Table E3. Techniques of Visual Rehabilitation, Restorative method

Reference	Year	Question	Type	#	Intervention	Primary Assessment	Outcome
Zihl (37)	1979	Can systematic stimulation restore function to a damaged central visual system?	NR Prosp	12 HH	Repeat measurement of light sensitivity threshold at visual area between intact and impaired vision on Tubinger perimeter, light intensity was lowered by 0.1 log point when patient successfully detected three consecutive targets.	Visual fields mapped with dynamic and static Tubinger perimetry Light sensitivity measured with Tubinger perimeter	-Increased light sensitivity after 3-5 sessions in most patients. -Larger increase in periphery (0.44 log units) than fovea region (0.19 log units) -Highly varied visual field expansion results
Zihl (40)	1985	Does systematic treatment lead to enlarged visual fields?	NR Prosp	55 HH with PC lesion	Saccadic localization of light stimuli with Tubinger perimeter in patients without any neuropsychological deficits	Visual fields mapped with monocular and binocular dynamic Tubinger Perimetry	-Visual field increase of at least 1.5° visual angle in 44 (80%) patients -14 patients had an expansion of more than 10° visual angle.
Kasten (41)	1998	Is computer based program VRT beneficial to post-chiasmic or optic nerve damage patients?	RC Pros	38 HH	Computer based program consisting of Presentation of white stimuli on dark background targeted to individualize 'transition zone' and fixation controlled by fixation target in10 optic nerve damage, 9 post-chiasmic damage patients, and 19 age/gender/lesion matched con. group.	HRP TAP	-Significant visual field expansion in patients with post-chiasmic damage (border shift of 4.9° visual angle) in comparison to HRP baseline. -TAP showed 0.43° shift of visual field border in test group after VRT. -Placebo showed no significant change in visual field.

Julkunen (68)	2003	Can computer based training restore vision in HH patients? Can the potential benefit be maintained?	NR Pros	8 HH & QH	Silmapeli computer based program. Presentation of bright white static stimuli, which decreased in size at subsequent trials of given location on black background.	-Goldmann Kinetic Perimetry -Octopus 101 static automatic perimetry -VEP -Subjective questionnaire	-Static perimetry showed 12.5%increased VF in 2 pts -1 pt maintained the benefit -Kinetic perimetry revealed field size increase in 3 patients (5° to 10), which was maintained in 2 -VEP detected defect in 4 patients, and showed improvements in 3 -4 patients reported subjective VF improvement and 3 reported improvement in daily life.
Poggel (43)	2004	Can cueing attention to areas of residual vision improve VF expansion in comparison to standard VRT?	RCT	19 HH	CG VRT (10 pts) stimuli were modified in both programs to increase in brightness from dark grey to bright white in four steps to show areas of residual vision. Attention cueing (EG) VRT (9 pts): First a dim grey square frame was presented enclosing seeing and blind areas, followed by a randomized interval, and then presentation of stimuli within previously enclosed area	HRP	-Both groups showed mean increased detection rate from 254.3 to 272.8 hits -No significant difference between con and cueing groups when entire visual field data was compared -When specific areas of visual field were compared, cueing was shown to have a greater effect on detection rate improvement -Detection rate improved in EG versus 2.9% in CG -There was no statistical significant difference in detection rate improvement in uncued areas of field of EG & CG.

Sabel (67)	2004	Is VRT beneficial when tested with HRP, TAP and SLO?	NR Prosp	16 HH	Six months of standard VRT in patients with PC lesions older than 1 year Fixation was controlled by fixation target color change, presentation of stimuli into center of fixation target and real time camera of retinal position in HRP, Tap and SLO methods, respectively.	HRP: Five presentations of stimuli at a given location to assess areas of absolute and relative defect. TAP: Resolution of 191 stimuli location within central 30° VA of white stimuli on bright background. Staircase method to find light sensitivity threshold used to measure relative defect. SLO: Laser projects image directly into retina. Stimuli are three black dots made by omission of laser. Pts verbally indicate how many dots, and which ones they can see. Present/not present response, measured absolute defect only.	HRP: Significant increase in detection rate from 63.04% to 69.63%. False positives did not have a significant increase (from 4.1 to 5.7) TAP: Significant decrease of misses by mean 8 points for both eyes. False positives changed from 97.5 – 94.0% OD and 94.0 – 90.7% OS (100% is perfect performance). Fixation rates changed from 77.56 to 85.19% OD and 87.75 to 84.56% OS. SLO: no change in border position of absolute defect. Absolute border comparison: the SLO assessed border was closer to midline than HRP and TAP at baseline (2.61°OD/2.98°OS compared to 5.28°OU and 4.56°OD/4.49°OS). After VRT the absolute border mismatch became more pronounced (2.87°OD/3.04°OS compared to 7.01° OU and 6.05°OD/5.47°OS). Relative border comparison: Relative borders assessed by TAP and HRP almost match absolute borders of SLO. After VRT, relative borders of HRP and TAP do not significantly change.

Reinhard (64)	2005	Is VRT able to expand visual field defect in HH using fundus controlled microperimetry?	NR Prosp	15 HH	Six months of VRT in patients with brain lesion of at least one year old	SLO: Training effect measured as difference of ratio of number of dots not seen over total dots before and after VRT Threshold was defined as E = 0.12, or a 1° shift of entire blind-field border. Retina was monitored by real time camera and all trials with retina movement were discarded	-No border shift was measured with SLO after VRT. -The mean E value OD and OS were 0.025 and 0.008, respectively. -1 pt had a significant E value in one eye (E = 0.178 OD). -3 pts had an increase in reading speed of more than 20% after VRT. -10 pts reported benefit. -5 pts denied any benefit. -Reports included ability to see whole TV screen, being able to read books, and being more secure in walking up stairs.
Poggel (44)	2006	Is attention cueing effective in visual field recovery when tested with HRP?	NR & Pros	23 HH	Compared attention field (where cue is presented) and probe field (uncued field). Fixation monitored with mirror.	HRP was completed x5: Neutral trials (no cue, 474 trials), valid trials (cue presented, stimuli presented in cued area, 144 trials), invalid trials (cue presented, stimuli presented in uncued field, 36 trials), and catch trials (cue presented, no stimuli presented, 20 trials)	Percent HRP detection rate change and change in reaction time during both valid (4% and 57ms) and invalid cued (3% and 29ms) trials increased when compared to neutral trials. Valid trials showed a more pronounced improvement than invalid trials (Difference of 1% and 28ms)
Schreiber (61)	2006	Is VRT effective in treatment of HH when assessed by TAP?	NR & Pros	16 HH	6 months of VRT	TAP (success was defined as 2° shift of central visual field or 5° shift of peripheral visual field. Which is an E value of 0.12 or greater)	TAP results did not reveal significant visual field changes after VRT. OD E = 0.05 and OS E = 0.05. 2 eyes of 2 patients had an E value that exceeded threshold of 0.12.

Mueller (50)	2007	Does VRT enlarges the visual field of patients with HH?	Retro	302 HH	Six months of VRT (paying VRT customers)	HRP	-Detection rate of HRP stimuli increased by 17.2% with an average visual field expansion of 4.9° visual angle. -Reaction time decreased by 17 ms -75.4% of patients reported subjective improvement in visual confidence.
Kasten (45)	2007	Is multiple stimulus program more effective than standard VRT?	NR & Pros	23 HH	Parallel costimulation: 2 stimuli presented in given located along same horizontal plane into blind field (7 pts). Moving costimulation: 2 stimuli presented in given location, one stimulus moved towards blind-field and returned to starting point (7 pts). 9 pts in VRT group	HRP TAP	-Pooled together, VRT data showed a percent increase detection rate on HRP of 4.5% and decrease of misses on TAP of 3.7% OD and 4.4% OS. -Costimulation did not yield different results than standard VRT.
Romano (51)	2008	Is VRT effective?	Coh. study	161 HH	VRT for 6 months	HRP	-Percent mean increase of HRP detection was 12.8% -A n average border shift of 4.87° visual angle.
Bergsma (75)	2010	How systematic training affects size of VF defects over time?	NR Prosp	11 HH	Adapted monocular Goldmann perimeter as training paradigm: stimulus detection thresholds were repeatedly measured on a background of 10 cd/m² luminance. Threshold was found by increasing stimulus luminance from 4 cd/m² to 318 cd/m² by 0.1 log units (~40 sessions).	Goldmann perimetry assessment was completed before, and after 10 sessions to show gradual changes. Fixation was controlled in assessment sessions by Eyelink II Eyetracker.	Border was gradually shifted away from midline and kept same general shape

Chokron (76)	2008	Is visual stimulation effective in visual improvement?	Prosp	9 HH	22 w, pointing to visual targets, letter recognition/identification, visual comparison between the two hemifields, target localization	AVF	Automated perimetry visual field testing improved in 8 patients
Das (77)	2014	Is visual stimulation effective in visual improvement?	Prosp	9 HH	20-40 s, discrimination task with static stimuli alone and motion and static stimuli together	Measurement of threshold (psychophysics)	Discrimination of not optimal stimuli for blindsight can be relearned and using complex stimuli in a double-training configuration maximizes generalization of learning across location/task
Henriksson (78)	2007	Is visual stimulation effective in visual improvement?	Prosp	2 HH	x2/w for a y Flicker stimulation in the blind hemifield	Measurement of threshold (psychophysics)	Flicker sensitivity improved
Sahraie (79)	2010	Is visual stimulation effective in visual improvement?	Prosp	4 HH	6-21 m, Neuro-Eye Therapy (detection of temporally modulated spatial grating patches at specific retinal locations within the field defect)	Measurement of threshold (psychophysics)	3 patients showed improvement that was accelerated using positive feedback
Sahraie (80)	2013	Is visual stimulation effective in visual improvement?	Prosp	5 HH	>10,000 trials Detection of a temporal modulated grating patch by 2AFC paradigm and subjective response of visual awareness	Measurement of threshold (psychophysics)	4 of 5 patients showed increased detection of stimuli of reduced contrast compared to chance/conscious visual awareness of stimuli increased

Sahraie (81)	2008	Is visual stimulation effective in visual improvement?	Prosp	7 HH	Detection assessment of spatially/temporally modulated Gabors	Measurement of threshold (psychophysics)	There is a "window of processing tuned to low spatial frequencies and intermediate temporal frequencies
Sahraie (70)	2006	Is visual stimulation effective in visual improvement?	Prosp	12 HH	3 m, grating visual stimuli vs uniform field discrimination: grating is optimally configured for blindsight from homogeneous luminance matched stimuli	Measurement of threshold (psychophysics)	Improvement in detection of gratings of SF of less than 3.5 cycles/degree compared to control area. Increased visual field sensitivity. Shrinkage of subjective perception of visual field defect.
Trevethan (82)	2012	Is visual stimulation effective in visual improvement?	Prosp	3 HH	Variable, >100 s Sinewave grating pattern detection	Measurement of threshold (psychophysics)	Visual sensitivity improvement, detection of stimulus of reduced contrast increased
Huxlin (83)	2009	Is visual stimulation effective in visual improvement?	Prosp	5 HH	9-18 m, Global motion discrimination	Measurement of threshold (psychophysics)	Direction integration threshold & conscious awareness of detection improved
Cavanaugh (84)	2017	Is visual stimulation effective in visual improvement?	Prosp	17 HH	Direction and/or orientation discrimination	24-2 and 10-2 Humphry visual field testing with online eye tracking	Trained patients recovered 108 degree^2 whereas control group improved 16 degrees^2 (on average)

Abbreviations: #: number of patients, Tx: treatment, w: weeks, m: months, y: years, s: sessions, 2AFC: two alternative forced choice, SF: spatial frequency, DM: double masked, COST: Cross over sham trial, HH: homonymous hemianopia, HRP: High-resolution perimetry, HQ: homonymous quadrantanopia, RC: randomized controlled, RCT: randomized controlled trial, NR: non-randomized, PC:

post-chiasmatic, Pros: prospective, Retro: retrospective, SLO: scanning laser ophthalmoscope, TAP: Tubinger automated perimetry, and VEP: visual evoked potentials, VF: visual field, VA: visual angle, pt: patient, Coh: Cohort, D: diopter, FP: Fresnel prisms, Cont: control, wpm: word per minute, OKN: optokinetic nystagmus, VET: visual exploration training, RT: reading training, AVF: automated visual field test.