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Video-based automatic analysis of axial postural abnormality in static and dynamic conditions

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Introduction: The current body of research has not yet led to a sufficient understanding of pathophysiology and management of axial postural abnormalities (PA) in Parkinson disease (PD) due to lack of agreement on validated, harmonized tools for measurements. Moreover, PA have been only measured in static conditions, but they may get worse in dynamic conditions, leading to different degrees of severity when compared with the static assessment.

Objective: To develop a software based on Deep Learning for marker-less and automatic video-analysis of axial PA in PD to systematically quantify changes of PA in both static and dynamic conditions of PD subjects.

Methods: A total of 168 minutes videos from 7 PD patients with different degrees of anterior and lateral trunk flexion were used for the development and pilot validation of a new software called AutoPosturePD++ (APP++); the patients were asked to complete different tasks: standing still, standing still while reading (dual task), walking straight back and forth for 2 minutes and walking straight back and forth for 2 minutes while reading (dual task). Postural abnormalities were measured in lateral and posterior view during the patients' activity.

Results: From the software accuracy point of view, we confirmed an excellent agreement between APP++ and the gold standard for static assessments (NeuroPostureApp®). For dynamic assessments, we quantified constraints for the video shooting (i.e., subject-camera distance and field of view for both lateral and posterior view) to preserve such accuracy. The preliminary results from included patients, while indicating the robustness of the software for dynamic posture analysis, suggest the presence of significant modifications of posture during dual task and while walking.

Conclusions: APP++ can be a valid tool for marker-less spine flexion measurement in PD, accurately supporting the measurement of posture during dynamic conditions and informing on the modifications of posture during different tasks.