

# Clinical Feasibility of Mental Practice for Gait Ability Improvement of Parkinson Disease Patients: ABA Single Subject Design

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**Purpose:** This study was carried out in order to verify actual applicability of mental practice in the clinical field by applying it to Parkinson disease patients.

**Methods:** The number of subjects was three and they were aged between 65 and 69. One year or longer period has passed since they were diagnosed with Parkinson disease. The baseline A consisted of three sessions. After the baseline period, the researcher applied mental practice to the subjects once per day, for 20 minutes per each time, for 10 sessions. The no-intervention withdrawal phase was composed of three sessions. Outcome measures 10 meter walking test(10MWT), timed up and go (TUG) test, 8-figure walk test (8FWT).

**Results:** All results indicated that 10 MWT, TUG, F8WT was improved when compared mental practice(B) to pre base line(A). base line(A) after mental practice intervention(B) was also sustained.

**Conclusion:** As a result of the mental practice, we can know that it helps straight gait, dynamic balance, curved gait to improve.

**Key Words:** Gait, Motor imagery, Parkinson disease

## I. Introduction

Parkinson disease is characterized by tremor, rigidity, bradykinesia, and instability of posture. In particular, Parkinson disease accompanies decrease in gait and cognitive functions together with reduction in balance ability.<sup>1</sup> Among them, decline in balance ability leads to more energy consumption than healthy people, triggering an inefficient gait pattern.<sup>2</sup>

Balance is a process of adjusting postural stability, in other words, the center of gravity against the base of support

and has an important influence on stability maintenance in a standing position, control of weight load, and motion performance of gait ability.<sup>3</sup> Therefore, improvement in gait ability is a crucial element of rehabilitation goals. As such intervention methods, treadmill training for weight support and neuro-physiological treatment have been much used, and recently mental practice has been proposed as a new intervention method.<sup>4</sup>

Mental practice is to imagine tasks in mind and is a process of indirectly obtaining motor sensory experiences one intends to perform.<sup>5</sup> Mental practice is economical, may be applied to diverse parts in ordinary life, and is highly useful because patients who need long-term rehabilitation treatment may practice it regardless of time and place as a therapeutic method for them.<sup>6</sup>

Mental practice was applied to stroke patients and motor areas activated when directly performing tasks were activated,

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Functional magnetic resonance imaging was used to compare when healthy people actually walked and when they imagined walking.<sup>7</sup> Motor neuron circuits were the same when they performed the two different activities; Mental practice was an effective method to promote actual performance practice and brain activation.<sup>8</sup> In addition, mental practice activated the cerebral motor cortex, temporarily delivering excitatory stimuli to the muscles.<sup>9</sup> Mental practice was performed on stroke patients and their gait speed improved.<sup>10</sup>

Research on whether mental practice promoted actual movements has been proceeding but largely concerned normal people and stroke patients. Other research applied mental practice related to gait to Parkinson disease patients and similar brain areas were activated to when they performed exercise.<sup>11</sup> Accordingly, this study was conducted in order to examine changes in dynamic balance of Parkinson disease patients by applying mental practice.

## II. METHODS

### 1. Subject

The subjects of this study were an inpatient and an outpatient at H hospital and one elderly person at J hospital and diagnosed with Parkinson disease. They partook in the experiment after a written consent to voluntarily participate in this study was obtained. The characteristics of the subjects are as follows. The number of subjects was three and they were aged between 65 and 69. One year or longer period has passed since they were diagnosed with Parkinson disease. Subjects 1 and 2 took medication controlling tremor and antidepressants together. The subjects had no problem with visual and auditory senses. Their scores of mini mental state examination-Korean, a cognition ability test, were all 24 points or higher. Their Vividness of Movement Imagery Questionnaire scores were all 2.26 points or lower, showing that their imagination ability was higher than the average.

### 2. Design and intervention

This study used an ABA design: The baseline phase A consisted of three sessions. The subjects' dynamic balance ability was measured for three days; The subjects did not

conduct mental practice and received balance training only. For the whole process of the study, other rehabilitation treatments such as physical therapy were applied as scheduled. Gait training was performed for 20 minutes and the test took about five minutes.

The intervention phase was comprised of 10 sessions. After the baseline period, the researcher applied mental practice to the subjects once per day, for 20 minutes per each time, for 10 sessions. Before starting mental practice on gait, the researcher sufficiently explained the purpose of mental practice. In order to maintain the subjects' concentration, the experiment was carried out in a physical therapy room with silent environment. Mental practice had a 20-minute amount and the researcher read the imaginary scenes. Mental training scenes is as follows. Relax, to concentrate on foot, walking to fit the beat, walking by change of direction, increasingly fast walk, and came way.

In order to check whether the subjects were imagining the trained scenes, the researcher asked questions twice or more in the middle of mental practice during each session. When a subject exactly answered a question, it was regarded that the subject was participating in mental practice. All the subjects exactly responded to the questions.

The no-intervention withdrawal phase was composed of three sessions. After finishing mental practice, the subjects' dynamic balance abilities were measured for three days with the same method used for the baseline period.

### 3. Measurement

For timed 10-meter walk test (10MWT), the subjects walked on a 14m straight line distance at an ordinary speed. For precise measurement, an acceleration phase and a deceleration phase of 2 m each were determined. The time taken to walk the middle 10 meters excluding the four meters was measured using a stopwatch. Test-retest reliability was 0.95 and inter-rater reliability was 0.90.<sup>12</sup> After a total of two measurements, averaged values were obtained.

For timed up and go (TUG) test, the time taken for the subjects to stand up from an armless chair receiving the verbal order "start", walk three minutes, turn around an obstacle, and sit back on the chair was measured. Intra-rater

reliability was 0.99 and inter-rater reliability was 0.99.<sup>13</sup>

For figure-8 walk test (F8WT), two obstacles were installed within a circle whose total length was 1.52 m and whose width was 1.21 m. Then a subject stood in the middle of the two obstacles. The time taken for the subject to turn around one obstacle in an anticlockwise direction, walk around the next obstacle in a clockwise direction, and then reach the original location was measured.<sup>14</sup> Inter-rater reliability was 0.90.<sup>15</sup>

#### 4. Data analysis

In order to compare dynamic balance prior to and after mental practice, measurements during the baseline period, intervention period, and no-intervention withdrawal period were expressed into means and standard deviations. Comparison was made with line graphs in order to represent changes and changes during each phase were examined through percentages.

### III. RESULT

The average of 10MWT results was 25.1 second, 15.8 seconds, and 15.2 seconds in the baseline phase A, 22.5 seconds, 13.2 seconds, and 14.5 seconds in the intervention phase B, and 23.2 seconds, 12.6 seconds, and 12.4 seconds in the no-intervention withdrawal phase. The values decreased in the intervention phase by 10.1%, 16.4%, and 4.7% and in no-intervention withdrawal phase by 7.5%, 20.2%, and 18.4% compared to in the baseline phase(Fig. 1).

The average of TUG results was 26.9 seconds, 15.5 seconds, and 14.7 seconds in the baseline phase A, 22.8 seconds, 13.6 seconds, and 13.9 seconds in the intervention phase B, and 21.9 seconds, 14.1 seconds, and 12.9 seconds in the no-intervention withdrawal phase. The values decreased in the intervention phase by 15.4%, 11.8%, and 5.7% and in no-intervention withdrawal phase by 18.7%, 8.6%, and 11.8% compared to in the baseline phase(Fig. 1).

The average of F8WT results was 27.5 seconds, 15.6 seconds, and 22.6 seconds in the baseline phase A, 24.7 seconds, 12.8 seconds, and 20.3 seconds in the intervention phase B, and 21.2 seconds, 12.6 seconds, and 19.0 seconds in

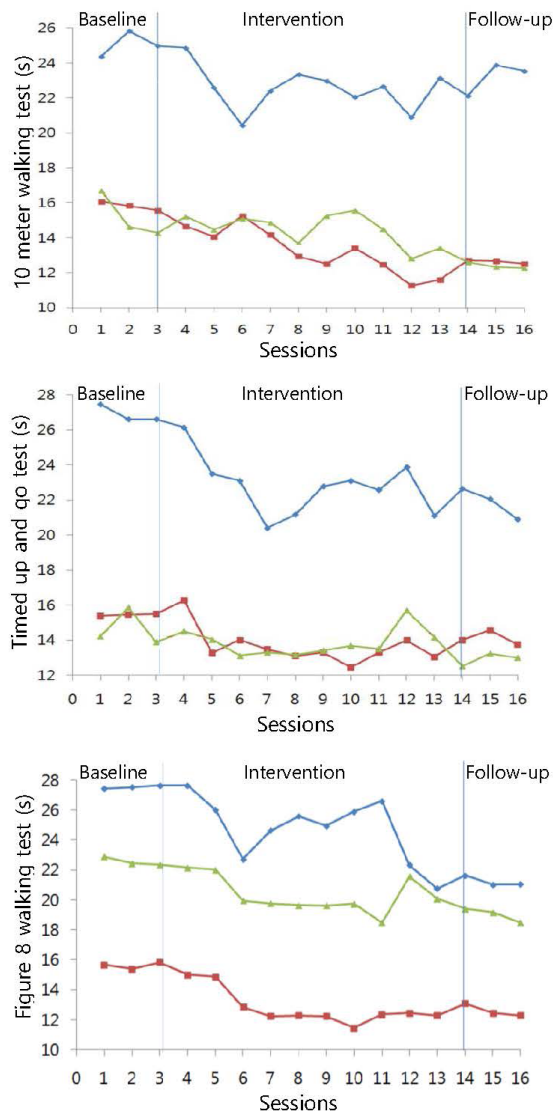


Figure1. The comparison of gait ability, ◆, Subject 1; ■, Subject 2; ▲, Subject 3

the no-intervention withdrawal phase. The values decreased in the intervention phase by 10.2%, 18.0%, and 10.0% and in no-intervention withdrawal phase by 22.9%, 19.3%, and 15.7% compared to in the baseline phase(Fig. 1).

### IV. Discussion

This study was carried out in order to verify actual applicability of mental practice in the clinical field by applying it to Parkinson disease patients. According to the result,

mental practice enhanced Parkinson disease patients' straight line gait, dynamic balance, and curve gait ability. This study utilized a single case study because it was able to continuously observe patients' performance ability in the clinical field and easy to apply and as a result treatment outcome of each patient was able to be evaluated. This study used an ABA design to compare effects in the baseline phase A, in the intervention phase B, and the no-intervention withdrawal phase A.

According to previous research, when mental practice and gait training were performed together on stroke patients, the experimental group's results of 10MWT, functional reach test, and Fugl-Meyer Motor Assessment lower extremity items were significantly different from the control group's. Among them, there was greatest improvement in their performance speed.<sup>16</sup> In the present study as well, performance speed in 10MWT improved. The reason is considered because direct imagination about gait and its beat was grafted onto the program and the cerebrum prepared and planned in advance, modifying existing errors.

That the subjects' functions improved after mental practice in TUG was the result of activating muscles, enhancing muscle strength, and activating the neurological system as in the research in which hemiplegic patients' mental practice increased the activation ratio of the paretic side quadriceps femoris muscle while they performed standing and sitting tasks through mental practice.<sup>17,18</sup>

There was positive improvement in F8WT as well. According to other case study results, mental practice was able to symmetrically provide weight load on both lower extremities.<sup>19</sup> During curved gait, improvement was made by having weight support on both lower extremities.

According to another research on stroke patients, mental practice of weight support increased weight load on the paretic side lower limb and triggered weight support on the bilateral lower extremities asymmetrically while going from sitting on a chair to standing from the chair rather than when performing training by preparing for and planning exercise; However, such training did not affect their performance speed.<sup>20</sup> Nonetheless, in the present study, performance speed of each item positively improved. Walk faster and faster and walk by

diverting in the content of mental training it is considered to have influenced the improvement of functional gait. The present study applied mental practice for ten days while it was performed for one day in existing research. However, relationship between intervention period and performance speed was not verified.

Limitations of this study was not able to properly control the learning effect of evaluation activities by repetitive evaluation and impossible to infer the population that does not use a statistical method. Therefore, in the future, research on a larger number of patients using different measurement tools is necessary to examine changes according to differing periods. To sum up the above study results, mental practice is regarded to contribute to straight line gait, dynamic balance, and curve gait control by stimulating the neurological system and muscular system. Therefore, it is considered that mental practice may be applied as a method of rehabilitation aimed at improving straight line gait, dynamic balance, and curve gait ability.

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