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“A Case Study on Assessing Balance in an Older Adult with NeuroCom”

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Capstone Approval Page

A case study on Assessing Balance in an Older Adult with Neurocom

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Abstract

Falling is the most common mechanism of injury as well as the leading cause of death from injury in people who are older than 65 years. This is a serious issue for the geriatric population because the frequency in falls increases with age. This increase is due to the increased likelihood of degenerative or infectious diseases, or the effects of injuries accumulated over time. Although falling has been a recurring problem from generation to generation, there is greater anticipation of falls now that the baby boomer generation is transitioning into older adults. An awareness of the dangers of falls is essential for older adults to sustain functional independence, to prevent falling, and to minimize injuries. There are effective treatments available by physical therapists who are specially trained in the evaluation and treatment of balance disorders. A single case study was conducted and analyzed using NeuroCom and a variety of balance tests to study the physiological and anatomic factors that contribute to poor balance.
Introduction

Balance problems in older adults are usually due to degeneration, which may consist of injuries, or a combination of impairments over time. There is no apparent underlying cause for individuals with poor balance. Desai et al. (2010) states that falls in older adults are known to be multifactorial, which can differ substantially from individual to individual. Yang et al. defines balance as “the ability to maintain the projection of the body’s center of mass within limits of the base of support, as in standing or sitting, or in transit to a new base of support, as in walking” (p. 25). There are greater consequences for older adults as falling can result in a loss of function or mobility because of serious age related physiological changes. Alghwiri (2012) defines a fall as "an unintentional loss of balance that leads to failure of postural stability" or "a sudden and unexpected change in position which usually results in landing on the floor" (p. 331). Postural control keeps the body in equilibrium, to stay balanced and the three sensory systems that contribute to postural control will be evaluated: vision, somatosensory, and vestibular.

The use of vision helps to avoid balance challenges from environmental hazards by discriminating alarming surfaces. The central nervous system adapts to what is being seen and helps maintain the body in an upright vertical position. Alghwiri (2012) states that examples of vision impairments in older adults may be due to strokes, diabetic retinopathy, glaucoma, macular degeneration, cataracts, or use of progressive, bifocal, or trifocal corrective lenses (p. 333). These health-related conditions can be associated with decreased visual acuity, contrast sensitivity, and depth perception (Alghwiri, 2012, p. 333). As a result, these limitations can interfere with safe mobility. These altered conditions can also cause confusion in older adults because the visual input helps control posture in a given environment and can be a determinant of appropriate speed in gait.
Alghwiri (2012) states that somatosensory sensations, which include vibration, proprioception, and cutaneous inputs, have been identified as the primary sensory information used to maintain balance (p. 332). These various inputs provide the central nervous system information about the body’s position and motion with reference to supporting surfaces. Alghwiri (2012) also states that “vibration sense is decreased or diminished in 10% of people older than age 60 years and 50% of people older than age 75 years due to increased high-frequency sway” (p. 332). While adults use somatosensory inputs to maintain an upright balance, alterations can result in a slow reaction time for the muscle and joint receptors. This disrupts an individual’s balance because the muscle responses that help stabilize balance would not react in time with such interferences.

The vestibular system helps control posture and locomotion. It regulates positions of the head and neck and produces proper body alignment, especially for fast movements. Examples of the changes in the vestibular system in older adults would be decreased hair cells, vestibular nerve fibers, and changes in vestibular ocular reflex (Alghwiri, 2012, p. 333). These health-related conditions can be associated with benign paroxysmal positional vertigo, unilateral vestibular hypofunction, bilateral vestibular hypofunction, and meniere disease (Alghwiri, 2012, p. 333).

Elderly individuals who have fallen or are at risk of falling may experience a loss of independence. In an online article, written by Gregg Warshaw, MD (2006), it was stated that “Fear of falling can be a very real reason for loss of mobility in the elderly. After a few falls, some people become so frightened and anxious that they will not attempt to stand even when there is adequate help and support.” This shows that not only can physical complications that occur from a fall may lead to a loss of independence, but the fear of falling can also prevent individuals from
partaking in their usual activities. There are ways to determine the levels of confidence in balance for an individual, such as the Activities-Specific Balance Confidence (ABC) Scale, which was used in this case study.

How NeuroCom Assesses Balance

The visual, somatosensory, and vestibulation inputs to balance can be measured on a device called NeuroCom. NeuroCom assesses balance in individual by detecting any abnormalities in the three sensory systems, using a Sensory Organization Test (SOT). This test consists of six sensory conditions: 1. All three senses are available and not altered, 2. Vision is absent, vestibular and somatosensory are present and not altered, 3. Vision is altered, vestibular and somatosensory are present and not altered, 4. Somatosensory is altered, vision and vestibular are not altered, 5. Somatosensory is altered, vision is absent, vestibular is not altered, 6. Somatosensory and vision are altered, and vestibular is not altered. These conditions are illustrated in figure 1.

Figure 1. NeuroCom diagram of the six conditions. Taken from NeuroCom.
In this case study, the patient was harnessed appropriately onto the NeuroCom and stands on a movable plate with a movable surrounding wall. The patient was tested with the SOT, and his scores were calibrated from each condition to the Sensory Analysis. This analysis helps determine which sensory systems are out of normal range. At the beginning of each trial, SOT shows the patient's center of gravity (COG) position in relation to the center of the base support at the beginning of each trial (Rose & Allison, 2012). A Strategy Analysis explains which strategy, hip or ankle is being used to maintain their balance in all six conditions. The ankle strategy should be used on a stable surface, and shifted over when using the hip strategy on a less stable surface (Rose & Allison, 2012). Desai et. al (2010) states that the SOT has been able to distinguish between fallers and non-fallers in community dwelling adults.

Case Study

History: 79 year old male diagnosed with difficulty in walking and fall risk sought physical therapy in 2008, and again in 2012. Arthritis resulted to past surgical history of right total hip arthroplasty in 1999, right partial knee arthroplasty 2003, left partial knee arthroplasty 2007, and left total hip arthroplasty 2009. His relevant past medical history consisted of vertigo. Patient has functional deficits walking for prolonged distances, and has difficulty with his daily life activities. Goals in physical therapy are to “keep limber.”

Different tests were provided to evaluate the patient's deficits in balance: The ABC Scale, Functional Gait Assessment (FGA), Timed Get Up and Go Test (TUG), Motor Control Test (MCT), Adaptation Test (AT), Limits of Stability (LOS), and SOT. Training, strengthening, and stretching in the patient's lower extremities were also used to improve patient’s balance.
The performance of the FGA helps to analyze the patient's ability to walk, balance and transfer from one place to another. The patient demonstrated a score of 23/30. Mild impairments were shown in gait level surface, gait with horizontal head turns, and steps. Severe impairments were shown in gait with a narrow base of support. This shows that there might be some impairment in the patient's vestibular and somatosensory systems.

TUG tests mobility of individuals. TUG is recommended as a measure to identify community dwelling elderly who are at risk of falling (Desai et. al, 2010, p. 758). This test is usually done on people who are able to walk on their own. No assistive device was needed for this patient. The patient was rated mostly independent as he was able to stand up from a chair and walk a distance of 10 ft and back in an average of 11 seconds. Less than 10 seconds is considered freely mobile while anything greater than 13.5 seconds demonstrates an increased risk for falls.

The ABC Scale collects information about the patient's perception of their balance and their confidence of their balance. The patient scored a 70/100, which shows a moderate level of functioning.

MCT is used on the NeuroCom to determine how quickly the patient's automatic motor system can recover following an unexpected perturbation.

In September of 2008, the patient was tested using the SOT. Conditions three and four displayed slight deficits; however, it was close enough to reach the normal range as his composite score was 72. These deficits were negligible in the Sensory Analysis, as the patient reached normal range in all three sensory systems: somatosensory, vision, and vestibular. The patient depends on his hips to maintain balance versus his ankles, which means there is not enough ankle support. The patient's center of gravity is significantly off, as it shifts to his left anterior. In the MCT, the
weight symmetry data shows that patient puts most of his weight on his left leg in both forward and backward translations. Although the patient's center of gravity is not in normal range, he is able to keep his balance. Composite score was in normal range, at 156.

February 3rd, 2012:

The patient reported back with a decrease in balance and stability while performing daily activities. He demonstrates a cervical shift to the right and experiences right-sided neck pain due to being rear-ended one and a half years prior. X-rays demonstrate a bend in his spine around C3-C5 that was rendered inoperable. The patient also has a lower right shoulder, bilaterally flexed knees, forward head posture, bilaterally swollen ankles, and increased supination of the left ankle. The patient’s gait shows bilaterally flexed knees, and irregular foot drop due to flexed knee gait. The patient overall, has good lower extremity strength when performing the manual muscle test.

February 6th, 2012:

The patient was assessed using SOT. Condition three showed a slight deficit, but improved in the second trial. His composite score was 79, which is an increase since 2008. The patient's sensory analysis also increased in all four categories, and shows improvement as he is in the normal range of sensory analysis. The patient uses more ankle support than before; however, he still shows trivial dominance in his hips. His COG remains anterior left, and puts more weight on his left leg in both forward translations. The patient shows improvement in the backward translations as the level of difficulty increases and is able to distribute his weight evenly to both legs on the third level. Patient also performed in the normal range of the AT, which means he is able to reduce his sway when exposed to changing surfaces.
The patient was trained on the NeuroCom, when performing Limits of Stability. The patient showed limitations to his right, backward, and left. He was able to find his center of gravity, and is in the normal range for all of the following: reaction time, movement velocity, endpoint & max excursions, and directional control.

**February 17th, 2012:**

Patient continued training on the NeuroCom and was able to find his center of gravity. No assessments were conducted. However, the patient was apprehensive when shifting backwards.

**February 24th, 2012:**

Patient performed on NeuroCom again, but still remains apprehensive when shifting backwards. No assessments were conducted. Lower extremity exercises were used, as well as lower extremity stretches.

**March 9th, 2012:**

Intervention was used on the NeuroCom again. The first treatment, Center 3 Posterior, shows the patient having major difficulty moving back. With the second treatment, Circle left, the patient was able to maintain movement from each box, but similarly exhibited problems leaning backwards.

**March 23rd, 2012**

Continuation of intervention was used on the NeuroCom again. The first treatment, Center 3 Posterior shows patient having major difficulty moving back. The 2nd treatment, Circle
right, the patient was able to maintain movement from each box, but continued to have problems leaning backwards.

April 27th, 2012

The patient was trained on the NeurCom with LOS. The patient is still apprehensive when moving backwards, but has improved. He was able to find his center of gravity, and was still in the normal range for all of the following: reaction time, movement velocity, endpoint & max excursions, and directional control. The patient was educated on how to accurately sit and stand on a chair, and how to walk at different gait speeds while maintaining his balance. The patient was discharged.

Conclusion

The patient has been showing patterns of difficulty swaying backwards, exhibiting poor postural control in that direction. However, he seems to be independent in the other areas tested, including the three sensory systems and when completing the balance exercises and strengthening. The patient also reports that he exercises at the gym at least twice a week for about 45 minutes with the recumbent bike for 10-15 minutes, walking forward and backward, climbing and descending stairs, light arm weight exercises, and knee extension and curls. The patient also demonstrates fatigue when performing NeuroCom and needs frequent breaks during training.

Nonetheless, because the patient shows difficulty when moving backwards during LOS, it is recommended for him to continue physical therapy to maximize improvement for postural control. Findings by Desai et. al (2010) demonstrates that movements in balance in mobility in older adults appear to be training specific (p. 758). Another SOT is not necessary to check on the patient’s sensory systems as there were no significant deficits in his results. The last LOS the pa-
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tient took showed progress since he started training on it. Patient demonstrated faster mobility.

As long as the patient continues with his strengthening and stretching in his lower extremities, his balance will be maintained. Given the patient's age, it is important for the patient to effectively manage his balance.
References


