A prospective study evaluating the relationship between the SWAY Balance™ Assessment, Dizziness Handicap Inventory (DHI) and Videonystagmography (VNG) test in dizzy patients

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Introduction

The evolution of smartphone technology has provided patients with an ability to self evaluate and quantify their physical symptoms prior to an evaluation by a medical professional. Modern mobile devices employ accelerometers which function to measure postural sway. The introduction of a new technology, SWAY Balance™, operates through a software platform utilizing a tri-axial accelerometer measuring postural sway. To our knowledge, this technology has not been utilized in patients with vestibular related disorders. Two current assessments used to evaluate patient dizziness include Videonystagmography (VNG) and the Dizziness Handicap Inventory (DHI). Presently used force platforms can be challenging due to equipment cost, size, mobility, accessibility, duration of use and need for specialized personnel. SWAY Balance™ provides an attractive means of screening dizzy patients for quantitative information associated with their dizziness and balance. Specific aims for the proposed study are as indicated:

Specific Aim 1: To determine the relationship between the DHI, VNG and SWAY Balance™ mobile Application in dizzy patients

Specific Aim 2: To determine the difference in performance between test subjects and controls on two SWAY Balance™ protocols: the fall assessment and modified Balance Error Scoring System (mBESS).

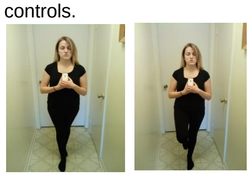
Methodology

Table 1: SWAY Balance™ Protocol

Fall Assessment (Eyes Open)	
Step	Instruction
1/4	Place feet together
2/4	Stagger one foot in front of the other
3/4	Place one foot in front of the other
4/4	Lift one foot, balance on other foot
mBESS Protocol (Eyes Closed)	
1/5	Place feet together
2/5	Place left foot in front of right
3/5	Place right foot in front of left
4/5	Balance on right foot, lift left foot
5/5	Balance on left foot, lift right foot

1. Score and review DHI
2. Provide SWAY™ protocol via mobile application (Table 1; Figure 1)
3. Perform VNG

Statistical analysis included a Pearson's correlation to determine the relationship between the VNG, DHI and SWAY™ Assessment. An independent t-test was used to calculate the difference between test subjects and controls.



Demonstration of mBESS protocol

Subjects recruited in accordance with HIC protocol #1412015057

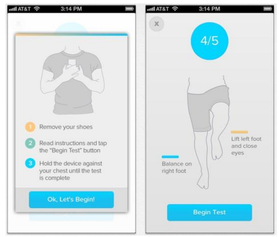


Figure 1: SWAY™ Balance Smartphone Instruction

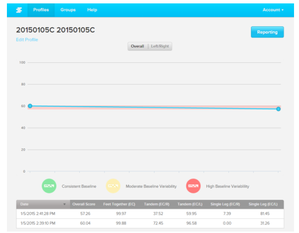
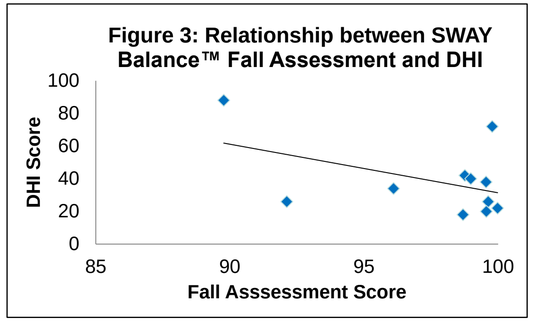
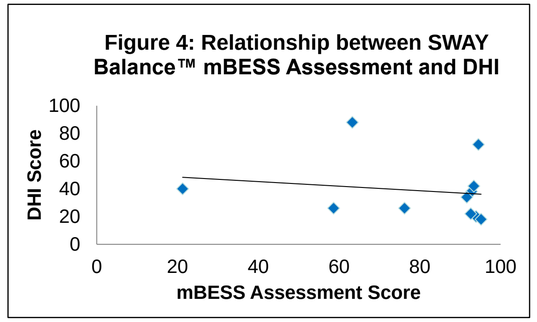
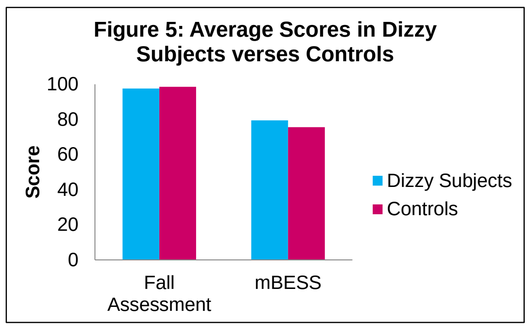


Figure 2: SWAY™ Balance Online Portal







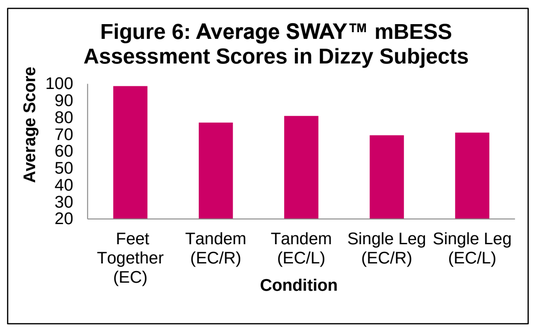


Table 2: Relationship between DHI, VNG and SWAY™ Balance Assessment

Subject	DHI Score	Fall Assessment	mBESS	VNG Abnormality / Medical Diagnosis
A: 24 y/o female	38/100: Moderate	99.55	92.82	Left peripheral pathology, vestibular neuronitis, migraines
B: 30 y/o female	34/100: Mild	96.1	91.65	Left peripheral pathology, migraines
C: 42 y/o male	22/100: Mild	99.98	92.62	Right peripheral pathology
D: 43 y/o female	40/100: Moderate	98.98	21.26	Right peripheral pathology, meningioma

Results

All recorded scores can be accessed through an online portal which graphically demonstrates patient performance (Figure 2). There was no significant correlation found between the DHI and two SWAY™ Balance Assessments and no significant difference in performance on the SWAY™ balance protocols between test subjects and controls. The average score for each condition of the mBESS assessment is demonstrated in Figures 6. Scores for those with an abnormal VNG are identified in Table 2; all other subjects tested had a normal VNG Assessment. None of the patients tested in this study presented with a central pathology.

Discussion and Conclusion

The SWAY Balance™ mobile application provides a convenient and attractive means of obtaining quantitative information on dizzy patients by measuring postural sway while isolating each component of the balance system. Our findings suggest there is no significant relationship between the VNG, DHI and SWAY™ Balance Assessment and no significant difference between test subjects and controls on the fall and mBESS assessment. Suggestions regarding the future direction of this research and potential modifications to the protocol are indicated below:

- Relationship of SWAY™ Balance with platform posturography
- Difference between symptomatic vs. asymptomatic patients
- Further investigation of performance from controls vs. test subjects (with stricter criteria established for those with vestibular disorders)
- Difference between peripheral vs. central pathology
- Difference between those physically fit vs. non-physically fit
- Effect of harness vs. no harness during testing

Our results demonstrated the ceiling effect among different portions of the SWAY™ fall assessment and no significant differences between our test subjects and controls. It is suggested that modifications to the SWAY™ Balance protocol specific for those with vestibular related disorders could make the test more sensitive to asymptomatic and symptomatic dizzy patients. Although this pilot study did not indicate a significant relationship between these three measures, further research is warranted under specific conditions modified for those patients with vestibular related disorders.

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