Reliability and Responsiveness of a Mobile Device Application for Measurement of Postural Sway in People with Parkinson Disease

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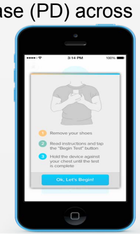
Introduction

SWAY Balance (SWAY) is an FDA-approved mobile software system that analyzes postural sway using the tri-axial accelerometer within Apple iOS devices. To date, it has primarily been studied as a method of baseline balance testing and sideline screening after suspected concussion in young adults[1] and fall risk screening in older adults[2]. A need exists for an objective, portable and easy to understand balance measure for high fall risk populations such as those with Parkinson disease (PD). However, SWAY has not yet been examined in people with progressive neurologic conditions. If found to be reliable and responsive, this technology may be useful to healthcare providers working with individuals with PD in a variety of settings to screen for fall risk and/or measure change over time.

Purpose

To determine the test-retest reliability and responsiveness of the SWAY Balance™ application (SWAY) for measuring postural sway under varied static standing conditions in individuals with Parkinson disease (PD) across Hoehn & Yahr levels (H&Y) 1-3.



Method

Study Design: Observational cross-sectional

Participants: Convenience sample from two Indianapolis PD fitness programs.

- ❖ H&Y levels 1-3; Age ≤ 80 yrs.; No dizziness or balance disorder unrelated to PD; No surgery in the last 6 mos.

Test Procedures:

- ❖ Two test days, 1 week apart, same time of day in "on-state" of anti-PD medications on both days.
- ❖ Three trials of each protocol performed on both days
- ❖ Randomized selection of initial protocol then alternated
- ❖ Mean SWAY score calculated from 4 conditions(0-100)
- ❖ Completed MDS-UPDRS III on day 1

Statistical Analysis:

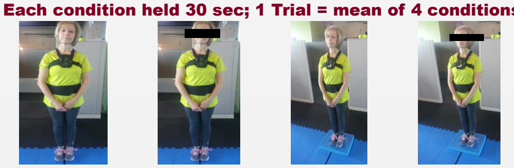
- ❖ Bootstrap bias-corrected (Bca) interval calculated to determine ICC due to non-normalized data with 95% CI on Trial 2 of both testing days.
- ❖ ICC >.60 as fair; >.75 good; >.90 as high

SWAY Fall Protocol

Each condition held 10 sec; 1 Trial = mean of 4 conditions

SWAY mCTSIB Protocol

Each condition held 30 sec; 1 Trial = mean of 4 conditions



Results

- ❖ No significant differences between H&Y levels for age, PD duration, falls, exercise or meds.

Participant Demographic Data n=30	
PD duration, mean (SD)	5.8 years (4.3)
Age, mean (SD)	69.2 years (7.4)
Falls ≥ 1x/6 months, n (%)	10 (33%)
Exercise yes/no, n (%)	29 yes (97%)
On Levodopa-Carbidopa, n (%)	20 (67%)

	Total Sample	H&Y 1 n=6	H&Y 2 n=18	H&Y 3 n=6	*p*
MDS-UPDRS III	33.6 (15.4)	14.7 (11.8)	35.0 (11.4)	48.8 (8.0)	< .001

p < .05; Mean (SD); MDS-UPDRS III = Movement Disorder Society – Unified Parkinson Disease Rating Scale

- ❖ SWAY demonstrates high test-retest reliability in the mCTSIB & fair test-re-test reliability in the Fall protocol.
- ❖ Unable to calculate SEM and MDC due to skewness of data

Protocols	ICC	95% CI
mCTSIB	0.92	0.84 - 0.97
Fall	0.72	0.57 - 0.84

mCTSIB = modified Clinical Test of Sensory Integration and Balance

- ❖ 12 of 30 and 7 of 30 participants were unable to maintain at least one test condition during a trial in the Fall and mCTSIB respectively.
- ❖ 80% of participants had a mean score of > 90/100 in both protocols.

Conclusion

Our results indicate both SWAY protocols demonstrate high to fair test-retest reliability in individuals with PD. The mCTSIB achieved high reliability that may ensure clinical validity. Further study with a larger, more heterogeneous sample is required to determine responsiveness with SEM and MDC, as well as normative values for this population. Because many participants were not able to maintain test positions, issues concerning measurement error and protocol difficulty should be explored.

Clinical Relevance

When choosing a SWAY protocol for fall screening for persons with PD, health providers should consider the patients ability to maintain the required test positions. Adding an amount of time in position may be of value in accurately characterizing participant performance. Use of a chest harness to secure the mobile device is helpful in minimizing the effect of upper extremity tremor due to PD.

Acknowledgements

Thank you to the staff and members of Rock Steady Boxing and The Climb of Indianapolis, IN for their participation in this study.

References

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