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Thomas Pocklington Trust
Housing and support for people with sight loss

Sight loss following stroke: impact and rehabilitation

Summary

About a third of people who have had a stroke experience some form of sight loss. In the majority of patients, this is a condition called homonymous hemianopia, which is the loss of half of the visual field in the same side of each eye. The impact of this condition on activities of everyday living can be devastating, both in the home and the community.

This publication is in three parts:

- A description of the background and the wider research context for vision rehabilitation among patients with hemianopia, as well as a range of therapeutic approaches.
- A brief summary of a study by the Fife Society for the Blind which used a specific therapeutic intervention for patients with hemianopia.
- Implications for policy development, clinical practice and patient education.

The study was based on the experiences of four stroke patients, who were able to walk but were experiencing difficulties with daily living activities as a result of sight loss following their stroke. It looked at the effects of the use of a specific scanning-based training intervention called the neurological vision training (NVT) scanner on these people.

The focus of the study was on patient and carer experience and the impact of hemianopia on everyday tasks and quality of life. Patients reported that they experienced some beneficial effects from the NVT scanner training, including

- Improvements in quality of life
- Improved ability to carry out everyday tasks
- Higher confidence levels.

The findings provide limited evidence that NVT scanning training is a promising intervention which merits further research. The study numbers are too small for any statistical claims and the researchers argue for a more in-depth study to validate their findings.

Background

Stroke and sight loss

Visual field defect is the most common form of neurological visual impairment after a brain injury. A multi-centre, observational trial of the prevalence of visual impairment after stroke found that between 20% and 57% of stroke patients referred to the trial (323) had a visual field defect.[1] What is not known is the number of stroke patients whose visual impairment remains undetected, despite the importance of vision in their rehabilitation. If the findings that *"the vast majority of Scottish UK stroke units have no protocol for management of visual problems"* is replicated in the rest of the UK, then the numbers are likely to be significant.[2] It is estimated that every year 150,000 people in the UK have a stroke.[3] A survey of stroke survivors in 2010 found that, out of 212 people who had sight problems, only 39% had their needs met.[4]

Homonymous hemianopia

Homonymous hemianopia is a loss of the same half of the visual field in each eye[5], and this condition constitutes 75% of visual field defects following stroke. It is usually associated with lesions in the occipital and parietal lobe areas of the brain and it can affect the same half of the left or the right side of each eye, depending on which side of the brain governing visual pathways is affected. In

[1] Rowe et al. 2009

[2] Hazleton et al. 2010

[3] The Stroke Association 2012

[4] The Stroke Association 2010

[5] Kerkhoff 2000

hemianopia, the processing of visual information by the brain is disrupted, so the brain does not understand or interpret what the eyes are seeing. The eyes themselves are not affected.

Hemianopia affects many cognitive visual functions. Although not aware of it, we all use visual search patterns, or "scanpaths" to *"select items of interest from their complex visual environment, and to navigate their safe passage in the world"*.[6] Patients with hemianopia cannot process images in the same way, and *"during searches for a target object hidden among non-target, they repeat saccades and fixations to the same object, resulting in longer search times, and longer unsystematic scanpath"*.[7] As well as visual search, hemianopia also affects safe navigation through changing environments and reading.[8]

This has a significant impact on many daily living activities because people are unable to use side vision to detect and respond to stimuli and hazards on either side of the body. People with hemianopia cannot pick up objects on the impaired side without moving their head and/or eyes to the side where the object is located. This results in difficulties such as eating food from only one side of the plate and bumping into objects. People are unable to navigate safely in their environment and are easily disorientated. They report walking into objects, tripping and falling, difficulty reading, feeling unsafe, getting lost and experiencing panic when in crowded or unfamiliar environments.[9]

A study by Warren highlighted the fact that, although the impact on everyday life is profound, few studies have looked at the wide range of difficulties experienced in extended activities of everyday living, instead concentrating primarily on reading, mobility and driving. Warren's study found, for example, difficulties with personal hygiene, feeding, shopping, food preparation, financial management, using telephones, watching television programmes and participating in social activities.[10]

Spontaneous improvement of homonymous hemianopia is common, and most recovery occurs in the first three months. The likelihood of spontaneous improvement decreases over time, with a

[6] Pambakian et al. 2000

[7] Ibid.

[8] Schofield & Leff 2009

[9] Pollock et al. 2011

[10] Warren 2009

50 to 60% chance of improvement within one month after injury, decreasing to about 20% at six months. Improvements after six months are limited and usually related to improvement in the underlying neurological injury.[11] In terms of evaluating therapies, this means that during the first six months it can be difficult to disentangle the benefits of vision rehabilitation training from spontaneous improvement.

Unilateral visual neglect (UVN)

Visual field defects can co-exist with a perceptual defect called unilateral visual neglect (UVN), sometimes called hemi-neglect, which is a spatial inattention to one side of the body. UVN can occur with or without homonymous hemianopia, and it can be difficult to distinguish between the two.[12] The incidence reported for UVN varies between 40 – 81% depending on the patient populations studied and the methods used to diagnose it. Poor rehabilitation outcomes are commonly associated with the presence of UVN.[13]

Hemianopic alexia

Of all patients with visual field defects, 50%-90% have a specific reading disorder called hemianopic alexia (HA).[14] They adopt an inefficient eye movement strategy when reading text: *"Text reading fluency is particularly impaired when essential visual information cannot be obtained from the right visual field (RVF) due to an acquired hemianopia, because word identification is difficult if only the initial letters can be seen, and fixations cannot be precisely directed onto as-yet unseen words"*.[15] Patients are deprived of essential visual information needed for reading and *"make many extra eye-movements. This slows them down. Patients with HA read more slowly than before, because of the brain injury that has damaged their vision"*.[16]

[11] Zhang et al. 2006

[12] Pollock et al. 2011

[13] Kerkhoff 2000

[14] Kerkhoff & Zoelch 1998

[15] Scott et al. 2006

[16] Read-Right 2012

The psychological impact of hemianopia

The impact of hemianopia is often complicated by psychological and emotional issues, fear and anxiety, leading to social isolation and depression. People *"avoid community environments and retreat to the stable and predictable environment of the home. The resulting social isolation may not only prevent the person from resuming a greater level of community reintegration but also hinder psychological adjustment to disability"*.[17] Many people are unable to return to work, and most are unable to drive, which can have profound financial consequences. Other research has also found that after a stroke, hemianopia can exacerbate the impact of other impairments on overall disability and negatively influence rehabilitation.[18]

Rehabilitation of hemianopia

There are three different therapeutic approaches to rehabilitation:

- use of optical devices, or prisms, to expand the visual field
- vision restoration therapy, which tries to restore portions of the visual field on the blind side
- compensatory or adaptive eye movement-based therapies, that is, scanning training.

All three approaches *"have one therapeutic principle in common: mass practice of a specific visual task, with the hope/expectation that improvement on this task will 'carry over' with differing levels of generalization to a range of ecologically useful visual functions"*.[19]

The recent Cochrane review also considered assessment and screening interventions for hemianopia, as well as vision rehabilitation aids such as eye patches, adapted lighting, magnification and environmental modifications.[20]

A discussion of the evidence base for the effectiveness of different interventions follows; the most promising treatment to date appears to be scanning training, which involves retraining of patients' eye movements to scan across the space in front of them and into the lost visual field, increasing scanning and making the scanning movements more ordered.

[17] Warren 2009

[18] Lotery et al. 2000

[19] Schofield & Leff 2009

[20] Pollock et al. 2011

The evidence base for the rehabilitation of hemianopia

There is considerable debate about the clinical effectiveness of the different rehabilitation methods. No single method has gained widespread acceptance in the field, mainly because few studies have controlled against placebo or no treatment. Many of the research studies' findings are observational, based on subjective ratings of success by patients. Another factor to be noted is the stated commercial interest of some of the study authors in the development of different systems, which could indicate bias.

The most controversial are therapies which are purported to work by actually restoring the visual field, vision restoration therapy (VRT). A sensational series of reports was produced from three main research groups, claiming to demonstrate restoration of the visual field. Later studies by other research groups could not confirm this effect. The VRT debate has polarised opinion in the field. Schofield and Leff offer a discussion of the arguments and note that *"The main contention is not whether patients improve but why they do"*.[21] Treatment results for VRT are challenged on the basis that it is uncertain whether improvements are due to neuroplasticity or compensatory eye movements. More studies are needed. *"An allied problem is the complex and expensive equipment that is often required for the visual field restitution studies, limiting studies to one or more specialist centres, or requiring the patients to pay large sums for the equipment to be used at home"*.[22] Time is another factor for consideration; typically patients are required to spend one hour a day for six months on VRT.

A study by Bowers and colleagues of peripheral prism glasses found, based on participants' reports and acceptance of the device, *"evidence of the functional utility of the peripheral prism glasses to aid hemianopic patients with general mobility. However, objective measures of functional performance with and without prisms, and a control or comparison treatment were not included"*.[23] A larger, randomised controlled study is planned.

The most promising approach from research appears to be compensatory or scanning training. Trials by Spitzyna et al.[24] and Schuett et al.[25] both demonstrate positive results for reading and

[21] Schofield & Leff 2009

[22] Ibid.

[23] Bowers et al 2008

[24] Spitzyna et al. 2007

[25] Schuett et al. 2009

near-tasks. An RCT by Roth and colleagues[26] showed *"substantial benefits of compensatory exploration training, including subjective improvements in mastering daily-life activities"*. The strategies, once learned, continued to be used in everyday life, and social activities also improved. A systematic review by Bouwmeester and colleagues[27] concluded that scanning therapy "seems to provide a more successful rehabilitation with more simple and user-friendly training techniques." A recent study by Lane and colleagues[28] found that *"attention plays a large role in the rehabilitation of homonymous visual field defects."* Comparisons between therapies will remain difficult because within the main therapeutic approaches there are several different treatment regimes, with different outcome measures. Until these are more standardised it will be difficult for research to judge which is most effective. In addition, not all patients benefit from scanning training, and the reasons why are not yet clear. The evidence of benefit to patients with co-morbidities such as UVN is scant, and more studies are needed.

Systematic review of interventions for visual field defects

The latest systematic review (2011) is the Cochrane Collaboration review of interventions for visual field defects,[29] which found only six out of thirteen studies reviewed had compared the effect of treatment against no treatment or a control or placebo treatment. The reviewers concluded that there was *"a small amount of evidence showing that scanning training was successful at improving people's ability to scan and also improved people's ability to read, although it did not reduce the size of the visual field defect. We did not find enough evidence to reach conclusions about the effect of scanning training on other activities of daily living. We found insufficient evidence to make conclusions about the effects of other forms of treatment, including using glasses with prisms or training to increase the size of the remaining visible area (visual restitution training (VRT)). In conclusion, scanning training is a promising treatment, but more high-quality research is needed into treatments for visual field defects."*[30]

[26] Roth et al. 2009

[27] Bouwmeester et al. 2007

[28] Lane et al. 2010

[29] Pollock et al. 2011

[30] Ibid.

These findings correspond to recommendations by the Royal College of Physicians that *"any patient whose visual field defect causes practical problems should be taught compensatory techniques"*.[31] The Scottish Intercollegiate Guideline Network (SIGN) guidelines for stroke rehabilitation, which are based on a number of reviews, state that there is *"limited poor quality evidence suggesting that visual scanning compensatory training techniques may be effective in improving functional outcomes after stroke"*.[32]

Studies evaluating the NVT system

To date, the effectiveness of the NVT system has not been evaluated in rehabilitation of hemianopia. Several observational studies by Goodrich (a research consultant to NVT systems) and colleagues working at the Western Blind Rehabilitation Centre of the Pala Alto Veterans Affairs Centre in California report on the use of NVT in a rehabilitation programme for troops returning from Afghanistan with neurological vision loss.[33] The authors argue that their clinical experience suggests that the NVT programme *"meets the goal of improving visual scanning in functional situations for patients with hemianopia."*

In Australia a double-blind randomized controlled, multi-centre trial of NVT is underway at present.[34] This consists of seven weeks of the standardised NVT programme at three times per week, which is compared to individualised, non-standard therapy recommended by clinicians, "usual care". The minimum numbers for the trial are 20, and there is no indication on the trial's website[35] of current participant numbers. It is noted that one of the four authors of this trial is currently involved in the commercialisation of the NVT Scanning Device.

[31] RCP 2008

[32] SIGN Guideline 118

[33] for example, Koons et al. 2010

[34] Hayes et al. 2011

[35] ANZCTR 2012

The Fife Society for the blind preliminary study into NVT scanning training[36]

The Fife Society for the Blind[37] study used a specific scanning-based training intervention for hemianopia, neurological vision training (NVT). The aim of their study was to evaluate the efficacy of this intervention and to contribute to the evidence base on the teaching of scanning techniques following neurological vision loss.

The NVT Scanning Device

The NVT Scanning Device was developed in the 1980s, based on a device used by Diller and Weinberg that consisted of a board of lights that could be illuminated to encourage subjects to visually search to the neglected side.[38] In the 1990s the NVT Scanning Device was linked to a software programme designed to standardise both the assessment and therapy. NVT is a commercial rehabilitation system produced by an Australian company, NVT Systems.[39] The NVT system includes exercises that relate to reading and mobility. Use of a vision rehabilitation programme using the NVT Scanning Device has formed part of standard clinical practice in Australia since the 1980s.

In 2006 the Fife Society for the Blind's Insight Team incorporated this system into the services they provided, and pioneered the use of the NVT Scanning Device in Scotland.[40] Demand for services for people with neurological vision impairment has steadily grown: to date the Insight Team has seen a total of 318 patients. Visibility, a charity and limited company, formerly GWSSB (Glasgow and West of Scotland Society for the Blind), have also used the NVT system for their "Sealladh" (Sight) Project and have produced an evaluation report.[41]

[36] **Assessment and Training in Scanning Techniques Using the NVT Scanner. Authors:** Jim Crooks, Client Services Manager, Insight Team, Fife Society for the Blind; Jill Beacon, Orthoptist, NHS Fife; Karen Simpson, Rehabilitation Worker, Insight Team, Fife Society for the Blind; Allison Hayes, Manager, Training and Development, NVT Systems Pty Ltd. Acknowledgements: Dr Alex Pollock, Nursing Midwifery and Allied Health Professions (NMAHP) Research Unit, provided advice relating to this support.

[37] The Fife Society for the Blind is a company limited by guarantee (FSB Enterprises Ltd.) and a charity http://www.fsbinsight.co.uk/about_us.php

[38] Weinberg et al. 1977

[39] NVT systems 2012

[40] According to their website, FSB Enterprises Ltd. at some point acted as an agent for the NVT scanning device in the UK: http://www.fsbinsight.co.uk/nvt_scanning_device.php

[41] Visibility 2012

Sampling and recruitment

The present study took place between April and September 2011. Referrals came to the Insight Team from the hospital eye service (NHS Fife), and professionals involved in stroke rehabilitation / rehabilitation medicine (NHS Fife). Patients were in the early phase after their stroke (8, 12, 13 and 23 weeks). The period of training required in the NVT system is specific to each individual: the four participants selectively recruited to the study completed their training and have undergone a final assessment.

Participant	Age (in years)	Male / Female	Location of infarct	Homonymous Hemianopia	Neglect	Other visual conditions	Visual Acuity	No. training sessions	Time period: infarct to initial assessment
A	48	M	Right occipital	Left	Y*	Mild convergence insufficiency** Diabetic retinopathy	R 6/7.5 L 6/7.5	7	12 weeks
B	66	F	Left occipital	Right	N	Nil	R 6/7.5 L 6/7.5	8	13 weeks
C	52	F	Left hemispheric infarct	Right	N	Significant convergence insufficiency***	R 6/7.5 L 6/15	6	23 weeks
D	58	M	Right temporal occipital parietal	Left	Y*	Diabetic retinopathy	R 6/7.5 L 6/9.5	2	8 weeks

* Determined by Behavioural Inattention Test scoring at initial assessment.

**Not treated during period of study as convergence only failed at close distance.

***Also noted was inability to locate reading segment of varifocals. Treatment was separate reading glasses with one lens occluded to treat convergence insufficiency.

Participant A and D's diabetic retinopathy had not significantly affected their visual function.
In general participants attended twice weekly and length of training varied (20-50 mins).

All four participants described the impact of vision loss on their everyday lives, such as being unable to return to work, difficulties with food preparation, identifying items of clothing, managing crowded environments, walking the dog safely, knitting, identifying coins, locating items on shelves in supermarkets and going down steps in dim lighting. The resulting lack of confidence caused extreme anxiety and sometimes panic. The "out of control" feeling they had after a stroke was compounded by the impact of hemianopia. Their independence was considerably reduced, and some felt heavily dependent on their families for support.

Initial assessment

The initial assessment was completed by an orthoptist in the participants' homes using the following:

- The National Eye Institute Visual Functioning Questionnaire – 25 (VFQ-25)[42] along with three additional questions relating to the subscale on Distance Vision.
- The full Behavioural Inattention Test[43] (BIT), an instrument for measuring UVN using a sample of everyday problems faced by patients with visual inattention.
- The NVT questionnaire (covering personal assessment, neurological assessment and functional assessment).

The first stage of the initial assessment took on average 90 to 120 minutes to complete (including short breaks when required). The second stage of the initial assessment was completed by one of the mobility officers and incorporated an assessment on the NVT scanner, along with a mobility walk where the individual faced the challenge of avoiding obstacles and identifying a series of coloured "targets" which are moved around frequently to encourage people to use scanning as an everyday activity.

The training intervention

The training intervention involved the use of the NVT scanning device, a panel of lights which extends approx 80cms (32") either side of central fixation, covering a wider field of view. The patient is required to use both head and eye movement towards the affected visual field in order to detect the light stimulus. Single and multiple

[42] National Eye Institute VFQ-25

[43] Behavioural Inattention Test (BIT)

light sequences are used in a graded manner to determine and train visual skills such as scanning, speed of processing visual information and visual memory.

The scanning skills learned on the NVT scanner are then transferred to activities of everyday living, both indoors and outdoors in a quiet residential setting. This training differs from other compensatory techniques in that it involves training in a larger real visual world. Participants were taught by rehabilitation workers qualified to undertake mobility training.

In general participants attended twice a week. The number of sessions needed varied between two and eight, and length of session depended on the individual's ability to perform and ranged from approximately 20 to 50 minutes.

Outcomes

The assessments were repeated after training to measure outcomes. Another assessment tool was added, 'Emotional Touchpoints', based on the work of Bate and Robert, who used patient experience-based design as a methodology for improved service development.[44] Emotional touchpoints have been used as a method of tapping into patient experience in different hospital settings, including a stroke unit.[45] It was used in this pilot to explore participants' feelings about the training and what difference it had made to their lives. The overall aim of the 'emotional touchpoints' approach is to provide the person with a series of prompts to help them elicit both the positive and negative emotions relating to their experience. Touchpoints included: "Life at home having had a stroke", "The family", "Getting better", "My fears", "My goals", "Moving about", "Independence", "Using appliances", and "Working with the Insight Team". Participants were given the option of highlighting any other key moments in their experience of attending for training that they would like to talk about.

[44] Bate & Robert 2007

[45] Dewar et al 2009

What the study found

Behavioural Inattention test: final assessment scores for participants A and D indicated that visual neglect[46] was no longer present.

VFQ 25 measure: Scores indicated that all participants felt that peripheral vision and distance tasks had improved. All scored better on rating their level of dependency following the training and three out of four scored better in the mental health category.

NVT Scanner and Training: Three out of four participants showed improvements on tasks undertaken on the NVT Scanner, including reduced time to complete the mobility walk and identifying more targets.

Emotional Touchpoints: Attending for training had clearly improved participants' confidence, enabling them to make progress and complete normal, everyday activities:

"I feel a lot safer now as I now know how to cross the road safely; how far I need to turn my head to check things out".

"With the scanning and everything, with Insight, and the help I have been getting that has definitely helped with the eyesight because I am now scanning what I am doing."

"Knowing that there is someone actively trying to help you makes a big difference. You are encouraged to do things on your own and I now feel I am able to go out more on my own e.g. for walks up the road on my own which I wouldn't have done before coming here [to Insight]."

[46] Visual neglect, or hemispatial inattention, is a visual processing problem which can occur following stroke, in which patients are unaware of objects or stimuli on one side.

Conclusions

These findings provide limited evidence that NVT scanning training is a promising intervention, which merits further research. In terms of assessing the effectiveness of this therapeutic approach the effects of the NVT scanner need further research. The report authors argue for a more in-depth study to validate their findings.

It needs to be noted that some participants were in the early phase post-stroke (8,12,13 and 23 weeks), so visual fields and neglect signs may not have been stable at the time. Given the incidence, discussed earlier, of spontaneous improvement, it would be possible that some of the findings could result from improvements in the visual field and not from the therapy. In future studies, visual fields would need to be re-checked and different phases of post-stroke analysed.

Future developments in research and practice

So far all the therapeutic approaches appear *"capable of providing a moderate amount of 'real-world' improvement to patients. Controversy still reigns over the mechanism of action of all but the optical methods"*,[47] and more robust studies are needed.

Given the devastating impact of hemianopia on people's lives, it can be argued that wider use of these therapies could, on an "action research" basis, both improve people's lives and at the same time generate the more robust evidence base which is needed. It should also lead to the identification of optimum treatment times and standardisation of therapies, without which comparisons are unlikely to have validity. A robust evidence base will be needed in the new NHS commissioning "landscape" if patients and their families are to get the full range of services and support they need.

Research on outcomes which are important to patients

Warren reported in 2009 that the impact on all aspects of everyday living can be profound. The impact of hemianopia on peoples' lives has still not been fully explored in research. An important finding from the 2011 Cochrane review was that only two studies assessed functional ability in activities of daily living as an outcome. No studies reported measures of extended daily activities. The authors "recommend that future RCTs should include outcomes which are of importance to people affected by this problem, such as quality of life, anxiety and depression".[48]

[47] Schofield & Leff 2009

[48] Pollock et al. 2011

Options which are cost-effective and accessible to patients

Patients can be vulnerable in this context of uncertainty about the effectiveness of treatments. As already noted, these therapies can involve a large investment of time (sometimes up to 100 hours for vision restoration therapy), effort and money for patients, especially when not available through the NHS. It is important not only to improve the evidence base with more research, but also to explore options which are cost-effective and accessible to patients.

Interventions which can be delivered in patients' own homes, using software on the internet, some free of charge, are already being developed. An example of this is UCL's free therapy for hemianopic alexia, Read-Right,[49] a therapy and research programme funded by the Stroke Association which is accessed over the Internet. There are plans to extend this website, making it interactive so that patients and/or their carers/therapists can use it for diagnosis and rehabilitation.

Developing more models of this kind could provide the much-needed wider evidence base on the impact of hemianopia, the effectiveness of therapies and be used as part of an integrated rehabilitation programme led by a multi-disciplinary team.

Improving current practice in stroke units

Visual field deficit is an important predictor of functional rehabilitation following discharge from a stroke unit. It has been argued that *"The orthoptist has an important role to play in stroke rehabilitation, and links between the stroke and orthoptic departments should be established in all units"*.[50]

In 2000 Kerkhoff noted that the 'possible influence of visual –sensory and oculomotor disorders is still neglected in neuro-rehabilitation."[51] The fact that patients with visual field defects still do not receive the assessment and rehabilitation they need has been highlighted by several authors. This is likely to be because of a lack of awareness of its importance in stroke services. The vision in stroke group (VIS), Rowe and colleagues' multi-centre trial, recommends that a key way to address this is ensuring "the outcome of eye assessment is relayed to the wider team of health care professionals".[52]

[49] Read-Right 2012

[50] Jones & Shinton 2006

[51] Kerkhoff 2000

[52] Rowe et al. 2009

A survey by Hazleton and colleagues in 2010 on the management of visual impairment after stroke in Scotland found that the vast majority of stroke units had no protocol for management of visual problems. Respondents highlighted this as a major barrier to the management of these patients.[53] It can be speculated that this may be the case in other parts of the UK. In 2010 Rowe sent a questionnaire to 134 orthoptic departments in the United Kingdom asking about the provision of orthoptic input and vision assessments in stroke services in their trusts. Results were (from a 42% response rate) that 45% of stroke services provided no formal vision assessment for stroke patients.[54] Improved survival rates for stroke patients will mean that many more will need therapies for neurological vision loss. Steps need to be taken to make them more widely available within the new NHS commissioning framework.

Improving patient education and clinical practice

The experience of the rehabilitation officers working on the Fife Study was that patients were often unaware that they had a visual field defect: *"It amazes me how often I ask individuals if they have a visual problem (e.g. missing area of visual field, double vision, etc.) and they insist they haven't. But when I give a scenario (e.g., do people appear from nowhere, etc.) they highlight how this is a major problem with their daily lives."*[55]

Pambakian's study[56] of saccadic vision training[57] for patients with hemianopia included a patient questionnaire covering the most common problems they may have experienced:

[53] Hazleton et al. 2010

[54] Rowe 2010

[55] Personal communication

[56] Pambakian 2004

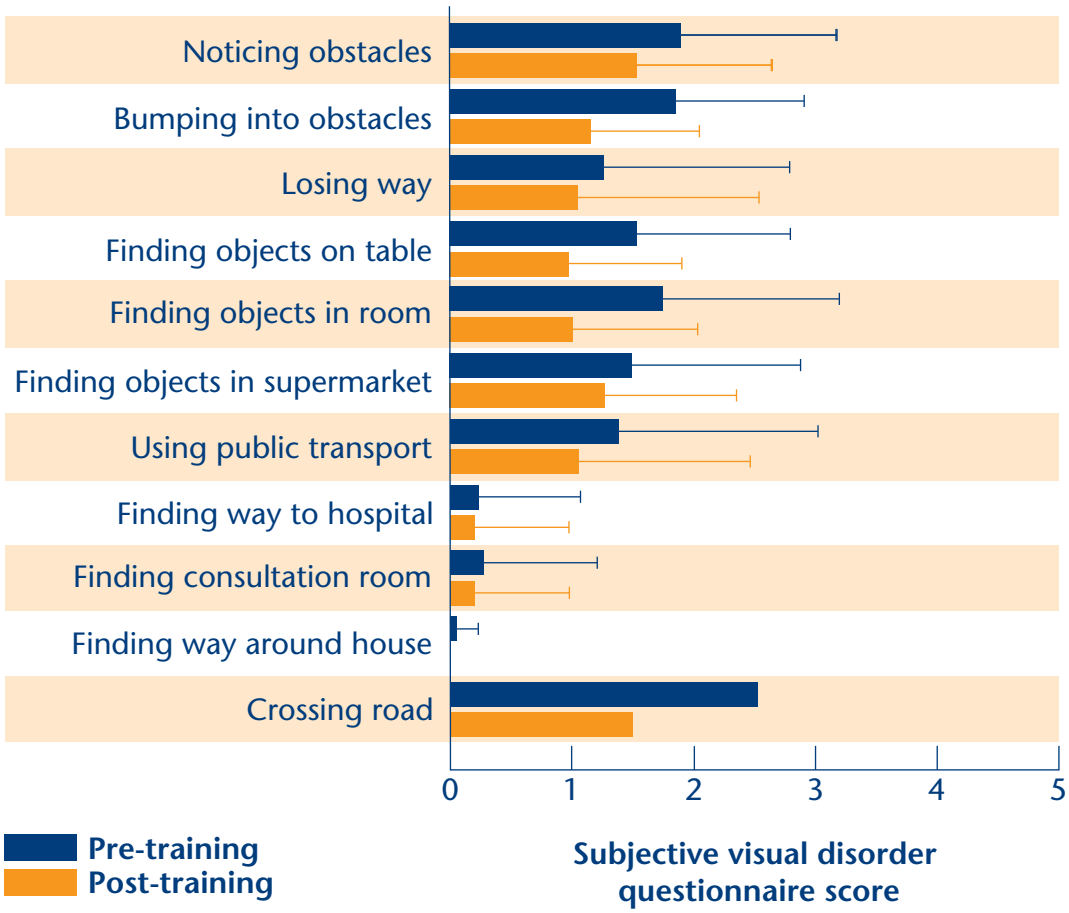
[57] Saccades are rapid, small movements of both eyes simultaneously as they fix on one point after another, as in reading a line of text. Saccadic vision training involves retraining the patients' eye movements to identify objects both in front of them and into the lost visual field, increasing scanning and making the scanning movements more ordered.

[58] Read-Right.

[59] The Stroke Association 2012

[60] Warren 2009

Group results of the subjective disorder questionnaire before and after training. 0, no problem; 5, very frequent problem.



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Pambakian A L M et al. J Neurol Neurosurg Psychiatry 2004;75:1443-1448

In relation to reading problems, the UCL Read-Right[58] website gives patients free access to a visual field test and online therapeutic intervention for hemianopic alexia. The Stroke Association factsheet, Visual Problems after Stroke,[59] gives a broad overview of different conditions and sources of help. A general checklist for symptoms of hemianopia could usefully be devised for all post-stroke patients, to help them recognise whether they have a problem, and directing them to the various sources of vision rehabilitation and assistance in their local area. This would need to address not only the practical aspects but also the psychological and emotional impact of hemianopia, which Warren's study[60] showed have such a devastating effect on activities of everyday living.

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