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Original article

Effects of 3-4 Weeks of Multimodal Complex Treatment for Parkinson's Disease on Motor Function and Quality of Life: A Retrospective Study

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Abstract

Purpose: The effectiveness of multimodal complex treatment for Parkinson's disease (PD-MCT) has recently attracted attention. However, there are differences in the PD-MCT content across institutions. Therefore, we aimed to elucidate the effectiveness of PD-MCT at our hospital and contribute to determining the optimal intensity and duration of the intervention.

Methods: This retrospective study enrolled 144 inpatients who underwent PD-MCT at our hospital between March 2015 and June 2023. The primary endpoints were the Movement Disorder Society-Unified Parkinson's Disease Rating Scale part III (MDS-UPDRS part III) before and after admission to assess motor function, and the Parkinson's Disease Questionnaire-39 summary index (PDQ-39 SI) before admission and 1 month after discharge to assess quality of life. The PD-MCT at our hospital was conducted during a 3-4-weeks hospital stay, with approximately 12 h of rehabilitation per week. After selecting participants with no missing data, 58 were selected for the MDS-UPDRS part III comparison, and eight were selected for the PDQ-39 comparison. The analysis was conducted using a paired t-test for normally distributed data and a Wilcoxon signed-rank sum test for non-normally distributed data, with a significance level of 5%.

Results: The total score of MDS-UPDRS part III was 34.7 ± 13.3 before admission and 28.6 ± 12.3 at discharge, and the PDQ-39 SI was 34.0 ± 13.5 before admission and 23.9 ± 9.9 1 month after discharge, showing significant improvement ($p < 0.01$ and $p < 0.05$, respectively).

Conclusion: Motor function and quality of life significantly improved in this study. In particular, the improvement in the quality of life was sustained even 1 month after discharge. However, the study was retrospective, and many participants were excluded during the selection process, which may have caused a selection bias.

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Introduction

Parkinson's disease (PD) is a progressive condition that affects both mental and motor functions due to decreased dopamine secretion resulting from the degeneration of the substantia nigra[1]. Treatment is centered on pharmacotherapy, but non-pharmacological interventions, such as rehabilitation and psychological care, also play a major role in maintaining and improving the psychomotor functions of patients[2]. In addition, as PD is progressive, patients' active participation in their treatment, such as understanding the disease and participating in various activities, significantly influences treatment effectiveness.

Because of the importance of multimodal complex treatment for patients with PD, a multimodal complex treatment concept for PD (PD-MCT) has been implemented in Germany by a multimodal complex team including physicians, pharmacists, dietitians, nurses, care workers, clinical psychologists, physical therapists, occupational therapists, speech therapists, and care support specialists[3].

Despite numerous reports on the effectiveness of PD-MCT in recent years, there is a lack of uniformity in these findings. The efficacy of PD-MCT varies greatly not only from country to country but also among providers in the same country[4]. In addition, the importance of using subjective evaluation scales as indices of the effectiveness of interventions for patients with PD has attracted attention in recent years, especially for the evaluation of quality of life (QOL)[5]. A systematic review[6] comparing the QOL of patients with PD with that of healthy participants found that the QOL of patients with PD was significantly lower than that of healthy participants, particularly in terms of motor function. Therefore, improving QOL in terms of motor function is an important aspect of therapeutic interventions for patients with PD. It is imperative to urgently clarify the effective intervention period and intensity for improving QOL with PD-MCT.

The duration of hospitalization and the hours of rehabilitation per week (duration/intensity) of PD-MCT performed at our hospital consisted of 3-4 weeks/12 h, and the duration of hospitalization and intervention intensity were between 4 weeks/21 h[7] and 2 weeks/7.5 h[8].

This study aimed to examine changes brought about by PD-MCT in the Movement Disorder Society Unified Parkinson's Disease Scale part III (MDS-UPDRS part III), a comprehensive evaluation scale for PD, and the Parkinson's Disease Questionnaire-39 (PDQ-39), a QOL scale specifically designed for patients with PD to determine the duration and intensity of intervention in PD-MCT.

Methods

Study design

This was a retrospective cohort study.

Participants

The participants included 144 patients who underwent PD-MCT (first session only) at our hospital between March 2015 and June 2023. Exclusion criteria were a diagnosis other than PD, severe mental or medical problems that prevented therapeutic intervention, and missing data in the collected data. This study was approved by the Ethics Committee of Aino Hospital.

Data collection

Basic information such as height, weight, sex, age, duration of PD, number of days hospitalized, Hoehn & Yahr (H-Y) classification at admission, hours of rehabilitation during the week, levodopa equivalent daily dose (LEDD) and the Mini Mental State Examination (MMSE) score at admission, Geriatric Depression Scale 30 (GDS-30) score at admission, MDS-UPDRS part III score at admission and discharge, and PDQ-39 at admission and within 30 ± 7 days after discharge were collected from the medical records.

Implementation procedure

First, the history of PD-MCT was retrieved from the patients' medical records, and only patients who were first-time PD-MCT users were selected. Next, patients diagnosed with PD who had no deterioration of their general condition or refused to participate in the program during hospitalization were selected, and basic information on these patients was collected. The dataset was constructed from patients with no deficits in the MMSE, GDS-30, MDS-UPDRS part III, or PDQ-39 on admission. The first analysis included patients who completed the MDS-UPDRS part III at discharge, and the second analysis included patients who were assessed with the PDQ-39 within 30 ± 7 days after discharge.

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Multimodal complex treatment

Team members included physicians, nurses, pharmacists, physical therapists, occupational therapists, speech therapists, clinical psychologists, dietitians, and social workers. The program included rehabilitation performed by rehabilitation specialists, medication counseling by pharmacists, dietary guidance by dietitians, and psychological counseling by clinical psychologists, with conferences held in the 1st and 3rd weeks to share information and determine future plans. Other programs include tea conversation meetings once or twice per hospitalization, a singing group (voluntary participation) once a week, Aino's Parkinson's dance® (about 30 min) twice a week, and tactile care once a week (Table 1).

Our PD-MCT encourages patient interaction through tea conversation meetings and Aino's Parkinson's dance®. Aino's Parkinson's dance® is a seated-based program consisting of "warm-up," "upper limb movement," "lower limb movement," "center of gravity shift," and "cool-down." The dance arrangement was created by physical and occupational therapists at the hospital, incorporating a "combination of simple movements," "repetition," and "concrete visualization of movements."

Outcome

The primary outcome was the total score of the MDS-UPDRS part III, and the scores of the questionnaire items were classified into four subscales: rigidity (No.3), tremor (No.15, 16, 17, and 18), bradykinesia (No.2, 4, 5, 6, 7, 8, and 14), and axial symptoms (No.1, 9, 10, 11, 12, and 13).

The secondary outcome was the PDQ-39, which consists of 39 questions (156 points) in eight domains (mobility, activities of daily living, emotional well-being, stigma, social support, cognition, communication, and bodily discomfort)[9].

In this study, the PDQ-39 Summary Index (PDQ-39 SI)[9], which standardizes the total score to a 100-point scale and the total score for each of the eight domains, was used. The PDQ-39 was completed by the patients themselves, and the MDS-UPDRS Part III was evaluated by therapists trained in the evaluation method.

Statistics

The MDS-UPDRS part III items (total, rigidity, tremor, bradykinesia, and axial symptoms) and PDQ-39 items (SI, mobility, activities of daily living, emotional well-being, stigma, social support, cognition, communication, and bodily discomfort) were compared before and after the PD-MCT.

For each value, normality was determined using the Shapiro-Wilk test. The paired t-test was used for normally distributed data, Wilcoxon signed-rank sum test for non-normally distributed data, and McNemar's test for nominal scales. For each effect size, Cohen's d was calculated for the paired t-test, and r was calculated by dividing the statistical test quantity converted to Z by $\sqrt{N}$ for the Wilcoxon signed rank sum test. SPSS statistics version 2 was used for all statistical analyses, with a significance

Table 1. One-week program of PD-MCT

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
9:00~9:45							Rest day
9:45~10:30	OT	OT	OT	OT	OT	OT	
10:30~11:15	ST	ST	ST	ST	ST	ST	
11:15~12:00							
12:00~13:00	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	
13:0013:45	Medication counseling	Psychological counseling			Dietary guidance		
13:45~14:30	PT	PT	PT	PT	PT	PT	
14:30~15:15					Singing group	Tea conversation meetings	
15:15~16:00							
16:00~16:45	Aino's Parkinson's dance®		Tactile care	Aino's Parkinson's dance®			
17:00~							

OT, occupational therapy; ST, speech therapy; PT, physical therapy

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level of 5%.

Results

Fifty-eight participants were included in the first analysis, and eight were included in the second analysis (Figure 1). The participants' characteristics (first/second measurement points) were as follows: duration of disease, 7.1 ± 5.8/6.9 ± 5.5 years; hospitalization, 24.9 ± 4.2/22.9 ± 3.8 days; rehabilitation time per week, 11.6 ± 1.3/12.1 ± 0.7 h; and LEDD 505 ± 246 mg/430 ± 159 mg per week. The number of women and Hoehn and Yahr stages 3, and 4 were significantly different (Table 2). The changes in the MDS-UPDRS part III before and after the PD-MCT showed significant improvements in all items (Table 3), and the changes in the PDQ-39 showed significant improvements in the dimensions of PDQ-39 SI, mobility, activities of daily living, and bodily discomfort (Table 4).

Discussion

In this study, we retrospectively investigated the effectiveness of PD-MCT (3-4 weeks, 12 h/week) performed at our hospital to determine the appropriate length of hospitalization and rehabilitation hours for PD-MCT.

The MDS-UPDRS part III change in this study was −6.1 points, which was higher than the minimal clinically important difference (MCID) of −3.25 points[9]. It was also comparable to the −4.8 score reported by Scherbaum et al.[8] (2 weeks/7.5 h), who conducted a PD-MCT intervention similar to that in the present study. The comparison of changes in the MDS-UPDRS part III showed significant improvements in all sub-items including rigidity, tremor, bradykinesia, and axial symptoms, with particularly high effect sizes for bradykinesia and axial symptoms. In our PD-MCT rehabilitation program, we used muscle-strengthening and balance-strengthening exercises to address the individual physical function problems of patients. In previous studies, such rehabilitation programs were effective in treating drug-resistant axial symptoms, and PD-MCT in the present study was

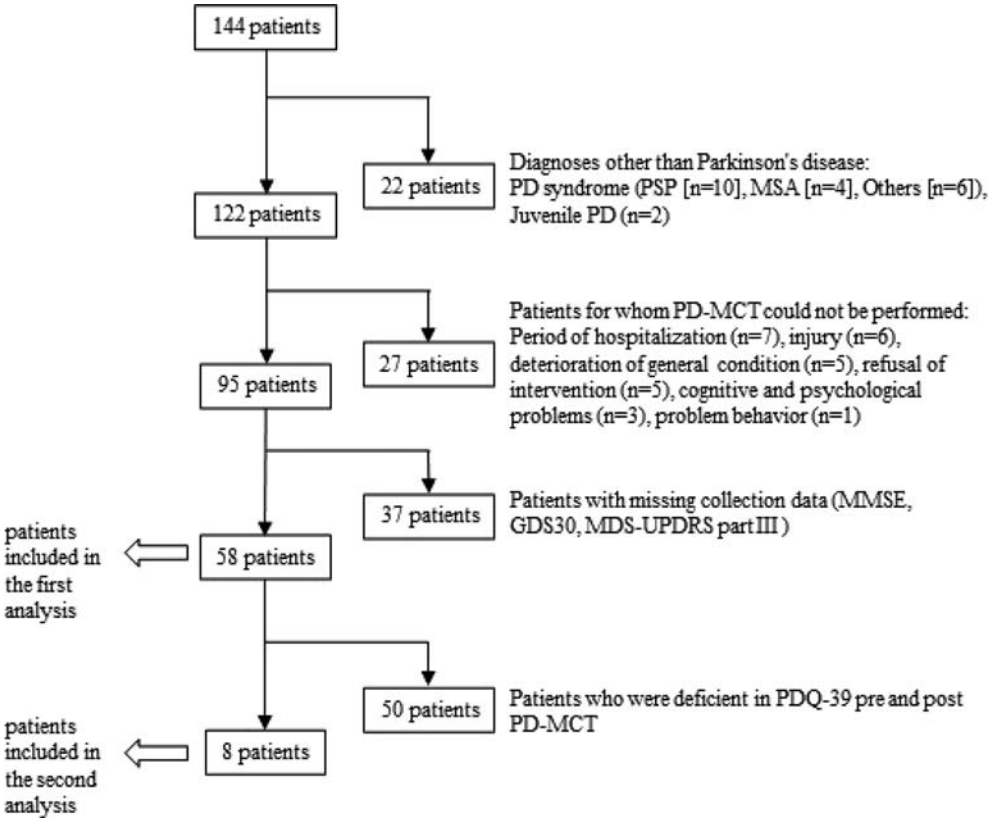

Figure 1. Participant recruitment chart

PD syndrome, Parkinson's disease syndrome; PSP, progressive supranuclear palsy; MSA, multiple system atrophy; PD-MCT, Parkinson's disease - Multimodal complex treatment; MMSE, Mini-Mental State Examination; GDS 30, Geriatric Depression Scale 30; MDS-UPDRS part III, Movement Disorder Society Unified Parkinson's Disease Scale part III; PDQ-39, Parkinson's Disease Questionnaire-39

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Table 2. Participants' basic information

	Patients included in the first analysis (n=58)	Patients included in the second analysis (n=8)	*p*-value
Female, n	23 (40)	4 (57)	$p < 0.001$
Age, year	73.4 ± 7.1	70.3 ± 5.0	$p = 0.201$
Height, cm	157.8 ± 10.2	154.8 ± 9.7	$p = 0.629$
Weight, kg	55.0 ± 12.6	51.8 ± 10.2	$p = 0.746$
Duration of disease, year	7.1 ± 5.8	6.9 ± 5.5	$p = 0.652$
Hoehn and Yahr stage, n			
1	1 (2)	1 (13)	$p = 0.077$
2	6 (10)	2 (25)	$p = 1.000$
3	31 (53)	3 (38)	$p < 0.001$
4	18 (31)	2 (25)	$p = 0.025$
5	2 (3)	0 (0)	$p = 0.114$
Period of hospitalization, day	24.9 ± 4.2	22.9 ± 3.8	$p = 0.410$
Intervention hours per week, time/week	11.6 ± 1.3	12.1 ± 0.7	$p = 0.742$
MMSE, points	25.9 ± 3.7	27.8 ± 2.4	$p = 0.394$
GDS 30, points	15.1 ± 6.6	11.1 ± 4.3	$p = 0.130$
LEDD, mg/day	505 ± 246	430 ± 159	$p = 0.599$

Nominal variable, n (%); continuous variable, mean ± SD; MMSE, Mini-Mental State Examination; GDS 30, Geriatric Depression Scale 30; LEDD, levodopa equivalent daily dose

Table 3. Comparison of MDS-UPDRS part III pre and post PD-MCT

	Pre	Post	ΔPre-Post	*p*-value	effect size
MDS-UPDRS partIII, points					
total	34.7 ± 13.3	28.6 ± 12.3	6.1 ± 5.6	$p < 0.01$	cohen's $d = 1.09$
Rigidity	7.7 ± 3.9	6.8 ± 4.0	1.0 ± 2.4	$p = 0.030$	cohen's $d = 0.41$
Tremor	3.4 ± 3.5	2.7 ± 2.9	0.7 ± 0.6	$p = 0.045$	$r = 0.26$
Bradykinesia	14.5 ± 7.3	11.7 ± 6.3	2.7 ± 3.6	$p < 0.01$	cohen's $d = 0.75$
Axial Symptons	9.1 ± 7.5	7.5 ± 4.5	1.6 ± 1.9	$p < 0.01$	cohen's $d = 0.85$
LEDD, mg/day	505 ± 246	528 ± 294	-23 ± 152	$p = 0.244$	—

Nominal variable, n (%); continuous variable, mean ± SD; LEDD, levodopa equivalent daily dose

Table 4. Comparison of PDQ-39 pre and post PD-MCT

	Pre	Post	ΔPre-Post	*p*-value	effect size
PDQ-39, points					
SI	34.0 ± 13.5	23.9 ± 9.9	10.2 ± 7.9	$p = 0.014$	cohen's $d = 1.16$
Mobility	22.3 ± 9.9	15.9 ± 8.8	6.4 ± 5.6	$p = 0.014$	cohen's $d = 1.14$
Activities of daily living	10.1 ± 6.2	7.0 ± 5.3	3.1 ± 3.6	$p = 0.046$	cohen's $d = 0.86$
Emotional well-being	7.3 ± 4.6	5.1 ± 3.3	2.1 ± 3.2	$p = 0.105$	—
Stigma	2.1 ± 2.0	2.0 ± 1.3	0.1 ± 0.9	$p = 0.857$	—
Social support	0.9 ± 1.1	0.8 ± 0.9	0.1 ± 1.2	$p = 0.785$	—
Cognitions	5.0 ± 3.3	3.5 ± 1.9	1.5 ± 2.6	$p = 0.149$	—
Communication	2.1 ± 2.2	1.0 ± 1.1	1.1 ± 1.9	$p = 0.197$	—
Bodily discomfort	3.4 ± 2.4	2.0 ± 2.3	1.4 ± 1.2	$p = 0.014$	cohen's $d = 1.16$
LEDD, mg/day	430 ± 159	485 ± 254	-56 ± 162	$p = 0.363$	—

Nominal variable, n (%); continuous variable, mean ± SD; LEDD, levodopa equivalent daily dose

considered effective in improving these symptoms.

The MCID of the PDQ-39 SI was reported at −1.6 points[10], whereas the change in the present study was −10.2 points approximately 4 weeks after discharge, indicating sufficient improvement. Scherbaum et al. (2 weeks/7.5 h)[8] reported that the effect was not maintained after 6 weeks. Mullar et al.[11] reported that PD-MCT was highly effective during a hospitalization period of approximately 21 days. In the present study, sufficient improvement was observed as measured with the MDS-UPDRS part III, and a sustained effect was demonstrated with the PDQ-39. This sustained effect, not observed in the 2-week intervention, suggests that 3 weeks or longer may be preferable as an effective period for PD-MCT in terms of a sustained effect on QOL. Marumoto et al.[12] compared the effects of a rehabilitation professional-centered intervention (Medical Rehabilitation: MR) and an intervention involving various means such as dance, music therapy, and other education and guidance (enhanced multidisciplinary care: EMC) and reported that the EMC group showed significantly improved QOL, axial symptoms, and non-motor symptoms compared to the MR group. In addition to rehabilitation, our PD-MCT program also includes tea conversation meetings, a singing group, and Aino's Parkinson's dance®. Various other activities are conducted in addition to rehabilitation, and it is possible that the effects of these interventions may be apparent.

The PDQ-39 sub-items showed significant improvement, especially those related to physical function such as mobility (Cohen's $d = 1.14$), activities of daily living (Cohen's $d = 0.86$), and bodily discomfort (Cohen's $d = 1.16$). In contrast, Ferrazzoli et al.[7], whose study had a similar length of hospitalization to that of the present study, reported significant improvements in all items except stigma, which may have been influenced by differences in intervention intensity (12 h in the present study and 21 h in the study of Ferrazzoli et al.[7]).

Based on the above, it is assumed that a length of hospitalization of 3 weeks or longer is preferable for PD-MCT. However, if a higher intervention intensity is effective in improving QOL, a length of hospitalization of 3 weeks or less may be sufficient. In addition to interventions by rehabilitation professionals, it has become clear that the involvement of multiple professions improves QOL; therefore, it is important to build an organization that allows the organic involvement of multiple professions. Recommendations for the organization of PD-MCT were proposed by Danique et al.[13] in 2020, and the accumulation of knowledge and information sharing regarding the organization of PD-MCT based on these recommendations will be an issue for the future. Complications in the introduction of PD-MCT include the complexity of the paperwork and the need for continued human resource development. The staff is burdened with sharing PD-MCT information, holding conferences, and training personnel to provide high quality treatment in addition to their busy normal schedule.

A limitation is this study is its retrospective nature, and there is a high possibility of selection bias in the results owing to the large number of dropouts. In other words, it is possible that participants who showed high adherence were easier to follow up, and as a result, participants who were more likely to maintain the effect of QOL improvement may have remained. In addition, it is difficult to verify the effectiveness of individual efforts because the PD-MCT is the result of an intervention involving various occupations.

Conclusion

The effectiveness of our PD-MCT (3-4 weeks/12 h) was verified, and a certain level of improvement in motor function and QOL was achieved. Further studies are required to determine whether shorter periods of PD-MCT are effective.

Conflict of Interest

The authors have no conflict of interest to declare.

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