CLINICAL ASSESSMENT OF LOW VISION

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INTRODUCTION

This chapter includes a review of:

- The purpose of low vision assessment
- The steps of low vision assessment

PURPOSE OF LOW VISION ASSESSMENT

- The purpose of low vision assessment is to assess the residual vision present and correlate it with the individual's social, educational, vocational and other needs, and to identify ways and means to enhance the residual visual functions
- Low vision assessment is different from a clinical eye exam. While the clinical procedure focuses on diagnoses and management of the eye disease, the priority in low vision assessment is to enable an individual to utilise his or her residual vision to its maximum potential
- Low vision assessment is a result oriented procedure, at the conclusion of which, the examiner should have a clear perspective of what needs to be done. That is, whether the client would benefit from low vision devices, if there is any training needed in the use of these devices or if the client has to be referred to any other specific department or service provider

STEPS OF LOW VISION ASSESSMENT

The following is the routine for a low vision examination:

1. Review of medical records
2. Observation and interview
3. Identification of needs
4. Visual acuity - distance
5. Visual acuity - near
6. Pinhole assessment of vision
7. Visual field assessment
8. Refraction
9. Contrast sensitivity
10. Glare sensitivity
11. Additional tests

1. REVIEW OF MEDICAL RECORDS

It is essential to review previous medical and surgical records. Careful review of records and examination may reveal an overlooked posterior sub-capsular cataract, active uveitis or suture-induced astigmatism in post corneal surgery, never addressed before. In such cases, low vision services may need to be postponed until all medical and surgical options are exhausted. It also helps us to know the starting point for examination of visual acuity, refraction, etc.

2. OBSERVATION AND INTERVIEW

Observing the client's behaviour and his physical status can provide an insight to the severity of the problem. Observation should begin in the waiting area and continue into the consulting room. This allows the eyecare practitioner to observe the following:

- How the patient negotiates his/her visual environment?
- Observe interactions with the family members
- Observation of postural abnormalities, mobility and appearance

POSTURAL ABNORMALITY	• Head turn or tilts are frequently found with peripheral field defects and the turn is towards the direction of field loss • Pronounced head and eye movement while travelling • A downward tilt may indicate the adaptation to significant photophobia/glare • Head turn while reading may indicate central scotomas in visual field
APPEARANCE	Note the overall appearance of the eye and look for the following: • Nystagmus • Obvious external disease • Strabismus • Eye poking (indicating Leber's congenital amaurosis) • Sunglasses worn inside the examination room (indicating severe photophobia/glare) • Soiled clothing or missing buttons (possibility of difficulty in daily living skills) • Fatigued appearance (indicator of serious systemic disorder, depression resulting from recent vision loss, or the impact of other psychosocial factors

2. OBSERVATION AND INTERVIEW (CONT.)

MOBILITY	• Indicators of peripheral visual field loss: o Tentative gait o Postural stiffness o Maintenance of close proximity to walls or handrails o Reliance on tactile information by holding onto an individual or trailing a wall

Interviewing is important in order to understand the emotional status and individual needs of the client.The interview also works as a platform for developing a rapport between the examiner and the client. The interview starts with the case history with emphasis on the visual problem. This is followed by the individual's personal history that includes occupation, education, living status and specific functional aspects, like independence, orientation, mobility and activities of daily routine.

3. IDENTIFICATION OF NEEDS

The daily routine of the client can identify the needs of the individual and areas where help may be needed. Bringing to focus activities that may be possible can help in narrowing down the objectives of the client. All the data from the interview has to be recorded in an organised manner so it could be used effectively in finding the solutions.

Significant areas of investigation of patient needs include:

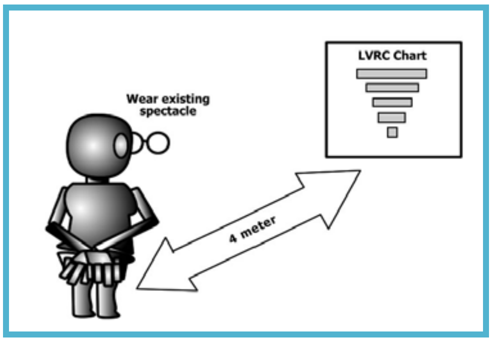
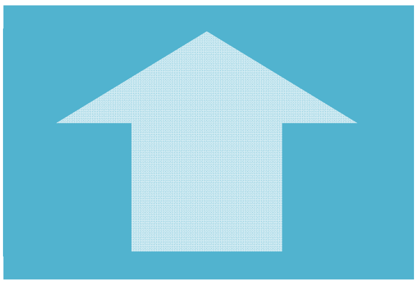
NEAR VISUAL ABILITIES AND NEEDS	• Special literary requirements - like what does the patient read, what does the patient wish to read, at what distance do they prefer to read, do they experience difficulty with reading? • Other intermediary visual abilities or needs - to perform activities like writing, sewing, cooking, and viewing the computer. Can the patient see to write cheques and balance their chequebook. Can they see to read small prints from a calculator screen or a watch?
DISTANCE VISUAL ABILITIES AND NEEDS	• Does the patient have a problem with recognising faces from distance? • Does he or she have any problem in watching television? • Does he or she have problem in reading bus numbers?
BASIC ACTIVITIES OF DAILY LIVING	• Can the patient see to perform routine housekeeping duties like cleaning, paying bills, laundry, etc? • Have the services of a rehabilitation professional to improve homemaking skills been sought ? • Are the patient's appliances marked to improve visibility? • Difficulty with self-help skills
INDEPENDENT TRAVEL ABILITY AND NEEDS	• Is the patient able to drive, can they manoeuvre in their environment or do they need assistance, do they use any form of assistance, etc?
LIGHTING REQUIREMENTS	• Can the patient tolerate light levels, do they have problems with light levels, do they experience delays in adjustments to light levels, etc.?
OCCUPATIONAL AND EDUCATIONAL DEMANDS	• What are the specific demands of the patient's occupation, are there safety issues, are there disruptions in the patient's ability to perform their tasks? • If the patient is going to school, then is the patient in a special needs or mainstream school, is child able to copy from the board, what is their sitting position from the board, is there interruption of interaction with other classmates as a result of the visual problem, are teachers and peers aware of the visual problem, etc.?

4. VISUAL ACUITY ASSESSMENT

The visual acuity assessment begins with determining the distance acuity of the patient. The procedure involves showing the patient large size letters on sheets from a certain distance and asking him or her to identify them. Optotypes, single-letter chart gratings and crowded letters of different sizes may be shown to the patient alternatively. The same procedure is repeated for each eye individually, followed by a binocular assessment.

(LVRC = Low Vision Resource Centre)

Figure 3-1: *LVRC LogMAR TEST CHART for DISTANCE ACUITY*
To measure the ability of the visual system to resolve detail

CLINICAL PREPARATION	Overall blurred vision affects an individual's ability to perceive sharpness of detail (See Fig. 2-1a and 2-1b of chapter 2) due to an alteration in the clarity of the refractive structures like the cornea and lens. In addition, abnormalities of the pupil and the vitreous can also contribute to overall blurred vision. Conditions affecting these structures also tend to produce significant change in the individual's contrast sensitivity. • Place the chart 4 meter away from the person • The person must wear the habitual spectacles • The chart must be placed under daylight (minimum 450 lux)  ***Figure 3-2:*** *Preparation of patient for distance VA assessment using LVRC logMAR test chart*
CHART SELECTION	Chart is chosen based on the literacy of patient. The order of the chart difficulty is as follows: **1.** ETDRS chart **2.** Number chart **3.** Landolt C **4.** Illiterate E  Increase in Difficulty, Accuracy of visual acuity increase

4. VISUAL ACUITY ASSESSMENT (CONT.)

PROCEDURE

1. Patient wears the habitual spectacles and occludes one eye at a time (Fig. 3-2)
2. Instruct the patient to read from the largest letters to the smallest letters
3. Encourage patient to read the next line with smaller letters. Stop the patient, when more than half the letters on a line have been missed. Direct patient to look into the pinhole and read the smaller letter again
4. If patient cannot read the first row at a 4 meter test distance with or without pinhole, move the chart closer to 2 meter. If patient still cannot read the chart, move to 1 meter

RECORDING VISUAL ACUITY IN LOGMAR UNIT

1. Record visual acuity for each eye separately
2. If patient reads 5 letters in a row, record the LogMAR unit as on the right of the chart
3. Each letter on the line contributes 0.02 log units. The worse the patient's VA, the higher the LogMAR value. Add the log units for each letter not read to the LogMAR line value
4. If patient read 4 letters only in a row, then add 0.02 to the LogMAR unit on the right of the chart
5. If patient read 3 letters in a row then add 0.04 (2 not read = 2 x 0.02log units), if 2 letters only, add 0.06 (3 x 0.02 log units) and if 1 letter only add 0.08 (4 x 0.02 log units) to the logMAR unit on the right of the chart (Fig. 3-3)

Example: Patient can read 3 letters in a row of 0.9 unit log MAR at 4 meter.

Then visual acuity is 0.9 + 0.04 (2 letters not read) equivalent to 0.94

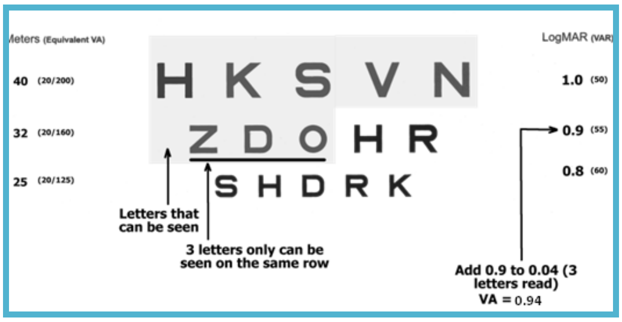


Figure 3-3: *Example of number of letters read by a patient*

6. In most of the cases, patient may not able to read at 4 meter, therefore the distance of the chart has to be halved from 4 meter to 2 meter or to 1 meter. In this case add 0.3 every time the distance is halved

Example 1:

Patient read 4 letters in a row at 0.7 unit log MAR at 2 meter. The log MAR acuity will be 0.7 + 0.3 (half of 4 meter) + 0.02 (reading 4 letters).

Answer: 1.02 log MAR

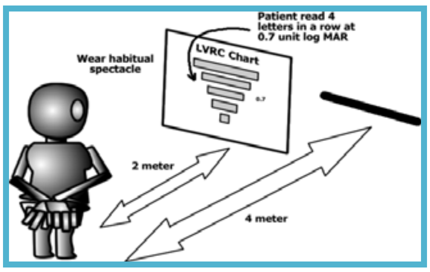


Figure 3-4*: Patient reading logMAR chart at 2 meters*

Example 2:

Patient read 2 letters in a row at 0.6 unit log MAR at 1 meter.The log MAR acuity will be 0.6 + 0.3 (half of 4 meter) + 0.3 (half of 2 meter) + 0.06 (reading 2 letters).

Answer: 1.26 log MAR.

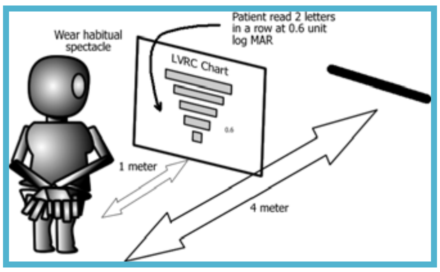


Figure 3-5: *Patient reading logMAR chart at 1 meter*

4. VISUAL ACUITY ASSESSMENT (CONT.)

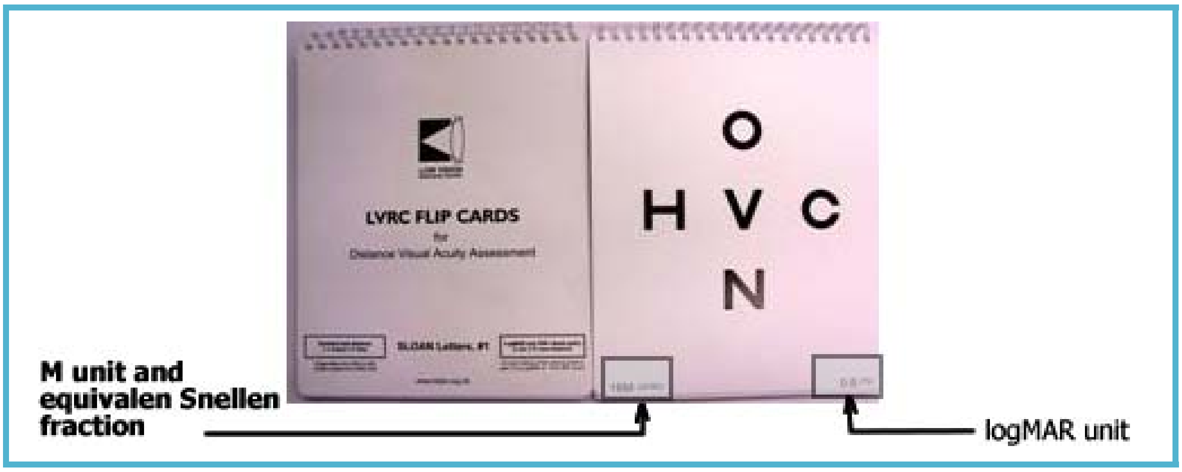
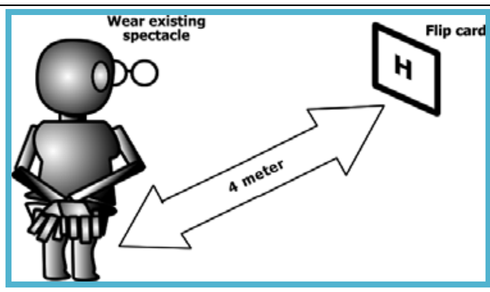
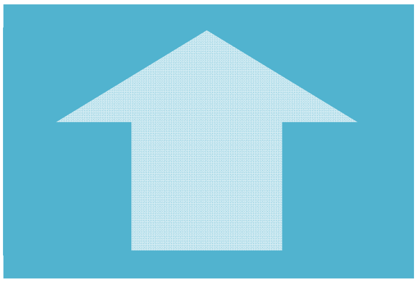


Figure 3-6: *LVRC LogMAR Flip Card for Distance Acuity*
To measure the ability of the visual system to resolve detail by measuring the size of object and working distance of the person

CLINICAL PREPARATION	• Place the flip chart 4 meter away from the person (Fig. 3-7) • The person must wear the habitual spectacle. • The chart must be placed under daylight (minimum 450 lux)	 ***Figure 3-7:*** *Preparation of patient for distance VA assessment using LVRC logMAR test chart*
CHART SELECTION	Chart is chosen based on the literacy of patient. The order of the chart difficulty is as follows: **1.** ETDRS chart **2.** Number chart **3.** Landolt C **4.** Illiterate E	 Increase in Difficulty, Accuracy of visual acuity increase

4. VISUAL ACUITY ASSESSMENT (CONT.)

PROCEDURE	**1.** Patient wears the habitual spectacles and occludes one eye at a time **2.** Instruct the patient to read from the largest letters to the smallest letters **3.** Encourage patient to read the next smaller letters. Stop the patient when the smaller letters are missed. **4.** If the patient cannot read the first letter, move the flip chart closer to 2 meter. If the flip chart still cannot be read, move the chart to 1 meter
RECORDING VISUAL ACUITY IN EQUIVALENT SNELLEN FRACTION	**1.** Record visual acuity for each eye separately **2.** Write down the M (metric) unit and the distance between the flip chart to the eye **3.** Record the visual acuity as in fraction, the numerator as distance in meter and denominator as M unit

EXAMPLE 1: RECORD	The smallest letter read by the patient is 40 M at 4 meter,	
	4	Distance in meters
	40	Size of letters read in metric notation

EXAMPLE 2: RECORD	The smallest letter read by the patient is 24M at 2 meter,	
	2	Distance in meters
	24	M unit

RECORDING VISUAL ACUITY IN LOGMAR UNIT	**1.** Record visual acuity for each eye separately **2.** Record the log MAR unit as on the bottom right of the flip chart whereby distance between chart and patient is 4 meter **Example 1:** Patient reads letter at 1.0 unit log MAR at 4 meter, then record VA as 1.0 log MAR In most of the cases, patient may not be able to read at 4 meter; therefore the distance of the chart has to be halved from 4 meter to 2 meter or to 1 meter. In this case add 0.3 every time the distance is halved. **Example 2:** Patient reads letter at 0.8 unit log MAR at 2 meter, then record VA as 1.1 log MAR, that is adding 0.8 to 0.3 (distance halved from 4 meter to 2 meter). **Example 3:** Patient reads letter at 0.6 unit log MAR at 1 meter, then record patient as 1.2 log MAR log MAR, that is adding 0.6 to 0.3 (distance halved from 4 meter to 2 meter) and 0.3 (distance halved from 2 meter to 1 meter).

5. VISUAL ACUITY ASSESSMENT- NEAR

In this step, the patient identifies or reads certain typeset of smallest size from a near distance. The distance is accurately recorded. The typeset size is denoted in M units. Reading acuity is the patient's ability to read a more congested and complex typeset print from a measured distance.

Near Visual Acuity is measured at the reduced distance of 25 – 40 cm. First test the right eye and then the left eye. Patient is given a chart on which letters of different sizes are printed and he/she is asked to read the smallest letter that he/she can read accurately. Then we can calculate his/her required magnification by simply using the same chart, according to the patient's own need.

We use the M units for measuring the Near Visual Acuity and for calculating the magnification required to read.

The following are examples of near reading charts

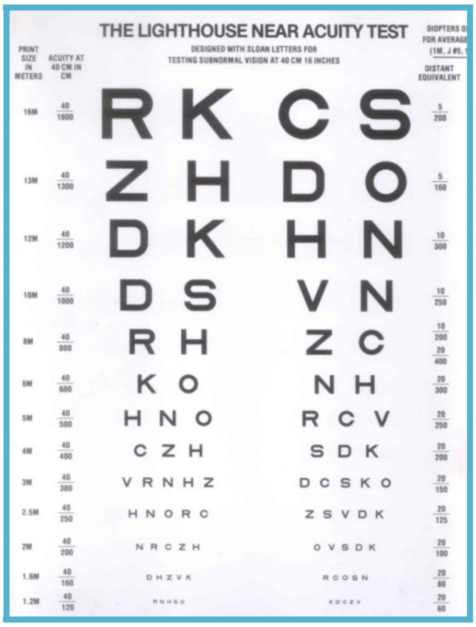


Figure 3-8: *Lighthouse Near Acuity test*

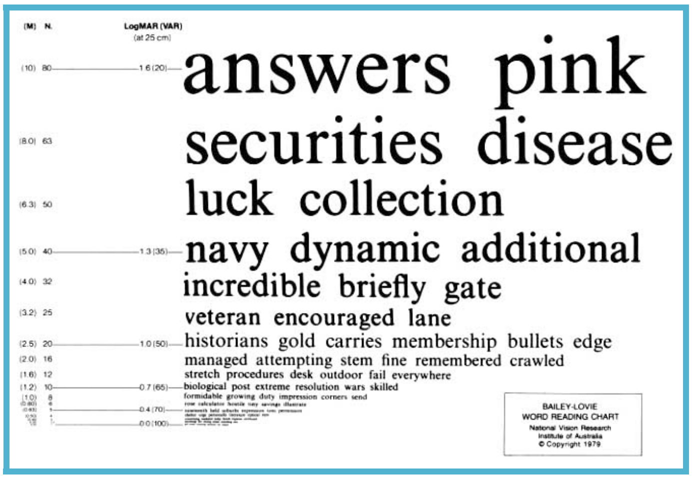


Figure 3-9 *Bailey-Lovie Word Reading Chart*

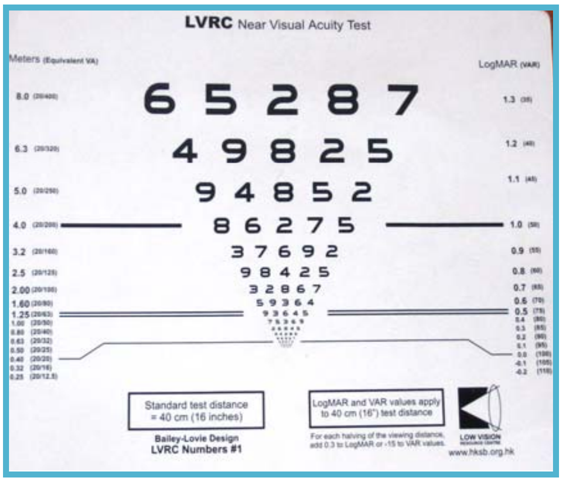


Figure 3-10: *LVRC Near Visual Acuity Chart*

There are numerous other charts available.

6. VISUAL ACUITY ASSESSMENT- PINHOLE

The pinhole acuity test is used to assess the presence or absence of a refractive error.

Improvement in vision through pinhole indicates that the person may benefit from refractive correction.

This can identify those people with poor vision who may need spectacles to improve their vision. The mask has very small holes in the area in front of the pupil (Fig. 3-11). People who have visual acuity improved with the pinhole should be referred for examination and treatment by an eye care practitioner.

Figure 3-11: *Pinhole Occluder*

7. ASSESSMENT OF VISUAL FIELDS

There are many techniques and equipment to measure visual fields. The visual field test helps to evaluate central scotomas, mid, long and peripheral constrictions. The visual fields of the client are important for orientation and mobility, and help in searching.

The most commonly done test is the confrontation test. It is a screening test. In confrontation, the examiner compares the examinee's visual fields with his/her own visual field size. The confrontation test gives an estimation of visual field losses in different quadrants.

Bernell's perimetry (Fig 3-12) is indicated when a more accurate evaluation of visual field is required. The procedure involves moving of a white target along a black curved scale. The recognition along its path measures the extent of the client's visual field in all four quadrants.

Amsler is a simple test, which helps measure any visual field losses in the central field by using a special grid.

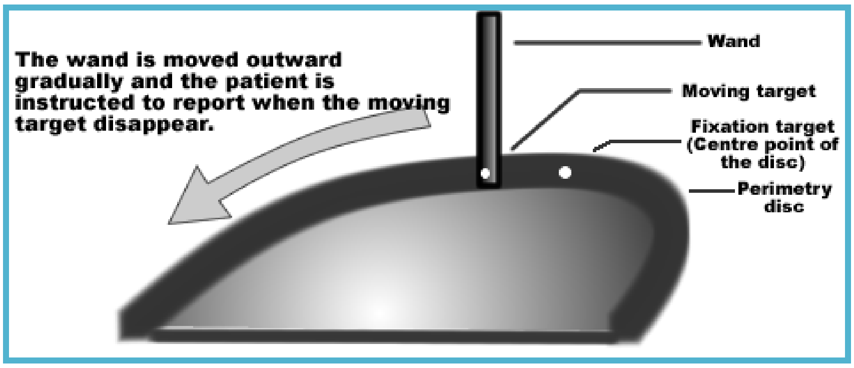


Figure 3-12:
Hand-held disc perimeter used to measure the field of vision

7. ASSESSMENT OF VISUAL FIELDS (CONT.)

PROCEDURE

1. Occlude the non-tested eye when doing the test
2. The patient is asked to hold the disc against the nose, and fixate on the central dot (fixation dot)
3. The wand with the desired size target is held slightly temporal to the centre dot
4. The patient is asked if he can maintain fixation at the centre dot and still see the peripheral target
5. The wand is moved outward gradually and the patient is instructed to report when the moving target disappears
6. Test is also done on the other side of the visual field
7. Tick on the ring where patient report moving target disappear
8. Examiner must ensure that patient is fixating at the central target
9. All four planes are tested. These include horizontal (Fig. 3-13), vertical (Fig. 3-14) or oblique (Fig. 3-15) (45 degree and 135 degree) positions
10. If a restricted field is discovered/noticed, the field is retested with a bigger target
11. To confirm patient's response, move wand to the blind spot. (About 15 degree temporally). Patient should respond that the moving target disappears and reappears again, otherwise patient could be malingering
12. Occasionally test with the wand turned around to hide the target during test.
13. If patient can still 'see' the target, malingering is confirmed
14. Repeat test on the other eye

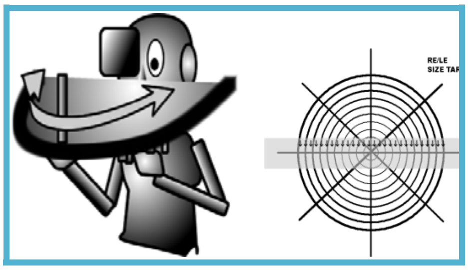


Figure 3-13:
Testing the horizontal field of view

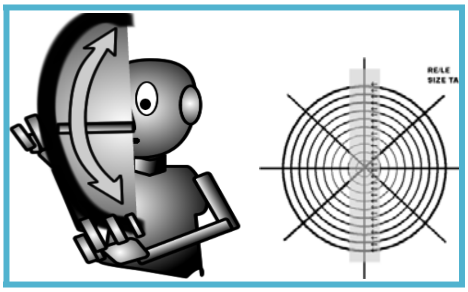


Figure 3-14:
Testing the vertical field of view

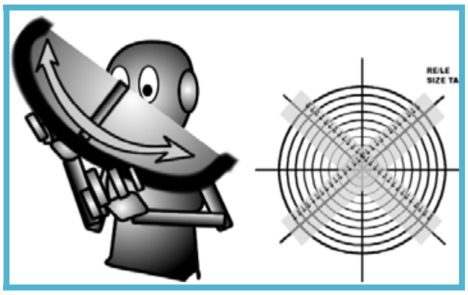


Figure 3-15:
Testing the oblique field of view

Once the patient reports the moving target disappears, tick the angle on the record sheet according to the plane of measurement; horizontal, vertical, or oblique

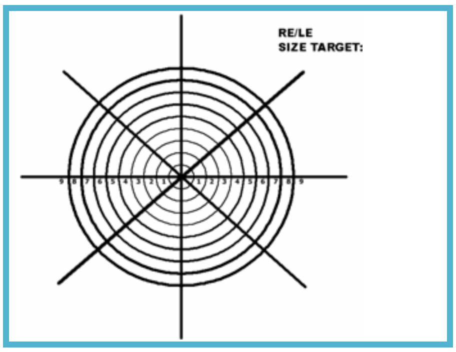


Figure 3-16:
Recording sheet for visual field defects

7. ASSESSMENT OF VISUAL FIELDS (CONT.)

Table 3-1: *Typical Size of Fields (in degree) with Various Sized Test Objects*

TARGET SIZE	TEMPORAL	INFERIOR	NASAL	SUPERIOR
1°	80	60	55	50
2°	85	65	60	50
3°	90	70	60	60
4°	95	75	60	60
5°	100	80	60	60

8. CONTRAST SENSITIVITY ASSESSMENT

Contrast sensitivity measures the ability to see details at low contrast levels.

Visual information at low contrast levels is particularly important:

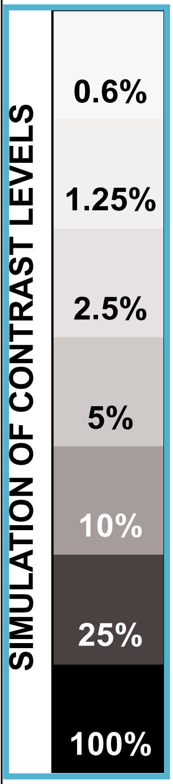
1. **In communication:** since the faint shadows on our faces carry the visual information related to facial expressions.
2. **In orientation and mobility:** where we need to see such critical low-contrast forms as the curb, faint shadows, and stairs when walking down. In traffic, the demanding situations are at low contrast levels, for example, seeing in dusk, rain, fog, snow fall and at night.
3. **In everyday tasks:** where there are numerous visual tasks at low contrast, like cutting an onion on a light colored surface, pouring coffee into a dark mug, checking the quality of ironing, etc.
4. **In near vision tasks:** like reading and writing, if the information is at low contrast as in poor quality copies or in a fancy, barely readable invitation, etc.

Contrast sensitivity is the reciprocal of the contrast at threshold,
i.e. one divided by the lowest contrast at which forms or lines can be recognized.

If a person can see details at very low contrast, his or her contrast sensitivity is high and vice versa. Depending on the structure of the stimulus used in the measurement - either gratings of different size or symbols - contrast sensitivity of a person gets different values.

8. CONTRAST SENSITIVITY ASSESSMENT (CONT.)

WHAT IS CONTRAST?



Contrast is created by the difference in luminance, the amount of reflected light, reflected from two adjacent surfaces. It can be defined in slightly different ways. In clinical work, we usually use the Michelson formula:

$$\text{Contrast} = \frac{L_{max} - L_{min}}{L_{max} + L_{min}}$$

There is also the Weber definition of contrast:

$$\text{Contrast} = \frac{L_{max} - L_{min}}{L_{max}}$$

Lmax = Luminance on the lighter surface
Lmin = Luminance on the darker surface

When the darker surface is black and reflects no light, the ratio is 1. Contrast is usually expressed as percent, and then the ratio is multiplied by 100. The maximum contrast is thus 100% contrast. The symbols of the visual acuity charts are close to the maximum contrast. If the lowest contrast perceived is 5%, contrast sensitivity is 100/5=20. If the lowest contrast perceived by a person is 0.6%, contrast sensitivity is 100/0.6=170.

There is no international recommendation on how contrast of visual acuity charts should be defined. Therefore there are differences in the contrast of tests of different manufacturers.

Source: http://www.accusight.com.br/Sensib/Contrast.htm

MEASUREMENT OF CONTRAST SENSITIVITY

Measurement of contrast sensitivity resembles audiometry: a pure tone audiogram depicts which are the weakest pure tones at different frequencies that the person can hear. Contrast Sensitivity Curve or visuogram shows the faintest contrasts perceived by the person. If the stimulus is a sine wave grating, then the curve depicts similar function as does the pure tone audiogram. Recognition is required if the stimuli are optotypes (letters, numbers or peadiatric symbols) and the test resembles speech audiometry. As in audiometry, the result of the contrast sensitivity measurement is not one single value but a diagram.

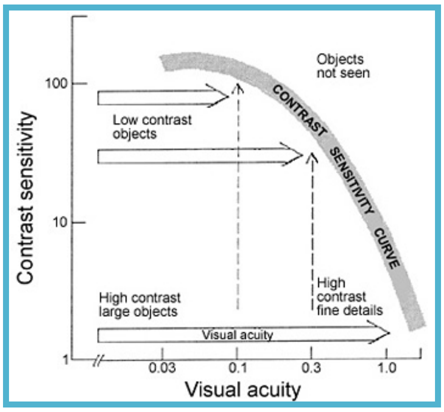


Figure 3-16:
Contrast sensitivity curve

Visual acuity is plotted along the horizontal axis. Contrast sensitivity is plotted along the vertical axis

The threshold values can be measured with two different techniques when using optotype tests:

1. By using low contrast visual acuity charts, or

2. By using tests with one symbol size and several contrast levels

TEST PROCEDURES WHEN USING LOW CONTRAST VISUAL ACUITY CHARTS	Testing is identical to the measurement of visual acuity at high contrast level, i.e., we measure the smallest size of the optotypes that the person can recognize. The threshold is defined as the line on which at least 3 out of the 5 optotypes are correctly recognized. The 2.5% test is the most practical test in clinical use. The resulting threshold point on the curve is far enough from the high contrast value so that the declination of the slope of the curve can be defined. In severe low vision, the test must be quite close, which may require use of reading lenses. Move quickly down the chart and ask the person to identify the first or the last symbol on each line. When the person hesitates or makes an error, recede one line and ask the person to read the entire line. To record the result carefully, record the number of optotypes read correctly, i.e., if on the 2.5% chart one of the symbols was read incorrectly on line 20/63 (6/18, 0.3) record the visual acuity value as 20/63 (-1) at 2.5%. If occupational tasks require good visual function at low contrast levels, visual acuity alone does not select the most suitable persons for that particular task. For example, if the task is to notice airplanes approaching within the low clouds, these planes are best seen by a person with good visual acuity in the contrast range of 1-5%. Since the declination of the slope varies even in normal individuals, it is possible that a person with lower visual acuity at high contrast has better function at the lower contrast levels than a person who has higher visual acuity at high contrast. This is important to remember in all such occupational tasks that require exceptionally good visual function at low contrast levels. Assessment of visual function at low contrast adds an important dimension in the evaluation of a person's capabilities. It should be a part of evaluation of vision in occupational health and in low vision services, as well as in all diagnostic work. With the easy-to-use optotype tests, it is possible to assess visibility of low contrast details. A person's ability to see low contrast lines requires grating tests, which presently are under construction.

9. REFRACTION

Importance of a good refraction in a low vision examination cannot be over-stated. Improvement in visual acuity may begin with the correction of refractive error. Many times, people with low vision will have improvement with just careful refraction.

The basic techniques of refraction of low vision persons are not too different from the normal refraction procedure, although specialised techniques like bracketing and over-refraction are commonly used. The main difference from routine refraction is reduced sensitivity to small changes in the power of trial lenses and slow responses. The refraction is performed both objectively and subjectively. In both techniques it is important to adjust procedures according to the eye condition of each individual client.

Often the persons with low vision are not sensitive to small changes in blur and the greater the degree of visual impairment, the smaller will be the blur sensitivity. The refraction procedure for persons with low vision needs to take this into account and the lens increments and the testing distance need to be adjusted accordingly. Quite often the ocular media is hazy or the pupil is constricted making it difficult to carry out objective refraction. In this case, the refraction technique needs to be modified to the individual patient. For persons with hazy ocular media and constricted pupils carrying out radical retinoscopy is effective. In this procedure, the distance between the retinoscope and the eye is gradually decreased until the reflex becomes sharp. The streak of the retinoscope is kept thin. The final prescription is adjusted for the working distance.

Another useful technique to carryout objective refraction is to refract the person with the spectacles on and add the auxiliary lenses in a clip mount over the patient’s spectacles. Once the neutralization is achieved, the final prescription can be calculated by measuring the combined power of the spectacle and the auxiliary lenses through a lens-meter.

For subjective refraction, bracketing can be performed where a combination of a plus and a minus lens are alternately introduced in front of the patient's eye and the size of the lens bracket is gradually reduced to determine the best power.

Stenopaic slits are often used to determine the axis of the cylindrical power. Auto-refractors and Keratometers can be helpful in the objective evaluation of the refractive errors; however, a good subjective refraction must be performed to verify the final prescription.

In summary:

- While performing refraction, the test chart should be at a distance where the patient can resolve at-least the top line
- The lens increments need to be adjusted according to the blur sensitivity of the patient
- More time is given to the patient to make a correct judgment
- The patient is allowed to make guesses to assess the threshold visual acuity
- Full aperture trial lenses should be used to allow the patient for any head-turn or eccentric fixation
- In some cases, prescription can be quite high refractive errors, back vertex power needs to be measured and the final prescription should be adjusted accordingly
- Fatigue can negatively influence the outcome of the refraction. Patient should be seated comfortably and given time to recover from any signs of stress and tiredness.

10. GLARE SENSITIVITY

In certain conditions, glare can significantly reduce the visual acuity of the client. Sensitivity to glare should become obvious during the interview and it can actually be assessed by taking visual acuity after exposing the client to a glare source and noting the reduction in vision. If the vision reduces by more than 3 lines, some type of absorptive filter lenses may be indicated. The client is given a number of different absorptive filter lenses and the most effective filter is recommended.

Figure 3-17:
Brightness Acuity Tester

11. ADDITIONAL TESTING

Cover test and alternate cover test reveal the presence of any latent or manifesting squints and give a crude idea about the status of binocular functions. Extra-ocular movements reveal any under action or over action of extra-ocular muscles. Before the end of the assessment, direct & indirect ophthalmoscopy is routinely carried out to follow the progress of any active pathology for further management of the disease.

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