Rehabilitation for people with hemianopia: the next step

Chair: Gera de Haan, PhD
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Gera de Haan, PhD, is working as a neuropsychologist at Royal Dutch Visio and performs research at the University of Groningen, the Netherlands, department of Clinical and Developmental Neuropsychology. The main focus of her research is on the consequences of brain damage (such as stroke, brain tumor, Alzheimer's Disease, Parkinson's Disease, Multiple Sclerosis) for processing visual information. She published several papers on hemianopia, its influence on daily living (including car driving) and the effects of scanning training. Combining research and clinical practice, her aim is to improve visual rehabilitation by increasing knowledge on visual disorders related to brain damage.

Symposium abstract

Homonymous visual field defects are common in patients with acquired brain damage. The number of training programs is growing, and several studies on the training effects have been performed. However, there is a large variety in research designs, training programs, and outcome measures among the different studies. This leads to confusion in the rehabilitation setting on what training program to use for which purpose. In this symposium, we integrate the knowledge from individual studies in order to provide direction to future studies and rehabilitation.

Several scientific studies will be presented on rehabilitation for patients with hemianopia. A diversity of training programs will be covered: several types of restitution training, NeuroEyeCoach, Rainbow Readers (paper-based), VISIOcoach (computer software), MyHappyNeuron (web-based), NeuroVisionTraining (specialised equipment), IH-CST, and gamified training.

On the basis of these presentations, we will discuss on how to proceed in this line of research. What lessons can be learned from previous studies? Which training elements seem to be effective for which functions and activities? What is the next step in research and clinical practice regarding rehabilitation for patients with hemianopia?

Lectures:

- Arash Sahraie (UK): Vision rehabilitation in patients with visual deficit after brain injury
- Joris Elshout (Netherlands): Improvement in activities of daily living after visual training aimed at restitution in patients with homonymous visual field defects using Goal Attainment Scaling
- Christine Hazelton (UK): Scanning training for rehabilitation of stroke-related visual field loss: using mixed methods to increase the evidence base
- Gera de Haan (Netherlands): Specificity of the effects of compensatory scanning training (IH-CST) for patients with hemianopia: a randomized controlled trial
- Jonathan Waddington (UK): Pilot study of a therapeutic video game for the (re)habilitation of children and young people with homonymous visual field loss
- Anna Nowakowska (UK): Visual search in simulated hemianopia is inefficient.

1. Vision rehabilitation in patients with visual deficit after brain injury

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Post-geniculate lesions of the visual pathway often lead to areas of reduced visual sensitivity or blindness. As the loss of sight in both eyes is similar in extent, the condition is referred to as homonymous hemianopia. In the acute stage, some spontaneous recovery may take place post injury. Following this period, any remaining deficits are often thought to be permanent and irreversible. In addition to the loss of sight, hemianopic patients tend to have deficits in eye-movements. These usually include reduced exploratory eye movements to bring items from the blind field into their sighted field. The pattern of eye-movements is also altered in that it is often disorganised, with smaller amplitudes and larger number of fixations, resulting in patients performing slower in visual exploration. In this talk, I present data from a number of studies, showing that repeated and systematic visual stimulation can lead to improved visual sensitivity within the blind field. Patients can also benefit from systematic visual search training by developing more efficient search strategy. The technologies discussed can be accessed by patients online, allowing patients to make use of the therapies either at clinical rehabilitation settings or at home.

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2. Improvement in activities of daily living after visual training aimed at restitution in patients with homonymous visual field defects using Goal Attainment Scaling

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Stroke is the most common cause of homonymous visual field defects. There is no standard protocol for treatment. In the current study we assess the clinical significance of visual training for vision restitution in patients with homonymous visual field defects by means of Goal Attainment Scaling (GAS). Thirty-five patients trained two predefined regions of the visual field successively at home. In each region we compared the effects of both training rounds, one of which was thus 'directed' and the other 'undirected'. Visual fields were measured with Humphrey and Goldmann perimetry. Quality of life was assessed with three stroke-related questionnaires and activities of daily living with GAS. Visual training improved the visual field for both Goldmann and Humphrey perimetry. All standardized stroke questionnaires were significantly improved after training, but showed no significant relation with field improvement. About 75% of the patients improved on their (personalized) GAS score. Interestingly, after both training rounds the GAS score increased in proportion to the extent of visual field improvement, for Goldmann border shift but not for Humphrey sensitivity increase. Multiple regression revealed that GAS score was linearly related to the directed training component for both types of perimetry, but not for undirected training. Together these data suggest that (1) visual training aimed at vision restitution leads to visual field improvement and (2) the extent of visual field improvement is linearly related to the improvement of personal activities of daily living as evaluated by means of GAS. In conclusion, a personalized evaluation to assess treatment success showed the clinical significance of a visual training for vision restitution.

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No conflicts to disclose.

3. Scanning training for rehabilitation of stroke-related visual field loss: using mixed methods to increase the evidence base

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Introduction: Visual field loss (VFL) persists in twenty percent of stroke survivors. In the UK management of VFL is varied, with a lack of evidence to support practice. Developing effective interventions is an identified research priority for stroke survivors. It is vital that this development considers and assesses the feasibility of intervention use in real-world settings. One rehabilitation option with evidence of 'potential' is compensatory scanning training.

Methods: Using an n-of-1 design we combined qualitative interviews and quantitative outcomes to explore the experiences of stroke survivors, before and after using scanning training interventions. Eleven home-dwelling stroke survivors took part: 6 right sided VFL, 6-16 months post stroke. Four interventions were delivered in randomised order: paper-based (Rainbow Readers), computer software (VISIOcoach), web-based (MyHappyNeuron) and specialised equipment (NeuroVision Training). Semi-structured qualitative interviews were analysed thematically to explore participant perspectives. Quantitative measures assessed training effect (visual search, reading, quality of life) and feasibility (diaries of adherence).

Results: VFL was perceived by participants to have a profound impact on daily life. Quantitative measures demonstrated no effect of any intervention, but participants reported improved confidence and ability in daily activities. Further exploration identified factors associated with variations in perceived effect, and a model of training effect was created. Intervention use varied from 0-300% of recommended duration; enjoyment and perception of safety increased interventions use.

Conclusions: Scanning training is a feasible way to address the broad impact of VFL on daily life, but its effects remain unclear. Conflicting inter-method evidence of training effect suggests that researchers must ensure that outcome measures accurately capture rehabilitation effect. We propose a new model of scanning training effect: further research is required to confirm and refine this. Using mixed methods is a new approach in this field, but has provided unique insight into VFL and its rehabilitation.

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4. Specificity of the effects of compensatory scanning training (IH-CST) for patients with hemianopia: a randomized controlled trial

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Several training programs have been developed for people with homonymous visual field defects. The Insight-Hemianopia Compensatory Scanning Training focusses on the use of a top-down, systematic horizontal scanning strategy in mobility situations. In the current study, the effects of this training were examined in a randomized controlled trial with 54 hemianopia patients (training vs. waiting list) and 25 control subjects. The effect measures included visual functions tests, a dot counting test, visual search tests, a hazard perception tests, an obstacle course, reading tests, and questionnaires on experienced difficulties in daily life.
Training improved detection of peripheral stimuli in mobility, mainly in dual task situations. No effects of training were found for visual functions, dot counting, visual search or reading. Positive effects of training on vision-related quality of life were still present at half year follow-up. These results confirm that different training exercises and training methods appear to affect different types of visual tasks and activities.

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No conflicts to disclose. I am an employee of the University of Groningen and Royal Dutch Visio, which co-funded the project.

5. Pilot study of a therapeutic video game for the (re)habilitation of children and young people with homonymous visual field loss

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Cerebral vision impairment is currently the most common cause of vision impairment in children from developed countries. It has been estimated that 11-22% of children with cerebral vision impairment have a homonymous visual field loss, a loss of part of the usual field of vision that affects corresponding areas as seen through both eyes. There is evidence that vision rehabilitation can significantly improve visual outcomes for adults with homonymous visual field loss. However, it is unclear whether training can improve visual outcomes for children. A particular challenge has been that previous training protocols were tiresome, uninteresting, and failed to keep children engaged. In this study we recruited one group of 8 children and young people between the ages of 7 and 21 years old to take part in 5-7 weeks of unsupervised training at home using a video game we had specifically designed for visual search training. We recorded game metrics during play that were analysed offline to retrospectively assess compliance and progress with training. We measured performance on five validated tabletop assessments at four site visits to assess transfer of visual search skills to activities of daily living. Participants engaged with the training but only completed 52% of the recommended number of tasks on average. Game metrics demonstrated that the percentage of onscreen targets found in affected quadrants within a time limit significantly improved (+9.8%, 95% CI [3.4%, 16.1%]), and these improvements plateaued before the third week of training. Training effects transferred to a 24% (95% CI [2%, 46%]) improvement in visual response time on tabletop assessments, similar to the effect size observed in previous studies with adults. We concluded that children can improve visual outcomes using gamified training with less time commitment than adults. Whether this difference in learning speed is due to age or gamification requires further investigation.

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No conflicts to disclose. I am an employee of the WESC Foundation, which part-funded the project.

6. Visual search in simulated hemianopia is inefficient

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A proportion of patients with hemianopia spontaneously adopt compensatory strategies to deal with their visual field deficit. Those patients who do not, can be trained to do so. One strategy known to compensate for a visual field loss is to saccade as far into the blind field as possible to maximize the proportion of the search area that falls in the sighted field. Our four experiments were designed to test if healthy observers can spontaneously adopt effective eye movement strategies to compensate for information loss similar to that experienced by patients with damage to visual cortex. To this end we simulated hemianopia in healthy participants using gaze-contingent method: we removed or degraded visual information in one hemifield on-line while participants performed a search task on a computer screen. In all four experiments participants were strongly biased towards their sighted field when searching for a target object. The proportion of saccades directed toward the “blind” field increased with the amount of information available in that field, suggesting fixations were driven toward salient visual information rather than toward locations that maximize information gain. In the first two experiments the search was effortful and participants had to check each item individually in order to indicate target presence (or absence) so the sighted field bias had a minimal impact on search performance. Crucially, the last two experiments demonstrated that participants concentrated their search on the sighted side even if the target could easily be detected in the periphery, thus making eye movements to the sighted side redundant. The findings that efficient strategies to compensate for visual deficits are not spontaneously adopted by healthy participants are discussed in the context of our recent data, showing that even healthy participants without visual field deficit fail to direct eye movements to the locations that would maximise information gain.

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