Performing a Low Vision Evaluation

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In most states properly trained opticians or ophthalmic assistants can perform low vision evaluations with the proper authorization from a medical doctor. Many times an optician who is thoroughly familiar with the mathematics of optics and refraction can more easily comprehend the principals that must be applied when performing a low vision evaluation.

First, the term “low vision” must be defined. A person is considered to have low vision if their ability to perform basic daily tasks is affected by their ability to see. The term “Low Vision” usually means the best attainable visual acuity is somewhere around 20/50 or worse. In order to help someone with low vision is best to thoroughly understand what it might be like to have low vision. Low vision can result in general cloudiness, central vision loss, peripheral vision loss, blurry areas, or blind spots causing a loss of some portion of the visual field

Next, the question “What causes low vision?” must be addressed. By far, the most common cause of low vision is macular degeneration. This condition most commonly results in the loss of vision in the central visual field. Although implants can usually correct the problem, cataracts can also cause low vision difficulties. Cataracts are a clouding of the crystalline lens that can cause glare, distortion, and a general loss of detail, although the visual field is normally unaffected. A detached retina is another cause of low vision. The visual field defect is apparent manifesting itself in the form of a dark wave or curtain effect usually across upper or lower part of the visual field. Diabetic retinopathy is another common cause of low vision. This condition occurs in some diabetics. It is caused by swelling and leaking of blood vessels which interfere with light passage through the eye and usually cause a loss of vision in the central visual field. Trauma to the eye or head can also cause low vision problems. Many trauma victims have resulting neurological damage therefore there tends to be a wide variety in the displayed vision symptoms.

A Low Vision Evaluation is an in-depth functional evaluation to determine if the current vision can be improved to do those things the person wants to do. The end result of the low vision evaluation will be to

determine the lens power and device that is best suited to meet the patient's needs. The low vision evaluation should explore the optical and non-optical systems that are currently available. A Low Vision Evaluation is not a medical evaluation to determine eye health. The person's regular eye doctor must continue to monitor their eyes for any conditions that might result in additional eye health complications or additional vision loss.

We must also address the question "Who can be helped?" Only those people who have accepted their vision loss and are motivated and willing to try new things can be helped. The patient must also have realistic expectations and goals.

The most common low vision devices are stand or hand-held magnifiers, clip-on magnifying loops, high magnification spectacle lenses, electronic magnification devices, and spectacle or hand-held telescopes.

Another possible solution usually not considered as a low vision device are gas permeable contact lenses. If the individual's ability to see is caused by a scarred or highly irregular cornea, rigid contact lenses may be the best answer. The tear layer fills in between the irregular cornea surface and the contact lens and optically removes the irregularity. Trial lens over-refractions must be used in order to develop an accurate contact lens prescription in these cases.

What testing equipment will you need? Personally, I recommend the following equipment to do the job right: A phoroptor or trial set (preferably both) a retinoscope, a keratometer, a distance Snellen visual acuity chart, a near Snellen equivalent visual acuity reading card, and amsler grid, a contrast sensitivity chart, and a simple color vision test of some type.

What near low vision devices should you carry? I recommend starting with the following near low vision devices for testing purposes: Hand magnifiers in 2, 4, 6, 8, 10, 12, 16, 20, and 24 diopters in power, a small assortment of clip-on jeweler's loops, clip-on near telescopes in 2.5x, 4x, 6x and 10x. For testing

purposes you may want to consider substituting an interchangeable head halogen magnifier in place of the separate hand magnifiers. It would also be a good idea to have some kind of electronic CRT magnifier for those who are beyond help using conventional lenses and telescopes.

What distance low vision devices should you have on hand? I would recommend the following devices for testing purposes: Distance telescopes in 2x, 4x, 6x, and 10x. Be sure to get the type that can be hand-held or mounted in a spectacle lens. You may want to carry 10x or 12x wide field light gathering binoculars for those who are beyond help by other means.

The first step in performing a low vision evaluation is to obtain complete medical and visual history and family visual history information. Try to get this information from the patient before their first visit if possible. During the first visit obtain complete information on the patient's visual habits and identify all problem areas from the information you have gathered. Most importantly, ask the patient to determine the goals they would like to achieve for distance and/or near vision. Remember that the goals must be realistic considering the patient's visual condition. In most cases you will find the patient's only concern is the near vision. The goal you will hear most often will be "I want to be able to see my mail and read the paper."

Low Vision Testing

I normally perform the following steps during the patient's first visit for a low vision evaluation:

- Starting visual acuity at distance and near
- Thorough objective and subjective refraction including Keratometry
- Determine best attainable visual acuity
- Amsler Grid test
- Confrontational visual field test
- Contrast sensitivity test
- Color vision test

The order of the tests may be modified to suite your needs. Also note that you may not need to perform every test on every patient. The following text describes each of these steps in greater detail.

Visual Acuity for Distance

- Use a standard Snellen visual acuity chart.
- If the patient is unable to see even the largest letters on the chart, move the chart closer to the patient until they can just see the large letters (You must convert the result to the Snellen 20-foot equivalent).
- Record the binocular and monocular visual acuity without correction, and with the patient's current correction.

Visual Acuity for Near

- Use a Snellen near reading card with distance equivalent notation beside each line.
- The Fonda-Anderson reading card is a good choice for this purpose.
- Record the binocular and monocular visual acuity without correction, and with the patient's current correction.

Low Vision Refraction - Keratometry

- Keratometry should be included as part of your refraction to assist in determining how much of the problem is being caused by an irregular cornea.
- If a highly irregular cornea is found to be part of the patient's problem, consider doing a trial lens over-refraction to determine how much the vision could be improved with gas permeable contact lenses.

Objective Low Vision Refraction - Retinoscopy

- If you observe a good retinoscopy reflex, you should rely primarily on your retinoscopy results rather than subjective results unless a subjective improvement in VA is noted.
- If you have a poor reflex, try to ignore the peripheral part of the reflex and continue.
- If the reflex is too poor to give a comfortable result, you may need to rely primarily on the subjective results.

Subjective Low Vision Refraction

- Be aware that many low vision patients are unresponsive to subjective tests.
- Be prepared to make larger changes of at least .50 or 1.00 diopters rather than the normal .25 changes in order to prompt a usable patient response.
- Try starting with at least a 1.00 diopter cylinder in the JCC to help the patient find the proper axis.
- If you are lucky enough to have different cross cylinders to choose from, the following chart provides a good guideline to use in selecting the best cross cylinder power for a given low vision situation.

Visual Acuity	Best Cross Cylinder Power
20/15 to 20/20	+-.12 D
20/25 to 20/30	+-.25 D
20/40 to 20/60	+-.50 D
20/70 to 20/200	+-1.00 D

Subjective Refraction Warning!

- Many low vision patients who have irregular reflexes in retinoscopy may subjectively take you to more than one axis and cylinder power! The one they will take you to may depend on which axis you were closer to when you began the subjective refinement.
- If this occurs, select the axis and cylinder that gives the best visual acuity then use a trial frame. The patient will usually prefer the axis that is closer to the axis of their previous eyeglass Rx.

Swinging Cylinder Test

- Another good subjective test to verify the axis position, especially if the patient seems to be unsure or unresponsive to the Jackson Cross-Cylinder test.
- Use this test after performing a normal subjective refraction if you still have concerns or doubts about the cylinder axis position.

- **Step 1:** Start with the best distance prescription dialed into the phoroptor as determined by a normal subjective refraction.
- **Step 2:** Have the patient look at the smallest letters they can see on the chart while you swing the cylinder off axis an equal number of degrees in both directions checking for equal blurring.
- **Step 3:** If the two off axis positions are not equally blurry, move the axis slightly toward the better of the two. Repeat steps 2 and 3 until the two off axis positions are equally blurry.
- **Step 4:** If you changed the axis using this test, you must once again refine the cylinder and sphere power.

Using the Stenopaic Slit to Find Axis

- Rotating the Stenopaic slit in front of the eye may help locate the principal astigmatic meridian that yields the best vision.

Amsler Grid Test

- Occlude the eye not being tested.
- Have the patient look at the center dot.
- Ask the patient:

  "Can you see the center dot?"

  "Are all the lines straight?"

  "Are any of the lines missing?"

  "Are any areas more blurry than others?"
- Identify and record the effected areas.

Confrontational Visual Field Test

- Sit directly in front of the patient and ask them to look directly at your nose.
- While you are also looking directly at the patient's nose, hold a penlight at your peripheral visual field positions, noting and recording the patient's visual field relative to your own. (This test assumes the tester's visual field is normal)

- Useful test for determining mobility problems.

Contrast Sensitivity Test

- Using a contrast sensitivity chart determine the minimum amount of contrast the patient can distinguish.
- Record the results relative to a normal eye.
- Useful to determine vision problems caused by the lack of contrast in some sources of printed reading material.

Matching Color Vision Test

- Have several colors of small pieces of yarn or other material available and ask the patient to group matching colors together.
- This test helps screen for color vision defects and help assess the macular cone and optic nerve function.
- Try lens tints that match the colors least effected by the patient's color vision defect.

At this point you should end the first visit. Do not try to do a complete low vision evaluation all in one visit. The patient and their eyes will have become tired at this point and it would be unproductive to continue. Tell the patient you will determine the best device(s) for them and call them to set up an appointment when the device(s) arrive.

Initial Low Vision Power Evaluation

Remember that visual acuities may be modified by information from Amsler Grid testing, lighting conditions, eccentric viewing, and any other factors you think might make a difference in the patient's success.

Initial Distance Power Evaluation

Step 1. Determine patient's distance visual acuity. If they can not see the largest letters on the chart at 20 feet, move them closer until they can just see the large letters. Multiply it out to convert the result to the normal Snellen notation. For example, if a patient can see the largest letters on the chart (20/200) at a distance of only 10 feet, then the patient's visual acuity would actually be 20/400. **VA : 20 / A**

Step 2. Determine the visual acuity the patient needs to have to perform the task(s) desired. The patient needs to have reasonable expectations considering the condition of their eyes of course. For example, if the patient needs to be able to see the letters on the 20/40 line at a distance of 20 feet, then the desired (or needed) visual acuity would be 20/40. **VA : 20 / B**

Step 3. Compute the magnification required to bring the patient's visual acuity to the required level by using the following formula: **M = A / B** *where A is from step 1 and B is from step 2.*

Step 4. Start with this magnification power for a telescopic low vision device. In the above examples substituting the values of the variables we find the magnification needed to bring this patient from 20/200 to 20/40 at distance to be 10x:

M = A / B

M = 400 / 40

M = 10x

Distance Magnification Limitations

- Telescopes up to 10x may be considered for patients with VA up to about 20/600.
- If distance VA is worse than 20/600 telescopes should not be considered. They may be candidates for light gathering binoculars and/or other special mobility training.

Initial Near Power Evaluation

Step 1. Determine the patient's near visual acuity using a reading card that uses the Snellen distance visual acuity equivalent notation. The Rosenbaum or Fonda-Anderson reading cards are both good choices for this purpose. They will give you an accurate distance visual acuity equivalent for near vision when used at a reading distance of about 14 to 15 inches. Again, if the patient can not read the largest letters on the card, you can move it closer as long as you convert it as described in step 1 of the distance low vision evaluation.

VA : 20 / A

Step 2. Determine the near visual acuity the patient needs to have to perform the task(s) desired. The patient needs to have reasonable expectations considering the condition of their eyes of course. For example, if the patient needs to be able to see the letters on the 20/40 line of the reading card, then the desired (or needed) near visual acuity would be 20/40. **VA : 20 / B**

Step 3. Compute the magnification required to bring the patient's near visual acuity to the required level by using the following formula: **M = A / B** *where A is from step 1 and B is from step 2.*

Step 4. Now determine the actual add or reading power in diopters that is required to produce the desired magnification. Assuming the patient is not contributing any useful amount of accommodation on their own, use the following formula: **D = M x 2.5**

Step 5. Next, you must determine the focal distance of this resulting dioptric power. This new focal distance will be where the patient must hold the reading material in order to have the desired effect (again, this assumes the patient has no useful accommodation available).

For result in inches use: **FD = 1 / D x 39.3**

For result in centimeters use: **FD = 1 / D x 100**

Quick & Simple Initial Near Power Evaluation Method

1. Determine the patient's near visual acuity as in step 1 above.

2. Divide the result of step 1 (variable A) by 20 to get the starting dioptric power. I.E. 20/50 would result in a power of 50/20 = 2.5 diopters. I.E.: 20/200 would result in a starting power of 200/20 = 10 diopters.

3. Next, you must determine the focal distance of this resulting dioptric power as in the previous method. This new focal distance will be where the patient must hold the reading material in order to have the desired effect (again, this assumes the patient has no useful accommodation available).

For result in inches use: **FD = 1 / D x 39.3**

For result in centimeters use: **FD = 1 / D x 100**

Near Add Power Limitations

- High add powers in bifocals may be considered as an excellent alternative to low vision devices for near. Be aware however that if the patient has usable binocular vision, you must limit the add power to no more than about +5.00 to avoid convergence problems.
- When using high add powers in binocular situations always adjust the patient's near PD to compensate for the extra convergence required to focus at the closer reading distance.
- Higher add powers than +5.00 may be considered in monocular situations or when the patient has useful vision from only one eye. Binocular vision is very difficult, and sometimes impossible when using add powers above +5.00.

Computing the Correct PD for High Add Powers

Use the following steps to compute the best PD for near when high add powers are involved or when the fitting vertex distance is greater than normal:

Step 1: First, compute the focal distance of the new add power in millimeters using the following formula:

FD = 1 / Add *1000

Step 2: The normal human eye rotates on a visual axis approximately 13 mm behind the cornea. Knowing this, we can geometrically compute the exact amount of adjustment for the near PD if we also know the vertex distance in millimeters. Substitute these known values in the following formula to get you answer:

New Near PD = (FD / (Vertex + 13 + FD)) x DistPD

Ordering the Desired Lenses and/or Devices

At this point you should have in mind what powers and devices you will try on the patient when they return for their second visit. If any of the lenses or devices you have ordered are on backorder, try to substitute another similar device whenever possible to avoid lengthy waits. Once the desired low vision devices have arrived, call the patient to set up an appointment for the second visit.

During the second visit have the patient try each of the devices and evaluate the visual acuity results. Also take into consideration the patient's ability to comfortably use the device. Once a determination is made of the most effective device, you must instruct the patient in detail concerning the proper use of the device in order for it to have its optimum effect. Make sure you give the patient proper instructions on the use of the device and the proper focal point of all near devices as explained in the steps below.

Reading Focal Distance Training

- After determining the best near vision device, determine the focal distance of the device.
- Instruct the patient concerning the importance of using the device at the proper focal distance.
- Supply the patient with large print and/or verbal instructions on the proper use and focal distance of the selected near vision device.

If the amsler grid test results indicate a possible vision improvement by use of the patient's peripheral vision for near, consider the use of eccentric vision training. If the patient is able and willing to practice

this procedure, their ability to read smaller print can sometimes be improved considerably. If eccentric-viewing training is indicated, follow the procedure as outlined below.

Eccentric-Viewing Training

- Identify the best area of near vision using the Amsler grid results.
- Instruct the patient on the best viewing position for near vision using the Amsler grid results as your guide.
- Give the patient large print training material and/or verbal instructions specifically designed for their particular situation.

After your first visit you should have a good picture of the patient's habits around the home and the home's lighting conditions. Always cover lighting recommendations, television viewing recommendations when appropriate, and always provide proper instructions concerning the focal distance of any near vision device as explained in the steps below.

Lighting Recommendations

- Reading vision can almost always be improved simply by increasing the quality of lighting.
- Consider increasing the patient's home lighting by using brighter bulbs in existing fixtures, or by adding an additional reading light.
- For reading, a shade or globe must be used to redirect the light onto the reading material and away from the patient's eyes.

Television Viewing Recommendations

- The most effective and least expensive solution is to simply sit closer to the TV screen.
- Consider purchasing a large screen TV.
- Sometimes, improvement can be obtained by increasing the brightness and contrast of the picture.

Always remember the importance of patient follow-up. Make sure the selected device(s) is continuing to have the desired result. Re-instruct the patient if necessary on the proper use and focal distance of the selected device(s). Re-evaluate the situation and select an alternate device if appropriate. If the device proves to be too difficult to learn to use for the patient, select a device that is easier to use.

It is important to remember the three things that almost always help low vision patients:

- Increase the quality and quantity of light.
- Increase the magnification of the image.
- Always hold the reading material at the proper focal distance for the power of the device being used.

Performing low vision evaluations can be one of the most fulfilling experiences you will ever have in this business, but remember that every situation will be unique. You must be compassionate and kind, but most importantly, you must have a never-ending supply of patience.

Bibliography

Michaels, David D. Visual Optics and Refraction. Saint Louis: The C.V. Mosby Company, 1975.

Veasey, Clarence A. Refraction Difficulties. Spokane: American Academy of Ophthalmology and Otolaryngology, 1950.

Fonda, Gerald E. Refraction Problems. Rochester: American Academy of Ophthalmology and Otolaryngology, 1969.

Freeman, Paul B., and Jose, Randal T. The Art and Practice of Low Vision. Boston/London/Oxford/Singapore/Sydney/Toronto/Wellington: Butterworth-Heinemann, 1991.

Milder, Benjamin, and Rubin, Melvin B. The Fine Art of Prescribing Glasses. Gainsville: Triad Publishing, 1991.

Carlson, Nancy B, et. al. Clinical Procedures for Ocular Examination. Norwalk: Appleton and Lange, 1990.

Garcia, George E. Handbook of Refraction. Boston/Toronto/London: Little, Brown and Company, 1989.

Jagerman, Louis. Understanding Magnification in Ophthalmology. Rochester: American Academy of Ophthalmology and Otolaryngology, 1970.

Parrish, Richard K. An Introduction to Visual Optics. Rochester: American Academy of Ophthalmology and Otolaryngology, 1967.