

OphthalmologyTM **ROUNDS**

AS PRESENTED IN THE
ROUNDS OF THE DEPARTMENT
OF OPHTHALMOLOGY
AND VISION SCIENCES,
FACULTY OF MEDICINE,
UNIVERSITY OF TORONTO

Low Vision Rehabilitation

BY SAMUEL N. MARKOWITZ, M.D., F.R.C.S.(C)

The practice and teaching of low vision rehabilitation (LVR) in all university-based ophthalmology programs is mandated by The Royal College of Physicians and Surgeons of Canada for the purposes of accreditation. Although formal training is acquired by most, and in spite of an ever-increasing need for practitioners of LVR, few ophthalmologists across the country (and, in fact, across North America) offer low vision (LV) services to their patients. A definition of LVR, a review of current methods for assessment, and current rehabilitation practice patterns are presented in this issue of *Ophthalmology Rounds*. It is my sincere hope that more eye care practitioners will be intrigued by this topic and will consider introducing LVR services into their practices.

Background

The aging of the Canadian population is creating an increase in medical problems and disabilities, including vision impairment. By age 65, 1 in 9 individuals experience severe vision loss, and by age 85, the number increases to 1 in 4.¹ A recent editorial from the United States estimates that 3.4 million Americans (3% of the population) are legally blind, with cataracts, age-related macular degeneration, diabetic retinopathy, and glaucoma as the leading causes for loss of vision.² Only about 10% of the people who are visually impaired are totally blind;³ the remainder of this population has some vision.

It is estimated that only 25% of all the people who need LVR receive some form of help. In Canada, comprehensive LVR is practiced in the Department of Ophthalmology at the University of Toronto and a few other centres. Other public institutions (eg, the Canadian National Institute for the Blind) also provide valuable contributions to LVR. However, only a handful of ophthalmologists and optometrists across the country – few by any account – are engaged in active LVR practice.

Definitions

The term “low vision” was introduced in North America after the Second World War when a distinction was made between totally blind and partially-sighted veterans returning home. The distinction was needed in order to tailor specific rehabilitation services for partially-sighted veterans returning to the work force.⁴

Whereas all surgical disciplines (ophthalmology included) emphasize restoration of structure *ad integrum*, the main goal of LVR is restoration of function *ad optimum*. Unfortunately, there are patients for whom our skills and technology are limited and what they often hear is, “Nothing else can be done for you,” instead of “There is no further surgical treatment that can be offered.” The first quoted statement is misleading,



FACULTY OF MEDICINE
University of Toronto



Department of
Ophthalmology and
Vision Sciences

Department of Ophthalmology and Vision Sciences

Jeffrey Jay Hurwitz, MD, Editor
Professor and Chair
Martin Steinbach, MD
Director of Research

The Hospital for Sick Children
Elise Heon, MD
Ophthalmologist-in-Chief

Mount Sinai Hospital
Jeffrey J. Hurwitz, MD
Ophthalmologist-in-Chief

**Princess Margaret Hospital
(Eye Tumour Clinic)**
E. Rand Simpson, MD
Director, Ocular Oncology Service

St. Michael's Hospital
Alan Berger, MD
Ophthalmologist-in-Chief

**Sunnybrook and Women's College
Health Sciences Centre**
William S. Dixon, MD
Ophthalmologist-in-Chief

**The Toronto Hospital
(Toronto Western Division and
Toronto General Division)**
Robert G. Devenyi, MD
Ophthalmologist-in-Chief

Department of Ophthalmology
and Vision Sciences,
Faculty of Medicine,
University of Toronto,
60 Murray St.
Suite 1-003
Toronto, ON M5G 1X5

The editorial content of
Ophthalmology Rounds is determined
solely by the Department of
Ophthalmology and Vision Sciences,
Faculty of Medicine, University of Toronto

since LVR is not taken into account as a remedy for improving visual function.

Today, LV is defined and understood as visual function that is less than “normal” and not satisfactory to the patient or his/her significant other and that cannot be improved with medical or surgical therapy or by correction with regular spectacle glasses.⁵ LVR has a role to play in these patients. The practice of LVR encompasses:

- assessment of residual visual function
- assessment of residual functional vision
- prescribing of devices for priority tasks
- dispensing of low vision devices
- occupational therapy training for visual disabilities
- social assistance for reintegration into society.

The Intake

For every new case, LVR starts with “The Intake,” a personal interview done by the practitioner when meeting a patient for the first time. Rehabilitation is a process that requires the cooperation, active participation, and co-management of the entire rehabilitation program by the patient. LVR is no different from any other rehabilitation process in this respect. The Intake offers an opportunity for the practitioner to directly assess the patient. He can then decide on the feasibility and extent of an LVR plan for each case before embarking on the lengthy and costly process of assessment, purchase of devices, and training.

The first item to discuss and clarify with the patient is the purpose of the LVR consultation. The patient and significant other must show interest, understand the benefits of LVR, and commit to being active participants in the process. Assessing the patient’s comprehension is essential in order to determine if he/she is a suitable candidate for LVR. Mature comprehension is desirable, whereas comprehension that is immature, senile, or regressed to a level where cooperation is unattainable, casts doubts on the entire rehabilitation process. At this stage, it is helpful to clarify if the patient has had previous experience with LVR and to review any devices that were previously prescribed. Knowledge of the social environment in which the patient lives will help clarify not only the tasks that the patient is required to perform, but also the potential help and assistance the patient may receive in this LVR attempt. A review of the general medical, ocular medical, and surgical history completes the Intake. Our own LV clinic Intake Form covers all of the

aspects mentioned above and is similar to the Belfast protocol.⁶

Assessing residual visual function

The structure responsible for visual function is the anatomical visual system that includes the oculomotor system, the bulbar system, the visual pathways, and the occipital cortex. Any disorder in any part of the visual system results in an impairment that causes reduced visual function.⁷

Assessment of oculomotor functions

Oculomotor functions are acquired after birth and reinforced throughout life. Their function is to fixate images on the macula, maintain stable fixation, and achieve simultaneous binocular fixation. In “normals,” the essence and purpose of the oculomotor functions are to land the incoming image on the foveola and maintain it there. In LV, the presence of documented macular pathology excludes any possibility of central macular fixation and, therefore, except in rare cases, fixation is eccentric like in strabismus.⁸ This new eccentric fixation location is viewed as a preferred retinal locus (PRL) that assumes renewed macular function. Recent studies show that PRLs develop naturally, soon after macular loss, in multiple locations and are task specific. They have visual acuity that is superior to the adjacent retina and can be trained for better vision. They are also the target for new saccades, smooth pursuit, and binocularity.^{9,10}

Objective visual observation of eye movements can help assess eccentric fixation and the ability to maintain fixation at that location. The Worth 4 Dot test provides reliable information if binocularity is absent. The fixation cross of any direct ophthalmoscope can identify the PRL when the patient attempts fixation on the center of the cross. Macular perimetry can offer indirect information on the PRL location by analyzing the location of the central scotoma.¹¹ Retinal photography with a fixation target will provide accurate location of the PRL when the patient attempts fixation.¹² The established “gold standard” tool for assessing PRL location and characteristics is scanning laser ophthalmoscopy. Unfortunately it is rarely available in clinical practice.⁹ New eye tracking technology offers hope for elucidating the fixation maintenance characteristics of PRLs, in addition to location identification and binocularity.¹³

The assessment of bulbar functions

The essential purpose of the bulbar system is to transmit, focus, and process light stimuli entering

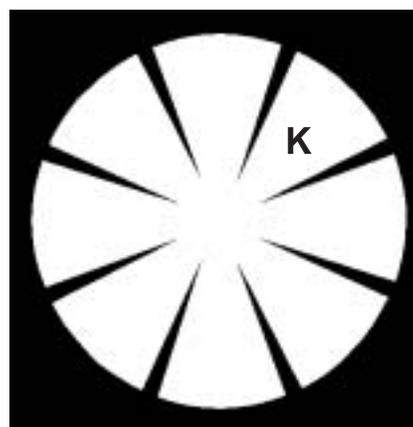
the eyeball and to transmit formatted images to the brain. Unimpeded, uniform, and optimal transmission of light is required to reach the retina. Any transmission defect (eg, corneal epithelial, stromal and endothelial, or lenticular or vitreal) will have a detrimental effect.

The focusing function of the eyeball depends on the refractive characteristics of the cornea and the lens, as well as the pupillary aperture and wave length of the refracted light. The processing of transmitted light takes place in the retinal photoreceptors where photons of light are converted into electrical impulses. Visual acuity, contrast sensitivity, color vision sensitivity, color contrast, photostress sensitivity, and metamorphopsia are visual functions created as a result of this process in the retina. Transmission of formatted images by the retina will be altered by retinal areas affected by pathology that have become nonfunctional. The expressions of such defects are the residual retinal fields of vision that may be central and/or peripheral, both, symmetric or asymmetric, with absolute or relative transmission.

Ophthalmoscopy and retinoscopy offer an instant, simple, and accurate way to assess media opacities. Findings can be confirmed with the slit lamp. Interference from media opacities results in scattering of transmitted light and will be perceived as glare. Short wavelength components of transmitted light create more internal reflections inside the eye structures than longer wave components, and add to the perception of glare. Glare can be quantified by measuring visual functions with selective transmission filters (Corning, Zeiss, Sundials, etc).

Assessment of the refractive error with retinoscopy and manifest refraction is an essential step for the final analysis.¹⁴ Refraction with eccentric fixation offers an additional refinement to macular retinoscopy. The standard in LV today is measurement of visual acuity with ETDRS (Early Treatment of Diabetic Retinopathy Study) charts,¹⁵ whereas a variety of charts can be used for testing contrast sensitivity (eg, the VCTS [Visual Contrast Test System])¹⁶ and others. Residual colour vision sensitivity can be assessed with different colour filters (Coloured overlays, Cerium Vision Technologies).¹⁷ Photostress can be assessed by using various levels of brightness and measuring the impact on various visual functions such as visual acuity or contrast sensitivity. The Amsler grid test is an excellent instrument for testing metamorphopsia. Various perimetric methods are available to assess residual retinal fields of vision. The tangent screen, automated instruments, and

Figure 1: Mackeben's Macular Mapping Test.



(With permission from M. Mackeben, The Smith-Kettlewell Eye Research Institute.)

scanning laser ophthalmoscopy can also be used. In most cases, the aim is to perform macular perimetry in order to assess residual macular fields of vision. The Macular Mapping Test¹⁸ is an easy to use, readily available, and reliable test that was specifically designed for LV (Figure 1).

Assessment of the visual pathways

The visual pathways modulate transmission of retinal fields of vision. Pathologies such as inflammation (optic neuritis), tumours (meningioma), or vasculopathies (stroke) will drastically reduce retinal field transmission, creating residual field patterns specific to the underlying pathology that are, therefore, diagnostic. Recorded field patterns could be central and/or peripheral, symmetric or asymmetric, with absolute or relative transmission.

Various perimetric tools are available to assess residual visual pathway (neurological) fields of vision, including the tangent screen or automated instruments. In most cases, performance of full-field perimetry is necessary to obtain clues about neurological loss.

The visual cortex functions

The cortical visual functions are located in the occipital cortex, as well as in other cortical areas. Processing visual information arriving via the visual pathways, sharing the information among various areas of the brain, and interpreting visual stimuli are the essential functions of the visual cortex. Binocularity, stereopsis, and comprehension are cortical visual functions that need to be assessed for each case.

The Worth 4 Dot test is a useful instrument for assessing central and peripheral fusion. The Titmus Fly test will provide information on stereopsis, as well as on stereo acuity, which is a good correlate to visual acuity. The intake can help assess if the candidate for LVR has mature comprehension, is immature or senile, or is simply comprehension-regressed to a level at which cooperation is unattainable.

Assessment of residual functional vision

While *reduced visual function* is an impairment and the expression of a structural organic defect, *residual functional vision* describes the inability of a person to perform certain skills based on visual functions. A macular hole is a disorder that results in an impairment of visual function (ie, reduced visual acuity) which, in turn, creates a disability or the loss of a skill such as reading. Our Activities of Daily Living (ADL) questionnaire covers a variety of skills that may be affected by the loss of vision (Table 1). Spotting, tracking, eccentric viewing, reading, and writing are common tasks related to accurate vision. Scotoma awareness relates to the ability to manipulate blind spots at will. Spatial orientation and mobility relate to peripheral vision. Visual discrimination relates to higher cortical skills.

Measurement tools

Assessment of skills involves measurements of accuracy, efficiency, and the level of difficulty in performing a certain skill.

- Eye movement perimetry¹⁹ is a good test for spotting, which will test saccade generation towards the new PRL.
- The KD test²⁰ is an objective indirect method for evaluating tracking eye movements, which in fact, reflects smooth pursuit using the new PRL
- Scotoma awareness tests manipulate fixation maintenance between macular fixation with perception of the central scotoma and PRL fixation with displacement of the central scotoma into a peripheral position in relation to the PRL.²¹
- The Minnesota Low-Vision Reading Test (MNread)²² and Colebrander tests are excellent for assessing accuracy and efficiency of reading skills.
- Barraga's visual efficiency test will assess perception of shapes and spatial arrangements and will quantify vision discrimination.

CAN YOU		DEGREE OF DIFFICULTY			
		Points	4	3	2
DISTANCE					
1.	Read street signs?				
2.	Recognize faces outside?				
3.	Enjoy scenery when out for a drive?				
4.	Recognize seasonal changes in the garden?				
5.	Walk alone in your neighborhood?				
6.	Walk alone outside your neighborhood?				
7.	Adjust to dark coming from light?				
8.	Adjust to light coming from dark?				
INTERMEDIATE					
1.	Watching television?				
2.	Distinguish a person's features in the room?				
3.	Distinguish objects in the room?				
4.	Notice steps and use them?				
5.	Prepare food in the kitchen?				
6.	Handle food in your plate?				
7.	Pour yourself a drink?				
8.	Cut your fingernails?				
NEAR					
1.	Read newspaper headlines?				
2.	Read regular print material?				
3.	Write and sign documents?				
4.	Can you identify money?				
TOTAL SCORE	_____ points _____ /80 _____ %				
		4 = No difficulty	3 = Little difficulty	2 = A lot of difficulty	1 = Can't

Prescribing devices for low vision

Once all the assessments have been completed, prescribing LV devices is the final outcome of the process. Only ophthalmologists and optometrists can prescribe every type of device. Each prescription is to remediate a certain visual skill necessary for a particular task. In principle, the first step would be to correct any refractive error. Image relocation would follow as a means of facilitating image accessibility to the preferred retinal locus. Selective transmission filters will reduce glare and photostress. Magnification provides desirable clarity for the selected task. In spite of all that is learned and heard, however, most LV patients would still prefer to have a prescription for spectacle glasses before any device is offered.

Dispensing of low vision devices

Fitting of LV devices, especially spectacle glasses, is the first step in dispensing. All head-borne devices must fit anatomical features properly, taking into account interpupillary distance and visual axis location relative to the frame. Technical considerations play a role in selecting the appropriate frame for the appropriate prescription. No less important to the patient are cosmetic considerations. The dispensing of LV devices serves as an opportunity not only to introduce the prescribed device to the patient, but also to offer instructions about its proper use.

Occupational therapy training for low vision

Initial instruction with the device at the time of dispensing is not enough in most cases. Training and enhancement of new visual functions are essential for renewal of lost visual skills. Occupational therapy is the profession that provides such training. Programs for scotoma awareness, training of new oculomotor skills such as tracking and smooth pursuit, reading, and writing, are available and in use all over the world.

Social assistance

The aim of the entire process of vision rehabilitation is to enable individuals to return to the occupational and leisure activities that make their lives meaningful. Social assistance may take the form of financial assistance or planning and implementing changes in the workplace in order to cope with a certain disability. Social workers will manage cases at this stage, which is the last step in the implementation of a visual rehabilitation plan.

Conclusion

In less than a generation, tremendous changes in technology have revolutionized traditional ophthalmic care. Cataract extractions are being done through tiny corneal incisions almost unnoticeable at the slit lamp, photodynamic therapy reverses the course of macular degeneration, translocation retinal surgery has become more daring and ubiquitous, and strabismus surgery has become increasingly intricate.

Many of us are unaware of the advances in technology over the last 20 years that have had a tremendous impact on the knowledge and practice of LV. Whereas in the recent past, simple

magnifying devices and social assistance were at the core of LV practice, today, new concepts are constantly being introduced into daily practice. We are able to identify PRL location and use prisms for image relocation to the PRL. By actively stimulating PRLs with more focused images, we are able to actively train them for better vision. With the use of prisms for image relocation, the strain is alleviated on new oculomotor skills used for fixation with the PRL. We are able to identify sensitivity to residual colour hues and manufacture tints matching these hues, enabling the patient to see better and, therefore, enhance vision. We are able to identify and manipulate photostress in order to obtain optimal contrast sensitivity. When used in conjunction with Vision Therapy (a branch of Occupational Therapy, which implements rehabilitation concepts with the help of training sessions), visual function can be improved and functional vision-related skills restored to levels unheard of before.

As ophthalmologists, we are eminently positioned and virtually irreplaceable for assessing and designing LVR plans. We need to strive for complete visual care for our patients, not only by medical and surgical means, but also by providing low vision rehabilitation. The awareness and understanding of low vision rehabilitation should play an important role in any ophthalmological practice.

Samuel N. Markowitz, MD, FRCS(C), is Director, Low Vision Program, Department of Ophthalmology and Vision Sciences, University of Toronto.

References

1. CNIB, The Canadian National Institute for the Blind Submission to the Commission on the Future of Health Care in Canada, December 21, 2001.
2. *Ophthalmology*, March 2003, editorial.
3. Hollins M. *Understanding blindness: An integrative approach*. Hillsdale, NJ: Lawrence Erlbaum; 1989.
4. Goodrich G, Bailey I. A history of the field of vision rehabilitation from the perspective of low vision. In: Silverstone B, Lang M, Rosenthal B, Faye E. (Eds.). *The Lighthouse handbook on vision impairment and vision rehabilitation*, New York: Oxford University Press; 2000:675-708.
5. American Academy of Ophthalmology, San Francisco, California, USA. *Preferred practice pattern, – Vision rehabilitation for adults*; 2000:6.
6. Hart PM, Chakravarthy U, Stevenson MR, Jamison JQ. A vision specific functional index for use in patients with age-related macular degeneration. *Br J Ophthalmol* 1999;83(10):1115-1120.
7. ISLRR – International Society for Low Vision Research and Rehabilitation. *Guide for Evaluation of Visual Impairment*, 2002. San Francisco, California, USA.

8. Von Noorden GK, Mackensen G. Phenomenology of eccentric fixation. *Am J Ophthalmol* 1962;53:642-61.
9. Fletcher DC, Schuchard RA. Preferred retinal loci relationship to macular scotomata in a low vision population. *Ophthalmology* 1997;104(4):632-8.
10. Whittaker SG, Budd J, Cummings RW. Eccentric fixation with macular scotoma. *Inv Ophthalm Vis Sci* 1988;29(2):268-78.
11. Markowitz SN, Miller C. Macular perimetry in low vision. *Can J Ophthalmology* 2003, Accepted for publication.
12. Somani S, Markowitz SN. Identification of fixation location in age-related macular degeneration with retinal photography. Presented as a free paper at the AAO meeting Orlando USA, 2002.
13. Gonzales E, Eskander E, Markowitz SN, Steinbach M. Calibrating eye positions in age related macular degeneration patients: Use of peripheral visual stimuli. Research Day, Department of Ophthalmology, University of Toronto; 2003.
14. Albert DL. Top ten ways to treat low vision without a low vision practice. Workshop, American Academy of Ophthalmology, Orlando, Florida; 2002.
15. Ferris L, et al. New visual acuity charts for research purposes. *Am J Ophthalmol* 1982;94:91-96.
16. Ginzburg AP. Clinical findings from a new contrast sensitivity chart. In: Fiorentini, et al. *Advances in diagnostic visual optics*. New York: Springer-Verlag;1987:132-140.
17. Coloured overlays, Cerium Vision technologies – <http://www.ceriumvistech.co.uk>
18. MacKeben M, Colenbrander A. Quick assessment of the topography of macular vision loss using a new PC-based field analyzer. Procedures of the International Low Vision Conference, O.N.C.E.; 1996: Madrid.
19. Trope GE, Eizenman M, Coyle E. Eye movement perimetry in glaucoma. *Can J Ophthalmol* 1989;24(5):197-199.
20. Bernell, 2003 <http://www.bernell.com/store/prodinfo.asp?number=VT9509&variation=&aitem=56&mitem=109>
21. Watson GR, Wright V. *Learn to use your vision for reading workbook*. Lilburn, GA: Bear Consultants;1995.
22. Legge GE, Ross JA, Luebker A, LaMay JM. Psychophysics of reading. VIII. The Minnesota Low-Vision Reading Test. *Optom Vis Sci* 1989;66, 843-853.

Associated links

<http://www.afb.org/> <http://www.aoanet.org/>
<http://www.brailleinstitute.org/> <http://www.cincyblind.org/>
<http://www.dallaslighthouse.org/>
<http://www.glaucoma-foundation.org/>
<http://www.jewishbraille.org/>
<http://www.nei.nih.gov/> <http://www.cnib.ca/>

Announcement

Visiting Professor's Rounds to be held on April 22, 2004 will be dedicated to Advances in Low Vision Rehabilitation. Our Visiting Professor will be Dr. Donald C. Fletcher from the Department of Ophthalmology of the University of Alabama in Birmingham, Alabama.

Upcoming Department Events

November 28, 2003
 Staff/Residents/Fellows Squash, Glendon Squash Club
 (Lawrence and Bayview on the East Side), "Proctor Field House"

2275 Bayview Avenue - 6:20 PM onward
 Cash bar and restaurant. All welcome for squash, socializing and a good time.
 Contact: Rosemary Williams 416-586-8888

December 5-6, 2003
 Walter Wright Day
The Aging Eye
 The Westin Harbour Castle, One Harbour Sq.
 Contact: CME office 416-978-2719

December 6, 2003
 University of Toronto Alumni meeting in conjunction with Walter Wright Day

January 15, 2004
 VPP – Dr. Susan Swiggam, Ottawa, Ontario
Under the Doctor Umbrella – Ethical and Legal Dilemmas in Delegation to Medical Trainee and Others

February 27, 2004
 Residents/staff basketball – Glendon College
 2275 Bayview Avenue, 6 PM

February 28, 2004
 Toronto Cataract Course, Sutton Place Hotel
 955 Bay Street
 Contact: CME office 416-978-2719

March 4, 2004
 Dr. Frank Buffam, Vancouver, British Columbia
Management of Ophthalmic Complication of VII Palsy

Note: 2003/2004 Visiting Professors Programme (VPP) site address:
 Toronto Western Hospital, West Wing, Room 401,
 399 Bathurst Street, Toronto.

Upcoming Scientific Meeting

24-27 January 2004
6th International Congress of Ocular Oncology
 Hyderabad, India
 CONTACT: Arun Singh, MD, Santosh G. Honavar, MD
 Tel.: 91-40-23-548-267
 Fax: 91-40-23-548-271
 Email: honavar@lvpeye.stph.net

4-5 April 2004
Royal National Institute of the Blind (RNIB)
8th International Conference on issues concerning low vision and sight – Vision 2005 London
 London, England
 CONTACT: www.rnib.org.uk/vision2005/register
 Tel.: 44(0) 20 7940 5362

This publication is made possible by an unrestricted educational grant from

Novartis Ophthalmics