Improvement of postural balance in elderly women with the use of additional sensory information

The natural process of human aging has morphological and physiological changes, such as balance and gait, increasing the risk of falling. Some studies have investigated the use of additional sensory information to improve body balance using a soft touch on a rigid and stationary surface, which showed a significant reduction in the body oscillation. Effects of the additional sensory information were evaluated during gait on elderly women. We evaluated 30 elderly women aged 60 or older. Sensory information was added by an infrapatellar bandage. Participants performed the tests proposed by the Dynamic Gait Index (DGI), the Timed Up and Go (TUG), and the 10-Meter Walk Test (10MWT), with and without infrapatellar bandage. Data comparisons were carried out by using paired t test and Wilcoxon test with \( p \leq 0.05 \). There was a significant difference in the TUG (without bandage: 10.13 ± 2.1; with bandage: 9.71 ± 2.1, \( p = 0.0007 \)) and DGI test (without bandage: 20.65 ± 2.1; with bandage: 22.1 ± 2.1, \( p = 0.002 \)). There was no significant difference in the use of 10MWT sensory addition. The results showed that the use of additional sensory information generated by the infrapatellar bandage promoted improvement of functional mobility and physical performance in elderly women.

Keywords | Aged; Gait; Postural Balance; Bandages.

RESUMO | O processo natural do envelhecimento humano apresenta alterações morfológicas e fisiológicas, como alterações de equilíbrio e da marcha, aumentando o risco de cair. Alguns estudos investigaram a utilização da informação sensorial na melhora do equilíbrio corporal utilizando o toque suave em uma superfície rígida e estacionária, verificando uma redução significativa da oscilação corporal. Avaliou-se os efeitos da informação sensorial adicional durante a marcha em mulheres idosas. Foram avaliadas 30 mulheres com 60 anos ou mais. A adição da informação sensorial foi feita por uma bandagem infrapatelar. As participantes realizaram os testes propostos pelo Dynamic Gait Index (DGI), pelo Timed Up and Go (TUG) e pelo Teste de Caminhada de 10 Metros (TC10m), com e sem a bandagem infrapatelar. As comparações dos dados foram realizadas com o teste t pareado e o teste de Wilcoxon, com \( p \leq 0.05 \). Houve diferença significativa na comparação do TUG (sem bandagem: 10.13±2.1; com bandagem: 9.71±2.1, \( p = 0.0007 \)) e no DGI (sem bandagem: 20.65±2.1; com bandagem: 22.1±2.1, \( p = 0.002 \)). Não houve diferença significativa no uso da bandagem no TC10m. Os resultados mostraram que o uso da informação sensorial adicional gerada pela bandagem infrapatelar promoveu melhora da mobilidade funcional e do desempenho físico em mulheres idosas.

Descritores | Idoso; Marcha; Equilíbrio Postural; Bandagens.
RESUMEN | El proceso natural del envejecimiento humano presenta cambios morfológicos y fisiológicos, que altera el balance postural y la marcha, aumentando así el riesgo de caídas. Hay estudios que analizaron la utilización de la información sensorial en la mejora del balance postural empleando el toque suave en una superficie rígida y estacionaria, resultando en una significativa disminución en la oscilación corporal. Se evaluó el resultado de la información sensorial adicional durante la marcha en ancianas. Participaron treinta mujeres de más de 60 años. Se realizó la información sensorial a través de vendajes infrapatelares. Las participantes hicieron las pruebas de Dynamic Gait Index (DGI), de Timed Up and Go (TUG) y de Caminata de 10 metros (PC10m), con y sin las vendajas infrapatelares. Para la comparación de los datos se emplearon la prueba t pareada y la prueba de Wilcoxon, con ps<0,05. La comparación de la TUG (sin vendajes: 10,13±2,1; con vendajes: 9,71±2,1, p=0,0007) con la DGI (sin vendajes: 20,65±2,1; con vendajes: 22,1±2,1, p=0,002) presentó diferencias significantes. En la PC10m no presentó diferencias significantes con la utilización de vendajes. Los resultados comprobaron que la utilización de la información sensorial adicional por el vendaje infrapatelar mejoró la movilidad funcional y el rendimiento físico de ancianas.

Palabras clave | Anciano; Marcha; Balance Postural; Vendajes.

INTRODUCTION

The physiological decline of the human body generated by aging can occur in several ways, including bone density and muscle mass reduction, increased postural instability, impairment of visual and auditory capacity, higher consumption of medicines, as well as environmental risks that can predispose older people to fall1.

Falls, defined as an unintended event that results in change of the starting position of the individual to the same level or lower, are an important cause of mortality, morbidity, disability, and hospitalizations in the elderly population1-3. A situation was observed within this population: women are the ones who fall the most2; 30% fall at least once a year and, out of these, 50% fall very often4. Falls are considered the sixth cause of death in patients older than 65, and they amount to 70% of the accidental deaths in older people aged 75 or older5.

Body balance, defined as maintenance of a body posture without causing oscillations, or maintenance of a certain posture during a motor ability performance that is intended to disturb the body’s orientation, occurs due to the interaction of sensory, musculoskeletal, and central nervous systems4.

Balance involves reception and integration of sensory stimuli, planning and execution of movements to control the center of gravity over the support base, being carried out by the postural control system, which integrates information of the vestibular system, visual receptors, and sensory-motor system. In older people, this system’s capacity is reduced; therefore, imbalance, instability, and falls may occur. Thus, evaluating body balance in older people is extremely important, since, after identifying the deficit, preventive measures could be taken as early as possible, avoiding the risk of falls in this population6.

Information related to balance change constantly, depending on the relative positions of the body segments and the magnitude of the forces acting on it. Thus, sensory information is connected to motor action and vice versa. Increase of sensory stimuli could reduce the body oscillation, keeping the body in a particular position and improving balance7. Some studies have investigated the use of sensory information in body balance using a soft touch on a rigid and stationary surface, and the results obtained showed a significant reduction in body oscillation. Towards this, additional sensory information can be used continuously for body oscillation reduction4,8-10.

Thus, an increase of proprioception, balance, and postural control can be obtained by the infrapatellar bandage mechanism4,7,11,12, increasing motor control organization, which may lead to a decrease in body oscillation13.

Despite the positive effects of the use of additional sensory information in the postural control8-10, there is still no evidence of the contribution of this additional information in a more dynamic process, such as the gait. Thus, this study aimed to analyze the effect of additional sensory information in postural balance improvement during the gait of old women.

METHODOLOGY

This was a clinical and randomized trial, with data collection between March and November
Thirty elderly women from Marília (SP) were evaluated. They were aged 60 years or older and selected in basic health units, community centers, and geriatric clinics. This research did not include elderly women with uncorrected vision problems, who took antidepressant medications and sedatives, who used gait support devices, and with sequelae from neurological diseases.

All procedures were carried out in the Building 1 – “Education”, from the Faculdade de Filosofia e Ciências of Universidade Estadual Paulista (FFC-Unesp), Marília, state of São Paulo.

The study was approved by the Research Ethics Committee of the School of Philosophy and Sciences (FFC)/UNESP – Marília (SP) under the protocol number 1.151.910. All volunteers signed the Informed Consent Form.

A cognitive screening was performed by the Mini Mental State Examination – MMSE, and the cut-off score was defined according to the educational background (30 points for top score; 18 points for illiterate older people; 21 for older people with 1 up to 3 years of education; 24 points for older people with 4 up to 7 years of education; and 26 points for older people with 8 or more years of education)\textsuperscript{14,15}.

Evaluation was divided into two phases: 1) condition of normal information (NI): without inclusion of additional sensory information; 2) condition of additional sensory information by including a infrapatellar, Salvape\textsuperscript{®} bandage, 2 cm wide, bilaterally positioned on the skin of volunteers (Figure 1).

![Figure 1. Infrapatellar bandage](image)

In each of these phases, three tests were conducted: Timed Up and Go, 10-Meter Walk Test, and Dynamic Gait Index. Test execution and use of additional sensory information followed a random order by draw of the test and the condition (with or without bandage) for each person evaluated.

Functional mobility was assessed by the Timed Up and Go (TUG) test, measuring in seconds the time spent by the volunteer to stand up from a chair without using the arms, walk a 3-meter distance, turn around, and return to the starting point. At the beginning of the test, volunteers kept their back supported by the back of the chair and, at the end, they should lean their back again. Participants receive the instruction “go” to perform the test, and time should be controlled from the voice command up to the moment volunteers lean their back again on the back of the chair. The test should be performed once for familiarization and a second time for time control\textsuperscript{16,17}.

Physical performance was evaluated in two ways: 1) 10-Meter Walk Test (10MWT); 2) Dynamic Gait Index (DGI).

The 10-Meter Walk Test (10MWT) evaluates the kinematic spatial and temporal attributes of the gait. In order to eliminate acceleration and deceleration, volunteers began to walk 1.2 min before the route start and finished 1.2 min after the 10-meter route in usual speed\textsuperscript{18}. The test was performed three times to minimize learning effect, and the best performance was used for data analysis by calculating the mean speed for each participant.

The Dynamic Gait Index (DGI) evaluates postural balance ability and gait. The test consists of eight tasks involving gait in different sensory contexts, including flat surface, changes in gait speed, horizontal and vertical head movements, going over and getting around obstacles, spinning around their own body axis, going up and down stairs. Patients were evaluated by an ordinal scale with four categories and received a score according to their performance in each task: 3 = normal gait; 2 = mild impairment; 1 = moderate impairment; and 0 = severe impairment. The maximum score is 24 points\textsuperscript{19}.

Data were presented as mean ± standard deviation. The Shapiro-Wilk test was applied to verify data normality. For abnormal data, statistical analysis was carried out by the Wilcoxon test, and, for normal data, the paired t-test was used. The significance level adopted was p ≤ 0.05.
RESULTS

In the evaluated sample, the mean age was 69.03 ± 5.2. The mean score in the MMSE was 26.8 ± 2.5, while
the mean quantity of medicines ingested was 2.6 ± 2.1.

 Significant difference was found in the TUG mean
time and in the DGI score in the situation with bandage
when compared to the situation without bandage. The
same result was not found in the mean speed, despite
clinical improvement (Table 1).

Table 1. Distribution of values as mean ± standard deviation and
p-value for the results of the evaluated variables

|                      | No bandage | With bandage | P       |
|----------------------|------------|--------------|---------|
| TUG (s)              | 11.33 ± 2.9| 10.80 ± 2.7  | 0.0001  |
| DGI                  | 20.93 ± 2.2| 22.5 ± 1.9   | < 0.0001|
| MS (m/s)             | 1.20 ± 0.24| 1.24 ± 0.28  | 0.11    |

TUG: Timed Up and Go; DGI: Dynamic Gait Index; MS: mean speed

DISCUSSION

The number of older people is increasing worldwide. Falls are a serious public health problem, which can lead
older people to immobility, hospitalization, and death, as well as generate fear of falling and decrease functional
capacity. According to an estimation, falls generate an annual cost around 1% of all health expenses in occidental countries. Therefore, investigating methods to reduce the risk of falling is extremely important for this population and for public health.

The data found support the hypothesis that the infrapatellar bandage improves functional mobility (TUG). The activities proposed by the TUG need strength, agility, and balance. Thus, smaller values indicate better functional mobility, better balance, increased gait speed and, therefore, a minor risk of falling, as well as a possible greater independence in daily life activities.

This mobility improvement may have been caused by the increase of proprioceptive feedback and postural adjusting reactions caused by an additional sensory stimulation. The infrapatellar bandage may have stimulated phasic tactile receptors, increasing quality and quantity of sensory information to the Central Nervous System, thus increasing the motor cortex activity.

Only one study was found about infrapatellar bandage use in the balance of older people without associated diseases. Carvalho et al. found similar results regarding additional sensory stimulation in older people with history of falls considering the time to perform TUG test. They concluded that addition of sensory information by infrapatellar bandage use improved mobility of older people who usually fall. Studies that investigated changes in postural balance with use of additional sensory information by infrapatellar bandage were carried out on young people with Patellofemoral Pain Syndrome or anterior cruciate ligament injury, and they concluded that the addition of sensory information improved balance. Another study evaluated infrapatellar bandage use on people with knee osteoarthritis and concluded that additional sensory information improved biomechanical parameters during task of overcoming obstacles.

Bal dan et al. carried out a systematic review to evaluate effects of gentle touch in rigid surface in people with change of balance and, among studies that evaluated various conditions, the authors found three that showed older people could benefit from this technique to reduce postural oscillation. Nevertheless, as discussed above, its use on a daily basis would be impracticable.

DGI mean score showed significant improvement with addition of sensory information. DGI consists of eight tasks involving gait at different sensory contexts, and higher scores suggest a better ability of older people to manage balance and gait on test requirements.

When Cabreira et al. assessed variables in the force platform, they found no improvement in the balance of elderly women by placing Kinesio Taping on gastrocnemius and midfoot muscles.

Regarding mean speed (MS), a value increase was observed, but without statistical significance. In geriatric rehabilitation, increased MS usually predicts advance in independence and mobility, as it brings improvement of physical functions and reduces disabilities and use of medical services. MS evaluation is simple, and it can indicate a good aging condition and greater ability to recover in situations in which older people suffer an overload, such as falling. MS can be used as a guide to map and categorize older people who present high and low risk of falls. Moreover, it is able to identify the fear of falling in this population.

Older people, especially the ones who fall, present mobility reduction and are more likely to have decreased muscle strength caused by aging process and inactivity, with consequent impact on gait, as well as ankle and
hips stabilization⁴. Increased stimulus coming from the infrapatellar bandage can favor kinematics of the knee joint and produce beneficial results in the mobility and speed of this population⁴,³⁴.

There are still doubts regarding real benefits of sensory information addition in the improvement of postural balance in older people. Our results indicate an immediate balance improvement, even in challenging situations such as the DGI. However, further studies need to be performed to clarify whether benefits can occur in a long term, in addition to its use on pathological conditions, such as Parkinson's disease, for example.

**CONCLUSION**

Our results showed it is possible to improve postural balance during gait in elderly women with addition of sensory information.

**LIMITATIONS OF THE STUDY**

One of the study’s limitations was the participation of older people, because, although it was just one day of evaluation, many of them refused to participate. In addition, the difficulty of forming a male group is worth a highlight.

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