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ORIGINAL ARTICLE

Effects of vibrotactile vestibular substitution on vestibular rehabilitation – preliminary study☆,☆☆

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KEYWORDS
Dizziness;
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Abstract
Introduction: Some patients with severe impairment of body balance do not obtain adequate improvement from vestibular rehabilitation (VR).
Objective: To evaluate the effectiveness of Vertiguard™ biofeedback equipment as a sensory substitution (SS) of the vestibular system in patients who did not obtain sufficient improvement from VR.
Methods: This was a randomized prospective clinical study. Thirteen patients without satisfactory response to conventional VR were randomized into a study group (SG), which received the vibrotactile stimulus from Vertiguard™ for ten days, and a control group (CG), which used equipment without the stimulus. For pre- and post-treatment assessment, the Sensory Organization Test (SOT) protocol of the Computerized Dynamic Posturography (CDP) and two scales of balance self-perception, Activities-specific Balance Confidence (ABC) and Dizziness Handicap Inventory (DHI), were used.
Results: After treatment, only the SG showed statistically significant improvement in C5 ($p = 0.007$) and C6 ($p = 0.01$). On the ABC scale, there was a significant difference in the SG ($p = 0.04$). The DHI showed a significant difference in CG and SG with regard to the physical aspect, and only in the SG for the functional aspect ($p = 0.04$).

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Conclusion: The present findings show that sensory substitution using the vibrotactile stimulus of the Vertiguard™ system helped with the integration of neural networks involved in maintaining posture, improving the strategies used in the recovery of body balance.

PALAVRAS-CHAVE
Vertigem;
Retroalimentação sensorial;
Doenças vestibulares;
Equilíbrio postural;
Reabilitação

Efeitos do biofeedback vibrotátil na reabilitação do equilíbrio corporal – estudo preliminar

Resumo
Introdução: Alguns pacientes com déficit severo do equilíbrio corporal submetidos à reabilitação vestibular (RV) podem não apresentar resultados satisfatórios.
Objetivo: Verificar a eficácia do equipamento de biofeedback Vertiguard™ como substituto sensorial do sistema vestibular em pacientes sem bons resultados à RV.
Método: Estudo prospectivo clínico randomizado. Treze pacientes sem resposta satisfatória à RV convencional foram randomizados entre grupo de estudo (GE), que utilizou o estímulo vibratório do Vertiguard™ por dez dias e grupo controle (GC) que usou o equipamento desligado. Para avaliação pré e pós-tratamento foi utilizado o protocolo Teste de Integração Sensorial (TIS) da Posturografia Dinâmica Computadorizada (PDC) e duas escalas de autopercepção do equilíbrio: ABC (*Activities-specific Balance Confidence*) e DHI (*Dizziness Handicap Inventory*).
Resultados: Apenas o GE apresentou melhora estatisticamente significante em C5 ($p = 0{,}007$) e C6 ($p = 0{,}01$) da PDC após treinamento. Na escala ABC houve diferença significante no GE ($p = 0{,}04$). No DHI ocorreu diferença significante no aspecto físico em ambos os grupos e no aspecto funcional ($p = 0{,}04$) apenas no GE.
Conclusão: O estímulo de substituição sensorial do Vertiguard™ auxiliou a integração das redes neurais e na manutenção da postura, melhorando as estratégias utilizadas na recuperação do equilíbrio corporal.

Introduction

Postural stability is achieved by the central processing of sensory afferents composed of visual, vestibular, auditory, and proprioceptive information.[1] The vestibular system, responsible for the integration of this information, determines the appropriate motor response to information incoming from, and outgoing to, environmental demands. The loss of vestibular information sets in motion a structural reorganization of the central nervous system (CNS), that creates new neural networks to replace the lost afferent input.[2] These changes are responsible for central compensation,[3] which occurs thanks to neuronal and neurochemical activity caused by sensory conflicts experienced in the absence of vestibular information.[4] Central compensation may be accelerated by means of vestibular rehabilitation (VR),[5] which uses physical exercise to restore the main reflexes related to body balance.[6,7] This concept of neural reorganization in order to address the loss of vestibular function has been termed sensory substitution (SS).[8]

SS can assist in the process of gait and posture stabilization,[9] by facilitating central compensation of sensory loss, whether partial or complete.[10] Currently, VR is supported by new man–machine interfaces (MMIs). These interfaces provide stimuli that replace missing natural information, enabling the creation of alternative pathways that act in maintaining balance.[11] Thus, MMIs are nothing more than alternative stimuli that act on the facilitation of SS. There are descriptions of the additional beneficial effects of neurofeedback in the recovery of body balance with electrotactile stimuli applied to the tongue,[12,13] auditory biofeedback,[14,15] and audiovisual biofeedback.[16] However, Basta and Ernst[17] believe in the effectiveness of using vibrotactile biofeedback; with this, the subject is not deprived of the natural perception of sound and visual stimuli from the environment. Studies have shown the effectiveness of vibrotactile biofeedback equipment applied on the lateral aspect of the trunk, with increased postural stability[18] and improved alignment of the center of mass.[19]

In a controlled double-blinded pilot study, 36 patients divided into five groups with vestibular disorders of different etiologies showed significant reduction in body oscillation after training with the Vertiguard™ device.[20] Another study with 105 patients suffering from balance disturbances showed a reduction in their symptoms only in the study group, with decrease in anteroposterior oscillation, increase in balance index value, and in conditions 5 and 6 of the