A course in low vision practice

Part 2 – The effects of low vision

Visual impairment has far-reaching effects on a person and their lives. In this module, **Barbara Ryan** and **Tom Margrain** outline the effects on visual function and touch on the social and psychological effects it can have. CET Module C1814

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A COURSE IN LOW VISION PRACTICE

In this series of 12 articles, Barbara Ryan and Tom Margrain from the School of Optometry and Vision Sciences, Cardiff University outline some of the basic theory required for low vision practice. These articles are based on modules which were developed to train the optometrists and dispensing opticians who provide The Welsh Low Vision Service which has been developed and is funded by the Welsh Assembly Government

VISUAL FUNCTION

It is essential to identify the pathology which is causing low vision, not least because of the need to consider whether medical treatment is required. However, from the perspective of a low vision practitioner, this information does not dictate how the patient will be treated. For example, there is not a particular hand magnifier for someone with albinism. It is knowledge of the mechanism of a particular pathology and its likely functional consequences that are most useful when determining the equipment and strategies that would most help a person with low vision.

High contrast visual acuity

A reduction in visual acuity (VA) causes difficulty seeing fine detail, including small print, signs and TV subtitles. Optometrists and dispensing opticians are very familiar with the effects of reduced VA.

Although there are many other reductions in visual performance that are caused by impairments to the visual system, a reduction in VA remains important because most people with low vision experience it and it is the thing that low vision practitioners can improve most easily using magnification.

The majority of patients attending a low vision service have reduced VA.[1,2] Conditions affecting the macula (such as macular degeneration and diabetic maculopathy), the ocular media (such as cataract) and the cornea (such as scarring or keratoconus) cause reduced VA from the early stages in the disease progression. People with nystagmus have reduced VA. People with peripheral retinal conditions (such as retinitis pigmentosa and diabetic retinopathy) or optic neuropathies (such as glaucoma) may have good VA initially but progress to have reduced VA.

Central visual field

A loss of central visual field causes difficulty recognising faces and seeing print. The development of central scotomas affects fixation and people will have unsteady fixation and/or adopt eccentric viewing which is described in more detail in a future article.

Figure 1. Maculopathy causes distortion prior to central loss. Images courtesy of the Macular Disease Society

The size and position of scotomas affect how well the person can function. For example, Whittaker and Lovie-Kitchin[3] found that central scotomas less than 22 degrees in diameter are required if fluent reading is to be achieved. Many people with central visual field loss will report difficulties with mobility and orientation tasks and the extent of central visual field loss has been shown to predict the time it takes a person to complete a mobility task and avoid objects.[4]

Conditions affecting the central retina, such as macular degeneration and diabetic maculopathy, may cause distortion and patchy loss before progressing to loss (Figure 1). No defect is usually experienced by people with conditions affecting the ocular media and cornea, but peripheral visual field loss in conditions such as retinitis pigmentosa may encroach centrally. Some forms of optic atrophy will also affect the central visual field.

Peripheral visual field

Although binocular peripheral visual field loss is not as common as either a reduction in VA or central visual field loss, as a cause of visual disability it can be extremely disabling.[5]

When the visual field is reduced the person will have difficulty getting enough information from their environment to orientate themselves and move safely within it without bumping into things or getting lost. Difficulties can also be experienced with near tasks, for example in finding their way around a page of text. Most people learn to scan the surroundings and thus will have a larger dynamic visual field.

People with paracentral loss, islands of peripheral loss or altitudinal defects, may find specific tasks difficult because of the position of the field loss, eg someone with superior visual field loss may find locating objects on a supermarket shelf difficult. If these patients also have reduced central vision, prescribing low vision aids can be particularly challenging to ensure an aid works ergonomically while not magnifying into an area of loss.

As practitioners will know, conditions that affect the retina such as retinitis pigmentosa, the optic nerve, (for example glaucoma) and the visual pathway (such as a stroke), all cause loss of the peripheral visual field. People with diabetic retinopathy may have a constricted visual field caused by pan-retinal photocoagulation.

Contrast sensitivity

Loss of contrast sensitivity affects all aspects of a person's life. The world is not made up of high-contrast objects and so a reduction in contrast sensitivity means all sorts of tasks become difficult.

Table 1 shows the contrast of some everyday objects and reading material. The ability to see a car, find a door in a room or be aware of where a chair is may be reduced if a person's contrast sensitivity is reduced. Therefore, it is not surprising that object contrast has been found to be a significant factor in determining the success of a visually impaired person in avoiding objects

Figure 2. Pelli-Robson chart: measurement of contrast sensitivity is important in visual assessment

in the travel path[8] and that contrast sensitivity measured with a Pelli-Robson chart has been shown to be a major predictor of good mobility. Reduced contrast sensitivity has been found to be one of the most significant factors in older people falling.[9] All sorts of activities like finding your food on a plate or distinguishing money may be affected.

Although from Table 1 it appears that the contrast of most printed material is quite good, because we need a contrast reserve of 3:1 for short spot reading tasks and 10:1 for longer fluent reading,[3] even small reductions in contrast sensitivity can greatly reduce a person's ability to read. (This is explained in more detail in a future article).

Cataract causes a marked loss of contrast sensitivity at all spatial frequencies. In MD, when the scotoma is small, a reduction in contrast sensitivity may only occur at high spatial frequencies, but as the disease progresses, moderate loss of low spatial frequencies can occur.[4] Glaucoma and retinitis pigmentosa cause a moderate loss of sensitivity at all frequencies but diabetic retinopathy tends to only affect high spatial frequencies.[11]

Glare

Glare is a significant subjective problem associated with many eye diseases. There are several types of glare:

- *Disability glare* – impairs visual function by casting a veil over the retinal image (like turning the lights on in a slide show). Vision is reduced in contrast without necessarily causing discomfort. The person will report seeing better on a dull day
- *Discomfort glare* – the person experiences discomfort without necessarily impairing visual function
- *Photophobia* – intense discomfort/pain is experienced when the light levels are excessive for the person.

Conditions affecting the cornea and lens, for example keratoconus, cataract, aphakia and lens subluxation usually cause a person to experience both disability glare and discomfort glare.

Photophobia usually affects people with anterior segment conditions (cornea, iris and ciliary body) such as achromatopsia, albinism, anterior uveitis, corneal ulcer and aniridia.

Light adaptation

When we move from a dimly lit room outdoors on a bright day it takes a few seconds for our eyes to adapt. Some people with low vision have a much slower adaptation to increases in ambient illumination and it can take several minutes for their vision to be optimised.

MD and conditions affecting foveal function cause light adaptation to be very slow. Conditions such as RP which have a marked effect on rod function also cause very slow light adaptation times. People with conditions affecting the media, cornea and optic nerve function are generally unaffected.

Dark adaptation and night vision

When you walk into a dark room, your vision will adapt after a short time, so that you are able to see well enough to navigate safely.

Some people with low vision have much longer adaptation times and a few never adapt so that they have great difficulty navigating at night.

It has been found that decreasing light levels from photopic to mesopic results in a doubling in the time required to complete a mobility course, regardless of the type of visual field loss.[8]

Any condition that affects rod function will affect dark adaptation and night vision, the best known being RP. Conditions affecting the peripheral visual field will also cause a reduction in dark adaptation if a large extent of peripheral field is lost, for example end-stage glaucoma. Dense cataracts may also reduce the little amount ▶

Table 1. Contrast of common objects and reading material[7]

Object	Approximate contrast
Glossy Magazines and good quality laser print	90%
Black car on a sunny street	82%
A back illuminated exit sign	80%
Paperback books	78%
A maroon chair on a light grey carpet	74%
Newspapers	70%
A wooden door against a light wall	64%
Money	55%
A grey car on a shady street	32%
A maroon chair on a maroon carpet	5%

of light reaching the retina at night and therefore also reduce a person's ability to function in the dark.

Colour vision

A reduction in colour vision can cause difficulty in performing tasks that require processing of colour information such as co-ordinating clothing colours.

Discrimination of colours of similar luminance (especially low), such as navy and black, is often reported by low vision patients. It must be remembered that a sizeable number of people in the population have anomalous colour vision and are not markedly disabled by it. For people with low vision, however, it is rarely reduced in isolation.

People with conditions that affect the fovea, such as MD and Stargardt's disease generally have poor colour vision because of the loss of foveal cones. Many acquired conditions affect blue sensitivity (such as glaucoma, cataract and optic neuritis) although the patient is often unaware. Occasionally, you may come across a rod or cone monochromat for whom the loss of colour vision can be very disabling.

OTHER EFFECTS OF VISUAL IMPAIRMENT

The reduction in visual function experienced by people with a visual impairment has ramifications in all aspects of a person's life. Most people with low vision experience difficulties performing everyday tasks like cooking, taking medication, reading the post, watching TV and getting about.[12] Visual impairment is associated with falls,[13,14] depression,[15] reduced capacity to perform activities of daily living,[16] the need for residential care,[17] and is one of the highest risk factors for functional status decline in community-living people.[18]

People with a visual impairment are less likely to go out alone and have difficulties in using public transport.[19] Most people with low vision are older and are more likely to live alone[20] and have other age-related conditions such as hearing loss[21] and physical limitations.[6] They are, therefore, frequently isolated and confined to their home for long periods.[19]

References

1 Leat S J and Rumney N J. The experience of a university-based low vision clinic. *Ophthal Physiol Opt*, 1990; 10:8-15.

2 Lindsay J, Bickerstaff D, McGlade A and Jackson A J. Low Vision Service Delivery: an audit of newly developed outreach clinics in Northern Ireland. *Ophthal Physiol Opt*, 2004; 24: 360- 368.

3 Whittaker SG and Lovie-Kitchin J. Visual requirements for reading. *Optom Vis Sci*, 1993; 70: 54-65.

4 Kuyk T and Elliot J L. Visual factors and mobility in persons with age-related macular degeneration. *Journal of Rehabilitation Research and Development*, 1999; 36: 303-312.

5 Sumi I, Shirato S, Matsumoto S, Araie M. The relationship between visual disability and visual field in patients with glaucoma. *Ophthalmology*, 2003; 110: 332-9.

6 Noe G, Ferraro J, Rait J, Keefe, JE. Associations between glaucomatous visual field loss and participation in activities of daily living. *Clinical and Experimental Ophthalmology*, 2003; 31: 482: 6.

7 Brilliant RL. *Essentials of Low Vision Practice*. Butterworth-Heinemann 1999.

8 Kuyk T, Elliott JL, Biehl J, Fuhr PS. Environmental variables and mobility performance in adults with low vision. *J Am Optom Assoc*, 1996; 67: 403-9.

9 1 Buckley J and Elliott D. Preventing falls in the elderly: Ophthalmic interventions and recommendations. OPTICIAN, 2003; 226 27- 30.

10 Crossland M D, Culham LE, Rubin GS. Predicting reading fluency in patients with macular disease. 2005; 82: 11-17.

11 Dickinson C. *Low Vision Principals and Practice*. Oxford. Butterworth- Heinemann 1998.

12 Bruce I, McKennell A, Walker E. Blind and partially sighted adults in Britain: the RNIB survey. Vol 1. London: HMSO, 1991.

13 Ivers RQ, Cummings RG, Mitchell P, Attebo K. Visual impairment and falls in older adults: the Blue Mountains Eye Study. *Journal of the American Geriatr Soc*, 1998; 46: 58-64.

14 Lord SR, Dayhew J and Howland A. Multi-focal glasses impair edge contrast sensitivity and depth perception and increase the risk of falls in older people. *J Am Geriatr Soc*, 2002 50:1760-1766.

15 Rovner BW, Zisselman PM, Shmuely-Dulitzki Y. Depression and disability in older people with impaired vision: a follow up study. *J Am Geriatr Soc*, 1996;44:181-184.

16 Haymes SA, Johnston AW, Heyes AD. Relationship between vision impairment and ability to perform activities of daily living. *Ophthal Physiol Opt*, 2002; 22: 79-91

17 Vu HT, Keefe JE, McCarthy CA, Taylor HR. Impact of unilateral and bilateral vision loss on quality of life. *British Journal of Ophthalmology*, 2005; 89: 360-363.

18 Stuck AE, Walthert JM, Nikolaus T, Bula CJ, Hohmann C, Beck JC. Risk Factors for the functional status decline in community – living people: a systematic literature review. *Soc Sci Med*, 1999; 48 (4): 445-469.

19 Baker M and Winyard S. Lost Vision. Older visually impaired People in the UK. London, RNIB 1998.

20 ONS. Living in Britain. General Household Survey. Office for National Statistics. London, HMSO 1996.

21Davis A. Hearing in Adults. The prevalence and distribution of hearing impairment and reported hearing disability in the MRC Institute of Hearing Research's National Study of Hearing. London, Whurr Publishers Ltd 1995.

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MULTIPLE-CHOICE QUESTIONS

1 Which condition is not generally associated with photophobia?
A Anterior uveitis
B Retinal detachment
C Corneal ulcer
D Albinism

2 Which statement is false about visual field loss
A People don't usually report difficulty with mobility with quite minor visual field loss
B If a person has a 15 degree central scotoma they may achieve fluent reading
C People with non central visual field loss may have problems navigating around a page of text
D Many people with central visual field loss will also report difficulties with mobility and orientation tasks

3 Which statement is true about contrast sensitivity loss in patients with macular degeneration (MD)?
A MD causes a marked loss of contrast sensitivity at all spatial frequencies
B MD causes a moderate loss of sensitivity at all frequencies
C MD only affects high spatial frequencies
D In the early stages MD causes a reduction in contrast sensitivity at high spatial frequencies but as the disease progresses it can affect low spatial frequencies

4 Which of the following can reduced contrast sensitivity cause?
A Increased risk of falling
B Difficulty getting about
C Difficulty reading
D All of the above

5 Which is not disability glare?
A When a person reports a veil over a scene on a bright day
B If a person experiences discomfort on a bright day
C A person reports seeing better on a dull day
D The glare reported by someone with cataracts

6 Which does not affect a person's ability to adapt to darkness?
A Retinitis pigmentosa
B End-stage glaucoma
C Uveitis
D Dense cataracts

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