Relationships between upper extremity performance and unified Parkinson's disease rating scale-motor exam

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Objective: Clinical measures that quantify upper extremity function are needed for the accurate evaluation of patients and to plan an intervention strategy. The purpose of this study was to examine the relationship between the Unified Parkinson's Disease Rating Scale (UPDRS)-Motor Exam and upper extremity performance as a quantifying clinical tool of upper extremity function in persons with Parkinson's disease.
Design: Cross-sectional study.
Methods: Thirty-two idiopathic Parkinson's Disease persons participated in this study. To investigate the relationship between the UPDRS-motor exam, Box and Block test (BBT), and Action Research Arm Test (ARAT) by two physical therapists. The examination took up to 1 hour, and the participants were invited to rest between each clinical measure in order to minimize the effects of fatigue. Clinical measures were assessed while the subjects were in the "on" phase of their medication cycle, generally 1-3 hour after taking their anti-Parkinson's medications.
Results: In more affected side, the UPDRS-motor exam was significantly negative correlated with the BBT ($p<0.05$) but it was not significantly correlated with the ARAT. In less affected side, only positively correlation was significantly shown between BBT and ARAT ($p<0.05$). On the other hand, between BBT and ARAT were not significantly correlated with the UPDRS-motor exam.
Conclusions: The UPDRS-motor exam is effective tool which was significantly correlated with manual dexterity in more affected upper extremity. But The UPDRS-motor exam is not effective tool in less affected upper extremity.

Key Words: Parkinson's disease, Upper extremity, Unified Parkinson disease rating scale

Introduction

Parkinson's disease (PD) is the most common progressive neurodegenerative disease next to Alzheimers disease, and develops as a result of loss of dopaminergic neuronal degeneration in the basal ganglia, especially the substantia nigra [1]. Individuals with PD may experience motor and cognitive impairment, such as slowness of movement, stiffness, episodes of freezing, and problems with memory and executive functioning [2,3]. These deficits can interfere with functional activities such as gait performance, writing, turning around, postural stability and transfer to other positions. Therefore, PD populations tend to be less active, and may provide evidence for the continued loss of independence in performance of daily activities and quality-of-life due to progression of motor deficits [4].

Due to the slowness of movement, many people with PD compromise the functional abilities of upper extremity to reaching, grasping, and manipulating objects. They may also generate abnormally high grip forces when performing precision grip tasks such as lifting a peg or a pencil, and a scaling disorder which can impede sequential tasks during

performance of daily activities, such as grooming, dressing, eating, and writing [5]. Clinical characteristics of PD may be explained by outcome measures that provide a simple and comfortable method for identification and assessment of changes in functional activities and effects of therapeutic intervention.

The Unified Parkinson's Disease Rating Scale (UPDRS) is used most widely and frequently for research and clinical practice to monitor psychological and physical aspects, and may apply comprehensive coverage of PD-related symptoms over time [1,6]. Although the UPDRS is the most common clinical assessment tool used in the measurement of functional abilities of PD patients, it presents some shortcomings that limit the predictive usefulness of functional abilities of the upper extremity, especially hand performance. In addition, items involving upper extremity performance in the UPDRS are five items used in the activities of daily living (ADL) section (e.g., handwriting, cutting food and handling utensils, dressing, hygiene, turning in bed and adjusting bed clothes) and four items in the motor examination section (e.g., action or postural tremor of hands, finger taps, hand movements, and rapid alternating movement of hands) [1]. These items may be insufficient for measurement of manipulation of objects and table activities using upper extremity. To examine the ability of PD patients using upper extremity in daily activities and work-related environments, the clinical measures need to involve repeated performance of a variety of functional activities.

The purpose of this study was to propose the feasibility of clinical measures in hand and arm performance of PD patients. We compared clinical measures with the UPDRS-motor exam section because physical therapists may find the section particularly useful.

Table 1. Common characteristic of study participants (N=32)

Variable	Participant
Sex (male/female)	18/14
Age (y)	75.97 (8.50)
Height (cm)	161.41 (9.42)
Weight (kg)	59.34 (9.99)
Dominant side (right/lift)	23/9
Hoehn & Yahr stage (2/3)	23/9
Expected duration (mo)	30.41 (6.49)

Values are presented as n or mean (SD).

Methods

Subjects

Thirty-two idiopathic PD persons participated in this study. General characteristics of subjects are shown in Table 1. The following inclusion criteria were used: a medically confirmed diagnosis of idiopathic PD. Patients were excluded from the study if they had a history without any other known neurologic or orthopedic disorders that would affect their functional activities, or severe cognitive deficits that precluded support based on the procedures of this study. Data collection was performed in the outpatient physical therapy department of H rehabilitation center in Seoul and G rehabilitation center in Gyeonggi.

Procedures

Clinical measurements were performed using the UPDRS-motor exam, box and block test (BBT), and action research arm test (ARAT) by two physical therapists to investigate the relationship between the UPDRS-motor exam and upper extremity performance. The participants were given the standard verbal instructions for the clinical measures in a quiet and well-organized therapy. The examination took up to 1 hour, and the participants were invited to rest between each clinical measure in order to minimize the effects of fatigue. The raters scored their own judgment of each participant without any discussion and watched the participant performing. The raters have more than 10 years of experience in evaluation of persons with neurological problems by clinical measures, and have previously used the UPDRS-motor exam in PD populations. Clinical measures were assessed while the subjects were in the "on" phase of their medication cycle, generally 1-3 hour after taking their anti-Parkinson's medications [2].

Clinical measurements

To investigate the correlation of the UPDRS-motor exam for PD patients, three clinical measures involving the UPDRS-motor exam, ARAT, and BBT were evaluated by clinical observation and testing. The UPDRS developed by Fahn *et al.* [7] has become the "gold standard" because it contains measures across the enablement/disablement spectrum and demonstrates excellent reliability [1,3]. The UPDRS consists of four sections; I-Mentation, Behavior, and Mood (4 items); II-ADL (13 items); III-MOTOR Examination (14 items); IV-Complications of Therapy (11 items) [4]. All sections except IV are scored using a 5-point

Table 2. Mean and standard deviation of the scores of clinical measures (N=32)

Tool	Mean (SD)	Minimum	Maximum
Less affected side			
Box and block test	39.84 (3.80)	29	45
UPDRS-motor exam	17.97 (4.89)	7	29
Action research arm test	46.84 (5.66)	35	57
More affected side			
Box and block test	35.06 (4.54)	24	43
UPDRS-motor exam	17.97 (3.87)	10	26
Action research arm test	41.63 (6.59)	31	55

Values are presented as n or mean (SD).
UPDRS-motor exam: Unified Parkinson's Disease Rating Scale-motor exam.

scale ranging from 0 (no impairment) to 4 (marked impairment). The UPDRS-motor exam was found to have excellent test-retest reliability (intraclass correlation coefficient, 0.90) in patients with PD [5].

The ARAT was devised for evaluation of specific changes in upper limb function after cortical damage. The test consists of 19 tasks grouped into four subtests: grasp, grip, pinch, and gross movement. The performance of each task is rated on a 4-point scale ranging from 0 (no movement possible) to 3 (movement performed normally), with a maximum obtainable score of 57 [6,8]. The test has reported evidence of predictive validity and reliability in patients receiving stroke rehabilitation [9].

The BBT was originally developed for evaluation of gross manual dexterity of adults with cerebral palsy and is used for evaluation of physically handicapped individuals. The test consists of moving, one by one, as many small wooden blocks as possible from one compartment of a box to another within 60 seconds [10]. The test was reported to have a very high inter-rater and test-retest reliability (ICC and rho for main variables > 0.95) [11].

Statistical analysis

This study divided the measured data into the less or more affected side according to functional activities and symptom appearance in extremities. This study measured Cronbach's alpha for internal consistency of the measured data. Pearson's correlations were used in quantification of bivariate associations between the UPDRS-motor exam and other measures (ARAT and BBT). All statistical analyses were performed using PASW Statistics 18.0 (IBM Co., Armonk, NY, USA). Results were considered statistically significant at p-value of less than 0.05.

Table 3. Correlation of upper extremity performance and UPDRS-motor exam in less affected side (N=32)

Variable	BBT	UPDRS-motor exam	ARAT
BBT		−0.160	0.525[*]
UPDRS-motor exam	−0.160		−0.140
ARAT	0.525[*]	−0.140	

UPDRS-motor exam: Unified Parkinson's Disease Rating Scale-motor exam, BBT: box and block test, ARAT: action research arm test.
[*]$p < 0.05$.

Table 4. Correlation of upper extremity performance and UPDRS-motor exam in more affected side (N=32)

Variable	BBT	UPDRS-motor exam	ARAT
BBT		−0.539[*]	0.703[*]
UPDRS-motor exam	−0.539[*]		−0.217
ARAT	0.703[*]	−0.217	

UPDRS-motor exam: Unified Parkinson's Disease Rating Scale-motor exam, BBT: box and block test, ARAT: action research arm test.
[*]$p < 0.05$.

Results

The value of Cronbach's alpha was 0.562. The mean scores for the UPDRS-motor exam, ARAT, and BBT are shown in Table 2. None of the evaluation scales showed a floor or ceiling effect. On the less affected side, the scores for the BBT, UPDRS-motor exam, and ARAT were 39.84, 17.97, and 46.84, respectively. On the more affected side, the scores for the BBT, UPDRS-motor exam, and ARAT were 35.06, 17.97, and 41.63, respectively.

Among the 32 participants, BBT showed significant positive correlation with the ARAT (r=0.525) on the less affected side ($p < 0.05$). However, BBT and ARAT did not show significant correlation with the UPDRS-motor exam. Table 3 shows the relationships between the clinical measures on the less affected side. On the more affected side, UPDRS-motor exam showed significant negative correlation with the BBT (r=−0.539; $p < 0.05$), whereas it did not show significant correlation with the ARAT. The BBT also showed significant positive correlation with the ARAT (r=0.703; $p < 0.05$). Table 4 shows the relationship between the clinical measures on the more affected side.

Discussion

This study was conducted in order to examine the feasibilities of clinical measures in hand and arm performance in individuals with idiopathic PD. The correlations between UPDRS-motor exam and BBT in the more affected side were investigated. However, the UPDRS-motor exam did not show a significant correlation with the ARAT. Correlation was observed between the BBT and the ARAT on both upper extremities.

Assessments should involve a previously established valid and reliable means for use by physical therapists in determining the effect and outcome of provided or providing a treatment and to determine the process and clinical characteristic of underlying disease for planning an appropriate treatment [1]. Reliable and valid measurements are also invaluable in both research and clinical settings for use in determination of the patient's disease status [12]. Therefore, selection of the assessment tools depends on the basic needs in clinical and research fields. The UPDRS is the most common clinical assessment tool used for evaluation of disease severity and has become the 'gold standard' because it contains measures across the enablement/disablement spectrum such as body structure and function, activity, and participation, and demonstrates excellent reliability [13]. However, due to the broad range of symptoms involved following PD, one of the major progressive neurodegenerative diseases, there is currently no single measure for comprehensive assessment of the full spectrum of disease manifestations. Therefore, continuous introduction and development for accurate and appropriate measurement of symptoms following PD is necessary. Clinicians who treat the individuals with PD, can evaluate outcomes using a range of assessment strategies such as elementary examination as well as measurement of functional activities, ADL, and quality of life.

Previous studies have reported that the UPDRS total score is used routinely in prediction of functional capabilities. Limited data support its predictive usefulness in persons with early-stage PD or across functional tasks [4]. There is insufficient evidence of the relationship between the UPDRS and upper extremity function for PD. This study was conducted in order to investigate the correlation between the UPDRS-motor exam and upper extremity function, such as manual dexterity, grasp, grip, pinch, and gross movement. In the more affected upper extremity, the UPDRS-motor exam showed to have a correlation with manual dexterity only but not with grasp, grip, pinch, or gross movement. In a recent report, it was suggested that the UPDRS does not reflect a comprehensive measure of mobility even in persons with more advanced PD. The findings are parallel to respect relating to walking performances and ADL function in other populations with central nervous system impairment [3]. The reason for the result showing no significant correlation between the UPDRS-motor exam and ARAT would be the specificity of each measurement. The test performance on the UPDRS-motor exam is based on single-repetition trials as well as optimal functional capability including speech, facial expression, tremor at rest, action or postural tremor of hands, rigidity, finger taps, hand movements, rapid alternating movement of hands, leg agility, arising from chair, posture, gait, postural stability, and body bradykinesia and hypokinesia [14]. However, the ARAT is based on a single trial, including grasp, grip, pinch, and gross movements [6].

This study was conducted in order to investigate the relationship between the UPDRS-motor exam and upper extremity performance in individuals with idiopathic PD. The UPDRS-motor exam showed to have a significant correlation with manual dexterity in the more affected upper extremity, whereas the tool did not show a significant correlation with manual dexterity in the less affected upper extremity and ARAT in both upper extremities. This is because our potential limitation of the study was a relatively small sample. The results of this study cannot necessarily be generalized to rehabilitation of more chronic and severe states of PD, because all of the participants had Hoehn and Yahr stages II to III PD. In future studies, ADL and quality of life will be measured for investigation of relationship with the UPDRS-motor exam.

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