

An Innovative therapeutic for improving balance in an elderly faller

Keywords: Elderly, Prevention, Balance, Falls

Abstract

Background: Falls are a well-known threat to the elderly population. One out of three older adults falls each year. We wish to present an innovative therapeutic rehabilitative device; which provides constant resistance and creates strong proprioceptive stimuli. The device enables walking and balance training and is used here as a form of perturbation while walking. Our aim is to observe if the Salute Just Walk device can improve dynamic stability as well as basic activities of daily living in an elderly 83-year old subject. **Methods:** This is a single-subject case-study of an 83 year-old woman with a history of recurrent falls. The subject participated in a single practice with the Salute Just Walk device. Measures were taken pre-and post-practice with the system. Outcome measures were Timed up-and-go and Functional Reach tests. **Results:** No adverse events or side effects were reported by the subject. Improvement was found in both TUG and Functional Reach at post-test compared with pre-tests. **Conclusions:** a single practice with the Salute Just Walk device resulted in an immediate improvement in balance and basic mobility skills.

Background

Falls are a well-known threat to the steadily growing population of the elderly in modern-day society (Berg et. al., 1997; Rubenstein 2006). We currently know that one out of three older adults falls each year (CDC, 2013). The population of older adults, aged ≥ 65 , is expected to rise from 35 million in 2000 to 72 million by 2030 representing 20% of the total U.S. population (MMWR, 2014). Since falls are a leading cause of injury death, and are the most common cause of nonfatal injuries (CDC, 2013) they are major contributors to immobility and may prevent an independent life (Rubenstein, 2006; CDC, 2013).

Among the risk factors for falls in older adults, impairments in gait and balance were found as the most significant (Rubenstein, 2006; Ambrose et al, 2013). Gait pattern in older adults tends to be rigid and with poorer postural control (Ambrose et al, 2013). This is due to the normal decline in many physiological systems such as peripheral sensation, proprioception, muscle force, vision, vestibular function and more (Lord et al 2003, Segev-Jacobovski et al, 2011; Ambrose et al, 2013).

Intervention programs which aim to reduce fall risk mostly include balance and resistance exercises, along with endurance and flexibility (Ambrose et. al, 2013; Sherrington et. al, 2016). Although balance exercises are mainly recommended, strength training generally should be included and added (Ambrose et. al, 2013; Sherrington et. al, 2016). One of the drawbacks of these exercise programs however, is that they usually include exercises in sitting or standing, and lack practice in walking in different conditions such as walking on a faulty sidewalk.

Other intervention that are aimed to reduce falls involve the use unexpected perturbations to balance while walking on treadmill (Kurz et. al, 2016). These kinds of interventions may be more specific and effective since they simulate a real fall and therefore induce real balance reactions; however the equipment used in these interventions is inaccessible to patients on a daily basis.

We wish to present an innovative therapeutic device; the Salute Just Walk device, which provides constant resistance and enables walking and balance training (for further description see the methods chapter). The resistance is creating a strong proprioceptive stimuli which is known to be important in gait rehabilitation (Dietz et al, 2002; Lam et al, 2006) and is used here as a form of perturbation while walking. The main advantage of the Salute's device is that it can be used on a daily basis, anytime and everywhere (on any type of surface, at home or outside).

Our aim in this single-subject case study is to present our clinical experience with the Salute Just Walk device when used as a balance perturbation during walking and while performing functional exercises.

We wish to observe if the Salute Just Walk device can improve dynamic stability as well as basic activities of daily living.

Methods

Participants and Study design

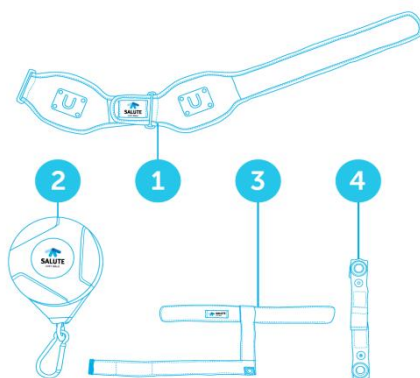
This study design was a single-subject, case-study. The subject participating in this study is an 83-year old female subject, with a history of recurrent falls and diabetes. The subject is able to walk independently indoor, without an assistive device. Supervision and the support of a cane are required in outdoor walking. One of the prominent impairments in her walking is a tendency to shuffle her feet while walking.

Experimental protocol

The subject participated in a pre-post case-study with the Salute Just Walk device which was placed on both legs and was connected to the forefoot. Practice was performed once and included a pre-test, then 15 minutes of functional exercises (e.g. stepping sideways, forward and backward, climbing up and down the stairs), walking with the Salute Just Walk device and then post-tests were performed. Functional tests were performed by a well-trained physical therapist in the following order; first without the Salute system (pre-test-without), then with the system (test-with), and once again at the end of the session (after practice) without the Salute system (post-test-without).

Salute Just Walk device description

The system is composed of a belt (1), placed around the patient's waist. The device (2) is secured in a residence unit in the belt. The device provides continuous linear and adjustable tension on the muscles by creating a magnetic force that is converted into kinetic energy. A tension cord in the device quick connects to the patient's foot / shoe via an adjustable foot strap that fits the feet and ankle strap (3). Variable resistance puts tension and pressure on the leg as the person walks. An extra strap (4) is supplied, that can be attached in alternative locations on the foot strip for additional functions. All components are Salute's technology designed especially for "Home user" patients. The device can be placed on both lower limbs and provides assistance in the initial swing and resistance in the terminal swing of the gait.



To use the device, the patient or the patient's caregiver places the belt around the patient's waist. The device is then secured in a residence unit into the U sign. To change the level of difficulty (resistance), the residence unit is rotated in a clockwise direction. The foot belt is adjusted around the feet and ankles. The patient then pulls the tension cord from the device and attaches the D-clip in the cord to the foot strap. The patient then walks with the device on.

Outcome measures

(1) Timed-UP and Go (TUG) – the TUG is a widely used, reliable and valid test for the evaluation and quantification of functional mobility that can also be useful in following clinical change over time (Newton, 1997; Hafsteinsdóttir et al, 2014). Also, it provides information on the basic activities and transition phases associated with balance, such as stand, turn and sit, as well as gait (Newton, 1997). The TUG requires participants to stand up from a chair, walk 3 meters as fast as possible, turn around, return to the chair, and sit down again. The time required to complete the test is recorded in seconds using a stopwatch (Hafsteinsdóttir et al, 2014). (2) Functional Reach Test - this test was used in order to evaluate

the subject's stability by measuring the maximum distance which can be reached forward while standing in a fixed position. It is known to have good reliability (Thomas and Lane, 2005).

Results

Safety - No adverse events or side effects were reported by the subject. The subject needed help in placing the belt, ankle and foot strap and to attach the tension cord with the D-clip to the foot.

Efficacy - Improvement was found in both TUG and Functional Reach, as described in Table 1. For the TUG, our results imply that even a single practice with the Salute Just Walk device leads to improvement in the TUG score. This improvement seems significant since the cut-points for falls in independent-living subjects are varied between 11 seconds and 13.5 seconds (Schoene et. al, 2013). The functional reach test improved as well. Although the improvement was small, the fact that both outcome measures of different aspects of postural control improved supports the assumption that the improvement was not coincidental (i.e. due to measurement error).

Table 1- TUG and Functional Reach scores

	pre-test-without Salute	test-with Salute	post-test- without Salute	Difference between <i>pre-</i> and <i>post-</i> score (without)
TUG test result (sec)	14.38	15.81	12.36	+2.02
Functional Reach test (cm)	28	20	30	-2

TUG= timed up-and go test

Subjective observation – when the subject first walked with the system it was eminent that the applied resistance restricted the speed of walking. However, the system clearly assisted with clearance and step height of both legs so that the shuffling of the feet was significantly reduced.

Discussion and conclusions

Our results in this single-subject case-study imply that the Salute Just Walk device can be an effective therapeutic device for gait and balance rehabilitation among elderly patients who suffer from balance impairments.

When observing the TUG and Functional Reach test scores with the system, it seems that the performance on the TUG test is slower and that the subject's ability in reaching forward is restricted. This could be due to the fact that the tests with the system were performed before the subject could adjust to the resistance while walking. We restricted the duration of the practice to 15 minutes because we were concerned that the subject will get too tired. We presume that if we had given the subject more time to practice, the results of the tests with the system would have shown an improvement as well. However, despite the fact that the subject didn't have enough time to adjust, the scores of the post-tests did show an improvement. As reflected by the TUG score of the post-test after the system was disconnected, the subject walked more easily and with higher steps.

These preliminary results show the immediate improvement achieved after only 15 minutes of a single practice. In future studies, practice should be performed at least 3 hours per week, as recommended for other balance exercises interventions by Sherrington et. al, (2016). We expect that with more practice, the improvement will be even more prominent.

In conclusion, our aims to see an improvement in dynamic stability as well as basic activities were achieved in this single subject case study. We expect to our future studies among elderly subjects to further establish these promising results.

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