

Original Article



KSNR Clinical Consensus Statements: Rehabilitation of Patients with Parkinson's Disease

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HIGHLIGHTS

- For setting the therapeutic goals for patients with Parkinson's disease (PD), rehabilitation specialist should confirm the disease diagnosis and progression of individual patients with PD.
- It is recommended for clinicians to assess the motor (gait, mobility, or balance), cognition, speech and swallowing function in patients with PD and to include a barrier or facilitator (environmental or personal factors) for evaluating their function and outcomes of the interaction between health condition and those factors.
- Assessment of functional status for rehabilitation in patients with PD is recommended at the time of diagnosis. Evaluation of function is recommended regularly every 3 to 6 months for patients who are receiving rehabilitation and every 6 to 12 months if not treated.
- The assessments of gait and balance function in patients with PD should be done with the diagnosis of the disease, and periodic assessments as the disease progresses should be performed at least a 3-month interval. The assessments of gait and balance function in patients with PD are recommended using the Unified Parkinson's Disease Rating Scale and Berg Balance Scale near to the same time as possible during the follow-up evaluation.
- To improve balance and gait in patients with PD, various rehabilitation approaches including aerobic exercise, balance exercise, aquatic exercise, dancing exercise, virtual reality, activity of daily living (ADL) training, Lee Silverman Voice Treatment (LSVT) BIG program, task-oriented occupational therapy, and self-exercise programs are needed.
- Patients with PD should be evaluated regularly regarding their ADLs since the first visit of clinics especially when an evaluation of therapeutic effect or a decision of therapeutic strategies is required.
- Occupational therapy is recommended for patients with PD who have limitations in ADLs. And treatment should be provided based on specific knowledge and understanding of PD with consideration of the individual needs and circumstances of the patient.
- Patients with PD who are suspected of swallowing disorder or those with a high risk of swallowing disorder (excessive drooling, excessive weight loss, frequent aspiration) need

to perform a videofluoroscopic swallowing study or fiberoptic endoscopic evaluation of swallowing.

- Patient and caregiver education about swallowing disorder should be provided at the early stage of PD. And compensatory approaches including chin tuck, external cues, and thickeners, and restorative approaches including LSVT and expiratory muscle strength training, can be considered for swallowing rehabilitation in patients with PD depending on the swallowing problems experienced by the patient.
- Communication disorders in patients with PD may occur at an early stage and require a careful observation because they greatly affect the quality of life of patients. Although there are no validated assessment tools yet, with difficulty in adjusting the volume of voice, caregiver education and careful observation are needed.
- Effective communication strategies should be developed and taught to patients and caregivers in the early stages of PD and speech and language therapy such as LSVT and compensation methods using instrumental aids should be considered according to the patient's communication ability.

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
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ABSTRACT

Clinical consensus statements (CCSs) aim to improve care for patients with Parkinson's disease (PD) and reduce the variability of rehabilitation methods in clinical practice. A literature search was conducted to find available evidence on the rehabilitation of patients with PD and to determine the scope of CCSs. The selection of PD rehabilitation domains and key questions was done using the modified Delphi method in 43 expert panels. These panels achieved a consensus on 11 key questions regarding rehabilitation assessment and goal setting, gait and balance, activities of daily living, and swallowing and communication disorders. After the completion of an agreement procedure, 11 key consensus statements were developed by the consensus panel. These statements addressed the needs of rehabilitation as a continuum in patients with PD. They included the appropriate rehabilitation initiation time, assessment items, rehabilitation contents, and complication management. This agreement can be used by physiatrists, rehabilitation therapists, and other practitioners who take care of patients with PD. The consensus panel also highlighted areas where a consensus could not be reached. The development of more focused CCS or clinical practice guidelines that target specific rehabilitation approaches is considered the next needed step.

Keywords: Consensus; Parkinson's disease; Rehabilitation

INTRODUCTION

Parkinson's disease (PD) is the second most common progressive neurodegenerative disorder after Alzheimer's dementia. It causes various motor manifestations which make it difficult to perform the activities of daily living (ADLs). The need for PD rehabilitation has been emphasized as a social problem for the aging population. Recently, there has been an increase in the number of degenerative diseases that limit the performance of a patient's ADLs. An example of such diseases is PD.

There is evidence that a multidisciplinary approach for patients with PD leads to an increase in community health care and the patient's quality of life (QoL) [1,2]. This often involves education of the patient and his family, assessment of functions and complications, and rehabilitation therapy. There is a variation in the management of patients with PD among

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Conflict of interest

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primary, secondary, and tertiary hospitals. The same holds true for inpatient units and outpatient clinics. In order to improve the QoL for PD patients, it is necessary to prepare a medical environment where patients can receive a certain level of care at any medical institution. However, evidence-based recommendations from systematic reviews have been difficult to elicit because the randomized control trials conducted on the rehabilitation of Korean patients with PD have been minimal.

The clinical consensus statements (CCSs) can be defined as statements based on expert opinions and the best available research which seek to identify—using an explicit a priori methodology—a consensus between areas of agreement and disagreement. These, therefore, form a combined version of the narrative review [3]. The CCS is most applicable to situations where the evidence base is insufficient for a clinical practice guideline (CPG); however, significant changes in practice exist with opportunities for quality improvement [3]. Thus, the Korean Society for Neurorehabilitation (KSNR) launched a task force and consensus panel composed of experts on brain disorder rehabilitation to create a CCS for the rehabilitation of PD. This study aimed to develop a CCS that would improve and reduce the variability of rehabilitation approaches in Korean patients with PD. A modified Delphi method was used for the consensus development.

MATERIALS AND METHODS

The process of reaching a consensus was carried out according to the following procedure: formation of the expert panel, preliminary literature search, selection of key questions, and use of the modified Delphi method for agreement. The overview of the process used to develop the CCS is shown in Fig. 1.

- 1) Expert panel: Initially, a task force (TF) consisting of 12 experts from the KSNR Committee of CPG launched the development of a CCS for the rehabilitation of patients with PD. The TF reviewed the purpose and scope of the CCS development process on the first conference call. Forty-three experts were listed to be part of the CCS panel consisting of highly experienced specialists in the neurorehabilitation of brain disorders, including PD.
- 2) Preliminary literature search: The initial literature search was conducted by the TF, in accordance with the scope and purpose of the CCS for PD. Each member of the TF researched published CPGs related to PD rehabilitation. These were then collectively reviewed by the TF for eligibility. As a result, eight guidelines met the scope of this CCS. These eight guidelines were reviewed by 2 members of the TF. The guideline results were shared and discussed in the second conference call.
- 3) Selection of key questions: During the second conference call, the core committee selected 10 key questions based on Population, Intervention, Comparison, and Outcome (PICO). From the key questions, a second literature search was performed using the databases of PubMed, EMBASE, and Cochrane Central. The literature search encompassed systematic reviews, meta-analyses, randomized control trials (RCTs), and observational studies. Only literature written in English were selected.
- 4) Modified Delphi Method: This strategy was chosen as the agreement procedure for the key CCS questions. All the expert panels were asked to answer each key question. The responses were reviewed in a conference call. Thereafter, the key questions were refined. The final key questions were selected based on the average value of the panels' priorities and the weight of the areas agreed upon by the members of the conference.
- 5) Statistical analysis: A descriptive analysis was used on each Delphi survey response, such as the mean value of priorities.

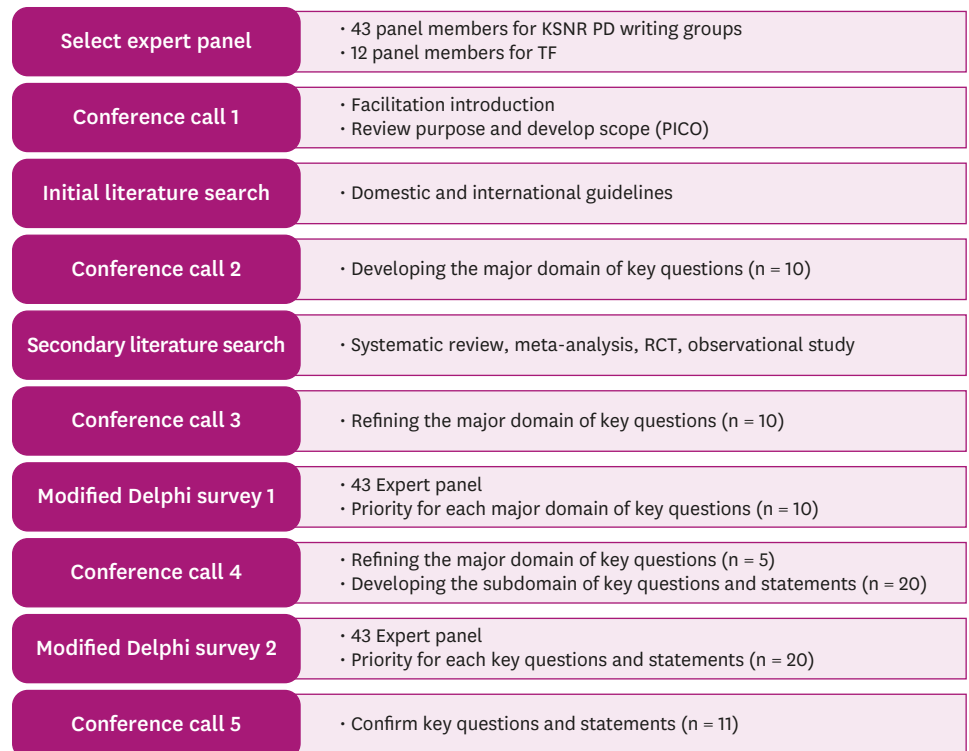


Fig. 1. Consensus development process using a modified Delphi method. KSNR, Korean Society for Neurorehabilitation; PD, Parkinson's disease; TF, task force; PICO, Population, Intervention, Comparison, and Outcome; RCT, randomized control trial.

RESULTS

Delphi surveys

As a result of 3 conferences, 10 key question major domains were selected. From these 10 major domains, 5 were dropped during the first round of the Delphi survey. In succeeding conferences, 20 subdomain key questions and statements developed from the 5 remaining major domains were discussed. After the second round of Delphi surveys, 11 final key questions and statements for the CCS were formulated (Table 1).

Key questions and statements

Key question 1: How should the goals of rehabilitation therapy be set for patients with PD?

Key statements achieving consensus: In setting the therapeutic goals of patients with PD, a rehabilitation specialist should confirm the diagnosis of each patient and monitor the progression of the disease.

PD is the second most common neurodegenerative disease after Alzheimer's disease [4]. Most patients with PD are diagnosed when they are above 60 years old. The prevalence of PD increases with age: 1.4% and 4.3% over the ages of 60 and 85, respectively [5]. The diagnosis is primarily based on clinical criteria: the presence of bradykinesia and the progressive reduction of speed and amplitude for repetitive movements [6]. In addition,

Table 1. Major domains and subdomains used in Delphi surveys

Major domain	Sub-domain
Evaluation and Goal setting	Evaluation
	Goal setting
Upper extremity function	Evaluation
	Treatment
Balance and Gait	Evaluation
	Treatment
Activities of daily living	Evaluation
	Treatment
Swallowing function	Evaluation
	Treatment
Communicative function	Evaluation
	Treatment
Musculoskeletal disorder	Evaluation
	Treatment
Affective function (Depression)	Evaluation
	Treatment
Cognitive function	Evaluation
	Treatment
Neuromodulation treatment	Purpose
	Indication

rigidity, resting tremor, or postural instability need to be present. Additionally, the “red flags,” including a symmetrical start and the symptoms of falling within the first year and no response to levodopa in the early stages, need to be absent. The symptoms of PD and atypical parkinsonism can show some (10%–20%) overlap [7]. Postural and axial symptoms (such as gait difficulty) express more rapidly than other motor symptoms; these appear to be the best indices of disease progression [8]. However, most patients with PD also have disturbances in non-motor function domains. In addition, individual variations in the disease progression are large. In general, women can reach a Hoehn and Yahr scale (HY) of 3 (Table 2) [9] and experience motor complications earlier than men. These motor complications include motor fluctuations, dyskinesia, and gait freezing [10]. Individuals with a longer duration of disease and treatment and those with a younger age at onset usually have higher rates of treatment-related motor complications than other subtypes (Table 3) [11,12].

To monitor the progression of PD, physicians often use the Unified Parkinson's Disease Rating Scale (UPDRS) or the newer Movement Disorder Society (MDS)-UPDRS revised by expert members of the MDS [13]. This tool provides a composite score for disease severity, including mental and motor function, ADL, and complications [13]. To set the goals for patients with PD, the rehabilitation specialist should confirm the diagnosis and monitor the disease progression of patients with PD individually. Before setting the individual goal, knowing where the patient is standing during his journey on this famous degenerative disease might be essential to the rehabilitation team. According to the European guidelines of physical therapy for patients with PD, the ultimate goal is to optimize activities, participation, and QoL. This is done by considering the patient's functioning, personal

Table 2. Hoehn & Yahr staging scale

Stage	Description	Phase
1	Unilateral involvement; minimal or no functional disability	Early
2	Bilateral or midline involvement; no impairment of balance	Mid
3	Impaired postural reflexes; mild to moderate activity limitations	Mid
4	Severe activity limitations, but able to walk or stand	Mid
5	Confinement to bed or wheelchair	Late

Table 3. Subtypes of Parkinson's disease

Classification	Subtypes	Associations clinical features
Age	Earlier onset (< 55 years) type	<ul style="list-style-type: none"> - Late onset of falls - Late onset of cognitive decline - Early onset of freezing gait - Higher risk for anxiety - Shorter time to dyskinesia - Longer time to HY 3
Clinical phenotype	TD type	<ul style="list-style-type: none"> - Poorer response to medication - Slower disease progression - Lower risk of mood impairments - Lower risk for dementia compared to PIGD type - Longer time to HY 3 compared to PIGD type
	PIGD type	<ul style="list-style-type: none"> - Predominant gait and posture impairments - Higher prevalence and severity of depression - Higher prevalence of dementia
	Non-motor PD-MCI type Dementia (PDD) type	<ul style="list-style-type: none"> - Only mild cognitive impairment - Only severe cognitive impairment

HY, Hoehn and Yahr scale; TD, tremor dominant; PIGD, postural imbalance and gait disorder; PD, Parkinson's disease; MCI, mild cognitive impairment; PDD, Parkinson's disease with dementia.

characteristics, and environmental factors [14]. Treatment strategies for patients with PD should focus on symptom control and compensation. Symptomatic treatments include a variety of drugs and rehabilitation approaches. Since patients with PD have a complex nature of symptoms, interdisciplinary health care professionals can be involved in the care of these patients [1,15]. Current medical management only has a partial effect in controlling the functional disturbances in PD. Motor and non-motor impairments occurring late in the course of the condition include gait freezing, imbalance, and cognitive impairments. In fact, medications may even worsen these functional disturbances. Consequently, even patients with optimal medical management can feel various problems in daily functioning. Therefore, a wide variety of healthcare professionals may be required. Furthermore, communication between the patient and healthcare professionals is very important [16].

Key question 2: What should be assessed for rehabilitation in patients with PD?

Key statements achieving consensus: It is recommended for clinicians to assess the motor manifestations (gait, mobility, or balance), cognition, speech, and swallowing function in patients with PD. The inclusion of a barrier or facilitator (environmental or personal factors) for evaluating a patient's level of functioning is warranted. The outcomes of the interaction between environmental or personal factors and the health condition must be evaluated.

The deterioration of symptoms in PD is manifested by the course of the disease but may also be due to medications or inactivity. These PD complexities go hand in hand with the rate of the disease progression and daily functioning. Therefore, the evaluation of patients with PD is important. It is necessary to undertake the challenge of describing the patient's functioning as to proper timing [13,14].

In clinical practice, the HY, UPDRS, and MDS-UPDRS are useful measurements to classify the disease severity and comprehend the overall function in patients with PD. Based on the HY stages, the early phase (HY 1 to 2) has little to no limitations. The goal of the therapeutic intervention is to engage in regular exercise and maintain a level of physical fitness.

Prevention of inactivity and improvement of physical capacity should be the main goals of intervention in this phase. Deconditioned patients with a reduced self-awareness of deficits may need to administer a self-management program [15]. In the mid-phase (HY 2 to 4), the treatment goal is to preserve activities. Hence, exercise therapy is focused on the motor functions including balance, posture, or gait. In the late phase (HY 5), it is important to educate the caregivers to prevent complications such as pressure ulcers and joint contractures [15]. However, specific attention to non-motor symptoms should also be given because these can manifest regardless of the disease severity [16].

Tools to evaluate the functioning of patients with PD include patient- or caregiver-reported questionnaires and performance-based assessments. Questionnaires are more practical for clinical applications; however, limited comparative data are available [17]. Performance assessments evaluate the patient's function objectively; however, these may be more time-consuming [17]. Therefore, it is recommended that clinicians select the most appropriate measurement for specific therapeutic goals [13].

The aim of assessment for rehabilitation is based on the daily functioning of patients. For this, it is necessary to include a barrier or facilitator (environmental or personal factors) which would evaluate the outcomes of the interaction between the patient's function, health conditions, and environmental or personal factors [13,14]. It is important to figure out the actual performance of a person in executing tasks in his or her current environment. This may be during history taking and physical examination, as well as during communication with other health professionals [13].

The areas of motor function addressed in PD patients are mobility, balance, fall, and gait freezing. Measurement scales that fulfill the recommended criteria of specific parameters are as follows: gait (gait velocity, gait distance, Freezing of Gait questionnaire); mobility (Timed Up and Go test, Parkinson's Activity Scale, 5 times sit to stand); balance (fall frequency, Berg Balance Scale, Dynamic Gait Index, Mini-Balance Evaluation System Test); and, fall efficacy (Fall Efficacy Scale, Activities Balance Confidence scale). The patient's physical capacity may be assessed through the routine physical activity and ADL. Furthermore, instrumental ADL (Functional Independence Measure, Assessment of Motor and Process Skills, Canadian Occupational Performance Measure [COPM]) can be evaluated with questionnaires or performance assessments.

The areas of non-motor functioning addressed in patients with PD are cognitive impairment (mild cognitive impairment, dementia), mood disorders (anxiety, depression), swallowing disorders (drooling, swallowing difficulty), impulsive control disorders, sleep disorders, autonomic function disorders (orthostatic hypotension, voiding disorder, erectile dysfunction), hallucinations, delusions, pain, and fatigue. Cognition, speech, and the swallowing function are related to rehabilitation interventions for non-motor symptoms. Evaluation of the cognitive function in PD is not just for the diagnosis of mild cognitive impairment or dementia. It is also geared toward effective motor learning in rehabilitation strategies. Cognitive status is one of the main determinants of a rehabilitation outcome. Feedback and motivation may be helpful in achieving cognitive engagement [18]. The speech problem generally originates from the weakness of the muscles related to articulation. The following speech areas need to be evaluated: loudness, articulation, fluency, resonance, and prosody. The standard evaluation of the swallowing function is a videofluoroscopic swallowing study (VFSS). It aids in assessing the swallowing function with clinical symptoms

such as drooling, choking, cough, nutrition status, feeding posture, and respiratory function [19,20]. In addition, certain factors can influence the rehabilitation goal setting. The overall QoL (PD-specific quality of life 39, EuroQol-5 Dimension), dystonia, dyskinesia, comorbidity, and the environment of a PD patient need to be assessed [17].

Most clinical assessments are for overall functioning. No instrument comprehensively evaluates PD specifically. Therefore, we suggest the development of a Parkinson's-specific, easily administered, and comprehensive assessment tool for rehabilitation intervention.

Key question 3: When and how often should patients with PD be assessed for rehabilitation?

Key statements achieving consensus: Assessment of the functional status for the rehabilitation of patients with PD at the time of diagnosis is recommended. Evaluations are recommended to be done regularly, every 3 to 6 months, for patients who are receiving rehabilitation. If untreated, functional evaluations should be carried out every 6 to 12 months.

The initial assessment for rehabilitation in patients with PD should be done at the time of diagnosis. Studies have shown that, compared to general populations of the same age, the activity of patients with PD is significantly lower at the time of diagnosis. That is, functional activity is already impaired at the time of diagnosis [17]. Therefore, patients diagnosed with PD should be considered for referral to a specialist to ensure regular assessment and training of motor and non-motor symptoms. The rehabilitation should be decided accordingly. Experts in PD have postulated that early-stage rehabilitation could slow the progression of PD symptoms [18]. In particular, referral to rehabilitation specialists for regular evaluation and treatment should be done to address balance and motor problems, independency of ADL, and swallowing and communication function. Although the consensus of the expert group has not yet agreed on an evaluation interval, the interval of 6-12 months is recommended for assessing the functional status of patients with PD [19]. For patients ongoing rehabilitation, the recommended treatment is at least 4 weeks for gait therapy, 8 weeks for balanced training, and 12 weeks for aerobic exercise and strength training [20].

Key question 4: When and how do you assess the gait and balance functions in patients with PD?

Key statements achieving consensus: The assessments of gait and balance functions in patients with PD should be done upon diagnosis of the disease. Periodic assessments should be performed with at least a 3-month interval as the disease progresses. The assessments of gait and balance functions in patients with PD using the UPDRS and Berg Balance Scale are recommended to be done near the same time as possible during follow-up evaluations.

The management of patients with PD has traditionally centered on pharmacologic options viewed as the gold standard treatments [21]. Despite optimal pharmacologic treatments, the gait and balance functions have become more severe. The risk of fall has consistently increased parallel to the progression of PD. The increased risk of fall can cause fall-related injuries such as traumatic brain injuries and fractures. Consequently, the overall survival of those who experience falls can be reduced [22]. Therefore, proper rehabilitation—in

conjunction with pharmacological treatment—is highly encouraged to improve and maintain the gait and balance functions [14,18,20,23]. In most studies about the effects of rehabilitation on gait and balance in PD patients, participants had mild to moderate severity with an HY of 2 to 3 [20,24]. There were few reports on PD patients with an HY of 4 to 5 gait and balance functions. However, according to the European guideline of physical therapy for patients with PD and the National Institute for Health and Care Excellence (NICE) guidelines of PD, the rehabilitation for gait and balance is recommended in all patients with PD, regardless of the disease severity. This is because the rehabilitation, which includes education for patients and caregivers, may be effective in improving the gait and balance functions [14,18]. In addition, comprehensive rehabilitation is recommended to maintain gait and balance in patients with severe PD. Therefore, the assessment of gait and balance function in patients with PD should be done upon the diagnosis of the disease. Periodic evaluations should be conducted as the disease progresses. Appropriate rehabilitation, including education, should be performed even if the gait and balance functions are not deteriorated. Because PD is a slowly progressive neurodegenerative disorder, periodic assessments of gait and balance function are essential. However, a clear recommended assessment schedule for gait and balance is not well known. Most studies on the effects of rehabilitation on gait and balance in patients with PD have reported that treatment effects continued for 3 to 12 months after rehabilitation [20]. In addition, a study of community-based dancing performed on patients with PD showed that the rate of participation decreased sharply at the 3-month time point [25]. Most studies on the effects of rehabilitation in patients with PD were based on a 3-month time point assessment of functional changes [14]. Based on the results of these studies, a follow-up evaluation with at least a 3-month interval is thought to be necessary to maintain or improve the compliance of rehabilitation in PD patients.

The gait and balance assessment tools recommended are UPDRS Parts III and IV (severity of PD), the 6-minute walk test, the 2-minute step test, and VO₂max for cardiopulmonary function. Balance Evaluation Systems Test (BESTest), mini-BESTest, Berg Balance Scale, and Five Times Sit-to-Stand Test were performed objectively to assess the balance function. The surveys of the Activities Balance Confidence Scale and the Fall Efficacy Scale can also be used to assess balance. For the gait function, a 10-meter walk test can be performed as an objective assessment tool. The Freezing of Gait Questionnaire can be used as a survey. In addition, the Timed-up and-go Test, Short Physical Performance Battery, Modified Physical Performance Test, and Contiguous scale-physical functional performance have been used to assess functional mobility [14,18,20]. It is recommended that these various measures be structurally divided into body function, activities, and participation according to the International Classification of Functioning, Disability, and Health (ICF) [14]. Although several assessment tools have been proposed, UPDRS and Berg Balance Scale have been proven clinically meaningful among the indicators of gait and balance function in patients with PD [18]. Most of the other indicators were not clear enough in establishing a minimal clinically important difference. It is difficult to expect a clinically meaningful change in the evaluation index after rehabilitation [18]. Therefore, it is recommended that UPDRS and Berg Balance Scale should be used as the primary assessment tools for periodic evaluations of gait and balance function in patients with PD. Other assessment tools can be used for additional purposes [18]. In patients with PD, gait and balance functions can vary greatly during different days. The measurements of these functions should be assessed during the patient's optimal functioning state and not during off states when the patient is most limited [14]. Therefore, the time of assessment should be recorded in relation to the medication state and time of day. Repeat assessments should be made as near as possible to the same time during follow-up evaluations [14].

Key question 5: How should rehabilitation in patients with PD be done to improve balance and gait?

Key statements achieving consensus: To improve balance and gait in patients with PD, various rehabilitation approaches are needed. These include aerobic exercise, balance exercises, aquatic exercise, dancing exercise, virtual reality, ADL training, Lee Silverman Voice Treatment (LSVT) BIG program, task-oriented occupational therapy, and self-exercise programs.

Gait difficulty and imbalance are frequently encountered in patients with PD. These may induce fractures by falls that have been reported in approximately 68% of patients with PD annually [26]. Moreover, gait difficulty and imbalance would gradually progress with disease progression. This would be reflected by the severity of PD [27]. In key question 4, the evaluation of gait and balance were introduced. In key question 5, the rehabilitation types for gait and balance would be described.

The gait and balance problems in PD have shown various phenotypes: postural sway, short stride, and gait freezing (typically start and turning hesitations) [28,29]. Rehabilitation approaches consist of compensatory methods such as providing external or internal cues and acquiring new gait patterns in patients with early-stage PD [30]. In the late stage of PD, the rehabilitation should provide more personalized and intensive programs. The general principles of rehabilitation in PD are: first, make the therapeutic goal; second, repeat the task or exercise until maximum effects are achieved in the results [31]. Balance training improved the balance, trunk control, and gait stability more effectively than resistance exercises [32]. For improvement of balance, aquatic exercise, and virtual reality have also been beneficial [33-35]. Several therapeutic strategies such as dance therapy, treadmill training, and cued exercise training have proven useful for improving balance and restoring gait [32,33,36-39]. The partial weight-bearing treadmill was also effective in improving the gait of patients with PD [40]. In a systematic review for the effects of occupational therapy on balance, several forms of occupational therapy—including basic daily life training—may help to promote balance and thereby, maintain maximum independence of daily life, work, and leisure activities [41,42]. Among these various treatment strategies, no strategy has been proven to be more superior than others. The combination of various strategies is recommended to be an effective treatment of PD [14,24,43]. These rehabilitation programs should be useful for controlling bradykinesia, improving the velocity of gait, preventing falls, and inducing independency of ADLs [23,43].

The LSVT BIG program has been used as a self-exercise program for improving balance and walking. After introducing LVST LOUD for improving speech and language, LVST BIG was developed to improve motor function in patients with PD [44]. Since the LVST BIG program has a bigger amplitude of voluntary motion, it may improve hypokinesia, velocity, and fine-tuning of motions [44]. It has been used for rehabilitation and self-exercise programs [44,45]. After the 16-week LSVT BIG program, improvements in the walking speed and gains of UPDRS scores were reported [46].

Several kinds of research on self-exercise programs (i.e., dancing) have investigated for improvements in motor function, balance, and QoL [39]. The several self-exercise programs shall be introduced in the forthcoming clinical guidelines for rehabilitation of PD.

Considering these recent researches and clinical guidelines, it is recommended that patients with PD be treated with various rehabilitation programs. These therapies consist of self-exercise, occupational therapy, or other various programs to prevent complications such as falls, balance problems, and gait difficulties [28,41,45,47]. The rehabilitation programs would be considered in the early stages of PD. The rehabilitative interventions should be approached by various methods such as aerobic exercise, balance training, aquatic exercise, therapeutic dance, virtual reality, training for the activities of daily living, and the LSVT BIG program [24,31,33,37,45].

Key question 6: When do you evaluate ADLs in patients with PD?

Key statements achieving consensus: With regards to their ADLs, patients with PD should be evaluated regularly—starting from the first clinic visit—especially when an evaluation of a therapeutic effect is required or therapeutic strategies are decided.

PD causes a variety of motor and non-motor symptoms and impairs independence in ADLs. A previous study reported the ADLs of patients with PD were impaired significantly even before the diagnosis [48]. Therefore, every subject with a suspicion of PD needs to be evaluated regarding the ADLs. ADL evaluation at the time of diagnosis enables an individualized rehabilitation from an early phase of the disease. Since the performance of ADLs is a reliable marker of disease progression, as well as an important factor of QoL in patients with PD, a follow-up ADL evaluation is needed to assess the disease progression and predict QoL.

Several longitudinal studies have shown that ADL parameters, such as MDS-UPDRS part II, change significantly annually. It is hard to provide a specific guideline regarding the evaluation interval, but it can be inferred that ADL evaluation should be done annually with the consideration of longitudinal study results. However, PD has heterogeneous clinical features. The disease progression and concurrent ADL performance can be affected by age at onset, disease duration, and comorbidities. Specifically, we may need to evaluate ADL performance more frequently in older subjects and subjects with the postural imbalance and gait difficulty (PIGD) type. They tend to frequently have a more rapid disease progression and functional decline [47].

The European guideline of physical therapy for patients with PD suggested evaluating patients based on appropriate assessment tools for evaluating the effect of rehabilitation therapy, both during and at the end of therapy [14]. Evaluation is required to decide on continuation, modification, or termination of therapy. It is also necessary to motivate patients to adhere to therapy and enable more effective communication within medical teams.

ADL evaluation is also needed in case a subject faces significant changes in therapeutic plans such as new medications, non-pharmacological (e.g., rehabilitation), or surgical (e.g., deep brain stimulation) treatments. Evaluation of the efficacy of treatment and application of appropriate therapies should be carried out before and during therapy.

Key question 7: How do you rehabilitate patients with PD to improve their ADLs?

Key statements achieving consensus: Occupational therapy is recommended for patients with PD who have limitations in their ADLs. Treatment should be provided based on specific knowledge and understanding of PD, with consideration of the individual needs and circumstances of the patient.

Regarding the ADLs of patients with PD, the NICE guidelines of PD [18] recommended offering disease-specific occupational therapies for these patients with difficulties. The Canadian guidelines on PD [23] suggested that occupational therapy should be available for patients with PD, with particular consideration on the improvement and maintenance of work and family roles, home care and leisure activities, transfers and mobility, personal self-care activities such as eating, drinking, washing, and dressing, and environmental issues in improving the safety and motor functions. Additionally, cognitive assessments and appropriate interventions should be undertaken. The Netherlands guidelines in PD rehabilitation [42] proposed that occupational therapy was indicated when the patient with PD experienced activity limitations or participation problems in ADLs, work, and leisure. Occupational therapy was also advised when the caregiver experienced problems in supervising or supporting the patient's ADLs and when the health care provider had questions regarding the patient's safety and self-reliance in carrying out ADLs.

Sturkenboom et al. [49] conducted a multicenter, randomized, controlled clinical trial that evaluated the efficacy of occupational therapy in patients with PD. One-hundred-ninety-one patients who felt they had difficulties in performing meaningful daily activities while living in their homes were enrolled. One hundred twenty-four participants in the experimental group received 10 weeks of occupational therapy, while 67 participants in the control group received usual care without occupational therapy. The experimental group showed significant improvements in self-perceived performance and satisfaction measured by the COPM at 3- and 6-months follow-up. In this study, occupational therapy was performed at the participants' home. All occupational therapists who provided treatment were experienced therapists who received separate training before beginning the intervention.

The following points should be considered when providing occupational therapy for patients with PD [42]: 1) Emphasize and encourage the importance of self-management in order to improve ADLs performance; 2) Adjust the daily structure and activities to optimize patient engagement and satisfaction; 3) Help reduce stress and time pressure in performing ADLs; 4) Practice arm or hand motor skills for meaningful activities within the patient's ability; 5) Train consciously focusing attention on the occupational performance; 6) Utilize cognitive movement strategies that train the step-by-step occupational performance when performing complex tasks; 7) Minimize dual tasks; 8) Use cues to improve movement and occupational performance; 9) Modify the physical environment to promote the safety, effectiveness, and efficiency of performing activities; 10) Advise and supervise caregivers (Table 4). The purpose of rehabilitation is to help patients with PD continue participating in the roles and activities that are meaningful to them. In providing rehabilitation for patients with PD, not only the

Table 4. Occupational therapy interventions for patients with PD

No.	Terms
1	Encouraging self-management
2	Optimizing daily structure and activities
3	Dealing with stress and time pressure
4	Practicing arm or hand motor skills
5	Occupational performance with focused attention
6	Applying cognitive movement strategies
7	Minimizing dual tasks
8	Using cues
9	Optimizing the physical environment
10	Advising and supervising caregivers

Recommendations from the Netherlands guidelines in PD rehabilitation [42].
PD, Parkinson's disease.

patient's basic ADLs, but also the vocational and leisure activities should be considered. Education and support for caregivers, as well as modification and improvement of the physical environment, should be included [50].

Key question 8: When and how should the swallowing function assessment be conducted in patients with PD?

Key statements achieving consensus: Patients with PD who are suspected of swallowing disorders or those with a high risk of swallowing disorders (excessive drooling, excessive weight loss, or frequent aspiration) need to perform a VFSS or a fiberoptic endoscopic evaluation of swallowing (FEES).

Swallowing disorders are very well-known symptoms of PD in almost every terminal period. These can have significant impacts on the QoL and increase the death rate; however, the diagnosis or importance of swallowing problems is undervalued [51]. Swallowing disorders are also highly associated with complications in the respiratory system. These include aspiration pneumonia, dehydration, malnutrition, and long-term prognosis for PD [51]. Therefore, it is very important to prevent such complications by assessing if the signs of swallowing disorders are present prior to providing the proper PD treatment.

In the Canadian guidelines on PD [23], it is recommended that swallowing disorders as symptoms of autonomic nervous system abnormalities in patients with PD be evaluated and properly treated. If excessive drooling or excessive weight loss are noticeable, in case of aspiration pneumonia, or if aspiration symptoms occur more than once a week, it is recommended that assessment for swallowing disorders be conducted using such the VFSS or FEES. In patients with PD, the problem of gastrointestinal movements in the esophageal and oropharyngeal phases can be concurrent. It is, thus, recommended to consult gastrointestinal specialists in cases of suspected gastrointestinal movement disorders such as gastroesophageal reflux disease [23].

Two screening tools specific for PD—the swallowing disturbance questionnaire (SDQ) the Munich Dysphagia Test-Parkinson's disease (MDT-PD)—have been developed [52,53]. These screening tools can provide information on the need for further evaluation using equipment. A patient's state of consciousness and oropharyngeal function may be evaluated. The bedside examination using a water swallowing test can help assess the swallowing difficulty of patients with PD. The direct swallowing test, especially the 3oz water swallowing test, determines swallowing disorders associated with airway aspiration. Both the sensitivity and specificity of this test have been found to be high [54].

Standard tests for swallowing disorders which use instruments or equipment such as VFSS and FEES provide biomechanical information not found in screening tests. These evaluate for silent aspiration and are useful in assessing swallowing disorders caused by PD [55,56]. The endoscopic swallowing test specialized for PD (PARK-FEES) has been developed and verified to be of high inter-rater reliability. Upon comparing the incidence of aspiration pneumonia using the VFSS and FEES, no meaningful difference was reported between the two tests. These were, in fact, complementary to each other. Either of these tests can be selected, depending on the patient's condition or clinical situation [51].

Regarding the problems of esophageal and pharyngeal associations, these can be assessed by a high-resolution manometry test. This test can also be useful for assessing swallowing disorders in patients with PD [57,58].

Key question 9: When and how should the rehabilitation of swallowing disorders be performed in patients with PD?

Key statements achieving consensus: Patient and caregiver education about swallowing disorders should be provided at the early stages of PD. Compensatory approaches including chin tuck, external cues, and thickeners should be considered. Restorative approaches including LSVT and expiratory muscle strength training should also be done for the swallowing rehabilitation of patients with PD. The approach would depend on the swallowing problems experienced by the patient.

Swallowing disorder is a common problem in patients with PD. The prevalence of a swallowing disorder was reported to be 16%–55% on subjective outcomes and 72%–87% on objective measurements [59]. Swallowing disorders may cause nutritional deficiency, dehydration, aspiration pneumonia, and asphyxia. Proper management of swallowing disorders is an important issue because pneumonia is the leading cause of hospital admission and death in patients with PD [60–62]. In this statement, the recommendations for the management of swallowing disorders in patients with PD were based on the NICE guidelines of PD [18], the Netherlands guidelines for speech and language therapy (SLT) in PD [63], and the results of some reported clinical trials.

Although there is no clear evidence when to perform rehabilitation of swallowing disorders in PD, it is recommended to consider assessment, education, and advice for swallowing in the early stages of PD. Also, offering proper treatment for patients who are experiencing problems with swallowing is deemed necessary [18]. Regarding the education for swallowing, it is recommended that physiatrists explain the normal process of chewing and swallowing to patients and caregivers and point out any errors in the present management. To reduce choking, it is recommended to educate patients on safe swallowing with attention and awareness. Chin tuck, smaller volumes, and thicker consistencies could be attempted for patients who easily choke on fluids. Activation exercises of the head-neck region prior to a meal, performing the swallowing process in conscious steps, and using specific cues are helpful for lengthy chewing. If these are not effective, slow initiation of swallowing and simpler food consistencies can be considered. For reducing pharyngeal residues after swallowing, effortful swallowing can be tried. If this proves to be difficult in improving residues, easier food consistencies can be considered. For patients who suffer from drooling, it is recommended to analyze the treatable causes and instruct the patients on proper strategies such as closing the mouth, adequate swallowing, and proper head and body posturing. It is advisable to actively involve the caregivers in the treatment of swallowing disorders, especially when the patient is dependent on external cues and movement strategies [63].

Although the rehabilitation of swallowing disorder in PD has been performed conventionally based on the abnormal findings confirmed by objective tests such as VFSS, there is a lack of evidence on the efficacy of these rehabilitations. LSVT is widely used for vocalization and swallowing improvements and in patients with hypokinetic swallowing disorders [63]; however, its efficacy has only been reported in a few small clinical studies [64,65].

Neuromuscular electrical stimulation using surface electrodes have been reported to have no additional effect on conventional swallowing therapy in patients with PD in terms of both the motor and sensory threshold stimulations [66,67]. The expiratory muscle strength training (EMST) which uses a device capable of controlling the target expiratory pressure of patients has been reported to reduce aspiration in patients with PD [68]. Therefore, EMST is a recommended swallowing therapy in PD [18]. Video-assisted swallowing therapy using visual feedbacks of the swallowing process has been reported to have additional effects on the conventional swallowing therapy in PD [69].

Key question 10: When and how should assessments be made for communication disorders in patients with PD?

Key statements achieving consensus: Communication disorders in patients with PD may occur at an early stage and require a careful observation because these greatly affect the patient's QoL. Although there are no validated assessment tools yet, for difficulties in adjusting the voice volume, caregiver education and careful observation are needed.

Approximately 80%–90% of patients with PD have a voice change, while 45%–50% have changes in pronunciation [70,71]. Recent studies have shown that, compared with their spouses, cognitive impairments were observed in patients with PD who had difficulty communicating. However, no dementia symptoms were noted [72]. In the early stages of PD, language and cognitive changes occur. Therefore, it is important to receive an immediate evaluation if there is a suspicion since this can greatly affect the patient's QoL [2]. Different reactions and difficulties in the usual daily function or simple participation in social activities should not be overlooked.

To date, there have not been any validated methods for assessing communication disorders in PD. No communication disorder assessment tools for patients with PD have been developed. However, the first change observed in patients with PD is the difficulty in adjusting the voice volume [63].

The assessment of communication disorders is done by the Nijmegen Dysarthria Scale (NDS). It is rated at a 0–5 point system and is largely divided into two areas: dysarthria severity and level of communicative effectiveness [73,74]. In addition, additional communication evaluation factors such as intonation and accent, automatic speech tasks, maximum speaking time, and vocal range are considered [75,76]. Recordings of patient daily life conversations or video footage can also be helpful in the evaluation. It is necessary to educate the patient's caregivers to perform them whenever necessary.

Key question 11: When and how do you provide rehabilitation for the communication function in patients with PD?

Key statements achieving consensus: Effective communication strategies should be developed and taught to patients and caregivers in the early stages of PD. SLT such as LSVT and compensation methods using instrumental aids should be considered according to the patient's communication ability.

Speech or voice disorders in patients with PD are reported to be 70%–100%. However, a 2005 study in the United States reported that only 3%–4% of patients with PD received SLT [77]. Contrary to this, the UK Parkinson's Disease Society published in 2008 that 34% of all patients with PD received SLT [78]. Recommendations for the rehabilitation of communication in patients with PD could be referred to the Canadian guidelines on PD [23], the NICE guidelines of PD [18], the Netherlands guidelines for SLT in PD [63], Spanish Clinical Practice Guideline for the management of patients with PD [79], and the results of recent systematic reviews and meta-analysis studies. Most guidelines recommend strategies for effective communication and SLT for patients with PD [18,23,63,79]. Although there is no clear evidence when rehabilitation of communication disorders should be initiated in patients with PD, it is suggested to consider assessment, education, and advice in the early stages of PD. Further, it is important to offer appropriate SLT for patients with PD who have communication problems [18]. In the Netherlands guidelines for SLT in PD, it is recommended that intensive SLT be applied to PD with hypokinetic dysarthria if the voice quality (loudness, clarity, and pitch) can be sufficiently stimulated, if the patient has enough motivation, and if the patient's attention and cognitive functions are sufficient to learn a new technique. The intensive SLT therapy should be done for at least 4 weeks, with 30 minutes per session, and more than thrice weekly. If the intensive therapy is not available, it is recommended to treat patients with less intensity and educate their caregivers [63]. Rehabilitation for the communication of patients with PD can be divided into the SLT—which directly improves the speech ability—and compensation methods. LSVT is the most widely used SLT and is recommended as a major program for patients with PD [18,23,63,79]. The LSVT has been shown to be effective in patients with PD in randomized controlled trials (RCTs) [80,81] and has been reported to have significant effects on the loudness of speech in a recent meta-analysis [82]. However, according to Cochrane reviews in 2012, there is insufficient evidence to conclusively support the efficacy of SLT versus placebo (or no intervention) in PD [83]. A comparative review of SLT techniques reported insufficient evidence on the efficacy of any form of SLT over another to treat speech problems in patients with PD [84]. However, it is unsafe to draw firm conclusions regarding the efficacy of SLT due to the lack of studies and large-scale RCTs [83,84]. The compensation methods for communication are as follows: using instrumental aids such as a pacing board, a metronome, and a portable amplification system. It is recommended that compensation methods be considered as communication strategies for patients with PD if the SLT is insufficient in helping to regain an acceptable communication or if the communication problems are severe [18,23,63,79].

DISCUSSION

The importance of rehabilitating degenerative brain disorders like PD is increasing. However, the evidence of rehabilitation is still lacking and large discrepancies of rehabilitation settings exist in clinical practice. These CCS were conducted to provide current available evidence on the rehabilitation of patients with PD and to reduce the variability in clinical practice by providing agreement statements after the completion of the modified Delphi method in 43 expert panels. Finally, consensus was achieved in 11 key questions and statements provided in the CCS.

At the beginning of developing the CCS process, 10 domains of common issues in PD were selected as major categories for voting: rehabilitation evaluation and goal setting, upper extremity exercise, balance and gait, ADLs, swallowing disorders, communication disorders, musculoskeletal problems, depression, cognitive dysfunctions, and neuromodulation therapy. In the first round of the Delphi survey, the expert panels responded with a

prioritization in the following order, from greatest to least: rehabilitation evaluation and goal setting, balance and gait, ADLs, swallowing disorders, communication disorders, cognitive dysfunction, upper extremity exercise, musculoskeletal problems, depression, and neuromodulation therapy. The upper extremity exercise domain was excluded because of agreement on low priorities. The panels pointed out that this was problematic only for patients with very advanced conditions. Furthermore, the panel gave low priorities for the depression and neuromodulation therapy domains because of the incongruence of the CCS scope and lack of well-designed researches and clinical trials on these topics. Finally, six domains of high priorities and 11 key questions were selected for the modified Delphi method. The consensus statements were listed together with explanations on currently available evidence in literature. This CCS may help to share current knowledge on the rehabilitation of PD and reduce variations or uncertainty in clinical practice.

Although we provided 11 key consensus statements, this CCS is insufficient for providing details on the rehabilitation approaches that health practitioners who are involved in treatment for patients with PD should use. The key statements provided in this study are not the same as the recommendations in a CPG. These should be viewed merely as expert opinions or suggestions. Some limitations of these CCS exist. One of the common disadvantages of the Delphi method is the lowering of the response rate per succeeding round, as we have also encountered. Additionally, the key questions selected in this CCS asked broad areas of the PD rehabilitation domain. Therefore, with reference to this CCS, the clinician should determine the evaluation and treatment options which best match the patient's current clinical status, interests, and needs.

In conclusion, the consensus panel has agreed on statements that address the needs of rehabilitation as a continuum in patients with PD. These statements include the rehabilitation initiation time, assessment items, rehabilitation contents, and complication management. This agreement can be used by physiatrists, rehabilitation therapists, and other practitioners who take care of patients with PD. The panel also highlighted the areas where a consensus could not be reached. Developing a more focused CCS or a CPG which targets specific rehabilitation approaches is considered the next step.

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