Improving CSF in Subjects with Low Degrees of Myopia using Neural Vision Correction™ (NVC™) Technology
Donald Tan 1,2,3
Singapore Eye Research Institute (SERI) 1; Singapore National Eye Centre (SNEC) 2; Department of Ophthalmology, Faculty of Medicine, National University of Singapore 3;

---
**Introduction**

NeuroVision’s VNC vision correction technology is a non-invasive, patient-specific treatment based on visual stimulation and facilitation of neural connections responsible for vision. The technology involves the use of an internet-based computer generated visual training exercise regime using sets of patient specific stimuli based on Gabor patches, to sharpen contrast sensitivity and visual acuity.

We evaluated the efficacy of NVC treatment in the enhancement of unaided visual acuity (UAVA) and contrast sensitivity function (CSF) in low myopes.

---
**Scientific Background**

Cortical neurons in the visual cortex function as highly specialized image analyzers or filters, responding only to specific parameters of a visual image, such as orientation and spatial frequency, and visual signals are transmitted through a series of interacting activity of many neuronal and interneuronal interactions both excitation and inhibition. Visual cortical neurons involved in vision processing, and neural interactions determine the sensitivity for visual contrast at each spatial frequency, and the combination of neural activities set Contrast Sensitivity Function (CSF)1,2. The relationship between neuronal responses and perception are mainly determined by the signal-to-noise ratio (S/N ratio) of neuronal activity, and the brain pools responses across many neurons to average out noisy activity of single cells, thus improving S/N ratio, leading to improved visual performance and acuity3.

Studies have shown that the noise of individual neurons can be brought under experimental control by appropriate choice of stimulus conditions, and contrast sensitivity at low levels can be increased dramatically through control of stimulus parameters4,5. This precise control of stimulus conditions leading to increased neuronal efficiency is fundamental in initiating the neural modifications that are the basis for brain plasticity6,7. Brain plasticity (the ability to adapt to changed conditions in acquiring new skills) has been demonstrated in many basic tasks, with evidence pointing to physical modifications in the adult cortex during repetitive practice1,12.

NeuroVision’s technology probes specific neuronal interactions, using a set of patient-specific stimuli that improve neuronal efficiency8,9 and induce improvement of CSF due to a reduction of noise and increase in signal strength. As perception quality depends both on the input received through the eye and the processing in the visual cortex, NeuroVision’s technology compensates for blurred (myopic) inputs, coming from the retina, by enhancing neural processing.

---
**Technology Implementation**

The building block of these visual stimulations is the Gabor patch (Figure 1), which efficiently activates and matches the shape of receptive field in the Visual Cortex.

The fundamental stimulation-control technique is called “luminance-reflectance” where every pair of Gabor patterns is displayed in addition to the target Gabor image. Each channel of the two Gabor patches is controlled by a pair of dimmers. The first Gabor patch is left activated and the second one is blanked out, which means that the patient is exposed to two short displays in succession. In a random order, the patient identifies which display contains the target Gabor image (Figure 2). The system provides the patient with audio feedback when provided with an incorrect response. The task is repeated and a staircase is applied until the patient reaches their visual threshold level.

---
**NeuroVision Treatment System**

The NeuroVision Treatment System is a software-based, interactive system tailored and continuously adaptive to the individual 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 efficiencies or deficiencies. Based on this analysis, a treatment plan is initialized, and subject specificity is achieved by administering patient-specific stimuli in a controlled environment.

Each session is designed to train, directly and selectively, those functions in the visual cortex, which were diagnosed to be further enhanced. At each session an algorithm analyzes the patient’s responses and accordingly adjusts the level of visual difficulty to the range most effective for further improvement. Between sessions, the progress of the patient is taken into account by the algorithm for the next session generation. Thus, for each subject, a novel training schedule is designed based on the initial state of visual performance, severity of dysfunction and progress in course of treatment. The treatment is applied in successive 30-minute sessions, administered 2-3 times a week, a total of approximately 30 sessions. Every 5 sessions, subject’s visual acuity is tested in order to continuously monitor subject’s progress. The average entire treatment duration is around 3 months.

---
**NVC™ Treatment for Low Myopia in Singapore**

The results reported here include 2 groups of patients:

- 20 adults with low myopia (mean spherical equivalent of −1.08D range 0D to −1.75D) recruited in a non-randomized, prospective pilot study (“P” of NVC™ treatment performed at SERI).
- 37 adults with low myopia (mean spherical equivalent of −1.33D range −0.25 to −2.5) given commercial (“C”) NVC treatment at SNEC.

Mean number of treatment sessions was 33. Investigations included manifest and cycloplegic refraction, LogMAR UAVA and sinusoidal grating CSF (Sine Wave Contrast Sensitivity charts). The pilot study patients were followed up for 12 months after completion of treatment.

Subjects comprised 32 male and 25 female with a mean age of 32 years (range 14 to 55 years). All 57 patients have completed the treatment.

---
**Treatment Results**

**Individual Unaided Visual Acuity Improvement**

The results of the NVC™ treatment suggest that this technology is able to improve UAVA and UACSF in adults with low myopia. A large-scale, placebo-controlled randomized clinical trial is currently ongoing.

---
**References**

10. NVC™ Technology & Treatment Results. NeuroVision Network Inc.