Efficacy of neural vision therapy to enhance visual acuity and contrast sensitivity function in amblyopia

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INTRODUCTION

Computer based cortical vision training (RevitaVision, Lawrence, KS USA) involves the use of server based software utilizing Gabor patch stimuli to enhance neuronal processing in the visual cortex. The purpose of this study was to evaluate the efficacy of the RevitaVision cortical vision training in enhancing Best Corrected Visual Acuity (BCVA) and Contrast Sensitivity Function (CSF) in amblyopic patients.

BACKGROUND

Visual processing involves the integrated activity of neurons in the visual cortex. Neuronal responses and visual perception is determined by the signal to noise ratio of neuronal activity, whereby the visual cortex collects responses across many neurons to average out noisy activity of single cells to improve the signal to noise ratio, leading to improved visual interpretation and acuity (Geisler and Albrecht 1997). Studies have shown noise of individual neurons can be influenced so that the contrast sensitivity at low levels can be dramatically increased when appropriate stimulus parameters are used (Polat and Sagi 1993; Polat and Sagi 1994; Polat, Miozzi et al. 1998; Kasamatsu, Polat et al. 2001). The use of such stimulus modifications in the visual cortex, which is the basis for 'brain plasticity' (Dosher and Lu 1998; Dosher and Lu 1999), whereby the brain adapts to change and acquires a new skill. In addition, repetitive performance of many basic tasks has demonstrated physical modifications in the adult cortex (Sagi and Tanie 1994; Gilbert 1998). RevitaVision cortical vision training is a server-based, interactive system tailored and continuously adaptive to the individuals visual abilities. In the first stage, the subject is exposed to a set of visual perception tasks, aimed to analyze and identify each subject's neural inefficiencies. The building block of these visual stimulations is the Gabor patch (Figure 1), which efficiently activates neuronal contrast sensitivity in children and adult patients with amblyopia.

METHODOLOGY

A total of 53 individuals with unilateral naturally occurring strabismic, anisometropic, mixed (strabismic and anisometropic) and iatrogenic amblyopia (20.3 ± 11.5 years, range 8 to 50 years; 62% male), with a BCVA of between 1.06 logMar to 0.20 logMar (approximately 660 to 6.95 Snellen equivalent) were included in this study. All amblyopic visits constituted; cover test, prism cover test, logmar visual acuity (using ETDRS letters), stereovision (Random Dot stereopsis), worth four dot test, CSF (Stereo Optical Company, Functional Vision Analyzer) and manifest cycloplegic refraction. If necessary, corrective glasses were prescribed and subject were instructed to wear them at waking hours, especially during the cortical vision training.

The treatment is applied in successive 30-minute sessions, administered 2-3 times a week, a total of approximately 60 sessions. Approximately every 20-30 sessions individuals are recalled for monitoring of their visual status. Visits generally comprise a total of 4 visits; including baseline, 1st visit, 2nd visit and treatment end. In the case where progression continued still at treatment and visit individuals were instructed to continue until progress in both visual acuity and/or CSF plateau. In this case their treatment end data was used and the 3rd or 4th visit was not analyzed.

TREATMENT RESULTS

All 53 individuals completed the study and analysis showed there were statistical significant improvements in both BCVA and CSF post-treatment when compared to pre-treatment data.

Visual Acuity

BCVA in the amblyopic eyes increased an average of 50.8%, equivalent to a mean improvement of 2.6 ETDRS lines, 37.7% improved between 3.3 to 6.6 lines, 39.6% improved between 2.0 to 2.9 lines, 20.8% improved between 1.0 to 1.8 lines and one individual had no improvement or regression of BCVA in the amblyopic eye. Individual improvement of each individual is given in Figure 1. Total improvement of BCVA was not influenced by initial BCVA.

One-way Analysis of Variance (ANOVA) comparing baseline measures with the baseline data, 1st Visit, 2nd Visit and treatment end, showed a significant effect of time, F(3.166) = 173.38, p < .001 (p < .77), indicating all four points are significantly different from each other (Figure 2). A t-test was used to compare the level of improvement in BCVA in males and females, showing level of improvement not to be significantly gender (F(4) = .72, p=.48).

CONCLUSION

Cortical vision training in amblyopia may improve BCVA and CSF.