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Pilot study of smartphone-based applications in assessing motor and gait disability in Parkinson's disease

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Abstract

Background: It is unknown how phone-based kinematic tests compare to the standard Unified Parkinson's Disease Rating Scale (UPDRS) in idiopathic Parkinson's disease (IPD).

Method: IPD Patients were recruited from neurology outpatient clinics. Rating of UPDRS Part III motor was performed followed by assessment by a novel smartphone application called EncephalogClinic™, which obtained phone-based motor parameters (PMP) from the 5-metre Timed up and go test (TUGT), finger tap test (FTT) and test for tremor.

Results: 65 IPD patients (mean age of 65, median UPDRS part III score 27 and Hoehn and Yahr stage II) and 65 control subjects were recruited. There was strong correlation between 5-metre TUGT standup time (r=0.82, p<0.001), moderate correlation between 5-metre TUGT total time (r=0.53, p=0.001) and UPDRS gait subscore; Moderate correlation between total tremor signals and UPDRS tremor subscore (r=0.54, p<0.001); Moderate correlations between total number of finger taps (r=-0.53, p=0.02), average time between finger taps (r= 0.58, p=0.03) and UPDRS bradykinesia subscore. Average stride length in 5-metre TUGT could distinguish IPD patients from normal subjects with AUC 0.821 (95% CI 0.744 - 0.898, p <0.001).

Conclusion: These phone-based tests could serve as alternative objective assessment tools of motor features and potential screeing tool for IPD. They are simple to use and do not require administration by healthcare professional, thus can be useful for home and remote patient monitoring. This is especially relevant during Covid-19 pandemic when patients may not be able to attend outpatient follow-up.

Introduction

Motor features of IPD were traditionally assessed by gold standard tool UPDRS, but it requires administration by trained clinicians and the assessment is relatively subjective. Modern smarphones are widely available and they all possessed inbuilt inertial motion sensors suitable for analysis of gait and other motor features. It is unknown how the phone-based motor parameters (PMP) can correlate with the UPDRS.

Table 1

UPDRS subscore	Phone-based parameters	Correlation coefficient	p value
Gait sub-score	5-metre TUGT standup time (second)	0.82	<0.001
	5-metre TUGT total completion time (second)	0.53	0.001
	5-metre TUGT average step length (metre)	-0.36	0.005
Tremor subscore	Tremor signals	0.54	<0.001
Bradykinesia subscore	Total number of taps	-0.53	0.02
	Average time between taps (second)	0.58 s	0.03
	Average press duration of each tap (second)	0.19 s	0.13

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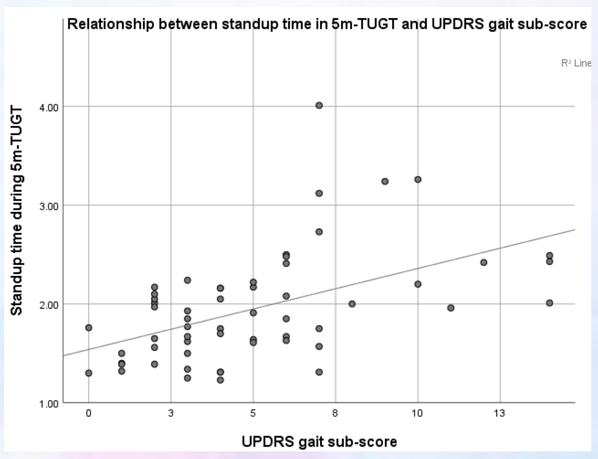
Methodology

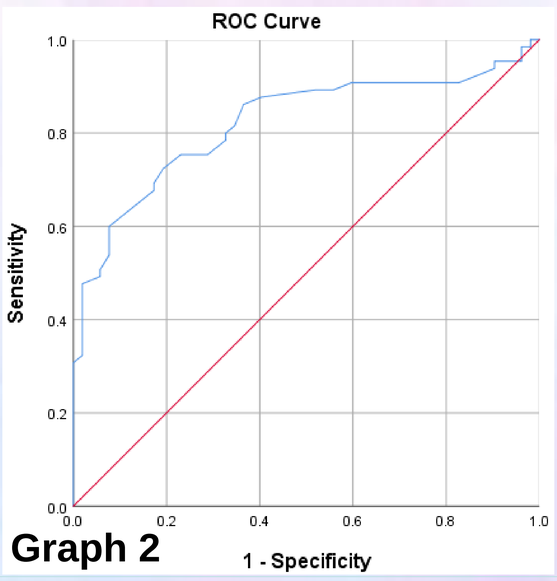
Patients with IPD were recuited from neurology clinics of QMH and TWH. A full rating of UPDRS Part III (motor) was performed on the patients by a trained clinician, followed by supervised use of the smartphone application Encephalog Clinic™. Phoned-based 5-metre Timed up and go test (TUGT), finger tap test (FTT) and test for tremor were done with phone-based motor parameters (PMP) obtained.

Results

65 IPD patients with mean age of 65, median UPDRS part III score of 27 and Hoehn and Yahr of stage II were recuited. 65 control subjects were also recruited. There was strong correlation between 5-metre TUGT standup time with gait subscore (r=0.82, p<0.001) (Graph 1); moderate correlation between 5-metre TUGT completion time and gait sub-score (r=0.53, p=0.001), total tremor signals and UPDRS tremor subscore (r=0.54, p<0.001), total number of finger taps (r= -0.53, p=0.02), average time between finger taps in FTT (r= 0.58, p=0.03) and UPDRS bradykinesia subscore (Table 1). The average stride length in 5-metre TUGT has good discriminant ability with AUC 0.821 (95% CI 0.744 - 0.898, p <0.001). The cut-off of average stride length 62 centimeters had the sensitivity of 75.4% and specificity of 76.9% to distinguish IPD patients from normal subjects (Graph 2).



Graph 1



Graph 2

Discussion

PMP from phone-based tests had moderate to strong correlations with UPDRS subscores. A larger scale study could combine these parameters for a composite parameter to further correlate and predict UPDRS. This could serve as remote monitoring of patients' motor features and for drug titration. 5-metre TUGT can be easily performed by subjects at home and the average stride length is a potential screening tool for IPD.

Conclusion

This pilot study is the first to utilize phone-based assessment of motor features in Chinese patients with IPD. These assessments could serve as potential objective assessment and screeing tool for IPD, for home and remote patient monitoring. This is especially relevant during Covid-19 pandemic when patients may not be able to attend outpatient follow-up.