Kinematics during the BBT: a pilot study on subjects with Parkinson's disease and post-stroke

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Introduction

The Box and Block Test (BBT) is one of the most commonly used tests to assess the manual dexterityability in neurological patients [1]. Kinematic analysis during the BBT using Inertial Measurement Units(IMUs) could provide an accurate and objective evaluation of upper limb and trunk movements, identifying potential compensation strategies [2,3]. This study aims to develop IMU-based kinematic analysis during BBT to characterize upper body strategies in Parkinson's disease and post-stroke subjects, comparing them with data obtained from able-bodied individuals.

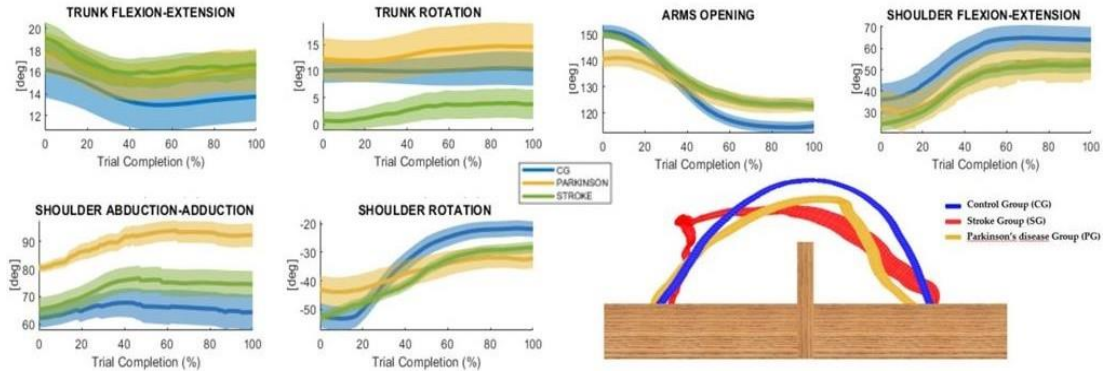
Methods

This was an observational single-session-assessment pilot study assessing upper body kinematics during the execution of a BBT motor task, comparing 5 able-bodies person (Control Group - CG), 5 subjects with Parkinson's disease (Parkinson Group - PG) and 5 post-stroke subjects (Stroke Group - SG). Demographic and clinical data were recorded for each participant. Seven IMUs (MOVIT, Captiks srl, Italy) were positioned on the following anatomical points: front head; C5; T10; L5; mid arm; mid forearm; and hand (III° metacarpus). Data were collected at a rate of 60 Hz. Each participant performedtwo tests with both upper limbs: standard BBT and targeted BBT. An in-house software (developed in MATLAB R2020a) analyzed the main joint angles**.** The 3D hand trajectory was estimated by using calibrated quaternions and anthropometric data. The Kruskal-Wallis test was applied between the PG and the CG, and between the SG and the CG with a significance level set to $p < 0.05$.

Results

The SG and PG were assessed with the Fugl-Meyer Upper Limb (mean±SD=49.0±12.02) and UPDRS (mean±SD=46.0±25.1). The clinical BBT test registered the following numbers of cubes: CG=63.7±4.3 (dominant), 65.2±6.3 (non-dominant); SG=31.5±24.3 (affected), 57.3±17.3 (unaffected); PD=51.4±20.8 (affected), 53 ± 20.5 (unaffected). Figure 1 depicts the joint angles which were significantly different, and the average hand trajectories (mean trajectory with the associated standard error) for each group of patients.

Figure 1. Preliminary results referred to joint angles and hand trajectory.



Discussion

The current study found significant differences between the CG and the SG and between the CG and the PG, showing compensatory strategies in neurological subjects. The proposed BBT protocol allows the assessment of manual dexterity tasks and could be used in the future to evaluate the efficacy of rehabilitation treatments with a muscle activity analysis by surface electromyography (sEMG). By achieving these goals, IMU-based BBT could serve as a potential system for standardized upper extremity assessment.

REFERENCES

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