

# Low Vision Assessment and Rehabilitation

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## Abstract

Low vision and blindness are a growing health problem that adversely affects the quality of life of an individual. Low vision rehabilitation (LVR) is the process of restoring functional ability and improving quality of life and independence of a patient with low vision. Currently India is a home to around one-third to one-fourth of the world's blind population. Lack of awareness about the low vision services are a major drawback in the rehabilitation of a low vision patient in our country. Thus, in this article we discuss about the methods of evaluation of a patient with low-vision and prescription of low vision aids.

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## Introduction

World Health Organisation (WHO) defines Low Vision (Visual impairment Categories 1 & 2) as "A person who has impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception, or a visual field less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task for which vision is essential" and Blindness (Visual impairment Categories 3, 4 & 5) as "Visual acuity of less than 3/60 or a corresponding visual field loss of less than 10 degrees in the better eye with best possible correction."<sup>1,2</sup> The term visual impairment includes both blindness as well as low vision.

The classification by NPCB (National Program for Control of Blindness) defined low vision as "Visual acuity of less than 6/18 but equal to or better than 6/60 in the better eye with available correction or a visual field loss of less than 10° from the point of fixation", and, blindness as "Visual acuity less than 6/60 in the better eye or a corresponding visual field loss of less than 10°."<sup>3</sup> Recently the definition of blindness has been revised by NPCB so as to bring about uniformity with the WHO criteria.<sup>4</sup>

Based on the current estimates, worldwide there are 161 million people with visual impairment; out of which 37 million are blind and rest 124 million are people with low vision.<sup>5</sup> Ninety percent of the people with visual impairment are living in the developing countries. Currently, India has around 12 million blind people which makes India home to one-third of the world's blind population.<sup>6</sup> With the increasing life expectancy and thus increasing age related problems, the magnitude of visual impairment is expected to rise in coming years.

Low vision is one of the priority areas of VISION 2020. Hence, visual rehabilitation of a patient with low vision, where further intervention is unlikely of any benefit, is of paramount importance and need of the hour. Table 1 enumerates various causes of low vision.

Low vision rehabilitation (LVR) is the process of restoring functional ability and improving quality of life and independence of a patient with low vision. It requires a thorough clinical and functional assessment of the disease, of patients' requirements and daily needs. Thereafter, the

**Table 1: Diseases leading to Low Vision: Presentation as per Anatomical Site**

Anatomical Site	Diseases presenting with Low Vision
Cornea	Microcornea, Adherent Leucoma, Corneal Opacities, Bullous Keratopathy, Microspherophakia, Dystrophies
Lens	Congenital cataract, Ecotopia Lentis or Dislocated IOL, Uncorrected Aphakia
Uvea	Coloboma of Iris or Choroid, Uveitis, Chorioiditis, Aniridia, Choroidal Degeneration
Vitreous	Persistent Primary Hyperplastic Vitreous (PHPV)
Retina	Heredo-Macular Degeneration, Stargardt's Dystrophy, Rod-Cone Dystrophy, Retinitis Pigmentosa, Age-Related Macular Degeneration, Oculo-Cutaneous Albinism, Retinopathy of Prematurity, Retinal Scars. Fundal Coloboma, Diabetic Retinopathy
Optic Nerve	Optic Neuropathy (Traumatic, Ischaemic, Congenital), Glaucoma
Ocular Motility	Squint, Nystagmus
Globe	Microphthalmos, Pthisis, Absolute Eye, Retinoblastoma, Atrophic Bulbi, Pathological Myopia or High Refractive errors, Amblyopia
Visual Pathway	Cortical blindness, Delayed Visual Maturation

rehabilitation is tailored to correspond to the type of the visual disability and the individual's expectations.

## Goals of Comprehensive Low Vision Examination and Visual Rehabilitation

- Identify and evaluate the cause of low vision
- Assess ocular health
- Emphasize the need of the patient/ beneficiary
- Clinical Assessment
- Maintain and improve visual function
- Optometric rehabilitation & intervention
- Counsel and educate
- Appropriate visual rehabilitation

### Patient evaluation:

- Patient history is an essential pre-requisite for low vision examination

It should include

- Nature and type of the problem
- Onset and duration of the presenting problem
- Condition-stable or progressive
- Visual difficulties
- Chief complaints
- Visual and ocular history, including ocular history of family members;
- General physical and mental health
- Social history;
- Use of low vision devices or history of vocational, educational or any other training.
- General examination- Details regarding name, age, address, family members, current profession, current academic status, financial status and information about the disorder (cause, time of onset, family history) are equally important.

### 2. Visual acuity Assessment

Distance Visual Acuity Measurement: It not only gives a baseline to monitor the pathology, but also helps to predict the magnification level of the optical devices. It is also essential to establish legal blindness, driving privileges, job eligibility etc.

Snellen, Bailey-Lovie, LogMAR or Feinbloom charts can be used for distance acuity measurement. LogMAR chart is considered to be ideal as there is a uniform progression of letter sizes with a standardized separation of letters.

Specific activities customized as per the need of profession of the patient should be checked.

- Blackboard/TV for school going children
- Recognising faces or reading bus number or metro stations for adults
- Photophobia from sunlight, glare from car light in night must be recorded.
- Need for different lights in different environments must be checked for proper low vision aid trial.
- Mobility must be noted; if the patient is independent or requires support in familiar or unfamiliar locations.

Near Visual Acuity Measurement is of paramount importance as most low vision patients struggle with reading. It is important to specify the near point acuity with the reading distance.

### 3. Refraction

All visually impaired patients should undergo refraction to ensure optimal correction for achieving best corrected visual acuity. Most low vision devices are used in conjunction with refractive correction. The presence of uncorrected presbyopia or significant uncorrected refractive error could affect success with low vision devices.

#### Tips for Refraction in patients with low vision:

- ✓ Auto-refractors have limited use, due to media problems or eccentric viewing (off axis fixation).
- ✓ Previous glasses can be a good starting point
- ✓ Keratometry can be useful to determine the amount and axis of cylinder.

Patient may have difficulty in fixation.

- ✓ Retinoscopy is most useful tool for refraction for low vision, especially if the patient is poor responder.

Amount of magnification can be calculated based on the present visual acuity and the required visual acuity

- If VA is measured in a LogMAR notation:

$$\text{Magnification} = (1.25)^n$$

Where n = number of steps

If the present acuity = 0.5 and the required acuity = 0.1

$$\text{Then Magnification} = (1.25)^4 = 2.44x$$

- Magnification required =  $\frac{\text{Required VA}}{\text{Present VA}}$

In Snellen notation to improve from 6/60 to 6/6

$$\text{Magnification required} = \frac{6 \times 60}{6 \times 6} = 10x$$

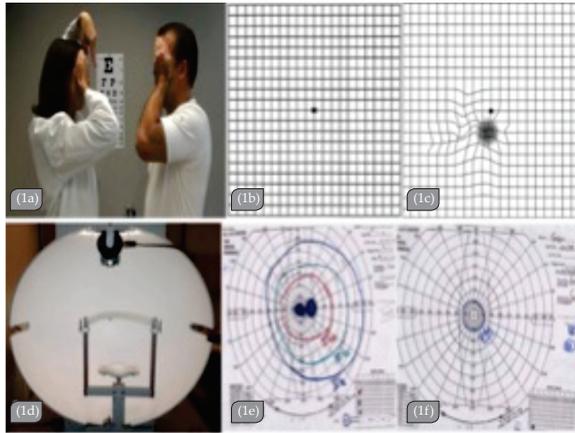
### 4. Ocular Motility and Binocular Vision Assessment

Gross assessment of ocular alignment, binocularity and stereopsis is needed.

### 5. Visual Field Assessment (Figure 1)

The size and location of the scotoma can affect reading ability, despite appropriate magnification and visual acuity improvement. Visual field assessment is important for orientation, mobility training, to guide patient for preferred retinal fixation or environmental modifications Assessment can be done using:

- Confrontation method for gross field defect is evaluated.
- Amsler or threshold Amsler grid assessment - The presence of significant distortion may hamper the quality of vision.
- Goldman Perimetry – It is very useful to quantitatively locate the size and extent of scotoma, to evaluate tunnel vision or peripheral visual field loss.



**Figure 1:** Visual field assessment in a patient with low vision. (A) Confrontation method for visual field; (B) Amsler grid; (C) Amsler grid depicting metamorphsia; (D) Goldman perimeter; (E) Goldman visual field - central scotoma; (F) Goldman visual field - Tunnel vision.

## 6. Ocular Health Assessment

- External examination (adnexa, lids, conjunctiva, cornea, iris, lens, and pupillary responses)
- Biomicroscopy (lids, lashes, conjunctiva, tear film, cornea, anterior chamber, iris, and lens)
- Tonometry
- Central and peripheral fundus examination under dilated pupils, unless contraindicated

## 7. Supplemental Testing

- Glare testing - Patients with albinism, cataract, posterior capsular opacification, aniridia, corneal opacities, corneal edema, glaucoma, lasered proliferative diabetic retinopathy, etc may suffer from glare. Testing glare acuity signifies the need to add filters or contrast enhancers to improve the distance vision. Glare disability can be tested objectively by using glare acuity tester and auto refractors, or subjectively by patients' complaints, comparing the visual acuity with or without illumination in vision chart.
- Contrast sensitivity is related to the visual functioning more closely than visual acuity. Contrast assessment can be done with Pelli-Robson contrast sensitivity chart at one meter, Lea contrast flip chart, Hiding Heidi contrast test chart. A patient with low contrast acuity will have to be prescribed a low vision aid with higher than expected magnification, higher illumination and/or absorptive filters or typoscopes.
- Color vision Testing - It can be done by Ishihara's pseudoisochromatic color plates, or by asking the patient to discriminate, match or sort out various color threads or buttons.
- Electrophysiological tests (Electroretinogram (ERG), Electro-oculogram (EOG), Visually Evoked potential (VEP)) - It is very helpful in patients of cortical blindness, LCA, mentally retarded patients, infants or kids where the visual acuity cannot be estimated subjectively and has a poor visual prognosis.

## Prescription of Low Vision Aids (LVA)

Before prescribing LVA in a patient, we need to define the patient's goals and develop his skills in using these devices. The basic principle of all optical low vision device is magnification. Magnification can be achieved in four different ways (Table 2).

### I. Near Optical Low Vision Devices:

1. Spectacle magnifiers (Figure 2) are high powered convex lenses that are prescribed as reading glasses. They can be spherical, aspheric with and without base-in prisms. Reading material is held at a distance that is equivalent to the focal distance of the lens. Major disadvantages are fixed close reading distance and a constricted field of view.
2. Hand held magnifiers (Self-illuminated and Non-illuminated) (Figure 3) are plus lenses that are held in front of the spectacle plane. It is convenient for short tasks like reading signs, labels, prices, books, identifying money etc. It has a limited field of view and requires good hand eye coordination.
3. Stand magnifiers (Figure 4) are mounted on a rigid stand. The patient needs to place a stand magnifier on the reading material and move across the page to read. A reading stand is recommended with this kind of magnifier. They are preferred in patients with constricted visual fields or central visual field loss. Too close reading posture makes it difficult to be used for long hours.

**Table 2: Types and principles to achieve magnification**

No	Type of Magnification	Principle	Formulae
1	Relative Size Magnification (RSM)	Enlargement of the size of the object No optical system	$RSM = \frac{\text{New Size}}{\text{Reference Size}}$
2	Relative Distance Magnification (RDM)	Moving the object closer to subtend a larger angle on retina Optical system required	$RDM = \frac{\text{Reference Distance (r)}}{\text{New Distance (d)}}$
3	Lens Vertex Magnification (M)	Angular Magnification	$M = \frac{\text{angle subtended by image at eye}}{\text{angle subtended at unaided eye}}$
4	By Telescopic systems	By electronic systems	



**Figure 2:** Spectacle magnifiers (A) Different types of spectacle magnifiers; (B) Close reading with reading magnifier.



**Figure 3:** Hand held magnifiers (A) Hand Held and Foldable magnifiers; (B) Position while reading with a hand held magnifier; (C) Self-Illuminated and Non-Illuminated hand Held Magnifiers; (D) Magnification with magnifier.



**Figure 4:** Stand magnifiers (A) Cut away stand magnifier; (B) Adjustable stand magnifier; (C) Reading stand; (D) Close reading with stand magnifier; (E) Dome magnifier; (F) Neck magnifier.

4. Digital Devices- This linear magnification device is controlled by a zoom lens attached to the camera. This helps in obtaining a higher magnification with a normal reading distance by varying the addition and the reading distance. Near work such as writing and typing can be done more easily with this device. Closed circuit television (CCTV) may be the only choice for patients whose vision is too impaired to benefit from routine optical aids. These devices could be a hand held (Figure 5) or a desktop magnifier. A study has reported a faster reading speed in patients using CCTV than other optical devices.<sup>7</sup> With the recent technological advances in the field of LVR, several portable electronic low vision devices have become available that are considered to be cost-effective than most other low vision aids.<sup>8</sup> Some of these devices are Optelec Compact+, Optelec Compact 4HD, Schweizer Mag43, Eschenbach Mobilux Digital

and OrCam. These electronic devices are capable of recognizing text, objects, currency etc.<sup>9</sup>

Off late, devices like smart phones, tablets and electronic readers are being increasingly used as low visual aids. Incorporated with the features of zoom, high-contrast screens, invert colors and bespoke apps, these internet-ready devices have proved to be valuable tool for low vision patients.<sup>10-12</sup>

## II. Low Vision Devices for Distance:

1. Telescopes (Unicocular or Binocular) (Figure 6) magnify the apparent size of distant objects, making them appear closer to the patient than they actually are. The optics is based on two principles (Table 3) - Galilean or Keplerian. Telescopes are expensive and have restricted field of view. Bioptic Telescope is a system where the telescope is attached to the top of a pair of eyeglasses. It allows the wearers to switch their sight between their "regular vision" and the magnified vision of the device by just a slight tilt of the head, similar to how one uses bifocal spectacles.<sup>13,14</sup>

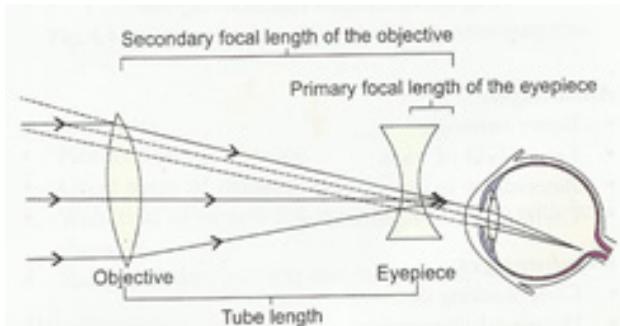


**Figure 5:** Hand held video magnifier



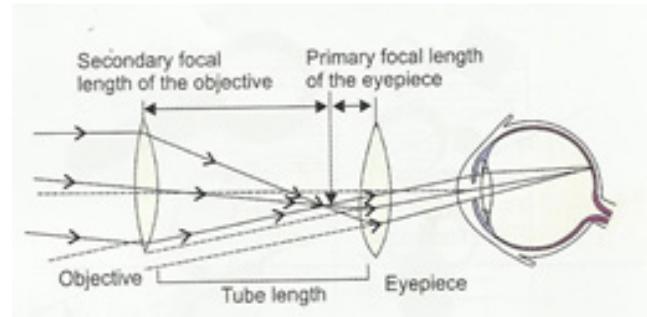
**Figure 6:** Telescopes (A) Uniocular hand held telescope; (B) Spectacle mounted telescope.

Table 3: Principles of telescopic system



#### Galilean Telescope

1. Eyepiece – negative lens, Objective – positive lens
2. Image – virtual and erect
3. Loss of light reduces the brightness of image to some extent
4. Field quality is relatively poor



#### Keplerian Telescope

1. Both Eyepiece & Objective – positive lens
2. Image – real and inverted
3. Loss of light is more in the system-greater loss of brightness
4. Field quality is relatively good

2. SEE TV Spectacles are also known as TV glasses and comes with 2.1 to 3x magnification. It is useful in students while watching blackboard, desktop or television. They are commonly used at a distance of 3 metres.

#### Non-optical devices for visual rehabilitation

Non-optical devices improve the visual function by altering illumination and light transmission, reducing reflection and glare, enhancing contrast, and linear magnification.

Non-visual or non-optical devices are used for profound visual impairment to assist in supplementing and improving visual function.

- Medical devices with signal or voice
- Reading machine
- Travel device
- Talking book, clock, calculator and watches.
- Typewriter –Audiologic equipment.
- Filters or tinted lenses

These include notex, typoscope, signature guide, lamp, filters/tints, contrast enhancers to aid activities of daily living and enlarged fonts.

There are certain things to be kept in mind before prescribing low vision aids. Patient's expectations should be discussed and the limitations of the prescribed device should be explained. The power of magnification prescribed should be as low as possible in order to give a wider field of view. After prescription of LVA, a thorough training should be conducted to enable the patients to use the devices smoothly. The family should be counseled for environmental modification and supportive services to utilize the residual vision maximally.

Low vision rehabilitation is a new emerging sub-specialty that aims to improve the functionality and independence of patients with visual impairment using a multi-disciplinary approach. Despite the advances in the field, uptake of

low vision services still remain low due lack of awareness amongst the patients as well as the ophthalmologists.<sup>15-18</sup> Hence, a low vision clinician should be aware of the range of specialists, vocational services and community based services needed by people with low vision.

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