



Effect of Counter-Clockwise Oscillation Platform Training on Balance in the Geriatric Population: A Pilot Study

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Abstract

Introduction: Vibration platform training involves creating perturbations from mechanical vibrations or oscillations while standing on a platform. This type of perturbation causes a disturbance of the user's motion and equilibrium. This study analyzed the effects of training with a counterclockwise oscillating platform on the community dwelling older adult's balance confidence and postural sway.

Materials and Methods: A pre-post repeated measures design was utilized. The sample consisted of 34 community-dwelling elderly subjects (mean age of 80). Each subject completed a Mini-Mental Evaluation, ABC Balance Confidence Scale, and the CDC4 SWAY Medical Balance Protocol prior to participating in the intervention for baseline measures. The intervention was over a five-week time period that required subjects to stand on the OS FLOW counter clockwise oscillation platform for five minutes a day, for four days a week. Final measures using the ABC Balance Confidence Scale and the SWAY Medical Balance Protocol were conducted at the cessation of the five-week protocol. Results: There was a statistically significant increase in balance confidence per ABC Scale ($t=2.10$, $p<.05$). Mean scores on the SWAY Balance test improved (mean pre= 81.6, mean post =83.2), but these changes were not statistically significant ($t=1.11$, $p>.05$). Conclusion: Balance confidence improved with the use of a counterclockwise oscillating vibration platform on the community dwelling older adults. The non-significant changes in SWAY scores were possibly due to the brevity of protocol duration or high starting SWAY scores of those participating, possibly indicting a ceiling effect.

Keywords: Balance; Training; Vibration

Introduction

There are several different physiological reasons that place the aged individual at greater risk for falls. It is usually multifactorial disorders such as impaired vision, vestibular dysfunction, sensory loss, muscular weakness, or gait disorders that contribute to more frequent falls experienced by the elderly [1,2]. It is hypothesized that the most significant underlying reason for weakness and atrophy in the older adult is actually muscle disuse and lack of activity, rather than the aging process itself [3].

Balance strategies

There two type of balance Strategies: Reactive Strategies and Proactive Strategies. Reactive Strategies are used when there is an external force that alters the body's center of mass. Proactive Strategies are used in anticipation of internally generated destabilizing forces that will shift the body's center of mass, such as reaching out the arms [4]. The elderly individual, however, often cannot integrate these strategies to correct for their lack of balance in time to prevent a fall. Decreased reaction speed and inability to correct for a disturbance in balance is another factor that leads to the prevalence of falls in the elderly population. With the ageing process, nerve conduction speed is reduced considerably [5].

Balance boards and vibration platforms

Whole body vibration is a training method that exposes the entire body to mechanical vibrations or oscillations while standing on a platform [6]. Vibration boards have a number of parameters including frequency, amplitude, and direction of the vibratory force.

There are several different types of vibration platform, each using a different mechanism of

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Figure 1: OSFLOW Vibration Platform.

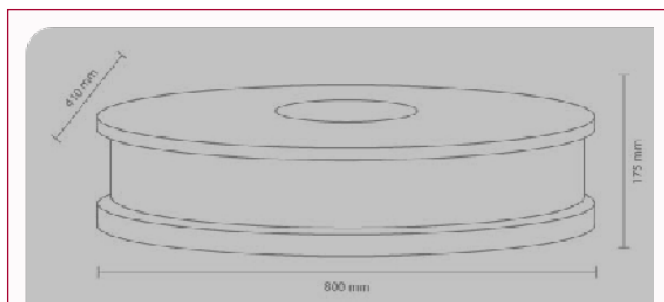


Figure 2: Vibration Platform Dimensions.

vibration [7,8]. Platforms generally operate using a sinusoidal wave and vibrating in either a side-to-side alternating or vertical direction [2]. The counter-clockwise oscillating platform uses spirally formed oscillations that rotate in a counterclockwise direction.

Vibration platform training causes rapid vertical and/or horizontal displacements with high levels of acceleration. These perturbations challenge the body to respond with appropriate balance correcting strategies to improve balance and balance confidence [9].

The purpose of this study was to determine whether the counter-clockwise oscillating vibration platform has a significant effect on balance and balance confidence of community-dwelling elderly.

Materials and Methods

Study design

This was a quantitative research study with a pre-post repeated measures quasi-experimental design. This design allowed participants to function as their own controls. The Institutional Review Board of XXXX University approved the study; the rights of human subjects were protected. The intervention was a 5-week protocol on a counterclockwise oscillating vibration platform. Each participant completed an ABC Balance Confidence Scale and SWAY balance measurement prior and at the conclusion of the intervention.

Sample

A non-probability convenience sampling strategy was used to gather participants. Fifty-four community-dwelling elderly were recruited at a local assisted living facility of which 34 participants completed the entire research protocol. The group included 17 males and 17 females. The average age of the participants was 80 (range 66 to 96). Exclusion criteria were as follows: Folstein Mini-Mental State Examination score of less than 24, history of thrombosis, inflammatory disease, fracture, joint implant, surgery, or malignancy.

Instrumentation

The OSFLOW counterclockwise oscillation vibration platform was used for the intervention in this study (Figure 1). The platform

Table 1: Seven Positions for Postural SWAY Measurement.

1.	Feet together
2.	Semi tandem with right foot leading
3.	Tandem with right foot leading
4.	Single leg stance on left leg
5.	Semi tandem with left foot leading
6.	Tandem with left foot leading
7.	Single leg stance on right leg

Table 2: Paired Sample Statistics.

		Mean	N	Std. Deviation	Std. Error Mean
ABC	Pre-Intervention	13.191	34	2.86756	0.50692
	Post-Intervention	13.804	34	2.44764	0.43269
SWAY Averages	Pre-Intervention	81.603	34	12.12175	2.11013
	Post-Intervention	83.244	34	11.66608	2.0308

frequency is adjustable from 8 to 12 Hz. Both platforms used in this study were set to 10 Hz. The dimensions of the platform are 31.5 inches in length, 15.75 inches in width, and 7.09 inches in height (Figure 2). The amplitude of the OSFLOW is set to 1 to 2 mm [10].

The SWAY Medical Balance phone application was used to collect data on the subject's balance and postural sway (Figure 3). Sway Balance is a medical device, received 510(k) clearance by the Food and Drug Administration, and is intended for use by qualified professionals to assess sway as an indicator of balance [11]. In a Sway Balance reliability study, repeated measures ANOVA revealed no significant mean differences between SWAY balance scores of the experimental trials ($F(5,115) 0.673$; $p 0.65$). Excellent reliability was found (ICC (3,1) 0.76; SEM 5.39) [12,13,14]. Altman et al. indicated that it is moderate to strong correlation to the Balance Error Scoring System (BESS) [12].

The CDC4 protocol used for this research is a combination postural sway measured with the participant standing stationary with their feet together, feet in tandem stance, and then finally when standing on one foot. From these scores, the SWAY application calculated an overall balance score for the left and the right leg. These two averages were then used to calculate a final overall balance score that included both the left and right.

The Activities-Specific Balance Confidence Scale (ABC Scale) was used as a subjective measure of confidence for the community-dwelling adult in performing various ambulatory activities without falling or a sense of unsteadiness. The test has excellent test-retest reliability, as well as excellent internal consistency [15].

Procedure

Potential participants attended an information session where the Informed Consent form was reviewed. Participants were then administered the Folstein Mini-Mental State Examination, and a Recent Health Survey to determine if they met the inclusion criteria. Confirmed participants completed the initial ABC Balance Confidence Scale for their baseline measurement, and initial balance evaluation using the SWAY Medical Balance Application. All participants were asked to remove their shoes prior to the testing of their balance. The researchers measured the postural sway of each participant in seven positions (Table 1).



Figure 3: SWAY Medical Balance App.

Table 3: Paired Samples Test.

		Mean	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	t	Sig. (2-tailed)
Pre-Post Paired	SWAY Averages	1.64121	8.42952	1.46739	-1.34776	4.63019	1.1118	0.272
	ABC	0.61313	1.65297	0.29221	0.01717	1.20908	2.098	.044*

Participants stepped onto the vibration platform, and the platform was turned on for five minutes. Each participant was instructed on how to appropriately position him or herself on the platform throughout the time period (feet shoulder width apart, chin up, and relaxed posture). The researchers were stand-by assist for the entirety of the intervention for each session within one foot proximity. For those who were deemed a fall risk, a gait belt was used every session. At the end of the five-week session, post-intervention measurements of the ABC Balance Confidence Scale and the SWAY Medical Balance Application were completed.

Each participant was required to attend four sessions a week for the five-week time period. Participants who missed more than three sessions were excluded from the data analysis.

Statistical analysis

Results of the study were analyzed using SPSS v.22. Descriptive statistics were obtained, and paired T-tests were performed to evaluate differences in pre and post intervention score for the ABC Balance Confidence Scale and the SWAY composite balance score. The Alpha level was set at 0.05.

Results

A total of 34 participants completed the study through the entire 5-week protocol, each completing 100% of the required sessions. No adverse side effects were reported. Several participants noted a transient feeling described as “getting off of a boat” or “feeling unsteady”. These effects subsided within the 1-minute waiting period after turning off the vibration platform.

Descriptive statistics for the ABC Scale scores are displayed in Table 2 (Table 2). Table 2 demonstrates the average scores on the ABC Scale prior to performing the 5-week protocol and on the final day of the protocol. The mean ABC score before the intervention was 13.2 out of a possible 16 points. The mean score after the protocol had been completed was 13.8 out of a possible 16 points. These scores represent percentage scores of 82.44% and 86.27%, respectively. The mean difference between these two scores was 0.6132. Results of the Paired T-test are displayed in Table 3 (Table 3). The Paired T-test demonstrated that there is a significant difference between the ABC Scale scores in the pre and post-test groups.

Descriptive statistics for the results of SWAY Balance test are displayed in Table 2 (Table 2). The average score represents the mean score of three different balance tests performed on each foot. The average score of the group before the intervention was 81.60 out of a possible 100 points. The average score of the group after the protocol had been completed was 83.24 out of a possible 100 points. The mean difference between these two scores was 1.64121. Results of the Paired T-test calculated by the SPSS software are displayed in Table 3 (Table 3). The Paired T-test demonstrates that there was no statistically significant difference between the SWAY Balance scores in the pre and post-test groups.

Discussion

There was a statistically significant change in ABC Scale score after completion of the protocol. The average pre-test ABC score was 13.19 (82.44%). The average ABC score after the completion of the protocol was 13.80 (86.27%). This demonstrates a 3.83% increase from baseline scoring. Despite the fact that the pre-intervention ABC scores were higher than the mean score for this age demographic (leaving a narrower margin for improvement), there was a statistically significant increase in balance confidence.

Of the 34 participants who completed an ABC survey before and after the protocol, 26.5% reported a decrease in their balance confidence. There are several possible explanations for this decrease in balance confidence, as the SWAY balance measures did not reflect this same decrease in overall balance. Prior to beginning the protocol, none of the participants had any experience with a vibration platform. Furthermore, the balance measures tested by the SWAY application included positions (tandem stance and single leg stance) that the participants did not frequently assume in their daily lives. After completion of the initial balance testing, many participants verbalized that they had not been aware of their balance deficiencies.

While there was an increase in the mean scores after completion of the five-week protocol, there was no statistically significant improvement in the scores of the SWAY balance test from pre-intervention to post-intervention. There are several possible explanations for the lack of significant difference.

First, the protocol itself required the participant to stand stationary on the vibration platform with their feet shoulder-width

apart and their lower-extremities in a comfortably relaxed position. While this is an appropriate posture that one assumes in every-day life, it was not a posture that was directly measured by the SWAY app. For many participants, the protocol itself may not have appropriately challenged the balance systems enough to elicit any positive adaptations. If participants had been challenged to a level reflecting their own personal abilities rather than using a uniform static protocol, results may have reflected larger improvements in postural sway.

Most participants in this study had a relatively low fall risk, as indicated by the ABC and SWAY Balance pre-intervention scores. This may have been a result of the convenience sampling strategy used. This potentially limits performance gains on both measures.

Conclusion

The results of this study demonstrated a statistically significant increase in the Activities Specific Balance Confidence Scale. The SWAY balance application scores demonstrated an increase in mean scores after completion of the five week study, but no statistically significant difference between the pre and post-intervention measures. Future research needs to be conducted to investigate the further benefits of an oscillating vibration platform on balance in the elderly population that includes a lower functional balance level population and a longer training time.

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