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Research Report

Technology-Based Objective Measures Detect Subclinical Axial Signs in Untreated, *de novo* Parkinson's Disease

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Abstract.
Background: Technology-based objective measures (TOMs) recently gained relevance to support clinicians in the assessment of motor function in Parkinson's disease (PD), although limited data are available in the early phases.
Objective: To assess motor performances of a population of newly diagnosed, drug free PD patients using wearable inertial sensors and to compare them to healthy controls (HC) and differentiate different PD subtypes [tremor dominant (TD), postural instability gait disability (PIGD), and mixed phenotype (MP)].
Methods: We enrolled 65 subjects, 36 newly diagnosed, drug-free PD patients and 29 HCs. PD patients were clinically defined as tremor dominant, postural instability-gait difficulties or mixed phenotype. All 65 subjects performed seven MDS-UPDRS III motor tasks wearing inertial sensors: rest tremor, postural tremor, rapid alternating hand movement, foot tapping, heel-to-toe tapping, Timed-Up-and-Go test (TUG) and pull test. The most relevant motor tasks were found combining ReliefF ranking and Kruskal–Wallis feature-selection methods. We used these features, linked to the relevant motor tasks, to highlight differences between PD from HC, by means of Support Vector Machine (SVM) classifier. Furthermore, we adopted SVM to support the relevance of each motor task on the classification accuracy, excluding one task at time.
Results: Motion analysis distinguished PD from HC with an accuracy as high as 97%, based on SVM performed with measured features from tremor and bradykinesia items, pull test and TUG. Heel-to-toe test was the most relevant, followed by TUG and pull test.
Conclusions: In this pilot study, we demonstrate that the SVM algorithm successfully distinguishes *de novo* drug-free PD patients from HC. Surprisingly, pull test and TUG tests provided relevant features for obtaining high SVM classification accuracy, differing from the report of the experienced examiner. The use of TOMs may improve diagnostic accuracy for these patients.

Keywords: Parkinson's disease, technology-based outcome measures, wearable sensors, balance, bradykinesia, gait analysis

INTRODUCTION

A correct diagnosis of Parkinson's disease (PD) is relevant both for prognostic and therapeutic purposes. To date, the diagnosis is still mainly based

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