Abstract

Effect of selected visual stimulus parameters on chosen characteristics of visual evoked potentials in relationship to visual acuity

The thesis is divided into two related, sequential experiments performed under standard laboratory conditions to ensure high reproducibility.

In the first experiment, we compared visual acuity for stimuli rendered by computer models (using Zernike's polynomial theory) with equivalent optical defocusing in emmetropic subjects with a relatively short viewing distance of 60 cm. Equivalent spherical refractive error with +1, +2 and +4 D metrics (equivalent defocus) was used in rendering of computer-blurred Landolt optotypes (LOs). The refractive error was achieved, in particular, (i) by unblurred LOs with the addition of an external lens (+1, +2 and +4 D) directly in front of the subject's eye; (ii) as in (i), but with added accommodation compensation and with peak distance taken into account. We examined visual acuity in 10 men with emmetropic vision to compare the three approaches described above. The patterns were observed on a CRT screen. Paired tests showed no statistically significant difference between digital blur and dioptric blur for all three levels of refractive error simulation (LO blur) (ii) ($p < 0{,}204$). Thus, our results show that even at short viewing distances, digitally rendered defocusing may be used to replicate the dioptric approach without substantially altering visual acuity in emmetropic subjects.

In the second experiment, we investigated the effect of dioptric blurring on visual evoked potentials (VEPs). Dioptric blurring method was used analogously to the dioptric blurring method from the first experiment. The effect of dioptric blurring (+1, +2 and +4 D) on the parameters (peak time and inter-peak amplitude) of motion-onset VEP (MO VEP) was investigated in 12 subjects using central (MO C8°), peripheral (MO M20°) and full-field stimulation (MO FF) with a structure of low-contrast concentric circles with the spatial frequency <1 c/°. The results were compared with the blurring effect on pattern-reversal VEP (PR VEP), pattern size of 15′ and 60′. The relationship between the degree of dioptric blurring and the two parameters (peak time and inter-peak amplitude) was mathematically described utilising regression analysis (linear regression). MO VEPs did not show a statistically significant increase in peak time ($p > 0{,}28$) or decrease in inter-peak amplitude ($p > 0{,}14$) with increasing blurring. For PR VEPs, we observed a statistically significant decrease in inter-peak amplitude ($p < 0{,}001$) and a statistically significant increase in peak time ($p < 0{,}001$) for both checkerboard sizes. Ergo, changing the dioptric blurring of patterns for MO VEP does not affect the peak time or the inter-peak amplitude of the dominant N2 wave.