Research Supporting Vision Restoration Therapy (VRT™)

VRT has been supported by 15 years of research with clinical studies published in more than 30 leading journals

Romano JG, Schulz P, Kenkel S, Todd DP (2008). Visual field changes after a rehabilitation intervention: Vision Restoration Therapy. **Journal of the Neurological Sciences**; 132: 70-74

Objective of this retrospective study was to determine the effect of Vision Restoration Therapy VRT on visual field defects in a US cohort. The study evaluated 161 Patients with postchiasmatic lesions who performed 6 modules of VRT with suprathreshold central visual field testing at baseline and after each module. Outcome measures were change in stimulus detection and border shift. Results: mean absolute improvement in stimuli detection was 12.8 %. Improvements of > 3 % was noted in 76 % of patients. The average border shift was 4.87 %. Patient age, time from lesion and type of visual field defect did not influence the degree of field expansion. Conclusions: VRT improves stimulus detection and results in a shift of the position of the border of the blind field as measured on suprathreshold visual field testing. These results support prior reports and support VRT as a useful rehabilitative intervention.

Plow EB, Obretenova SN, Fregni F, Pascual-Leone A, Merabet LB (2012). Comparison of Visual Field Training for Hemianopia With Active Versus Sham Transcranial Direct Cortical Stimulation. **Neurorehabilitation and Neural Repair**; 20 (10): 1–11

Vision Restoration Therapy (VRT) aims to improve visual field function by systematically training regions of residual vision associated with the activity of suboptimal firing neurons within the occipital cortex. Transcranial direct current stimulation (tDCS) has been shown to modulate cortical excitability. This study was performed to assess the possible efficacy of tDCS combined with VRT. The authors conducted a randomized, double-blind, demonstration-of-concept pilot study where participants were assigned to either VRT and tDCS or VRT and sham. Outcome measures included objective and subjective changes in visual field, recording of visual fixation performance, and vision-related activities of daily living (ADLs) and quality of life (QOL). The VRT and tDCS group demonstrated significantly greater expansion in visual field and improvement on ADLs compared with the VRT and sham group. The combination of occipital cortical tDCS with visual field rehabilitation appears to enhance visual functional outcomes compared with visual rehabilitation alone. TDCS may enhance inherent mechanisms of plasticity associated with training.

Marshall RS, Ferrera JJ, Barnes A, Zhang X, O'Brien KA, Chmayssani M, Hirsch J, Lazar RM (2007). Brain activity associated with stimulation therapy of the visual borderzone in hemianopic stroke patients. **Neurorehabilitation and Neural Repair**; 22(2): 136-144

Study objective was to examine whether VRT would induce visual field location-specific changes in the brain's response to stimuli. Six chronic right hemianopic patients underwent fMRI – responding to stimuli in the trained visual borderzone versus the non-trained seeing field before and after 1 month of VRT. Percent change in Blood oxygen level dependent (BOLD) activity was compared between conditions. Results: BOLD activity at the borderzone was significantly increased after one month of training as compared to activity in the seeing field. Greatest response was shown in right inferior and lateral temporal, right dorsolateral frontal, bilateral anterior cingulate and bilateral basal ganglia region. Conclusion: VRT appears to induce an alteration in brain activity associated with a shift of attention from the non-trained seeing field to the trained borderzone. The effect appears to be mediated by the anterior cingulate and dorsolateral frontal cortex in conjunction with other higher order visual areas in the occipitotemporal and middle temporal regions.

Kasten E, Wuest S, Behrens-Baumann W, Sabel BA (1998). Computer-based training for the treatment of partial blindness. **Nature Medicine**; 4 (9): 1083-1087

Partial blindness in the form of a visual field defect (VFD) after brain injury has long been considered non-treatable. A prospective double-blind placebo-controlled study was performed to evaluate the treatment outcome of computer-based Vision Restoration Therapy (VRT) on patients with VFD after a post-chiasmatic brain injury (n= 19) or after optic nerve injury (n=19). VRT was performed twice a day for about six months. VRT led to a significant 29.4 % improvement in stimulus detection over baseline in patients with post-chiasmatic lesions, and a 73.6 % improvement in patients with optic nerve lesions. An average visual field enlargement of 4.9 / 5.8 degrees of visual angle was found in computer-based suprathreshold central visual field testing. 72 % of patients reported subjective visual improvements in their daily life. Patients receiving a placebo treatment did not show comparable improvements. In conclusion, VRT has proven to significantly improve visual functions of patients with visual field defects due to post-chiasmatic or optic nerve lesions.

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Mueller I, Poggel DA, Kenkel S, Kasten E, Sabel BA (2003). Vision Restoration Therapy (VRT) after brain damage: subjective improvements of activities of daily life and their relationship to visual field enlargements. **Visual Impairment Research**; 5 (3): 157-178

Study objective was to determine whether VRT-induced visual field enlargements are relevant to visually guided activities of daily life (ADL). A retrospective analysis of 69 patients who were interviewed after performing 6 modules of VRT was carried out. Patient testimonial statements were categorized posthoc and were correlated with demographic status and pre/post VRT changes. Results: stimulus detection ability was significantly increased after VRT, 88 % of patients report subjective benefits in ADL. Significant correlation was found in the categories "carrying out hobbies" and "general improvement of vision". A trend was evident for "reading". The categories "visual confidence/mobility" and "ability to avoid collisions" did not correlate with size of visual field improvements. Thus, visual field size appears only to be one, surprisingly minor, factor among others to determine subjective vision in brain damaged patients.

Poggel DA, Mueller-Oehring EM, Kasten E, Bunzenthal U, Sabel BA (2007). The topography of training induced visual field recovery: Perimetric maps and subjective representations. **Visual Cognition**; 16 (8): 1059-1077

The cognitive representation of blind regions varies considerably between patients with vision loss and may influence compensatory behavior and treatment motivation. We measured "objective" visual field topography (perimetry) in 19 patients with postgeniculate lesions and related this to the subjective scotoma representation as expressed by patients' drawings of the defect. We monitored changes during VRT-induced recovery of function. Blind regions were mostly adequately represented; however, central regions were overestimated and peripheral areas underestimated in size. Perimetric and subjective defect size decreased significantly during training. Again, central visual field border shifts were larger in subjective than in perimetric maps but vice versa in the peripheral field. Thus, VRT improves "objective" visual field size along with its cognitive representation. Subjective topography is shaped by the functional importance of visual field regions, thus resembling neural representation in visual cortex (cortical magnification).

Poggel DA, Kasten E, Sabel BA (2004). Attentional cueing improves vision restoration therapy in patients with visual field defects". **Neurology**; 63: 2069-2076

Objective of this study was to examine whether directing attention to defined areas with residual vision at the visual field border by using a visuospatial cue increases long-term neural plasticity and enhances permanent training outcome. In a prospective, randomized clinical trial, VRT treatment outcome was compared in patients with postgeniculate lesions receiving either standard VRT (control group, n=10) or VRT with attentional cueing (experimental group, n=9). Visual field size was determined before and after a 6-month-treatment period with standard perimetry and suprathreshold visual field testing. Results: Overall, subjects displayed a significant average stimulus detection improvement after VRT. In the area utilizing a cue for VRT, stimulus detection was better than in areas without a cue or in the control group. Focusing attention at an area with residual vision changed topographic and temporal patterns of recovery. Authors propose that top-down signals preactivate partially damaged areas of V1, thus linking visual and attentional neuronal networks with the effect of better therapy outcome.

Gall C, Mueller I, Gudlin J, Lindig A, Schlueter D, Jobke S, Franke GH, Sabel BA (2008). Vision and health-related quality of life before and after vision restoration training in cerebrally damaged patients. **Restorative Neurology and Neuroscience**; 26: 341-353

Aim of the study was to examine whether VRT-related improvements in stimulus detection of patients with VFD are associated with changes in self-reported vision-and health-related quality of life (QoL). 85 patients with VFD after brain damage underwent VRT for overall 75 or 150 hours. Stimulus detection was quantified pre and post VRT with suprathreshold central visual field testing. QoL was assessed by the Health-Survey SF-36 and the 39-item National Eye Institute Visual Functional Questionnaire NEI-VFQ. Results: both vision- and health-related QoL measures improved after VRT. Significant increases were found in 8 out of 12 subscales of the NEI-VFQ, and in 3 out of 8 subscales of the SF-36. Changes in stimulus detection were related to changes in the subscale ratings "general vision", "difficulty with near vision activities", "limitations in social functioning" and "driving" of the NEI-VFQ. In conclusion, visual field enlargements after VRT were related to improvements in vision-related Quality of Life of patients.

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