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BRIEF COMMUNICATION

Dance Intervention Using the Feldenkrais Method Improves Motor, and Non-Motor Symptoms and Gait in Parkinson's Disease: A 12-Month Study

Sung Hoon Kang,[1*] Jinhee Kim,[1*] Ilsoo Kim,[1] Young Ae Moon,[2] Sojung Park,[2] Seong-Beom Koh[1]

[1]Department of Neurology, Korea University Guro Hospital, Korea University College of Medicine, Seoul, Korea
[2]Representative Feldenkrais Training Institute of Korea, Seoul, Korea

ABSTRACT

Objective The aim of this study was to assess the effects of dancing (using the Feldenkrais method) on motor and non-motor symptoms, quality of life (QoL), and objective parameters of gait at the time of intervention and at the end of the 1-year study period.

Methods This was a single-arm study in which 12 subjects with Parkinson's disease (PD) received dance intervention during a 6-month period. Objective motor scales, gait analysis, and questionnaires on non-motor symptoms were evaluated at baseline and at 3, 6, and 12 months.

Results Dance intervention decreased motor scale (Unified Parkinson's Disease Rating Scale and Tinetti scale) scores and improved gait disturbance (gait velocity and step length) without increasing levodopa equivalent dose. Furthermore, dancing decreased non-motor scale (Non-Motor Symptoms Scale and Montgomery-Asberg Depression Rating Scale) scores and improved QoL.

Conclusion Our findings suggest that dance intervention can be a complementary management method for PD patients.

Keywords Dance; Gait; Motor; Non-motor; Parkinson's disease; Quality of life.

Several motor symptoms, such as gait disturbance and postural instability and non-motor symptoms in Parkinson's disease (PD), are not well regulated with dopaminergic therapy, resulting in lower quality of life (QoL).[1] In this regard, a large number of trials for complementary approaches have been performed to improve these symptoms in patients with PD.[2] Dance intervention based on the Feldenkrais method is a complementary approach to motion-related, perceptual learning[3] and has shown good effects on imbalance and gait disturbance,[4] which affect general motor scale scores, depression, and QoL in the elderly population. Thus, it was hypothesized that dance intervention would improve gait disturbance, general motor scale scores, depression, and QoL in patients with PD. This single-arm study investigated the effects of dancing on motor and non-motor functions in patients with PD.

MATERIALS & METHODS

Study design and participants

The present study was a 1-year, single-center, single-arm study of patients with PD. From June 2019 to July 2019, 12 prospectively recruited subjects with PD who visited the movement disorder clinic of Korea University Guro Hospital in Seoul, Korea, were recruited. Detailed inclusion and exclusion criteria are presented

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Corresponding author: Seong-Beom Koh, MD, PhD
Department of Neurology, Korea University Guro Hospital, Korea University College of Medicine, 148 Gurodong-ro, Guro-gu, Seoul 08308, Korea /
Tel: +82-2-2626-3169 / **Fax:** +82-2-2626-1257 / **E-mail:** parkinson@korea.ac.kr
*This authors contributed equally to this work.

in Supplementary Material 1 (in the online-only Data Supplement). After recruitment, subjects received a dance intervention based on the Feldenkrais method[5] in addition to classical dopaminergic medications (Supplementary Material 2 in the online-only Data Supplement). The intervention was performed once a week over a 6-month period. Baseline comprehensive motor function evaluations, including the Unified Parkinson's Disease Rating Scale (UPDRS),[6] Hoehn and Yahr stage,[7] and Tinetti scale;[8,9] gait analysis; and questionnaires on non-motor symptoms, including the Non-Motor Symptoms Scale (NMSS),[10] Montgomery-Asberg Depression Rating Scale (MADRS),[11] and Parkinson's Disease Questionnaire-39 (PDQ-39),[12] were completed for all subjects (Supplementary Material 3 in the online-only Data Supplement). Follow-up motor function evaluation, gait analysis, and questionnaires were performed after 3 and 6 months. The dance intervention was terminated at six months, and then subjects only received classical dopaminergic medications. The final follow-up motor function evaluation, gait analysis, and questionnaires were completed at 12 months (6 months after discontinuation of dance intervention). Three subjects did not attend more than 50% of the dance intervention and were excluded (Figure 1). Because subjects who dropped out during follow-up were unavailable for follow-up assessment, 9 subjects were included in the final analyses.

This study was approved by the Institutional Review Board of Korea University Guro Hospital (IRB No. 2019GR0023). Written informed consent was obtained from the patients.

Statistical analyses

To explore the effects of dancing on motor and non-motor symptoms in patients with PD, the Wilcoxon signed rank test was used for the UPDRS part III (UPDRS III), Tinetti scale, NMSS, MADRS, and PDQ-39 scores at baseline and at 3, 6, and 12 months. To investigate the effects of dancing on gait function, the Wilcoxon signed rank test was used for the parameters of gait velocity, cadence, step length, and step length covariance at baseline and at 3, 6, and 12 months.

All reported *p*-values were two-sided, and the statistical significance level was set at 0.05. All analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Patient demographics

The mean baseline age was 69.1 ± 4.3 years, and 4 of 9 (44.4%) patients were female. The mean duration to disease onset was 5.3 ± 3.7 years. The mean UPDRS III, Tinetti scale, NMSS, MADRS, and PDQ-39 scores at baseline were 18.2 ± 6.5, 24.8 ± 1.2, 29.7 ± 20.6, 10.3 ± 8.3, and 21.4 ± 15.5, respectively (Supplementary Table 1 in the online-only Data Supplement).

Effects of dancing on longitudinal motor symptoms

During the dance intervention, UPDRS III scores at 3 and 6 months were lower than at baseline, although without statistical significance (baseline vs. 3 months, $p = 0.092$; baseline vs. 6 months, $p = 0.438$). After the dance intervention, the UPDRS III

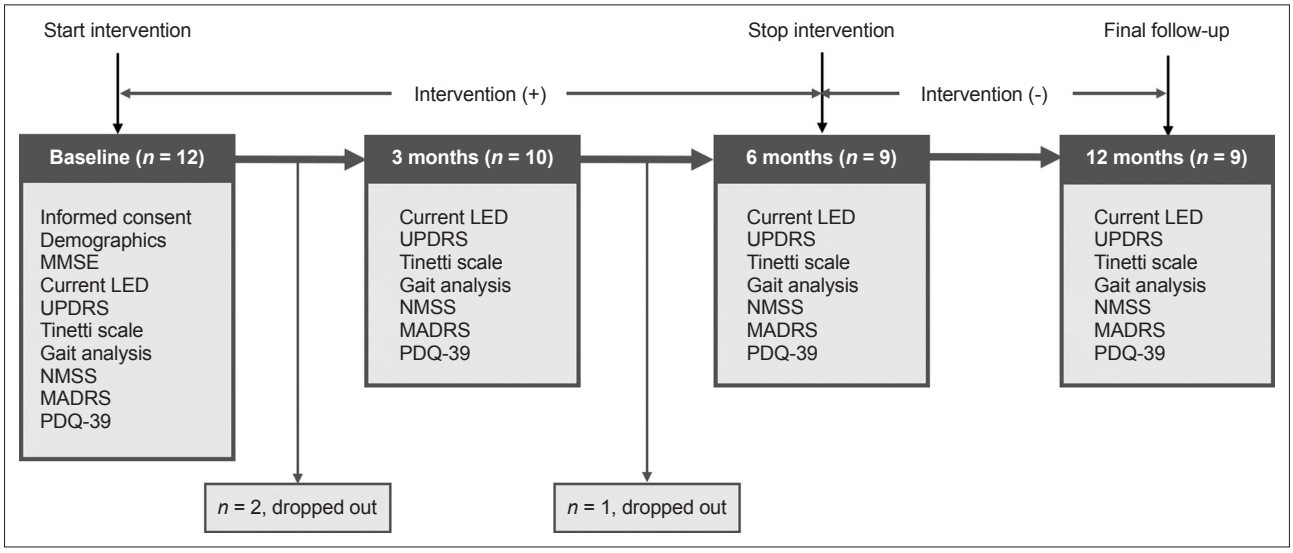

Figure 1. Flowchart of the study design. A total of 12 patients with Parkinson's disease underwent comprehensive evaluation for eligibility at baseline and were recruited for the study. After recruitment, the patients received dancing intervention for 6 months. During intervention, 3 patients dropped out, leaving 9 of 12 patients to complete all courses of dancing intervention and underwent follow-up evaluation at 3, 6, and 12 months. MMSE, Mini-Mental Status Examination; LED, levodopa equivalent dose; UPDRS, Unified Parkinson's Disease Rating Scale; NMSS, Non-Motor Symptoms Scale; MADRS, Montgomery-Asberg Depression Rating Scale; PDQ-39, Parkinson's Disease Questionnaire-39.

score at 12 months was significantly higher than that at baseline and at 3 and 6 months (baseline vs. 12 months, $p = 0.015$; 3 months vs. 12 months, $p = 0.011$; 6 months vs. 12 months, $p = 0.011$) (Figure 2A). Tinetti scale scores at baseline and at 3 and 6 months did not differ (baseline vs. 3 months, $p = 1.000$; baseline vs. 6 months, $p = 0.581$; 3 months vs. 6 months, $p = 0.458$); however, Tinetti scale scores at 12 months were lower than at baseline and at 3 months (baseline vs. 12 months, $p = 0.039$; 3 months vs. 12 months, $p = 0.020$) (Figure 2B). Furthermore, during the dance intervention, the levodopa equivalent dose (LED) was stable over 6 months; however, the LED was increased at 12 months after the dance intervention (Figure 2C).

Effects of dancing on longitudinal gait disturbance

Gait velocity (3 months vs. 6 months, $p = 0.028$) and step length (3 months vs. 6 months, $p = 0.011$) improved between 3 and 6 months. After dance intervention, gait velocity and step length worsened (Supplementary Figure 1A and C in the online-only

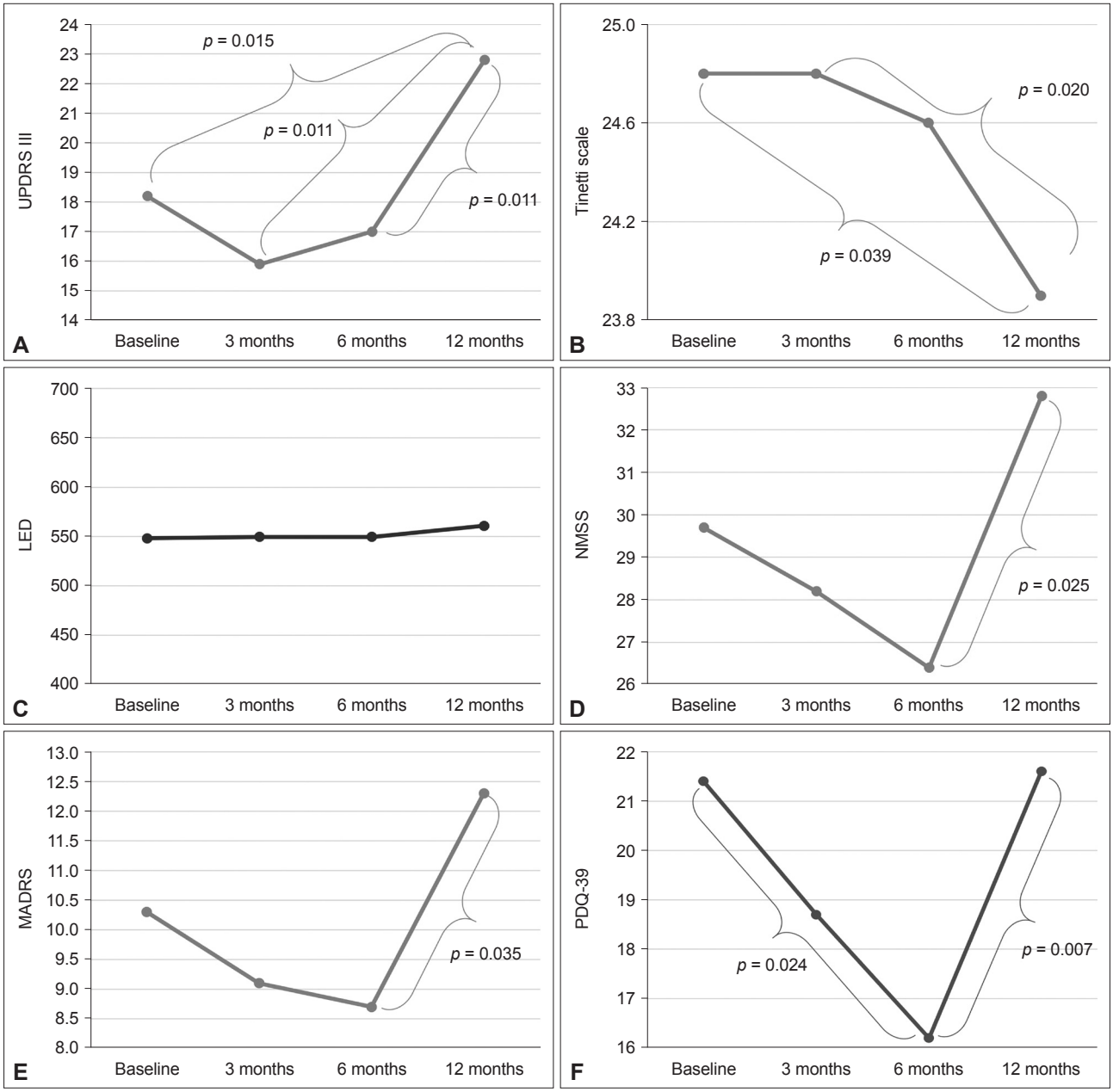

Figure 2. Longitudinal changes in motor and non-motor scales. Values depicted in the line plot represent mean UPDRS III (A), Tinetti scale (B), LED (C), NMSS (D), MADRS (E), and PDQ-39 (F) scores. UPDRS III, Unified Parkinson's Disease Rating Scale part III; LED, levodopa equivalent dose; NMSS, Non-Motor Symptoms Scale; MADRS, Montgomery-Asberg Depression Rating Scale; PDQ-39, Parkinson's Disease Questionnaire-39.

Data Supplement). Cadence was stable for 6 months during the dancing intervention but increased at 12 months after the dance intervention (Supplementary Figure 1B in the online-only Data Supplement). However, cadence was not significantly different at baseline vs. 3 months ($p = 0.678$), 3 months vs. 6 months ($p = 0.859$), and 6 months vs. 12 months ($p = 0.192$). Step length covariance decreased over the 6-month period but increased at 12 months; however, the changes were not statistically significant during follow-up (Supplementary Figure 1D in the online-only Data Supplement).

Effects of dancing on longitudinal non-motor symptoms

During the dancing intervention, NMSS scores decreased steadily from baseline to 3 and 6 months, although without statistical significance (baseline vs. 3 months, $p = 0.859$; baseline vs. 6 months, $p = 0.312$; 3 months vs. 6 months, $p = 0.260$). After the dance intervention, the NMSS score at 12 months was significantly higher than that at 6 months (6 months vs. 12 months, $p = 0.025$) (Figure 2D). The MADRS score decreased steadily from baseline to 3 and 6 months, although without statistical significance (baseline vs. 3 months, $p = 0.234$; baseline vs. 6 months, $p = 0.154$; 3 months vs. 6 months, $p = 0.766$). After dance intervention, the MADRS score at 12 months was significantly higher than that at 6 months (6 months vs. 12 months, $p = 0.035$) (Figure 2E). The PDQ-39 score decreased steadily from baseline to 3 and 6 months, and the scores at 6 months were significantly lower than those at baseline ($p = 0.024$). However, because the score increased after the dance intervention, the PDQ-39 scores at 12 months were higher than those at 6 months ($p = 0.007$) (Figure 2F).

DISCUSSION

In the present study, the effects of dancing on motor or non-motor symptoms in patients with PD were investigated. The major findings showed that dancing decreased motor scale scores and improved gait disturbance without increasing LED, decreased the non-motor scale scores, and improved QoL. Taken together, the results indicated that dancing can be an alternative therapy for the management of various symptoms in PD.

As expected, dancing decreased the motor scale (UPDRS III and Tinetti scale) scores and improved gait disturbance. Specifically, the UPDRS III score, representing the severity of motor symptoms in PD, decreased over the first 6 months when subjects received the dancing intervention despite stable LED. However, after discontinuing dance intervention, the UPDRS III score sharply increased at 12 months. The Tinetti scale score, which represents the severity of imbalance and gait disturbance, showed a similar pattern to the UPDRS III score. Although it was not possible to compare the progression of motor symptoms between groups with and without dance intervention due to the study design, when considering the features of degenerative disease, dancing might have positive effects on motor symptoms in PD. In addition, gait parameters of velocity, step length, and step length covariance improved during dance intervention. To the best of our knowledge, this was the first report in which the relationship between dancing (based on the Feldenkrais method) and objective motor scale scores in patients with PD was presented. In terms of non-motor symptoms, dancing decreased the non-motor scale (NMSS and MADRS) scores and improved QoL (PDQ-39). These findings were consistent with the results in a previous study showing that the Feldenkrais method could affect depressive symptoms and the QoL of patients with PD.[13]

The present study had several limitations. First, the sample size was relatively small because this was a pilot study. Second, the effects of dancing on motor or non-motor symptoms were modest. In particular, a multiple comparisons correction, which might lead to Type I error, was not performed. However, because this was an exploratory study, the multiple comparison correction might result in overlooking the important associations shown in the preliminary analysis. Further studies using large sample size and randomized controlled trial design are needed to confirm our results. Nevertheless, the study results are noteworthy because this is the first report showing the effects of dancing on objective motor scale scores in patients with PD. Because frequent falls due to imbalance and gait disturbance are not well controlled with medical treatment and closely associated with poor prognosis and mortality in patients with PD, the findings indicate that dance intervention might be a complementary management for PD, although further studies are needed to support the results.

Supplementary Materials

The online-only Data Supplement is available with this article at https://doi.org/10.14802/jmd.21086.

Conflicts of Interest

The authors have no financial conflicts of interest.

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None.

Author Contributions

Conceptualization: Seong-Beom Koh. Data curation: Jinhee Kim, Ilsoo Kim, Young Ae Moon, Sojung Park. Formal analysis: Sung Hoon Kang, Jinhee Investigation: Sung Hoon Kang, Jinhee Kim. Methodology: Jinhee Kim, Seong-Beom Koh. Project administration: Seong-Beom Koh. Supervision: Seong-Beom Koh. Visualization: Sung Hoon Kang. Writing—original draft: Sung Hoon Kang. Writing—review & editing: Sung Hoon Kang, Seong-Beom Koh.

ORCID iDs

Sung Hoon Kang https://orcid.org/0000-0002-2481-0302

Jinhee Kim https://orcid.org/0000-0002-1004-7385
Ilsoo Kim https://orcid.org/0000-0002-5217-3427
Sojung Park https://orcid.org/0000-0003-1514-7120
Seong-Beom Koh https://orcid.org/0000-0002-9411-4863

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SUPPLEMENTARY MATERIAL 1

Inclusion and exclusion criteria

Subjects who fulfilled the following criteria were included: 1) 45−75 years of age, 2) diagnosis of Parkinson's disease (PD) based on the UK Brain Bank criteria,[8] and 3) Hoehn and Yahr stage[9] 1−3. Patients with any of the following conditions were excluded: 1) severe cognitive impairment (Mini-Mental State Examination [MMSE][10] score < 20), 2) visual or hearing impairment, 3) psychosis, 4) conditions affecting physical performance other than PD such as musculoskeletal problem, severe lumbar stenosis, or severe cardiopulmonary disease, 5) severe white matter hyperintensities (WMHs), which were defined as deep WMHs ≥ 25 mm and periventricular WMHs ≥ 10 mm on fluid attenuated inversion recovery image, and 6) territorial infarction or lobar hemorrhage.

SUPPLEMENTARY MATERIAL 2

Dancing intervention

One-hour sessions were held once per week for 6 months (total 24 sessions) using the Feldenkrais method.[5] The content of the sessions was based on common Feldenkrais themes as previously described in detail, with calming music, focusing on balance and mobility. All sessions were conducted by a certified Feldenkrais teacher.

SUPPLEMENTARY MATERIAL 3

Assessment of outcomes in motor scales, gait parameters, and non-motor symptoms

All subjects underwent comprehensive Parkinson's disease (PD) evaluation including history taking, neurological examination, determination of Hoehn and Yahr stage,[7] and motor function severity. The degree of motor function severity was quantified using the Unified Parkinson's Disease Rating Scale (UPDRS).[6] For consistent evaluation, we always assessed the UPDRS at 9:00 am. Balance and gait function were assessed using the Tinetti scale, which includes 17 items. The items were divided into two domains: balance (9 items, 16 points) and gait (8 items, 12 points). The scores on the Tinetti scale range from 0−28, with higher scores indicating better balance and gait function.[8,9]

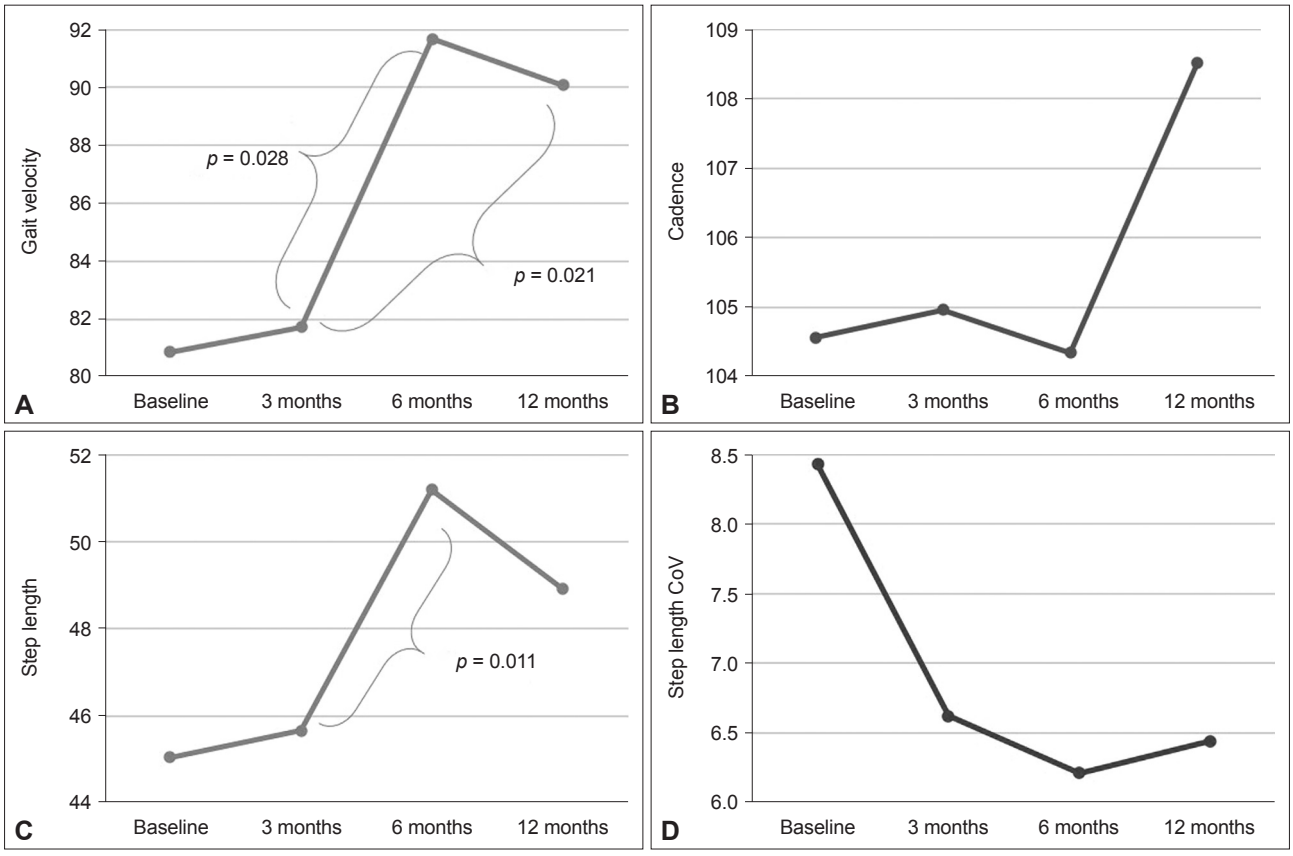
All subjects underwent comprehensive gait evaluation regarding spatial and temporal parameters of gait dynamics using the GAITRite system (CIR System Inc., Franklin, NJ, USA) with a 4.6-meter-long walkway. Average spatiotemporal parameters such as gait velocity, cadence, step length, and step length covariance were calculated after the subject walked forward 10 times.

Non-motor symptoms were assessed using the Non-Motor Symptoms Scale (NMSS), which contains 30 items. The scores on the NMSS range from 0−360, with higher scores indicating higher severity and frequency of non-motor symptoms.[10] Depression was assessed using the Montgomery-Asberg Depression Rating Scale (MADRS), which includes 10 items, each scored from 0−6 points. The total score on the MADRS ranges from 0−60, with higher scores indicating more severe depression.[11] Quality of life (QoL) of patients with PD was assessed using the Parkinson's Disease Questionnaire-39 (PDQ-39), which is composed of 39 items to cover the eight domains of mobility, activities of daily living, emotional well-being, stigma, social support, cognition, communication, and body discomfort. The scores on the PDQ-39 range from 0−100, with higher scores indicating poor QoL.[12]

Supplementary Table 1. Clinical features of patients at baseline (*n* = 9)

Patients with PD	Values
Demographics	
Age, yr	69.1 ± 4.3
Female	4 (44.4)
Duration to disease onset, yr	5.3 ± 3.7
Education, yr	9.8 ± 4.0
Baseline evaluation	
MMSE	27.9 ± 1.5
UPDRS III	18.2 ± 6.5
LED	548.3 ± 232.7
Tinetti scale	24.8 ± 1.2
NMSS	29.7 ± 20.6
MADRS	10.3 ± 8.3
PDQ-39	21.4 ± 15.5

Values are presented as mean ± standard deviation or number (%). PD, Parkinson's disease; MMSE, Mini-Mental Status Examination; UPDRS III, Unified Parkinson's Disease Rating Scale part III; LED, levodopa equivalent dose; NMSS, Non-Motor Symptoms Scale; MADRS, Montgomery-Asberg Depression Rating Scale; PDQ-39, Parkinson's Disease Questionnaire-39.



Supplementary Figure 1. Longitudinal changes in gait analysis. Values depicted in the line plot represent mean gait velocity (A), cadence (B), step length (C), and step length CoV (D). CoV, covariance.