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Visual field defects after stroke

A practical guide for GPs

Background
Visual field defect after stroke can result in significant disability and reduction in quality of life. Visual rehabilitation aims to maximise the residual vision and decrease functional disability. Understanding the rehabilitation options available, and where to refer patients with visual defects after a stroke, can help patients, and their families, in the rehabilitation process.

Objective
This article provides a review of the functional disability from visual field loss and discusses the various forms of visual rehabilitation.

Discussion
Optical therapy, eye movement therapy and visual field restitution are the rehabilitation therapies currently available. Rehabilitation needs to cater to each patient's specific needs. Any patient recognised as having a visual field defect after stroke needs prompt referral for further assessment and consideration for visual rehabilitation.

Keywords: homonymous hemianopia; stroke; visual fields; hemianopia/therapy; rehabilitation/methods

Stroke is the third most common cause of death after heart disease and cancer, with 48 000 new cases each year.[1] More than three out of four stroke sufferers report some form of disability, of which visual impairment is becoming more recognised. Approximately 16% of these have a homonymous visual field defect poststroke.[2]

A homonymous visual field defect is defined as a loss of part of the field of vision as a result of interruption of the visual pathways distal to the optic chiasm. A stroke patient may be unaware of their field defect and thus engage in activities such as driving, where such a field defect could have deleterious outcomes.

Visual field loss: location and types

The most common type of visual field loss is a complete homonymous hemianopia (HH). This occurs in approximately 8% of all strokes.[3] Homonymous hemianopia is a loss of the right or left halves of the visual field of both eyes (*Figure 1a*, *1b*) and usually occurs as a result of a middle cerebral or posterior cerebral artery stroke affecting either the optic radiation or visual cortex of the occipital lobe (*Figure 2*). The tip of the occipital lobe may receive a dual blood supply from both the posterior cerebral artery and end arteries of the middle cerebral artery, and thus the central or macular portion of the visual field of the patient may not be affected, resulting in an HH with macular sparing (*Figure 1c*, *Figure 2*).

A superior quadrantanopia results from an insult to the optic radiation inferiorly in the temporal lobe, resulting in a 'pie in the sky' type of visual field defect (*Figure 1d*), while an inferior quadrantanopia is caused by damage to the parietal lobe optic radiation (*Figure 1e*). The quadrantanopia can also be complete or incomplete depending on the extent of the involvement of the optic radiation. In general, a homonymous quadrantanopia is less functionally debilitating.

Zhang et al[4] analysed the location of homonymous field defect in stroke and found the majority (54%) were occipital lobe lesions, followed by optic radiation (33%), optic tract (6%), multiple sites (5%), and lateral geniculate body (1%).

Visual field loss after stroke

Spontaneous visual field improvement can occur poststroke but in varying degrees. This has

been reported in up to 50% of patients, usually within the first 3–6 months. After this period spontaneous recovery is possible, but usually at a much slower rate.[5]

Impact

Visual field loss following a stroke can interfere with an individual's ability to perform activities of daily living and threaten the ability to live independently. The impact of visual impairment can be wide ranging. Impact on functional performance can include a general reduction in mobility, a reduced ability to judge distance and impaired stereovision. An immediate consequence is a higher risk of falls due to bumping into objects on the side of impaired vision.[6] It is important to diagnose visual field impairment, particularly in the elderly population, to prevent further poststroke injury from falls.[7]

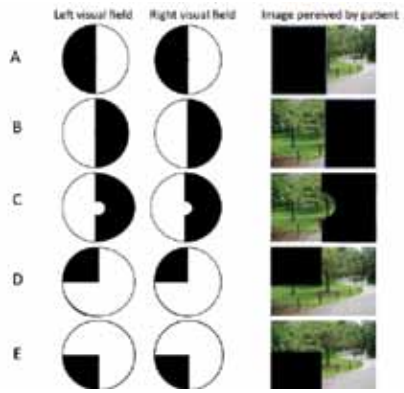

Figure 1. Visual field defects seen in each eye's visual field and the image perceived by the patient: a) right HH; b) left HH; c) left HH with macular sparing; d) right superior quadrantanopia, 'pie in the sky'; e) inferior quadrantanopia 'pie on the floor'

Hemianopic alexia is a term used for specific patterns of reading deficit caused by focal brain injury, usually a stroke, often affecting the left hemisphere. Reading involves using the right-hand side of a word to help plan reading eye movements across the line of the text. A right HH and resulting hemianopic alexia results in deficiencies in this process with insufficient eye movements and text reading. Reading impairment poststroke is commonly reported and can be severely debilitating.[8]

Using a vision specific quality of life questionnaire, Chen et al[9] noted that the presence of an HH was associated with reduced quality of life as measured by vision specific social functioning, mental health and dependency. These may in turn be associated with a loss of confidence, depression and reduced quality of life.[10]

There is a significant effect of a complete hemianopia on a person's peripheral vision and driving. Patients may pose a risk to themselves and the general public if they have a poststroke visual field defect and continue to drive. It is important that all GPs are aware of the current guidelines regarding fitness to drive.

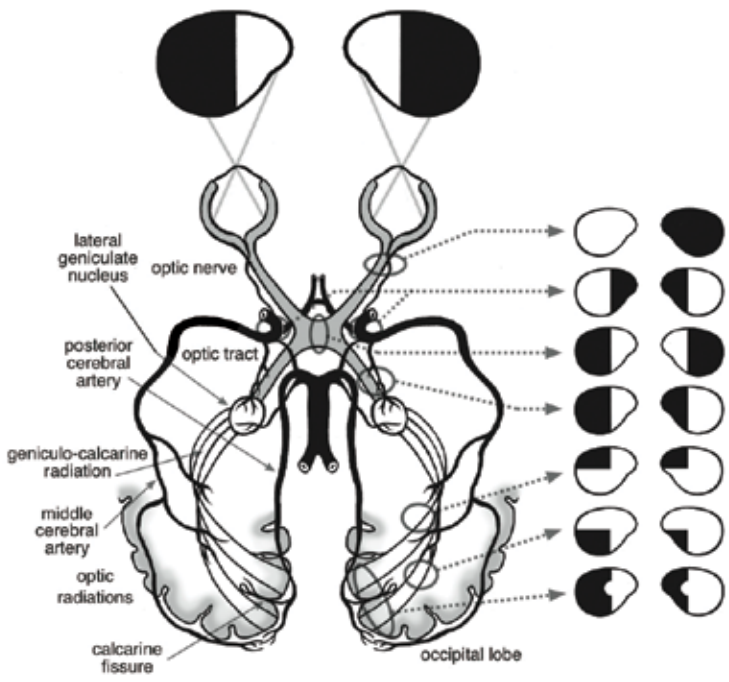

Figure 2. Neuroanatomy of the visual pathway and the blood supply. Lesions at a particular site of the visual pathway result in a specific visual field defect depicted on the right hand side

Associated visual disabilities

Visual neglect is a spatial inattention to one side of the body. It is commonly caused by a defect in the dominant parietal lobe – commonly the left parietal lobe.[11] Visual neglect can occur with or without a homonymous visual field defect. However, due to the visual neglect, the person cannot learn to compensate because they cannot mentally attend to that side. A man with visual neglect may only shave one side of his face. A left visual neglect patient, when asked to recall a description of a well known area, will fail to mention the things to their left side. Visual neglect usually indicates a worse prognosis for recovery and these patients usually benefit from occupational therapy to learn to attend the affected side.

It is also common for visual field loss to be associated with abnormal eye movements as there are frontal and parietal eye fields that help initiate and modulate a saccade movement to initiate look to one side and maintain the gaze at a position. There may be impaired fast eye movements to the side of impaired vision which contribute to reading difficulties.[12]

Legal driving requirement

The National Transport Commission's minimum medical standards for vision for driving in Australia[13] in regards to visual acuity and visual fields are Snellen visual acuity of 6/12 or better in the better eye or with both eyes together, with maximal correction (with glasses if necessary) and on automated static perimetery, binocular visual field must have a horizontal extent of at least 120 degrees with 10 degrees above and below the horizontal midline.

Screening for neurological visual loss

In the general practice setting, screening for neurological visual field loss is performed by

confrontation testing. The examiner should sit approximately 1 metre from the patient, directly in front and facing the patient. It is first performed with both the patients' eyes open to detect if the defect is homonymous (ie. present with both eyes open). The examiner holds out fingers on the left and right superior quadrant simultaneously and asks how many fingers are being held up. It is advisable to use one, two or five fingers as three and four fingers are easy to confuse. It is also advisable to have different numbers of fingers on each of the two hands (eg. one on the right hand side and two on the left hand side) to detect which side the patient is missing. Repeat the same process in the inferior quadrants. This quickly delineates if there is a homonymous lesion with omission of one side with both eyes open and also determines if it is a hemianopia or quadrantanopia. After this, test each eye individually with finger counting in the four quadrants.

To better delineate the degree of field loss and to detect if the defect is macular sparing, the patient is asked to look at a central fixation such as the examiner's nose. Test one eye at a time by covering the contralateral eye and move a red pin from the peripheral towards the centre in eight directions (superior, superior temporal, temporal, inferior temporal, inferior, inferior nasal, nasal and superior nasal) and ask the patient to say 'yes' as soon as they see the red pin.

Part of the problem of the visual field confrontation test is that it may underestimate the degree of field loss.[2,14] It is therefore important to refer for formal visual field testing those patients with suspected visual field loss (*Figure 3*). The ophthalmologist can help assess the visual field loss using automated perimetry.

To assist driving eligibility, binocular visual field testing is done using an automated perimetry program called an Esterman visual field. Ability to see the central 120 x 10 degrees without more than two continuous spots missing satisfies the driving visual field criteria. Some patients with incomplete quadrantanopia or selected patients with incomplete HH with macular sparing may still achieve the binocular field for driving.

Rehabilitating homonymous visual field loss

The aim of rehabilitation is to improve awareness of the area of visual field loss and to employ strategies to promote the patient's ability to scan in the area of the defect. Current rehabilitation strategies for HH are based on several different theories and the three main approaches (eye movement therapy, optical therapy, and visual field restitution) are described in more detail below.[15,16]

Eye movement therapy

Most of the vision rehabilitation therapy offered in Australia is based on eye movement therapy, also known as compensatory or visual search training. Eye movement therapy improves visual performance by regulating the eye movements. This encompasses improving awareness of the visual field loss and employing visual search strategies to promote the individual's ability to scan to the impaired side.

Patients with HH involuntarily compensate by making extra saccades, ie. increased eye movement towards the hemianopic field, particularly during tasks such as reading or scanning. Unfortunately, for the majority of patients, these compensatory eye movements are disorganised, resulting in longer search times and inappropriately increased fixation.[17] This can result in problems with reading as a result of an inability to generate efficient reading saccades across static text. Eye movement therapy or scanning therapy helps patients practice large saccades into the hemianopic field, which improves visual search in this area. The eye movements move from large oculomotor movement to fine saccadic eye movement to help reading text moving horizontally which induces a small field optokinetic nystagmus. Eye movement therapies improve visual search response times and saccade efficiency. Training over multiple sessions is required.

Each of the rehabilitation service agencies offer slightly different forms of eye movement based therapy. At present, the eye movement therapy is subjective and negotiated between the therapist and patient. There are some structured training of saccadic movements on a standardised computer screen followed by mobility training. Training of oculomotor or saccadic movements has been demonstrated to lead to an improved visual search field and reading ability.[18–21]

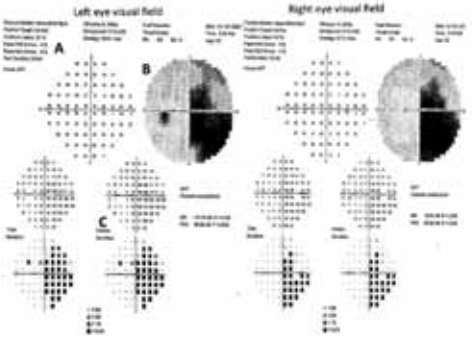

Figure 3. An automated perimetry printout using a SITA 30–2 strategy to test the central 30 degree visual field of each eye. The printout is placed with the right visual field on the right side and similarly on the left, as if seen by a patient: a) the reliability indices to show if there are fixation losses during the testing; b) the grey scale as a gross visual representation of the area and extent of the visual loss. This patient had an inferior quadrantanopia on confrontation testing but on automated perimetry, an incomplete HH, denser inferiorly than superiorly; c) the pattern deviation which is the plot commonly interpreted by ophthalmologists. The pattern deviation compares the deviation of the patient to someone of the same age and plots out focal areas of relatively greater visual field loss, hence is a more sensitive plot to show degree of abnormality compared to the grey scale

Optical therapy

Optical therapies aim to expand the visual field using optical aides such as prisms, mirror lens or telescopes. Prisms are often used and are placed on the spectacle lens of either one or both eyes, causing distortion and displacing images from the hemianopic field across into the seeing side. Patients may then use head turning and eye movements to view the objects of interest on the affected side. The acceptance rate is variable with some patients discontinuing the prism glasses due to inadaptability to distortion and image jump. On the other hand some patients report an improvement in their visual fields, with a potential to expand the visual field by up to 20 degrees.[22]

Visual field restitution

Visual restorative therapy includes flicker stimulation of the blind field, which produces changes in cortical function with cortical

reorganisation.[23] It is based on the theory that training reactivates surviving neurons of the partially damaged area of the brain and thus restores visual function. Patients practice detecting simple stimuli (eg. small circular lights) presented in the area of the damaged visual field or at the border of the field defect.

Visual field restitution is usually carried out using a commercialised computer based program via a laptop at 30 cm, patients perform 2 x 30 minute sessions per day, 6 days a week for 6 months. Each month, performance data is reviewed and the patient is sent a new program based on their performance. Treatment results remain controversial and when improvements in the affected visual field are seen, it is uncertain whether the improvements are due to neuroplasticity or to microsaccadic eye movements.[24,25] Visual restitution therapy is currently not available in Australia.

Vision rehabilitation services

In every state in Australia there are agencies that offer vision rehabilitation (*Table 1*), or that offer community services such as orientation and mobility training, that would benefit people with neurological vision loss. Some agencies offer a multidisciplinary assessment in a low vision clinic comprised of an ophthalmologist, an optometrist and an occupational therapist/counsellor. The ophthalmologist and optometrist help confirm the diagnosis and define the extent of the visual field defect and loss, as well as provide refraction or aids to maximise vision. The occupational therapist/counsellor can help define the area of vision most troublesome to the person and advise appropriate management such as counselling or visual aids. In selected patients who wish to use optical devices, an orthoptist is involved in the assessment for prism fitting and training. Vision rehabilitation for neurological vision loss is usually provided by an occupational therapist in the context of community services for orientation and mobility as well as independent living. Other community services provided by agencies may include leisure with services such as audio books to help with reading difficulties as described above. Referrals can be made directly to the services.

Summary of important points

- Visual field defects poststroke affect activities of daily living including mobility, reading and driving.
- Recognising patients with visual field defects after stroke is important as visual rehabilitation may help retain independence and improve quality of life.
- It is important to diagnose visual field impairment, particularly in the elderly population to prevent further injury poststroke from falls.
- Patients with HH should be referred to a low vision centre for further assessment and consideration of visual rehabilitation.
- Visual rehabilitation therapies need to be individualised and tailored to the specific needs of each patient.
- The current legal driving criteria is a best corrected visual acuity of 6/12 or better and a binocular visual field of 120 degrees horizontally and 10 degrees vertically.

Table 1. Australian vision rehabilitation services for neurological vision loss

State	Agency	Website
South Australia	Royal Society for the Blind	www.rsb.org.au
	Guide Dogs SA.NT	www.guidedogs.org.au
New South Wales	Guide Dogs NSW/ACT	www.guidedogs.com.au
	Vision Australia	www.visionaustralia.org
Northern Territory	Guide Dogs SA.NT	www.guidedogs.org.au
	Vision Australia	www.visionaustralia.org
Victoria	Guide Dogs Victoria	www.guidedogsvictoria.com.au
	Vision Australia	www.visionaustralia.org
Queensland	Guide Dogs Queensland	www.guidedogsqld.com.au
	Vision Australia Queensland	www.visionaustralia.org
Australian Capital Territory	Vision Australia Canberra	www.visionaustralia.org
Tasmania	Guide Dogs Tasmania	www.guidedogstas.com.au
	Vision Australia Tasmania	www.visionaustralia.org
Western Australia	Association for the Blind of WA	www.abwa.asn.au

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