Two – Year Results of NeuroVision Treatment in Adult Patients with Unilateral Amblyopia

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Purpose:

To investigate the effectiveness and the long term persistence of visual function in older children and adults with amblyopia, using the NeuroVision system.

NeuroVision:

NeuroVision is a novel, noninvasive, patient-specific treatment modality based on the principles of perceptual learning. It is designed to train the neuronal network by stimulating the neuronal populations in the primary visual cortex.

The NeuroVision system employs an interactive, computer-assisted, internet-based technology. The basic element of visual stimulation is the Gabor patch (Figure 1), which matches the shape and orientation of the primitive receptive fields of neurons in the primary visual cortex and effectively activates them. The stimulation-control technique, called lateral masking, involves the display of two co-linearly oriented flanking Gabor patches in addition to the target Gabor image.

During the treatment sessions, sets of tasks were displayed on a computer screen. In each task the patient was exposed to two short successive displays of Gabor patches. Only one of these displays (randomly selected) showed the target Gabor image. The patient was then asked to identify the display that contained the target Gabor image (Figure 2).

Methods:

Twenty-six patients, aged 10 to 59 years with unilateral amblyopia underwent NeuroVision treatment.

Best-corrected visual acuity (BCVA) (ETDRS charts), contrast sensitivity (Optec 6500 system), and stereoacuity (Titmus test) were compared before and after visual stimulation training.

Follow up examinations were performed at 3.5 months, which was the end of the treatment period, and 12 and 24 months later. 18 out of 26 (69%) reached the 24 months examinations.

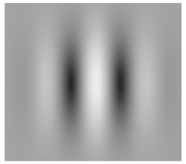

Fig 1.
Gabor patch: The basic element of NeuroVision visual stimulation. It matches the shape and orientation of the primitive receptive fields in the visual cortex.

Display with a target Gabor patch

Display without a target Gabor patch

Fig 2.
Lateral masking. The fundamental stimulation technique includes two collinearly oriented flanking Gabor patches which are displayed in addition to the central target Gabor image (display with a target Gabor patch). The display with the target and the display without the target are shown sequentially in a random order. The patient has to respond to the display with the target.

Results

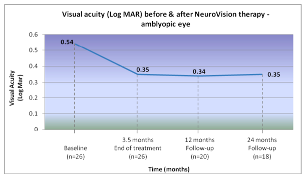

Fig 3.
Visual acuity (LogMAR) in the amblyopic eye through the course of the study. An improvement of 1.9 lines logMAR is noted at the end of the treatment (3.5 months). This improvement in visual acuity is maintained at 12 and 24 months.

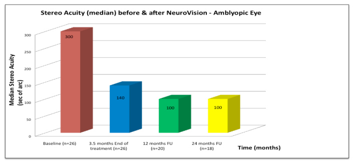

Fig 4.
The median stereo acuity in the amblyopic eye through the course of the study. An improvement in median stereo acuity from 300 to 140 seconds of arc was noted at the end of the treatment (3.5 months). A small additional improvement to 100 seconds of arc was noticed at 12 and 24 months.

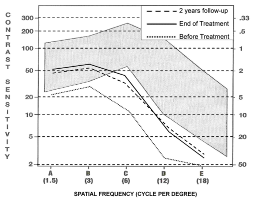

Fig 5.
Contrast sensitivity in the amblyopic eye through the course of the study. Significant improvement in the low frequency range is noted and maintained at 24 months follow-up examination.

Results:

Mean BCVA (logMAR) improved from 0.54 ±0.16 (20/70 or 6/24) before treatment to 0.35 ±0.15 (20/45 or 6/15) (1.9 lines) ($p=0.004$) at the end of treatment. The improved mean BCVA was maintained at 1 and 2 years follow-up examinations (0.34±0.13, 0.35±0.17 respectively) (Figure 3).

However, at the 24 months examination two eyes had gained 1 line and 2 eyes had lost 1 line of BCVA compared to the BCVA achieved at end of the training session.

Following the visual training two patients passed a driving license test for driving a bus, which requires a BCVA of 6/12 (20/40) in each eye.

Median stereo-acuity improved from 300 to 140 seconds of arc at the end of training period with further improvement to 100 seconds of arc at 1 and 2 years follow up examinations (Figure 4). This improvement without further training may be explained by binocular function learning curve.

Contrast sensitivity improved in all frequencies, with statistically significant difference in the lower frequencies ($p< 0.05$). This result was maintained at 1 and 2 years follow up (Figure 5).

Conclusions:

NeuroVision treatment for amblyopia can improve visual performance including visual acuity, contrast sensitivity and stereoacuity in older children and adults.

This improvement was found to last for 24 months, without further visual training.

* The authors have no financial interest to disclose