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ORIGINAL ARTICLE

Reproducibility (test–retest) of vestibular evoked myogenic potential☆,☆☆

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KEYWORDS
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Abstract
Introduction: There is still no consensus in the literature as to the best acoustic stimulus for capturing vestibular evoked myogenic potential (VEMP). Low-frequency tone bursts are generally more effective than high-frequency, but recent studies still use clicks. Reproducibility is an important analytical parameter to observe the reliability of responses.
Objective: To determine the reproducibility of p13 and n23 latency and amplitude of the VEMP for stimuli with different tone-burst frequencies, and to define the best test frequency.
Methods: Cross-sectional cohort study. VEMP was captured in 156 ears, on the sternocleidomastoid muscle, using 100 tone-burst stimuli at frequencies of 250, 500, 1000, and 2000 Hz, and sound intensity of 95 dB nHL. Responses were replicated, that is, recorded three times on each side.
Results: No significant difference was observed for p13 and n23 latencies of the VEMP, captured at three moments with tone-burst stimuli at 250, 500, and 1000 Hz. Only the frequency of 2000 Hz showed a difference between captures of this potential ($p < 0.001$). p13 and n23 amplitude analysis was also similar in the test–retest for all frequencies analyzed.
Conclusion: p13 and n23 latencies and amplitudes of VEMP for tone-burst stimuli at frequencies of 250, 500, and 1000 Hz are reproducible.

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PALAVRAS-CHAVE
Potenciais evocados;
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Eletromiografia

Reprodutibilidade (teste-reteste) do potencial evocado miogênico vestibular

Resumo
Introdução: Ainda não existe consenso quanto ao melhor estímulo acústico utilizado para a captação do potencial evocado miogênico vestibular (PEMV). Respostas amplas são observadas para estímulos de baixa frequência, porém estudos recentes ainda utilizam cliques. A reprodutibilidade dos traçados é um importante parâmetro de análise para observar a confiabilidade das respostas.
Objetivo: Verificar a reprodutibilidade dos parâmetros ''latência e amplitude das ondas p13 e n23'' do PEMV para estímulos com diferentes frequências de estímulos do tipo *tone burst*, e definir a melhor frequência de teste.
Método: Estudo de coorte-transversal. Captou-se PEMV em 156 orelhas, no músculo esternocleidomastóideo, com 100 estímulos do tipo *tone burst* nas frequências de 250, 500, 1000 e 2000 Hz e nível sonoro 95 dB NAn, registrados três vezes de cada lado.
Resultados: Foram constatadas similaridades para latências de p13 e n23 do potencial estudado nos três momentos com estímulos *tone burst* em 250, 500, 1000 Hz, e diferenças entre as captações desse potencial ($P < 0.001$) para a frequência de 2000 Hz. A análise da amplitude de p13 e n23 se mostrou semelhante, no teste-reteste, para todas as frequências analisadas.
Conclusão: Existe reprodutibilidade das latências e amplitudes de p13 e n23 do PEMV para estímulos *tone burst* nas frequências de 250, 500 e 1000 Hz.

Introduction

To capture the vestibular evoked myogenic potential (VEMP), sound stimuli of tone-burst type at frequencies between 100 and 3200 Hz[1–4] or clicks[5,6] may be used. In general, tone bursts are more effective than clicks for obtaining VEMP. Among tone-burst stimuli, low frequencies ($\leq$1000 Hz) are more effective than high frequencies,[7,8] and 500 Hz is the most commonly used.[2,8,9]

There is still no consensus in the literature with regard to the best acoustic stimulus used for VEMP recording. A recent study[10] used click stimuli, which stimulate the region of sensitivity with a range 1000–4000 Hz. Research shows that high-frequency stimuli result in poor definition of waves p13 and n23, and the appearance of vagueness of tracing.[7,8]

VEMP waves present reproducibility for circumstances and parameters of controlled stimuli. The reproducibility of the tracing is an important analytical parameter to observe the reliability of responses.[11]

To date, there are no studies in literature (databases: SciELO, LILACS, Scirus, ScienceDirect, and Scopus) presenting the same methodological design adopted in this study, which aim to determine the reproducibility (test–retest) of the parameter ''latency and amplitude of waves p13 and n23'' for the VEMP, for stimuli with different tone-burst frequencies, and to define the best test frequency.

Methods

This was a historical cross-sectional cohort study in accordance with Resolution No. 196/96 of the National Health Council (*Conselho Nacional de Saúde*). It was submitted to the Research Ethics Committee of the university where the data were collected, and approved under number 1010. The data collection was conducted from March 2010 to March 2012.

Recordings of VEMP were collected from 78 volunteers (156 ears); 40 female and 38 male subjects aged between 18 and 31 years old (21.28 ± 2.90 years). The subjects were selected by the following inclusion criteria: normal hearing thresholds, *i.e.*, $\leq$20 dB nHL, for frequencies between 250 and 8000 Hz obtained by pure tone audiometry test; and as to tympanometry, the subjects were required to demonstrate a type A tympanogram.

The following exclusion criteria were adopted: changes in external and/or middle ear; occupational or leisure noise exposure and/or ototoxic medication; presence of tinnitus, vertigo, dizziness, or other cochleovestibular changes; and presence of systemic changes that could contribute to cochleovestibular pathologies, such as diabetes, hypertension, and dyslipidemia and/or hormonal changes.

VEMP tests were performed with a specific apparatus for capture of this potential, developed at the Center for Instrumentation, Dosimetry, and Radiation Protection, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo (USP-FFCLRP),[12] which is composed of biological amplifiers, filters, an electrical protection system, and a logic system that enables a detailed investigation of VEMP. This equipment was validated with gold-standard commercial equipment and has been used in previous studies.[13–15]

The recording was performed using disposable silver- and silver chloride-type (Ag/AgCl) surface electrodes, in which the active electrode was placed on the upper half of the sternocleidomastoid muscle, ipsilateral to stimulation; the reference electrode on the ipsilateral upper edge of the sternum, and the ground electrode on the frontal midline. Impedance among the electrodes up to 3 kΩ and of each isolated electrode of 5 kΩ was allowed.