The effects of a somatosensory interventions training on balance in healthy elderly

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Abstract

Background: The somatosensory system plays an important role in balance control and age-related declines in somatosensory function have been implicated in falls incidence. Different types of insole devices have been developed to enhance somatosensory information and improve postural stability. However, they are often too complex and expensive to integrate into daily life and textured surfaces may provide an inexpensive and accessible means to enhance somatosensory input. The aim of this study was to examine the effect of exercise somatosensory on balance elderly.

Method: A total of 16 healthy elderly men volunteered for this study and were divided into two groups of somatosensory and control. In the pre and post subjects tests (limit of stability) of Biodex system was the difficulty level 8. The overall balance index score was calculated as the balance score. Exercises for both groups 3 weeks, 5 sessions per week were performed. Training session’s time was 1 hour of exercise which was described by Suzuki with the exception that somatosensory Group exercises on the textured surface and control group exercises performed on a flat surface. To analyze data using a repeated-measure analysis of variance and the statistical significance was assessed at p< 0.05 level.

Results: Results of statistical analysis showed significant effects of exercise on balance in elderly (P<0.05).

Conclusion: According to research findings, practice walking on textured surfaces may stimulate pressure receptors in the feet and increase sensory input from the plantar lead to improved balance in the elderly.

Keywords: textured surfaces, flat surface, pressure receptors

Introduction

Balance is a fundamental skill that is often compromised with advancing age. Balance impairment in older adults increases the risk for falls, which ultimately can lead to increased morbidity, mortality, and health care costs. One third of adults over the age of 65 years fall each year, and fall-related costs are expected to exceed $32 billion by the year 2020. Falls in older adults also are associated with decreased confidence in movement and balance. Loss of confidence, or fear of falling, often results in decreased physical activity that, in turn, may perpetuate further decline in postural stability and quality of life. Consequently, researchers and clinicians have an intense interest in identifying the components that contribute to postural instability and falls in older adults (Shaffer and Harrison, 2007).

Age-related declines in sensory and motor function can result in postural instability and an increased risk of falls leading to injury, hospitalization and mortality (Qiu et al., 2012). Several sensory systems play a role in control of balance. The somatosensory, visual and vestibular systems are important in the detection of balance perturbations and control of balance (Wilson et al., 2008).

When walking, the foot is the first point of contact between the body and the external environment, providing sensory information to the central nervous system for stability and locomotion (Wilson et al., 2008). Accurate detection and integration of somatosensory information from the feet is important for balance control (Bronstein et al., 2004). Degeneration of peripheral sensory receptors, exemplified in diabetic peripheral
neuropathy, (Simoneau et al., 1995) can lead to a diminished capacity to detect information from the soles of the feet during interactions with the external environment (Inglis et al., 1994; Perry, 2006).

Standing on textured surfaces or wearing textured shoe insoles can alter balance performance. This evidence, although inconclusive, offers a potential intervention for improving balance in older adults. A textured surface, whether used as a foot wear intervention or floor covering, may have the capacity to ameliorate age-related declines in balance by adding sensory input at the feet (Hatton et al., 2011).

There is evidence to support the role of footwear as a mechanism to enhance postural control. Recent research indicates that footwear interventions, including foot orthoses and insoles, can influence balance (Corbin et al., 2007; Palluel et al., 2009; Qiu et al., 2012; Wilson et al., 2008).

The effects of these different types of insoles or soles are consistent with theories about somatosensory mechanisms that play a role in control of balance. More and better quality research is needed to support the prevalent use of appliances in these populations (Hijmans et al., 2007). Footwear may influence the quality of sensory feedback from the feet and may act as a sensory filter between the feet and the external environment (Qiu et al., 2012). However, sandals may not be suitable footwear for all individuals and their use can be limited by environmental, work and social constraints. Textured surfaces may provide an inexpensive and accessible means to enhance somatosensory input. The aim of this study was to examine the effect of exercise somatosensory on balance of elderly.

Materials and Methods

Participants

A total of 16 healthy elderly men volunteered for this study. Characteristics of the participants were summarized in table 1. All elderly subjects were ambulatory and lived at home. They self-reported to be free from any diagnosed neurological or musculoskeletal diseases (diseases potentially associated with a central or peripheral neuropathy), any history of falls for the last 6 months, any known balance impairment, and any current use of medication that could affect their PS sensitivity or their balance.

Table 1: characteristics of participants

<table>
<thead>
<tr>
<th></th>
<th>control group(N=8)</th>
<th>somatosensory Group(N=8)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age(years)</td>
<td>65.62±4.93</td>
<td>66.37±7.08</td>
<td>0.81</td>
</tr>
<tr>
<td>Tall(cm)</td>
<td>176.87±5.35</td>
<td>175.5±8.73</td>
<td>0.71</td>
</tr>
<tr>
<td>Weight(kg)</td>
<td>75.5±8.68</td>
<td>83.87±9.93</td>
<td>0.094</td>
</tr>
</tbody>
</table>

Test protocol

The pre-test subjects tests ((limit of stability)) of Biodex system was the difficulty level 8. The overall balance index score was calculated as the balance score. Exercises for both groups 3 weeks, 5 sessions per week were performed.

Training session’s time was 1 hour of exercise which was described by Suzuki (Madureira et al., 2007; Suzuki et al., 2004), with the exception that somatosensory Group exercises on the textured surface and control group exercises performed on a flat surface. In the pre-test and post-test, measures were similar.

Statistical analyses

Normal distribution of the data set was evaluated with statistical testing including the Kolmogorov-Smirnov test. A repeated-measure analysis of variance was used to compare surface inserts used over time in the data analysis. The difference between textured surface and flat surface was tested with the interaction considered. Statistical significance was established at P < .05 using 95% confidence intervals. All data analysis was conducted with commercially available software (SPSS version 21.0).
Results

Kolmogorov-Smirnov tests indicated that all data were normally distributed. Test of repeated measure ANOVA for balance of the participants were summarized in table 2. Clear differences in balance as a function of surface were revealed by a significant Group*Surface* interaction for balance (p< 0.05).

| Table 2: Test of repeated measure ANOVA for balance (group as a factor and pre and posttest as a condition) |
|-------------------------------------------------|---------|-------|------|
| balance                                        | Sum of Squares | F    | P value |
| factor                                         | 2048    | 53.294 | .000  |
| factor * condition                             | 648     | 16.862 | .001  |
| condition                                      | 684.5   | 7.897  | .014  |

Discussion and conclusion

The findings of this study showed that a walking training on the textured surface improves balance in older adult compared with a walking training on the flat surface.

The findings of this study, similar with (Westlake, 2008; Pinington, 2005) appear to support the original hypothesis that the ability of older adults to reintegrate proprioceptive inputs is augmented following sensory specific training, and this effect is not likely to be attributable to an increase in lower-extremity strength or activity level (Pinington, 2005; Westlake and Culham, 2007).

The results of the current study are also in agreement with those of (Iglesias, 2012; Palluel, 2008 and 2009) who reported that, there were significant improvements in postural sway when subjects stood on both soft and hard insoles compared with standing barefoot, with more pronounced improvements when a hard insole was used. Providing increased sensory inputs with hard insoles may be an inexpensive and effective way to reduce fall risk in older adults (Iglesias et al., 2012; Palluel et al., 2008; Palluel et al., 2009). Increased afferent information from textured insoles improves postural control in bilateral stance. (Corbin et al., 2007)

It is also in agreement with (Gauchard, 2003; Hatton, 2011) who reported that Standing on textured surfaces can affect ML sway in healthy older people. The presence of effect only with eyes closed suggests that texture may provide a surrogate source of sensory information for balance control when one or more of the remaining sub-sensory systems are redundant (Gauchard et al., 2003; Hatton et al., 2011).

According to research findings, walking on textured surfaces may stimulate pressure receptors in the feet and increased sensory input from the plantar can lead to improved balance in the elderly.

These findings suggest that textured insole surfaces can reduce postural sway in older people. Textured surfaces may afford a low-cost means of decreasing postural sway, providing an important intervention in falls prevention.

References


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