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ORIGINAL ARTICLE

Influence of sensory information on static balance in older patients with vestibular disorder☆

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Abstract
Introduction: With aging, the sensory systems suffer an accumulation of degenerative, infectious and/or traumatic processes that may hinder the body balance maintenance.
Objective: To assess the influence of sensory information on static body balance of elderly individuals with vestibular disorders.
Methods: Cross-sectional study of elderly individuals with vestibular disorders. The Clinical Test of Sensory Interaction and Balance and posturography integrated with virtual reality (Balance Rehabilitation Unit™) were used. Posturography parameters analyzed included center of pressure and velocity of body sway.
Results: 123 individuals with mean age of 73.11 were assessed. Worst performance was observed in the Clinical Test of Sensory Interaction and Balance condition of visual dome-unstable surface. Differences between conditions were: firm surface-open eyes/firm surface-closed eyes, unstable surface-open eyes/unstable surface-closed eyes ($p < 0.001$), and unstable surface-closed eyes/unstable surface-visual dome. Considering center of pressure and velocity of body sway, significant differences were observed between the following conditions: firm surface-open eyes/firm surface-closed eyes: firm surface-saccadic stimulus/firm surface-vertical optokinetic stimulus; firm surface-optokinetic stimuli/firm surface-visual–vestibular interaction; and firm surface-visual–vestibular interaction/unstable surface. Worse performances were observed in conditions firm surface-closed eyes, firm surface-vertical optokinetic stimulus, F-visual–vestibular interaction, and unstable surface-closed eyes. There was a difference in the center of pressure between firm surface-closed eyes/firm surface-saccadic stimulus, with a worse performance in the condition of firm surface-closed eyes, and of velocity of body sway, between firm surface-saccadic stimulus/firm surface-horizontal optokinetic stimulus ($p < 0.001$).

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Conclusion: Static body balance in elderly individuals with vestibular disorders is worse when the sensory conditions are more challenging, i.e. stable and unstable surfaces, visual stimuli, such as optokinetic and visual–vestibular interaction, and with the eyes closed.

PALAVRAS-CHAVE
Idoso;
Equilíbrio postural;
Reabilitação;
Tontura;
Doenças vestibulares

Influência das informações sensoriais no equilíbrio corporal estático de idosos vestibulopatas

Resumo
Introdução: Com o envelhecimento, o sistema sensorial sofre um acúmulo de processos degenerativos, infecciosos e/ou traumáticas que podem dificultar a manutenção do equilíbrio corporal.
Objetivo: Avaliar a influência das informações sensoriais no equilíbrio corporal estático de idosos vestibulopatas.
Método: Estudo transversal, cuja amostra foi constituída por idosos vestibulopatas. Empregaramse o Clinical Test of Sensory Interaction and Balance (CTSIB) e a posturografia integrada à realidade virtual (*Balance Rehabilitation Unit*.). Os parâmetros avaliados à posturografia foram: área do centro de pressão (COP) e velocidade de oscilação (VOC).
Resultados: Foram avaliados 123 idosos, com média etária de 73,11 anos. O pior desempenho ocorreu na condição cúpula visual-superfície instável (SI) do CTSIB. As diferenças entre as condições foram: superfície firme (SF)-olhos abertos (OA)/SF-olhos fechados (OF) e SI-OA/SI-OF ($p < 0,001$); SI-OF/SI-cúpula visual. Observou-se diferença da área do COP e da VOC entre as condições: SF-OA/SF-OF; SF-estímulo sacádico/SF-estímulo optocinético vertical; SF-estímulos optocinéticos/SF-interação visuo-vestibular (IVV); SF-IVV/SI, com pior desempenho nas condições SF-OF, SF-estímulo optocinético vertical, SF-IVV e SI-OF. Observou-se diferença do COP entre as condições SF-OF/SF-estímulo sacádico, com pior desempenho na condição SF-OF, e da VOC entre as condições SF-estímulo sacádico e SF-estímulo optocinético horizontal ($p < 0,001$).
Conclusão: O equilíbrio corporal estático de idosos vestibulopatas é pior à medida que as condições sensoriais são mais desafiadoras, ou seja, em SI e SE, estímulos visuais como os optocinéticos e interação visuovestibular e OF.

Introduction

Body balance maintenance is influenced by the integration of sensory information from the vestibular, visual, and somatosensory systems. Any conflict between this information may cause changes in body balance.[1]

With aging, the sensory systems suffer an accumulation of degenerative, infectious and/or traumatic processes that hinder their adequate functioning. Although an isolated change in one system does not result in a major impact on the development of postural instability, a combination of such deficiencies is a key factor for body imbalance in the elderly.[2,3] Among these systems, the vestibular system deserves attention due to the high prevalence of vestibular disorders and dizziness with advancing age (11.0–36.0%).[4,5]

Assessment of these systems by clinical and laboratory tests can be used to verify the involvement of sensory information in postural control.[6] These tests simulate the demands involved in body balance through manipulation of sensory inputs, through changes in visual input, changes in surface, and reductions in the support base. The Clinical Test of Sensory Interaction and Balance (CTSIB) is a clinical test, whose purpose is to provide information about the individual's capacity to adapt and maintain body balance in the presence of sensory conflicts.[7]

Another way to assess the influence of sensory information on body balance is through laboratory tests involving force platforms, electromyography, and photo-filming systems. These evaluations primarily measure body sway, shifting the center of gravity and muscle activation.[8] The Balance Rehabilitation Unit™ (BRU™) is a static posturography device that uses the technology of virtual reality to recreate environments and situations in order to measure the postural response of the individual in the presence of different stimuli.[9]

The knowledge of the deficits found in sensory conditions using the data from CTSIB and posturography and a comparison of the progression of difficulty imposed by the