Optimization of Check Size and Contrast on the Visual-Evoked Potential (VEP) in Visually-Normal Individuals

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INTRODUCTION

The visual-evoked potential (VEP) refers to an electrical signal generated over the primary visual cortex (V1) in response to a time-locked visual stimulus. The VEP is an objective, rapid, repeatable, and non-invasive method to assess functionality and integrity of the retinal and early-afferent, visuo-cortical pathways [1]. Due to its objective nature, this technique has proven to be beneficial for special populations (e.g., infants and young children, non-verbal patients, cognitively-challenged patients) [1, 2, 3]. Critical VEP parameters include check size, contrast, luminance, and temporal frequency [1]. Two parameters with particular physiological and clinical importance are check size and contrast, the main focus of the present study.

METHODS

Subjects were comprised of visually-normal adults (n=20, 8 male and 12 female). They had a mean age of 26.8 ± 5.1 years, with a range from 24 to 38 years. Conventional full-field VEP testing was employed using the Diopsys® NOVA-TR system (Diopsys Inc., Pin Brook, New Jersey, USA) on 17° H x 15° V stimulus size, 64 cd/m², 1 Hz temporal frequency, 1 meter distance, binocular viewing with spectacle correction) with three different check sizes (10’, 20’, and 40’) and at two contrast levels (20% and 85%) (Figure 1). Test duration was 20 seconds for each trial. The average of four trials for each of the 6 test conditions (i.e., 3 check sizes X 2 contrast levels) was used in the analysis. All 6 test conditions were counterbalanced.

RESULTS

(1.) Mean VEP amplitude

The group mean, visually-normal amplitude values are presented in Figure 2. A repeated-measures, two-way ANOVA was performed on the group mean for the factors of check size and contrast. There was a significant effect of check size (p < 0.05) and contrast (p < 0.05) on the VEP latency. The post-hoc Tukey test results showed that the 40 min arc check size produced the consistently shortest latency at both contrast levels (i.e., at 20% = 103.36 ms and at 85% = 103.46 ms), which were not significantly different. Furthermore, the VEP latency decreased exponentially with increase in check size at both low (r = +0.895) and high (r = +0.861) contrast.

(2.) Mean VEP latency (P100)

The group mean, visually-normal latency (P100) values are presented in Figure 3. A repeated-measures, two-way ANOVA was performed on the group mean for the factors of check size and contrast. There was a significant effect of check size (p < 0.05) and contrast (p < 0.05) on the VEP latency. The post-hoc Tukey test results showed that the 40 min arc check size produced the consistently shortest latency at both contrast levels (i.e., at 20% = 103.36 ms and at 85% = 103.46 ms), which were not significantly different. Furthermore, the VEP latency decreased exponentially with increase in check size at both low (r = +0.895) and high (r = +0.861) contrast.

CONCLUSIONS

At both contrast levels, use of the 20 min arc check size was optimal with respect to amplitude. This would be useful for amplitude-sensitive conditions, such as amblyopia and macular degeneration, in which reduced amplitude would be expected at both contrast levels, which likely reflects a parvocellular (P) deficit. In contrast, the 40 min arc check size was optimal with respect to latency. This would be useful for latency-sensitive conditions, such as glaucoma and multiple sclerosis (MS), in which a larger low contrast stimulus would result in delayed and abnormal latency, which likely reflects a magnocellular (M) deficit.

The present findings are consistent with psychophysical and neurophysiological findings with respect to high and low spatial frequency and contrast processes of the dual visual systems (12-14).

This would be important in the assessment of axonal integrity of the P and M pathways at both the retinal and visuo-cortical levels. Therefore, these optimized parameters would be clinically promising in their diagnostic evaluation.

REFERENCES


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