an age of 65 years old or older; and patients who had been diagnosed with Parkinson’s disease five years ago. There are many exercise methods for enhancing standing posture, such as using the hands or equipment on the neck, shoulder, chest, or pelvis to create a properly aligned body posture. In this study, shoulder external rotation exercises and trunk extension exercises were the activities used in order to enhance trunk rotation through extensor muscle activity (Fig. 1). The study subjects actively performed the exercises, which consisted of a total of three sets of ten repetitions. This was done three times a week for twelve weeks. The study subjects took a sufficient rest break of five minutes or longer after completing each set. The study subjects were instructed on how to perform the shoulder external rotation: shoulder 90° abduction with elbow 90° flexion to shoulder 90° external rotation with a standing posture (Fig. 1). In this manner, the subjects actively exercised their shoulders in external rotation using their body for a total of three sets of ten repetitions. The trunk extension exercises were described so that patients would use as much trunk extension in the prone posture as possible. Turning around (360°) is most problematic for people who experience episodes of freezing or motor instability.

![Fig. 1. The performance exercise and measurement of the number of steps and time taken for the turning round motion by Parkinson’s disease patients](image)

The performance exercise and measurement of the number of steps and time taken for the turning round motion by Parkinson’s disease patients

The subjects were instructed to perform shoulder external rotation (shoulder 90° abduction with elbow 90° flexion to shoulder 90° external rotation in a standing posture). Trunk extension exercises were described so that patients would use as much trunk extension in the prone posture as possible. Turning around (360°) is most problematic for people who experience episodes of freezing or motor instability.

![A. Shoulder external rotation](image)

![B. Trunk extension](image)

![C. Turning round](image)

**Table 1. General characteristics of the Parkinson’s disease patients**

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td>74.6 ± 7.0</td>
<td>75.0 ± 6.0</td>
<td>74.8 ± 6.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>164.7 ± 3.8</td>
<td>152.0 ± 9.9</td>
<td>159.5 ± 9.3</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>67.8 ± 6.8</td>
<td>53.3 ± 4.2</td>
<td>61.8 ± 9.3</td>
</tr>
</tbody>
</table>

Mean ± standard deviation

shoes that the subject normally wore and was familiar with. Then, black ink was applied to both shoes. When the study subject was in a standing posture and wearing the shoes, the investigator told the study subject, “Make a complete turn” in the same manner as before. While the study subject was performing the turning around motion, the number and duration of the steps taken, from the toe off of the first step to the heel strike of the final step, were measured. In this manner, the number and length of the steps were measured each week for twelve weeks. The general characteristics of the study subjects were investigated before the study, and the effect of the standing posture-enhancing exercise on the number of steps and the time taken to perform turning around by Parkinson’s disease patients was analyzed. The frequency of the general characteristics of study subjects was analyzed. Gender and age differences before the study, and after 4 weeks, 8 weeks, and 12 weeks compared by repeated measure ANOVA (p<0.05) using SPSS 12.0. The protocol
for the study was approved by the Committee of Ethics in Research of the University of Yongin, in accordance with the terms of Resolution 5–1-20, December 2006. These tests measured the changes before and after the standing posture-enhancing exercise.

RESULTS

Changes in the number of steps and time taken to perform turning around by the Parkinson’s disease patients of each gender were reviewed by gender as follows. In the case of males and females, the number of steps and time taken significantly decreased, compared to before the study every week over the treatment period (Table 2). Furthermore, in the case of the subjects in their 60s, 70s, and 80s, the number of steps and time taken significantly decreased every week over the treatment period (Table 3).

DISCUSSION

Parkinson’s disease patients often find it easy to forget or have difficulty with balance. However, they respond well to visual or auditory stimulation intended to help. Therefore, a study was conducted to enhance exercise abilities using visual or auditory stimulation. Parkinson’s disease patients were trained with external stimulating signals for three weeks. Exercise frequency and exercise performance time improved significantly, but there were difficulties in proving the effects of the stimulation, because the study period was short.

Table 2. Changes in the number of steps and time taken by the Parkinson’s disease patients of each gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Before Study</th>
<th>4 Weeks</th>
<th>8 Weeks</th>
<th>12 Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>18.6 ± 3.2</td>
<td>15.7 ± 3.4*</td>
<td>13.5 ± 3.0*</td>
<td>12.1 ± 2.0*</td>
</tr>
<tr>
<td>Female</td>
<td>15.6 ± 2.6</td>
<td>12.3 ± 2.3*</td>
<td>11.9 ± 2.2*</td>
<td>10.4 ± 2.6*</td>
</tr>
<tr>
<td>Total</td>
<td>17.4 ± 3.2</td>
<td>14.3 ± 3.4*</td>
<td>12.8 ± 2.8*</td>
<td>11.4 ± 2.4*</td>
</tr>
</tbody>
</table>

Mean ± standard deviation. * p<0.05

Table 3. Changes in the number of steps and time taken by Parkinson’s disease patients of different ages

<table>
<thead>
<tr>
<th>Age</th>
<th>Before Study</th>
<th>4 Weeks</th>
<th>8 Weeks</th>
<th>12 Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>60s</td>
<td>16.8 ± 3.0</td>
<td>14.4 ± 3.6*</td>
<td>13.6 ± 2.7*</td>
<td>11.6 ± 2.7*</td>
</tr>
<tr>
<td>70s</td>
<td>17.1 ± 2.1</td>
<td>13.9 ± 1.7*</td>
<td>12.3 ± 2.5*</td>
<td>11.0 ± 2.3*</td>
</tr>
<tr>
<td>80s</td>
<td>18.2 ± 5.0</td>
<td>14.8 ± 5.3*</td>
<td>12.8 ± 3.6*</td>
<td>11.8 ± 2.6*</td>
</tr>
<tr>
<td>Total</td>
<td>17.4 ± 3.2</td>
<td>14.3 ± 3.4*</td>
<td>12.8 ± 2.8*</td>
<td>11.4 ± 2.4*</td>
</tr>
</tbody>
</table>

Mean ± standard deviation. * p<0.05

on the ground, it was difficult to expect efficient effects from exercise because it was not good posture. Meanwhile, trunk rotation of the body when performing a functional operation minimizes energy consumption and increases the efficiency of functional movement. Trunk forward bending makes shoulder joints rotate internally and limits the range of motion, making functional movement difficult, thereby limiting the range of activities available in daily living. Forward bending motion of trunk also will be weakened in the muscle strength and endurance. However, in the present study, the results indicate that performing standing posture-enhancing exercises for twelve weeks significantly decreased the number of steps and time taken to perform the turning around motion as compared to before the study. We consider the conflicting results are attributable to differences in study methods. In the study of external stimulating signals were given during exercise, and a 10 m test of walking at home was given for twelve weeks. Walking speeds increased from 0.83 m/s to 0.94 m/s, and step length increased from 51 to 55 cm. Posture scores assessed using UPDRS (items 13–15, 29–30) increased from four points to six points. This result was similar our study. It was indicated good posture was closely related performing functional movement. Parkinson’s disease patients performing a balance of visual surround and low-extremity strength training programs improved their equilibrium and strength. Balance and low-extremity muscle strength was need to maintain good posture. In the study of subjects exercised for six weeks with external stimulating signals and were re-evaluated after six weeks. Six weeks after the completion of the exercise program, significant differences in before and after exercise. But after the 6-week exercise, the activities of daily living scores of the group that performed exercise with external stimulating signals and those of the group that did not perform exercise with external stimulating signals were similar to each other. Posture evaluation was performed using UPDRS (items 29–30). The group that performed the
exercises with external stimulating signals showed similar results after six weeks, while the group that did not perform exercise with external stimulating signals showed a four-point increase in score, without significant difference\textsuperscript{24}. This indicates that exercise for six weeks does not result in significant benefits for subjects. Thus, continuous exercise for at least twelve weeks is necessary. Shoulder external rotation exercises and trunk extension exercises were conducted in this study to change trunk forward bending, one of clinical characteristics of Parkinson’s disease patients, into a proper standing posture. We examined the effects of the exercises on the number of steps and time taken to perform the turning around motion. The results of this study demonstrate that standing posture-enhancing exercises had significant effects on the number of steps and time taken to perform the turning around motion by Parkinson’s disease patients. These results indicate that correcting bent trunk posture into a proper standing posture is effective at improving Parkinson’s disease patients’ functional movement.

REFERENCES