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ORIGINAL ARTICLE

Hearing performance as a predictor of postural recovery in cochlear implant users[☆]

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Abstract
Objective: This study aimed to evaluate if hearing performance is a predictor of postural control in cochlear implant (CI) users at least six months after surgery.
Methods: Cross-sectional study including (CI) recipients with post-lingual deafness and controls who were divided into the following groups: nine CI users with good hearing performance (G+), five CI users with poor hearing performance (G−), and seven controls (CG). For each patient, computerized dynamic posturography (CDP) tests, a sensory organization test (SOT), and an adaptation test (ADT) were applied as dual task performance, with first test (FT) and re-test (RT) on the same day, including a 40–60 min interval between them to evaluate the short-term learning ability on postural recovery strategies. The results of the groups were compared.
Results: Comparing the dual task performance on CDP and the weighted average between all test conditions, the G+ group showed better performance on RT in SOT4, SOT5, SOT6, and CS, which was not observed for G− and CG. The G− group had significantly lower levels of short-term learning ability than the other two groups in SOT5 ($p = 0.021$), SOT6 ($p = 0.025$), and CS ($p = 0.031$).
Conclusion: The CI users with good hearing performance had a higher index of postural recovery when compared to CI users with poor hearing performance.

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PALAVRAS-CHAVE
Tontura;
Vertigem;
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Perda auditiva;
Posturografia;
Potenciais evocados auditivos;
Implante coclear

Desempenho auditivo como preditor de recuperação postural em usuários de implante coclear

Resumo

Objetivo: O presente estudo teve por objetivo avaliar se o desempenho auditivo é preditor de controle postural em usuários de IC pelo menos 6 meses após a cirurgia.

Método: Estudo transversal consistindo em recipientes de implante coclear (IC) com surdez pós-lingual e controles, que foram divididos nos seguintes grupos: nove usuários de IC com bom desempenho auditivo (G+), cinco usuários de usuários de IC com desempenho auditivo insatisfatório (G-) e sete controles (GC). Aplicamos o teste de posturografia dinâmica computadorizada (PDC), teste de organização sensitiva (TOS) e teste de adaptação (TAd) como desempenho de dupla tarefa, primeiro teste (PT) e reteste (RT) no mesmo dia, com intervalo de 40-60 minutos entre testes, com o objetivo de avaliar a capacidade de aprendizado em curto prazo nas estratégias de recuperação postural. Comparamos os resultados dos testes.

Resultados: Comparando o desempenho de dupla tarefa no teste PDC e a média ponderal entre todas as condições de teste, o grupo G+ demonstrou melhor desempenho no RT nos TOS4, TOS5, TOS6 e EC, o que não foi observado para os grupos G- e GC. O grupo G- obteve níveis significantemente mais baixos de capacidade de aprendizado em curto prazo *vs.* outros dois grupos no TOS5 (p = 0,021), TOS6 (p = 0,025) e EC (p = 0,031).

Conclusão: : Usuários de IC com bom desempenho auditivo tiveram índice melhor de recuperação postural, quando comparados a usuários de IC com desempenho auditivo insatisfatório.

Introduction

Cognitive resources from the right cerebral hemisphere significantly contribute to postural control. The assessment of adults with vestibular disorders showed that implementation of mental tasks during the performance of the platform test can both increase or reduce subject oscillations and body balance control.[1] Working memory, short-term memory, and executive function are frequently and more highly disturbed in those stricken by bacterial meningitis.[2] In a previous study performed at the present clinic with cochlear implant (CI) users (study submitted), a significant increase was found in P3 latency in patients with post-lingual deafness due to meningitis, suggesting an impairment of cognitive function.

Sensory input coming from hearing, vision, vestibular, and proprioceptive systems is processed in the central nervous system (CNS), resulting in spatial orientation, image fixation on the retina, and balance control.[3] Postural adjustments necessary for balance stability result from complex motor responses, learned motor tasks, and proactive and feedforward postural strategies.[4]

Balance control is the ability to maintain body movement within the base of support without falling. It is a complex control process that depends on mainly two distinct and interdependent systems: (1) the gaze stabilization system, which maintains gaze direction of the eyes and visual acuity during head and body movements, and (2) the postural stabilization system, which keeps the body in balance while standing and moving in daily life. They are distinct because they rely on inputs from different senses, motor reactions from different parts of the body, and are mediated by different brain pathways. They are also interdependent because gaze stability is not possible unless the body is also stable, and because accurate vision is a critical sensory input for postural control. Therefore, balance depends on various sensory inputs which inform the brain about body position related to the environment. It is a highly complex network that includes numerous synaptic pathways, nonsynaptic pathways, and their intersections. The brain must analyze and plan the motor responses and movements necessary for postural stabilization.[5]

At this moment cognitive function is required for the accurate sensory integration to achieve a suitable body balance control. The following are part of cognition: (1) the sensory input integration of the brain map composed of movement strategies learned throughout life, (2) appropriate latencies of postural responses, and (3) the ability to plan and execute movement patterns necessary for controlling the center of the body mass. The cortex must process and integrate these functions to be aware of the risk and the task being performed. Thus, balance control is influenced by cognitive factors like attention, motivation, memory, and intent. In normal individuals, the whole system works in harmony and is processed automatically, but may require voluntary control when there is imbalance at some point of the track.

The acquisition of new motor skills is related to CNS structures responsible for memory and learning.[6] Among structures required for that task are areas of the medial temporal lobe, particularly the hippocampus, motor cortical regions (striatum sensory motor cortex), cerebellar cortex and nucleus, parietal cortex, and frontal association areas.[4,7,8] Among the various injuries that may affect the postural reactions, those affecting the hippocampus may