ECCENTRIC VIEWING IN CENTRAL VISION FIELD LOSS, CFL

The art of understanding, training and learning to see in the periphery outside your central vision by using your Best Retinal Area, BRA

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Symptoms determine function more than diagnoses

Eye specialists refer patients with visual acuities lower than 0.4 to low vision centers in Sweden. There are 34 LVCs in the country with more than 340 professionals. In the referral the documents involve a diagnosis and other measured values. In low vision rehabilitation, though, we do not primarily describe patients based on a diagnosis, but more often on their functional reduction in vision. The symptoms are more important than the diagnosis. This is because, for example, different causes of macular degeneration different diagnoses can have similar symptoms and the symptom is more important when choosing the right method to read, look and see at far distance.

Low vision rehabilitation involves trying out assistive devices and setting up a training program. This is largely based on discussions with the patient and information in the referral concerning the visual field, eye movements, contrast perception and acuity. Together we draw up a program to determine the visual aids and methodology that will achieve the best possible visual effectiveness.

People with uncontrollable nystagmus or those who have central vision loss are unable to use normal reading behavior with saccadic eye movements – fixations, fixation movements and regression movements (line changes). Because they are unable to fixate, they have to re-learn and learn anew in relation to the way people with normal vision read. Magnification also requires shorter reading distances and lighting adaptations.

A mental transition is crucial

The transition from a life as a person who can see well into another kind of life as a person with low vision takes time and its own crisis management. It's hard to imagine simply saying to yourself in this situation:

"Now I've lost the ability to see what is right in front of me. Let's see what I can do instead."

It is obvious that a visual acuity of less than 0.1 or 20/200 results in a great number of changes in your life. You can no longer recognize people, drive a car, read, and work with what you usually do or do everything you want. You become limited, afraid, worried, sometimes depressed and subjected to a whole range of reactions to the crisis. Many of these personal and fluctuating reactions are described in the book *See Bad Feel Good* (2003) (Figure 1).

A person's motivation is determined by the degree to which he or she can take in and accept or adapt to what has happened:

"If you have a problem and deny it, you REALLY do have a problem. . . . But when you get around to accepting your situation, you can accomplish almost anything – just like anybody else." From Täppas Fogelberg's preface to See Bad Feel Good (2003).

The definition of a central scotoma

You have a central vision loss when your visual acuity is less than 0.1. Acuity below that threshold value means that you have no functional central vision. The cone density of the retina is at its greatest within the central 5-7 degrees of the visual field and when these central parts are out of order, the remaining cones at the edge of the macula have a visual acuity of 0.1 or less. Ten degrees out, the visual acuity is 0.05. You cannot see straight ahead, and when you are unable to use your direct vision, you are unable to fixate and then you have to learn to see from "sideways". We call this method "eccentric viewing". "Eccentric fixation" describes the skewed vision when squinting according to the semantics of the vision professionals.

Sometimes it may be necessary to use eccentric viewing even when the acuity is 0.1 or higher. This is because there are often a number of smaller scotomas in the macula that make it impossible to place the text in the "channels" or "bays" between the "islands"; instead you have to move the entire "cluster of islands" (i.e. fixate eccentrically) in order to read fluently with optics outside the small scotomas. This kind of visual fields can be described as an archipelago of ever so many micro scotomas.

Eccentric viewing, as we call it in low vision rehabilitation in Scandinavia, requires that the person has an area outside of the core vision loss that can be used and that he or she can control eye movements. The most common diagnoses in this group are people with different types of hereditary or acquired macular degeneration, where the final stages of age related macular degeneration, AMD, is the leading cause. Other causes include hereditary macular degeneration, Stargard´s disease, Leber's optic neuropathy and optic atrophies, conditions that arise after brain tumor surgery, various forms of retinitis pigmentosa (RP) and diabetic retinopathy.

The question is if eccentric viewing is something you teach yourself or if it is a method that you need help practicing. The answer is quite simple. It depends on how easy it is for you to learn and the factors that come into play in your individual case. Some people find it difficult to adapt to the new situation and technology. For others it may be sufficient just to become aware of the possibility to "see on the periphery". If a person only uses his scotoma, he is guaranteed to see very poorly. But even though it is obvious that you can see better with indirect vision, it is not always obvious that you will use the right method. In any case, it is necessary to practice reading with eccentric viewing because it requires a new behavior other than just seeing in the periphery of the retina where the density of cones are much lower than in the center.

Viewing eccentrically is, of course, not something you are eager to do after having a visual acuity of 1.5 that is reduced to 0.08 or something similar – how interesting is it to exclaim: “I can use my peripheral vision, of course! I can compensate with the low cone density outside of the macula with magnification and short reading distances while I direct the image of what I want to see to an area outsider my scotoma!”

The process towards a better vision strategy and desire to see is called low vision rehabilitation. When you start to use your residual vision more than grieving over what you have lost, then the mental part – the identification of the problem – has at least started.

Apart from the acceptance process, the ability to use eccentric viewing depends on how easy or difficult it is for you to fixate eccentrically and find the Best Retinal Area for reading, BRA. It may not be just one new place on the retina that will help you see; sometimes you even need to find a different BRA for different visual functions: one for reading, one for recognizing faces, one for occasional reading with or without a telescope, one for orientation in traffic, and so on. In the research world, BRA is referred to as PRL, Preferred Retinal Locus. Patient-related activities, though, need to be in understandable terms.

The low vision teacher and the optometrist form a team

Regarding the debate about the significance of low vision training, keep in mind that any behavioral change is influenced by the actual training and by understanding why. As early as 1974, Nathalie C. Barraga described motivation as the key factor in succeeding in rehabilitation.

This is especially true when it comes to motor training – when learning to ride a bike, do the long or high jump, or to eat properly. All of these depend on motivation, role models and the level you wish to achieve. If you want to reach a higher and optimal reading capacity, both in terms of speed and endurance, then it is essential that you follow your personal trainer (PT), a low vision teacher who works with opticians and ophthalmologists and who is familiar with the low vision teaching methods that are described here and was described the first time by a younger version of myself in 1975 (Low Vision Training, Backman & Inde) and in an article on Low Vision Training in Sweden in 1978 (JVIB, Inde, K).

The low vision teacher should be able to interpret a visual field test, be knowledgeable of reading techniques for both sighted people and those with low vision, and knowledgeable of optics, above all magnification correction needs. He or she also needs to understand the principles of learning in different steps.

But before a person with low vision can do anything concerning techniques and methodology, he or she has to, as previously stated, accept what has happened and realize that it is possible to go on living even if your acuity is 0.1 or less.
The optometrist makes sure that the technology works. An important rule of thumb to calculate the need for magnification is to compensate for low acuity so that the patient sees 0.5 (20/40) or more.

Figure 1. My eyes are bad but I am good. That is the message in *See Bad Feel Good (2003).* It is available free on the internet.

This means that the optometrist has to prescribe magnification correction at 5 or 6X or 20 or 24 dioptres for a person with acuity of 0.1 or slightly under. If a person has a visual acuity of 0.05, then he would need 10X or 40D to compensate for the lower cone density outside of the macula (in the Best Retinal Area) so that the resolution is sufficient to be able to read 8 point letters (i.e. ordinary newspaper text). It is often advisable to provide more magnification than less before you find you're BRA, or not to be content stumbling through reading at 8 points. Consequently, it is better to over correct and provide more magnification in order to read comfortably. More than less is better when it comes to optical magnification.

The methods - step by step

A brief description of the method in different steps is provided here to capture the instrumental and technical process. To fully implement it requires that you have access to the materials described – and the time to do it.

This is how you can go about finding the Best Retinal Area, BRA, in an interaction between the trainer and the person being trained in the best of worlds. The prerequisites for the training to work are obvious:

1) Be sure that you arrange a meeting with your patient
2) The meeting is personal (not private) and
3) It creates a trusting relationship by you asking: What can I do for you and what do you want to achieve? *Do not put the focus on the patient, but put yourself in the patient's focus.*

Then you can start by asking yourself and your patient a series of questions to elicit a number of essential facts:

1. Is visual acuity lower than 0.1 with the best-corrected visual acuity (BCVA)? Computerized eye test charts are frequently used, such as Text Chart Xpert, where it is possible to use larger optotypes at a shorter distance and calibrate the distance in relation to the size of the optotype.

2. Measure the visual field according to Goldmann (Figure 2) and ensure that the central vision loss – the scotoma – is carefully measured with different isopters (light points of different intensities) so that you can see where the patient sees and does not see in relation to different degrees and sizes of texts and images. Here it is important to assess whether the scotoma is relative or absolute. In the latter case, there is no visual function in the area of loss; in a relative scotoma it may be possible to measure visual function when the points of lights are larger and "move" around in the scotoma.

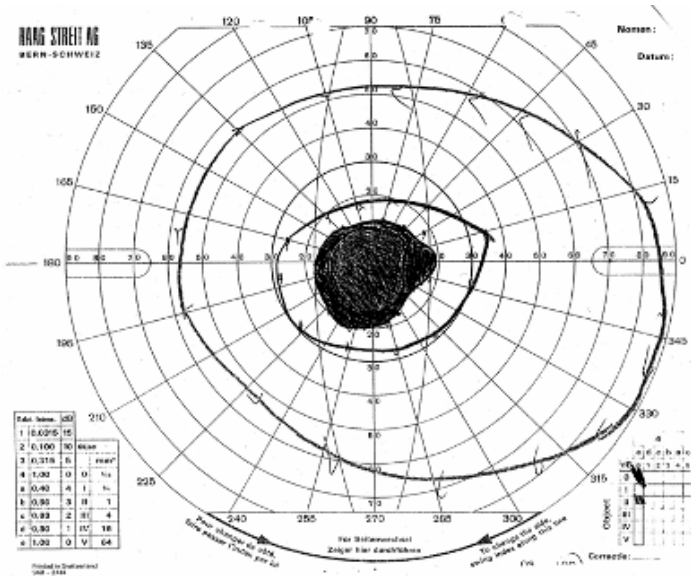


Figure 2. Goldmann visual field from a patient with a large, absolute central scotoma.

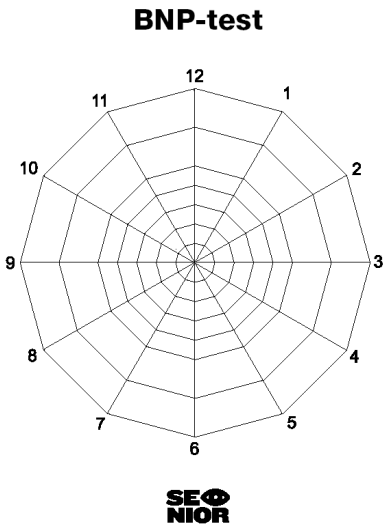
3. It is also possible with the patient to measure the central loss using the Amsler grid. It is preferable to carry out the measurement on several occasions at different time intervals and compare the results to see if they are the same, and how the scotoma corresponds to the Goldmann test graphs in the visual field templates. This provides a higher degree of awareness in the owner of the scotoma. The patient is asked to look in the middle of the grid and to mark where the lines are distorted, blurry or missing.

4. Carry out a BRA test (Figure 3) with symbols and measure the direction of the patient's gaze at which he/she can best see the symbols. Is it at the clock positions of 12, 3, 6 or 9? Or somewhere in between?

   Use one eye at a time and add +3 to +4 diopters for a working distance of 25-33 cm. Let the patient draw where the scotoma is positioned relative to the center with a whiteboard marker. If necessary, use the BRA test "pointer" so that the patient has something to follow from the center out towards the different clock positions.

5. Measure the same thing with a BRA test using words instead of symbols and see if it gives the same results. Perhaps the patient prefers to use several retinal areas, that is to say, a number of functional BRAs. The BRA word test is specifically for reading, while the symbol test is for recognition of faces or pictures.

Figure 3. The BRA test is made of plastic and you can fill in and erase the areas of loss that the patient produces when he or she describes what is in the middle. With a rotating disc, you can change the object or the text in the middle.



6. Ask the patient to look at your face using the new gaze direction. Check if the direction is as good for identification/recognition as it is for reading. Ask the patient to look at your hair, chin and both ears by focusing on these with his or her central vision, namely, placing the scotoma there and then asking: Where do you see my eyes the best? When do you see my hair? My chin? Right or left ear? This is something you can do both before and after the BRA testing.

7. Measure the need for magnification using *Come Closer* (Project SEEnior, 2008) (Figure 4). Start from the back and ask the patient to look with his or her best eye armed with the additional +3 or +4D at the most (depending on the need for presbyopia correction). Flip forward from the last cover page in the booklet and locate where the text on the lower part of the left page is too small. Then go forward one page and note the magnification required. Correction of acuity lower than 0.1 almost always requires more than 6 to 8X magnification for acquired vision impairments, often much more. The magnification correction often needs to be adapted to the eye's refraction, which has to be done carefully and professionally before you start assessment of low vision devices.

Figure 4. *Come Closer* indicates the magnification a person needs for reading. It also aims to show that there are magnifications between 1X and 10X in the head mounted optic and which one is best in the individual case.

8. Check if the estimated magnification is sufficient by putting the lenses in a test eyeglass frame and using the near vision chart. It is often appropriate to over correct so that the patient can read fluently and not have to stumble through the text. Usually, a person needs different magnifications for different text sizes.

9. Go through the pictures in *Come Closer* and discuss the appropriate reading distance with the current magnification in the lenses. Make a copy of the page with the current reading distance so that the patient can take it home as a reminder and can look at it and show relatives the results of the testing. In many cases relatives are hesitant to close reading as is the patient, when the truth is that this is a prerequisite for reading with low vision.

10. Measure the number of letters per fixation in *Read More* (2008) or other materials where you can also practice reading with fixations or help lines and texts with different amount of magnification.

11. Use the correct magnification and read single words that are progressively longer with fixations lines. Read through by moving the text while keeping it on an exact reading distance and putting your elbows on the table – what is referred to as a moving reading surface.

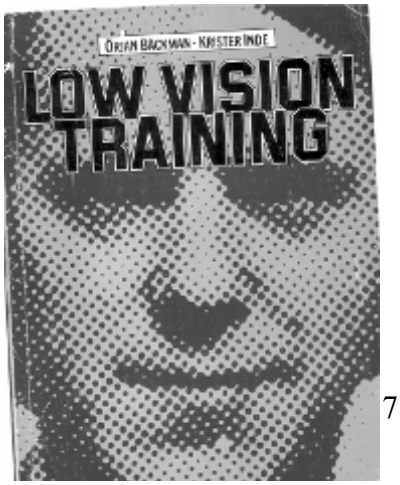
12. Manufacture or borrow individually tested optics with 6 -12X for the best eye. Occlude the eye that is not being used when needed. Often you can occlude only the lower part of the single glass at the same level of the pupil, so it occludes the eye while reading and permits the patient to look over it for better overview.

13. Look at individual words with the fixation lines and place the scotoma according to the BRA test, usually over the symbol or the text. Move the text from the right to the left, starting reading the short words and progressing to the longer ones. A moving reading surface means that you have to “hold your eye steady” in the determined gaze direction, but in reality the eye is moving from right to left in a “gliding fixation”. The fixations are faster and smaller then when reading with full sight and, when the eye makes its return movement, it is important that your gaze does not fall on the text again. You have to decondition this behavior, as Pavlov would have told you.

14. Alternate these exercises with the fixation lines and with the *MoviText* method (it is software making the text move). Assess whether it is better to start with *MoviText* before starting with the strong magnification correction, referred to as “pre-optical training”. You learn in both of these instances that the text has to move in front of your eye and to hold your gaze under, above or beside the text being read, both with the *MoviText* method and when you have advanced magnification correction in eyeglass frames. Use Zoom Text 7.1 in Doc Reader with the Ticker Mode and set the speed and magnification individually. Press Enter and you can start reading the scrolling text.

15. Practice reading in *Read More* or other similar materials. Start by doing a reading speed test for one minute, which can be repeated later to determine whether the new optics and reading technique has increased reading speed.

16. Complement by practicing with CCTV Reading (CCTV is Closed Circuit Television)= after you have learned to use the magnification correction in the eyeglass frame. You can, of course, start with CCTV Reading if you find the optical aids too difficult to use and apply them later for occasional reading. *CCTV* is an excellent assistive device and you do not need to practice eccentric viewing intensively to the same degree as when using head-mounted magnification. It allows you to magnify to a higher level and the scotoma becomes relatively smaller, and when the scotoma becomes relatively smaller the higher the magnification and the smaller the visual field or the overview. The disadvantage is that you cannot use your CCTV everywhere, but the new video magnifiers can be a good remedy for short reading on the train, at the store, etc.



17. Practice at home as follow-up for 4 to 8 weeks and measure on each occasion reading speed, either with the Low Vision Training Book (1979, 2008) three different tests for 3, 6 or 9 minutes, or the shorter reading test in *Read More* (2008) for one minute. The goal is to read 100 words a minute or faster.

Figure 5. *Low Vision Training (Backman - Inde)* from 1975. This is the cover of the English version from 1979.

When this goal is achieved, you can practice reading for longer periods to increase your stamina.

Practice without neck and headaches

Make sure that the lighting is optimal and directed so that the light does not reflect into the eye. It is also important to ensure that you do not bend forward when reading but actively hold your head straight without leaning forward. This way you can avoid tension where the neck muscles attach to the skull, which often results in neck and headaches and reduced stamina. A suggestion is to read for shorter periods and in between, relax the musculature. Ideally, you should practice actively and carry out motor movements that counter balance the often unnatural, static reading behaviors.

Everything else with new gaze directions and BRA

Your BRA can be used in situations other than text reading such as to read signs with and without a telescope, to ride you bike (not the car), to recognize people with and without optics and a camera, to watch TV at a short viewing distance or with a telescope. Several other everyday situations are also included in the continued training that combines your BRA and ADL, activities of daily living. The same goes for work situations at a computer, at a machine, in the gym and in all other situations where you can manage well – especially the second, third and fourth times you are in what was an unfamiliar place. It is a matter of using your visual memory to orientate yourself in unfamiliar places until they are no longer unfamiliar. You can compare it with the skier who familiarizes himself with the slope by first recognizing himself with it and then going down numerous times.

The BRA for cycling, running, walking, skating, skiing etc is often upward, so that you have a panorama under the central loss that is intact where you can detect objects – especially those that move – and avoid hitting them.

Is viewing eccentrically worthwhile?

One might ask what happens in the brain when you lose your central vision. When this happens, the part of the visual cortex that receives these signals is left without stimuli from the retina. Researchers have discovered that the parts of the visual cortex that are no longer used start to respond after a time to signals from another part of the retina than the macula. There are many other examples of the plasticity in the cortex and it is shown and not very surprising that the visual cortex, the part that receives visual impulses, is plastic even in adults and older people and can start a

new career receiving impulses from a Best Retinal Area used and trained to see, even if the density of cones is lower.

Exactly how this plasticity operates was unknown until recently. A study from MIT in Boston and another one from Regensburg, Germany, showed that the area of the visual cortex normally receiving information from the macula shows a large amount of activity in people with central scotomas after many years' experience of using eccentric viewing, and only from those portions of the retina that they have trained and used in eccentric viewing. Thus, it is fair to believe that it is worthwhile to practice the ability to use another retinal area than the one suffering from central visual loss and try to reclaim the area in the cortex normally used for central vision.

It is as if the cells in the brain that lost their inputs are content with the next best signals. That is why there is reason to utilize this plasticity and to practice using the peripheral parts of the retina. In order to be able to do that the strategy includes ~~to~~ magnifying the image and training a new seeing and reading behavior. This takes acceptance of the new personality, where you see bad and feel good. But if you have a problem that you don't accept, then you have problems, and one of them is lack of real motivation to learn to train and use a new focus in life and in the eyes. We ones described this training to be built on a desire to see more, or in short - visual desire.

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