The Structured Low Vision Exam

The low vision examination has evolved from a series of independent procedures into a structured evaluation. Each part of the sequential examination provides the clues that will help in determination of the low vision device and provide insight into apparent success or lack of success with a low vision aid. The structured examination includes the current methods in the determination of visual acuity at distance and near with the ETDRS charts and functional testing techniques including the Amsler grid, contrast sensitivity testing, and the Brightness Acuity test. An understanding of the importance of the various components of the low vision evaluation will enable the examiner to prescribe the appropriate low vision device, including spectacles, hand magnifiers,stand magnifiers, telescopes, absorptive lenses, video-magnifiers, optical or nonoptical devices, or refer for other service or additional testing procedures.

The foundation for the present day low vision evaluation was set in 1935 by Dr. William Feinbloom in the monograph **An Introduction to The Principles and Practice of Sub-normal Vision Correction**. The elements of the subnormal vision evaluation or low vision evaluation, as it is known today, included a detailed case history, ophthalmometry, ophthalmoscopy, slit-lamp, visual field test, static retinoscopy, subjective examination at distance with "simple lenses," subjective examination at distance with sub-normal vision device, and subjective examination at near with subnormal vision device. A second visit was scheduled to establish the patient's prognosis, confirm the subjective and objective evaluation, and verify the objectives set forth in the case history. This was followed by selection of the optical device, training with the device, and prescription of the low vision aid. The monograph is also noteworthy in the discussion of the psychology of the low vision patient and the importance of illumination.

It took another 30 years before Dr. Gerald Fonda covered the basics of the low vision examination in **The Management of the Patient with Subnormal Vision.** He outlined the examination procedures as the history, testing of visual acuity at distance and near, retinoscopy, keratometry, subjective testing, and prescribing a reading prescription.

Dr. Eleanor E. Faye, however, was the first low vision clinician to discuss the importance of understanding the pathology during the low vision evaulation. In **The Low Vision Patient**, she discussed the basic eye conditions related to subnormal vision. She further underscored

the relevance of the pathology to the management of the low vision patient with a functional classification of eye disease in **Clinical Low Vision**. And for the first time functional testing procedures, such as the Amsler grid, became part of the low vision evaluation.

The sequence of the low vision examination became further standardized in **Low Vision Care** by Dr. Edwin B. Mehr and Dr. Allan N. Freid. They were also instrumental in elaborating on the significance of the psychology of the low vision patient and the success-oriented examination. Other applicable additions to the low vision examination included color vision testing, response to illumination, and a systematic approach to near testing.

Dr. Jay Newman further clarified the low vision evaluation, while The New York Lighthouse Low Vision Continuing Education Program formalized, revised, and organized the structured low vision examination to what is essentially the accepted format of the low vision evaluation. A sequential low vision examination insures a higher rate for success as well as predicts difficulties encountered with the low vision patient.

Low Vision Basics

The basic low vision examination consists of the history, visual acuities, external evaluation, keratometry, subjective and objective evaluation, predicting the add, functional testing, selection of the appropriate low vision aid, instruction, and prescription or loan of the low vision aids.

The examination begins with a history which provides clues not only to the prescription of low vision devices but to any further services that may be required, such as medical counseling, mobility, rehabilitation and training, educational support, or surgical intervention. Among low vision clinicians there is a philosophical difference as to whether the case history should be taken before the low vision evaluation by means of a questionnaire sent home, by a social worker before the low vision evaluation, or on the day of the examination by the low vision clinician. Although a list of questions answered before the low vision examination may seem to expedite matters, it does not provide the answers to many questions that are obtained through direct observation or interaction with the patient. More importantly, face-to-face contact begins to establish a meaningful doctor patient patient doctor relationship. The patient may begin to relax and feel more confident in the fact that the doctor is taking the time out to listen to his or her complaints. Through the eye-to-eye contact, the patient often will realize that this doctor is interested in his or her vision problem.

At the outset it is usually best to let the patient relate the course of his or her visual changes, medical procedures, medications, surgeries, or their feelings without interruption (within a reasonable amount of time). This generally will relax the patient, lets them know you are interested in their visual history, and sets the tone for the examination. Because the majority of low vision patients are accompanied to the examination room by a friend or relative, it is also not unusual to obtain information from them when the patient is unresponsive or is sketchy about details. Conversely, the examiner must give the patient the chance to provide the answers, not the one who accompanied the patient. It also may be necessary to either ask the friend or relative to refrain from answering for the patient or on occasion ask them to take a seat in the waiting room. The examiner must be in full control so the examination can proceed in an orderly and time efficient manner.

The examiner then can structure and guide the patient into distinctive areas such as eye, medical, social, and educational history. Specific distance, near, and intermediate objectives, lighting needs, glare sensitivity, and mobility also should be explored.

By the completion of the case history, the clinician should have an impression of the patient's objectives and goals, whether or not they are realistic, the patient's reaction to the vision loss, and discern how much time to spend with the patient. That is, the examiner should sense what can and cannot be covered during the initial evaluation without fatiguing the patient.

Visual Acuity Measurements

Visual acuity measurement, the first test of visual function, follows the case history. The Feinbloom number chart was the first such distance visual acuity chart developed for the evaluation of the "partially blind," as the condition was originally was called (now known as the partially sighted). The chart is filled with optotypes ranging in size from a 700- foot to a 20-foot sized number. Individual pages consist of one to seven numbers. The first chart, however, that Feinbloom found suitable for the low vision patient was the B&L H591 Snellen chart (later known as the B&L AMA rating chart) placed at 10 feet instead of the traditional 20-foot test distance. This became the standard low vision test distance for over 50 years. This chart had optotypes ranging from 200- to 109- foot letters on one side and 97.5 to 20.0-foot letters on the other. The Lighthouse distance visual acuity charts were introduced with optotypes based on Sloan letters. The testing distance was generally 10 feet (recorded in feet) with the patient walking toward the chart or the chart brought toward the patient when the largest line could not be seen. The visual acuity was then recorded as the smallest line seen (e.g., 10/160), hand motion (HM), counts fingers (CF), light projection (LPROJ), light perception (LP), or no light perception (NLP). Counts fingers and hand motion was viewed by many clinicians as an inaccurate method of recording functional visual acuity and is generally no longer accepted by low vision practitioners.

The low vision visual acuity charts in use were not standardized. For example, there was unequal difficulty for each line or page on the eye chart, unequal spacing between letters, chart construction with one to 13 letters on a line, and various style optotypes, including serif and sans serif.

Dr. Jan Lovie and Dr.Ian Bailey, rectified the chart confusion by designing a new type of eye chart. The new ch art, which was based on a logarithmic progression became the basis for the Ferris Bailey chart used in the Early Treatment Diabetic Retinopathy Study (ETDRS).

Procedure With the Distance Acuity ETDRS Chart
The rear illuminated Ferris-Bailey ETDRS visual acuity charts are designed to be used at 4, 2, or 1 M. They are available in three randomly arranged letter charts, a number, HOTV, and Landolt C configurations. Visual acuity can be noted in the metric, Snellen, or LogMar systems with this chart. Visual acuity is taken without correction at 4 M in the right eye with the left eye occluded and repeated for the left eye with the right eye occluded. Binocular visual acuity is also taken. The chart should be moved in to 2 M or even I M when the top line cannot be seen. Correction is to be used in cases with significant refractive error such as high myopia or aphakia. The examiner also should instruct the patient in viewing eccentrically during the taking of visual acuity. This procedure introduces the patient to the techniques of eccentric viewing while also demonstrating that the vision may improve if the fixation changes from a central to eccentric area.

Peeking, unintentional though it may be, frequently results in misleading visual acuity measurements. The examiner should therefore closely watch the patient's eyes even when the eye is covered with a paddle occluder or clip-on occluder (e.g., Halberg, Bernell).

Recording of visual acuity is noted as test distance over letter size in meters. Visual acuity, for example, is noted as 4/20-2, 2/32-1, or 1/40. To find the 20-foot Snellen equivalent,

multiply the numrator and denominator by 5,10,or 20 for the 4-,2-, and 1-meter test distances. The Designs for Vision number chart is still of value in estimating visual acuity less than 1/40 (20/800). When acuity falls below that which can be recorded on standard eye charts, the examiner should test for light projection, light perception, or no light perception. The upper range for successful visual rehabilitation with low vision optical devices is 1/40. Cogenital or determined low vision patients, however, often succeed with low vision aids when the visual acuity falls below this range.

Incoming Near Visual Acuity Recording

The objectives of the near visual acuity test are to determine the visual acuity as well as the habitual working distance. The later is often indicative of uncorrected refractive error.

Using the Lighthouse "GAME" card and recording the acuity in M notation, the instructional set given to the patient is to read the smallest word at their normal reading distance using the habitual reading correction. Again, visual acuities are taken with the right, left, and both eyes. The Lighthouse "NUMBER" card can be used as well as the Designs for Vision Near Reading Cards for the Partially Sighted. Test distance and card used should be noted on the record.

Careful attention should be paid to illumination. Adjustable lamps for reading should be readily available. Conversely, the examiner should also note whether decreased illumination enhances performance.

External Examination

The external evaluation, which follows visual acuity measurement, should include pupillary position, size, and responses, and position of the lid, eyes, and orbits and nystagmus. It is important to note any change from either the previous status or the information provided on an incoming eye report.

It is also important to take note of any information that might provide clues on the prescription of low vision devices. For example, large sector iridectomies might be the cause of a complaint of photophobia, whereas unequal pupillary positions might influence the type and position of a telescopic lens.

Carefully note the monocular pupillary distance and any height anomalies in the position of the pupil. As previously pointed out, this information will be of value in the positioning of any telescope.

Transillumination is always to be performed in suspected cases of albinism and differential diagnosis. However, transillumination also should be done when the decrease in visual acuity is not always explained by the findings presented from the low vision evaluation.

Keratometry

Keratometry is an objective finding that should be performed on the initial evaluation even when nystagmus is present. It should be performed after corneal and especially cataract surgery since the amount of cylinder, and axis of the cylinder, may shift over time.

Keratometry is also an important technique in establishing the integrity of the cornea. For example distorted mires might indicate the development of keratoconus, irregular astigmia, while a flat cornea might be indicative of micro-ophthalmus.

Keratometry is also an especially useful procedure for estimating astigmatic error in the nonverbal patient or child.

Static and Subjective Findings

Static retinoscopy is preferably performed with a wide aperture trial lens using a trial frame or by over-refracting with a Halberg type clip. In addition to the standard retinoscopy techniques, the examiner should use radical and off-axis retinoscopy. That is, move in when a poor or no reflex is seen, or until some motion is detected. Move the retinoscope off the line of sight to see if a reflex can be obtained. This is especially useful in high myopia or individuals with small pupils.

Subjective evaluation is also generally performed with the retinoscopic finding placed in the trial frame. The bracketing lenses are dependent on the incoming acuity. For example, the bracketing lenses used with an incoming acuity of 4/40 (20/200) is ± 1.00. This is derived by taking denominator of the Snellen fraction and dividing it in half. The bracketing lenses for acuity of 2/40 (20/ 400) would be ± 2.00, while the lenses used for 1/40 (20/800) would be ± 4.00. If the acuity improves during refinement, for example, from 4/40 to 4/20 (20/100), the bracketing lens should also be changed to ± .50 because the sensitivity is increased to smaller lens changes.

Predicting the Add

One of the keystones of the low vision evaluation is predicting the add. This information will be used in the selection of the low vision aid such as spectacle, hand magnifier, stand magnifier, or telescope.

Placing a +2.50D lens over the best distance subjective distance correction, in either a trial frame or Halberg-type clip, hold the Lighthouse Near Visual Acuity Test Chart (Modified ETDRS with Sloan Letters, second ed. at 40 cm. Viewing the chart monocularly, read the smallest line and record the acuity in M notation. Repeat the procedure with the left eye and with both eyes. If the 8 M line can not be read, place a +5.00D lens in the trial frame and read the smallest line with the chart held at 20 cm. Note the dioptric power necessary to read 1 M print under the column, denoting 40-cm or 20-cm test distance.

Sum the predicted add to the subjective refractive correction. For example, a -10.00 myope reading 4 M would require a + 10.00D lens to read 1 M. This could be achieved by removing the distance correction when reading. The same individual reading 8 M would require a +10.00 D correction lens (A +20.00 D add). Conversely, an aphakic patient with a prescription of +14.00 = -2.50 X 90 reading 4 M would require a starting lens of +24.00 = -2.50 X 90. The same individual who could only read 8 M would need a lens of +34.00 = -2.50 X 90, while the emmetrope reading the same 4 M would need a +10.00 add.

The add predicted with the ETDRS chart is single-letter high-contrast visual acuity. Proceed with either the Lighthouse Continuous Text Card for Adults for Near Vision or children) to determine reading acuity. This card, which contains sentences from 8.0 to 4.0 M on one side and 3.2 to 0.4 M on the other is used at a 40 cm with a +2.50 add. The predicted add is generally higher with reading then single-letter acuity.

Additional tests of visual function should follow the prediction of the add. These tests include the contrast sensitivity test, Amsler grid, brightness acuity test, and visual fields.

Contrast Sensitivity Testing

Contrast sensitivity testing with the Vision Contrast Test System is done at 1 M with the best corrected distance subjective and a +1.00 add (for absolute presbyopes). The patient should be instructed to look at the four bottom patches on the chart while the examiner demonstrates that the patches contain either lines going up and to the left, up and to the right, straight up, or the patch is gray. Pointing to each patch, the patient should demonstrate the direction of the lines with his hand. Proceed to the next line when the patient reports that the patch is gray or they are incorrect. Guessing should be encouraged.

The contrast sensitivity is done monocularly and binocularly with the recording done on the sheet provided for the 1- test distance.

The information provided by the contrast sensitivity test often will helpful in determining monocularity verses binocularity, increased need for illumination, necessity for occlusion, the need for control of brightness and contrast, and the need for a higher than predicted add.

Amsler Grid

Hold the Amsler grid at 33 cm. With the best distance correction and a +3.00 add, note the responses monocularly and binocularly. Variations include using the Amsler grid containing diagonal lines for fixation.

The Amsler grid can also be used for a quick determination of a severely constricted visual field. By introducing a 3-mm wand from the periphery, with the patient fixing the central dot, the examiner will be able to determine fields as small as 1 degree.

Visual Fields

Standard tangent screen and modified for the low vision patient, as well as static and kinetic perimetry should be performed where indicated. The Goldmann (Topcon) bowl perimeter is recommended for the evaluation of peripheral fields.

Brightness Acuity Test

The Mentor BAT Brightness Acuity Tester can be used to subjectively determine the effect of a glare source. While viewing through the aperture in the BAT and wearing the best subjective distance correction, the patient reads the distance ETDRS chart under low, medium, and high settings. The fellow eye is occluded.

The BAT can also be used as macular photostress test when the aperture is closed.

Additional Tests

Slit-lamp evaluation, direct and indirect ophthalmoscopy, and tonometry should be performed as needed and where indicated. However, additional testing procedures that are not routinely performed during low vision evaluation may be regarded as necessary, especially, for example, if there is a sudden change in vision. The patient should be referred back to the primary eye care practitioner or other specialists for these prodecures. They may include the following: electroretinogram (ERG); visual evoked potential (VEP); electro-oculograrn (EOG); potential acuity meter (PAM); laser interfornetry; ultrasound (A and B scan); fluorescein angiography, and fundus photos. Computed axial tomography (CT) scans, magnetic resonance imaging (MRI), and analyses of blood chemistries and blood pressure also may be performed.