Demonstrating and Teaching Low Vision Aids
Definition

• A low vision aid is any device included non-visual devices that enables the low vision patient to improve performance.
Optical aids

- usually are convex lens magnifier, mirror, prism, or electronic devices.
– Non-optical aids are those which can improve visual function, for instances, specific illumination, light transmission, reflection control, enhanced contrast, and linear magnification.
Non-visual devices are used by profound visual impairment to replace visual acuity. This is often requiring a referral to evaluate.

- Medical devices with signal or voice
- Reading machine
- Some travel device
- Talking book, clock, calculator and watches.
- Typewriter
- Audiologic equipment
Type of magnification

• Relative distance magnification

Figure B.4. \( d' < d, \frac{h}{d'} > \frac{h}{d} \). Decreasing the distance increases the angle size.
- Relative size magnification

Figure B.3. \( h' > h, h'/d > h/d \). Increasing the size of the object increases the size of the angle.
Angular magnification

\[ M = \frac{\Theta'}{\Theta} = \frac{y}{fe} / \frac{y}{d} = \frac{d}{fe} = d(Fe) \]

\[ d = \text{reference distance (m)} \]
Organize your low vision exam

- Usually you may need more than one visit to complete your low vision care. The first visit is diagnostic in nature. The others will be the follow-up visits, but after three such visits the case should be reviewed to certain the patient’s objectives were expressed and interpreted realistically. You should allow approximately 1 ~ 1.5 hours of examination time with a new low vision patient in the first visit. At the end of the first visit you should:
• Know the general refractive status and have a specific plan for helping the patient with optical and non-optical option
• Know the relationship between the disease and the vision related functional difficulties
• Identify all other community rehabilitation sources appropriate for the patient
A loaner lens system

• Low vision clinics usually include a loaner lens service. Patient may take aids home for comparison and trial that they can return in 2 weeks for further supervised instruction before they make decision. The loaner lens system is worth in patient satisfaction.
• The following visit typically takes 30 ~ 45 minutes for reviewing the patient’s history, checking if the patient is able to use prescribed aids properly, and performing tests to determine any functional changes in order to modify your plan for the patient.
Low Vision Care

Know the outcome: Goal-oriented history
Evaluate and manage: Examination and follow-up
Monitor the outcome:
   In office—SOAPS format for record keeping (Subjective, Objective, Assessment, Plan, Subjective)
   At home—telephone calls to check patient progress, and patient diary
Modify direction when needed:
   Approach—different forms of magnification or minification
   Outcome—reality check, modifying unrealistic goals
Referral for other services

• An additional follow-up visit may be necessary for the person who need services to complement the low vision evaluation. This may be made at the first visit if it become obviously. These referral services are:
• Medical care
• Psychological evaluation
• Audiological evaluation
• Social services
• Rehabilitation training / or vocational evaluation and training
• Educational evaluation
• Orientation and mobility instruction
• Library services, including for large-print books, talking books and tapes.
• Recreation
• Centers for old adults
Revisits

• Low vision patient should be seen annually unless they are stabilized and have no further difficulty.

• All patients should be advised to check their health and should they notice a change in vision to request a reevaluation for low vision aids.
• Patients look forward to coming for checkups. The clinician cannot offer anything new and they are basically satisfied with their aids, they wish to come for reassurance and to ask about new discoveries.
  – Although reading is easily replaced by radio, television, and talking tapes, this patient may accept a hand magnifier if only to read a program or a bulletin.
Instruction room

• Table with non-glare top
• Lamp
• Reading stand, reading materials with large print
• Optical aids
• Pamphlets on low vision and eye disease
Consider aids in ordering categories

- Spectacles
- Hand held magnifiers
- Stand magnifiers
- Reading telescopes
- Closed-circuit television (CCTV)
- Distance telescopes
- Other new aids that received media publicity
Solving patient’s near visual concerns

• Explore and define the patient’s goals
  – Daily living, educational, vocational, and recreational tasks

• Determine the patient’s functional vision

• The patient’s skill in using the devices, as well as the advantages and disadvantages of the various devices, to determine the most appropriate magnification device. (the equivalent power of each device)
Predict near magnification

- Trial and error approach frustrates and tires both the patient and practitioner.
- Calculate the proper amount of magnification required by the patient.
  - The patient’s refractive error has been fully corrected otherwise will cause discrepancies in the expected results.
• “Reciprocal of vision” rule
  – Use the patient’s best corrected DVA and near target size: for example, a patient’s best corrected DVA is 20/200, and wants to read 20/50 print size. The Mag. is 200/50 = 4X, then the required equivalent power = 4 x 4 = 16D
    ( \( M = D/4 \) )
• It is not recommended that distance VA be used to predict near magnification because there are many variables that prevent a true relation between them. For example, accommodation, pupil, the size and location of scotoma, as well as cornea or lens opacity.
M notation

• Define patient’s near VA with M notation
  – 1M target is generally considered the most print size to read (e.g., newspaper, magazine), however there is a difference between VA and reading acuity. 1M can be used a starting point.
  – When evaluating near vision for low vision patient, an attempt made to provide enough magnification so that the patient can read his goal material with some comfort and fluency.
– For example 1: if patient’s near VA is 0.40/4M, then what lens would be required to read 1 M?
– Sol: 4M/1M = 40cm/? so, ? = 10cm, this is +10D lens for the patient to hold the material at 10cm to read 1M print
– Example 2: how about if the patient’s near VA is 0.24/3M, what lens is needed to read 0.8M print?
  Ans: 15.63D
• Use the predicted power to test the patient if he can read the other material such as a newspaper which has been found to have an average contrast about 65.4%
Convex lenses

• Monocular and binocular spectacles
  – Standard full diameter
  – Half-eye frame
  – Attached loupe

• Types of glasses
  – Spheres
  – Spheres with prisms
  – Aspheric lens
  – Doublet lenses
• Optically, the convex lens in spectacle form (microscope) is a simple converging system
  – Acting on divergent ray from near objects to zero vergence (parallel rays)
  – The image on retina is enlarged, and no accommodative effort is required
• Pt holds print at the focal distance of the lens, the system can magnify a specified amount
  – A 16 diopter lens is often called a 4 x lens.
• The working distance of a spectacle lens is fixed
  – Reading material can be held no farther away than the focal distance of the lens
  – May be held closer if pt has residual accommodation
• Color and peripheral aberrations may be minimized by aspheric design and use of doublet system
• Monocular spectacle lens has from 1 diopter to 60 diopter
• Binocular spectacle lens usually from 4 to 12 diopters with base in prisms in each eye to aid convergence
• Evaluate the patient’s reading rate and reading skills
  – Difficulty in reading may suggest a need for more magnification or a poor reading skills.
• Note the changes in illumination affect the patient’s reading rate.
• Evaluate whether the patient does better monocularly or binocularly.
• Note the patient’s preference. Does the device enable him to meet his reading goals?
Spectacles

• First introduce b/c it is a familiar type and frequently prescribed
  – Use the better eye for near, occlude the other eye if there is diplopia
  – If pt appreciates binocular correction, use base in prism half-eye frame
  – Help pt hold the reading material at the focal distance, put a card or typoscope if needed
  – Adjust the light so that it falls directly on the page
• As the pt tries to read, the examiner observes the pt’s reaction to the close distance, looking for signs of acceptance.
  – If positive reaction implies that head-borne, such as high add bifocal or clip on loup, would be acceptable
Monocular aids

- Convex sphere with full diameter, usually has peripheral aberrations, is least expensive (to 20 diopters)
- Aspheric sphere with full diameter to minimize peripheral aberrations (12 to 20 diopters)
- Clip on loupes like bifocals, they are low cost and removable
- Half eye frames, allowing unobstructed distance vision
Binocular aids

• Base in half eye glasses
  – Low powers; +4.00 with 6 BI OU; +5.00 with 7 BI OU
  – Higher powers, +6.00 with 8 BI OU; +8.00 with 10 BI OU; and +10.00 with 12 BI OU
  – Above +12.00 is a special order
  – Conventional bifocals to + 6.00 diopters of add; decenter 1 mm OU for each diopter of add
Advantage of spectacles

• The most acceptable
• Free both hands to hold or to write
• Has widest field
• Useful for prolonged reading
• Can be useful for tremors pt
• Can be monocular or binocular
Disadvantage of spectacles

- Fixed reading distance
- Fixed optical center (for eccentric viewing or head tilt)
- Writing difficult
- Reduced reading speed
- Obstructs illumination
Consideration

- Always presented first to the pt
- Most are monocular unless the VA is 20/200 or better and nearly equal in both eyes
- Selection of high add bifocal
  - May be more easily tolerated by young people and significant refractive error
  - May interfere with the lower field when walk, especially for constricting field disorder pt.
Dealing with rejection

- Usually for old people:
  - Due to prescribe the maximum add for the initial prescription, unfamiliar reading distance and slow learning time

- Use weaker add for large print or hand and stand magnifiers
Hand magnifiers

• The virtual image comes from infinity if the object is kept in primary focal plane of the lens; no accommodation is required and maximum magnification is achieved

• The distance from the eye to lens is independent of lens power
  – May affect the reading field
Hand magnifiers

• To get the full effective power, pt should wear distance Rx

• Show the pt to begin by placing the lens on the page, and raising it until the image large and clear without distortion, adjust the light

• Show how the lens at it’s focal distance looks like, as pt moves far away or closer without changing the magnification, but the field change. Move the lens closer to the page decreases magnification
• Present several types of magnifiers, both stronger and weaker than the calculated strength

• Unless aphakic or high myopia, encourage pts also to try magnifiers without distance Rx to decide their convenient
• Rejection of a magnifier is usually expressed by exaggerated hand motions or head turns

• Do not easily let pt reject magnifier initially. Move pt’s hand and lens closer to the eye and push the reading card up to the focal distance to let pt try again
• If the pt using a hand magnifier looks through a bifocal add, the lens must be moved closer to the page and the head moved closer to the lens.
  – The sum of powers is decreased
• Some magnifiers are rated according to magnifying power
  – 4 diopters = 1 x

• Others according to diopter power
  – The magnification is varies with the manner of use. The true dioptic power is more significant in clinical use
  – Available in a range of 3 to 68 diopters
Advantages of hand magnifier

- Greater working range
- Easy to manipulate even for eccentric viewing
- Useful for short term tasks
- A conventional familiar aids
- Can be used with distance glasses, without or bifocal add
- First choice as a training aid
Disadvantages of hand magnifier

- Reduced field of view as compared with spectacles
- Occupies both hands
- Reduce reading speed
- Difficult to use with tremor pt
- Must held at correct focal distance
Consideration

• Widely accepted for tasks
  – For regular reading and short term viewing
• Try with a battery operated light magnifier
• Pt with decreased reading acuity may be satisfied with a stronger hand lens than re-learning a new technique with a spectacle aid
• May be the choice for pts have constricted field or dense central scotomas

• A pt should be encouraged to try more than one model and several strengths
Dealing with rejection

• As VA fails, the stronger hand magnifier becomes less useful
  – Acceptance for reading is greatest between 5 and 16 diopters
  – Above 20 diopters, pt begins to lose the advantage of greater eye to lens distance
• Stand magnifier should be introduced
Stand magnifiers

• Fixed-focus stand with eye at a distance to the lens
• Stands designed to be used with eye close to the lens
Stand magnifiers

• If pt responds well to a hand magnifier, it is tempting to stop there, however, a pt should be exposed to every form of aid and may show an unexpectedly response
• Pt must wear a reading glasses or a standard bifocal
• Introduce a stand with power in the range of spectacle and hand magnifier
• Show pt the correct distance from the lens. If pt lifts a stand from the page, either is lens too weak or hand magnifier is preferred
• 立式放大鏡的設計是為使鏡片穩定、較貼近物體以減少鏡片產生的周遭收差效應，這可增加看的品質，一般是設計配合舒適的閱讀距離以保有恰當的鏡片離眼睛的距離，但隨著每個人習慣與使用的近距加入度，立式放大鏡的規格變得較為複雜，需查對各不同廠家的標示。
### TABLE 6-1
Various Parameters Needed to Understand How Stand Magnifiers Are Used and Work in a Clinical Setting

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<th>Name of device</th>
<th>Manuf catalog number</th>
<th>LH catalog number</th>
<th>Manuf label power</th>
<th>LH power (TDP)</th>
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<th>L-1 (cm)</th>
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</table>

Columns 6, 7, 8, and 9 are a compilation of prior published values, actual measurements, or calculations from other variables, made by R Cole, R Rosenberg, B Freed, and K Citek.
Example

• 有+10D鏡片架設離平面5 cm高的立式放大鏡，由算式虛像位置 \( U' = U + F = -20 + 10 = -10D \) ，這是在鏡片下10cm處，如果你想：

1. 離立式放大鏡30cm閱讀，那就戴+2.50D加入度，此時立式放大鏡與你的近用眼鏡的總對等鏡度是\( Fe = 10 + 2.5 - 0.3 \times 10 \times 2.5 = +5.0D \)
\[ F_1 = +10.00 \text{ D} \quad u' = -10 \text{ cm} \]
\[ F_2 = +2.50 \text{ D} \quad TM = 2X \]
\[ F_e = +5.00 \text{ D} \quad h = 30 \text{ cm} \]

**FIGURE 6-14** 2X stand magnifier with a +10 D lens.
2. 貼近立式放大鏡閱讀，需戴+10D加入度，總對等鏡度是：

$$Fe = 10 + 10 - 0 \times 10 \times 10 = +20.0D$$
Figure 7-6. An illuminated stand with a flexible arm and a low-powered lens can help a low vision patient with writing, sewing, and typing.
• Set the lens closer to the page than its focal distance to reduce peripheral aberrations
  – The emerging rays from the stand are not parallel but divergent, requiring accommodative effort or proper reading add to bring the image to focus
• Stands are available in powers from 3.5 diopters to 20 x (equivalent power 68 D)
Advantage of stand

- Predictable focus
- Reading distance relatively normal
- Useful for specific short term detailed tasks
- For people cannot hold hand magnifier and for children
- For specific eye condition such as constricted field
- Can be self illuminated source
Disadvantage of stand

- Reduced field: need to move closer to the stand
- Posture may be awkward and tiring
- Lens aberration if view from an angle
- Limited number of aids over 20 diopters
Consideration

- Can adjunct to spectacles and hand magnifiers
- For pt who are unable to hold hand magnifiers or who cannot tolerate close reading distance
- Most prescribed are COIL 9 diopter and 17.6 diopter and illuminated stands
- For first few grades of school children
Dealing with rejection

• Due to reduce field and cut down on illumination, and postural discomfort
  – Introducing focusable and self illuminated magnifier. Postural fatigue may be relieved by tilted reading surface as reading stand
  – Pt may accept during the instruction period or at a later visit when interests are more explored

• Continues to object, a telescopic aid should be introduced
Reading telescopes

• Spectacle mounted (bioptic)
• Nonfocusable full diameter and wide angle Galilean spectacle telescopes with fit over caps for intermediate or near vision
• Focusable prism monoculars and Galilean monoculars
• Expanded-field, focusable prism telescopes
Reading telescopes

• If pt requests a greater working distance than convex lenses allow, reading telescopes (telemicroscopes) should be presented
  – Usually used for some special vocational requirement such as reading music, dials, writing and typing etc.

• There are some types of telemicroscopes for close range
• Critical focal range and reduced diameter of field when compared with a convex lens spectacle
中短距離之管狀鏡

• 將可調整焦距的管狀鏡裝設於眼鏡框架，或在遠距管狀鏡前加套上閱讀鏡蓋，即可做為固定中短距離的輔具。如2.2X之望遠管狀鏡加上5D閱讀鏡蓋後，可看20cm處，其對等鏡度相當於2.2x 5 = 11D。比起使用11D的放大眼鏡，需在10cm距離以內好多了。
Telescopes for distance

• Distance telescopes
  – Use angular magnification to enlarge the image
  – There are two types of systems:
  – Galilean:
    • Convex objective lens combined with a concave ocular lens, the concave ocular lens always has the higher power
    • Produces a real, upright image when separated by the difference in their focal lengths
Distance telescopes

• Distance telescopes are presented last unless a person has specifically requested aids for distance or intermediate vision early in the exam or history
• Avoid confuse pt by the complexity of aids
• There are three types of telescopes for distance
• Galilean (monocular or binocular, hand held or spectacle mounted, focusable or non-focusable)
• Prism (Keplerian)
• Binoculars (hand-held)
• Show the pt a monocular telescope.
  – Start with a simple Galilean telescope (2.5X) to evaluate the pt’s initial reaction
  – Demonstrate stronger prism monocular if necessary
  – Demonstrate spectacle-mounted telescope, nonfocusable and focusable types
  – Demonstrate binoculars
• Both negative and positive response have to analyze
• To hasty present a sophisticated device may confuse the pt
• Cosmetic aspect must be dealt with realistically
• Pt must be aware of the effect of reduced field
• Cost also must be considered
• For the average pt, the telescopes is better left until the second visit
• Keplerian
  – Convex objective and ocular are convex lenses
  – Prisms are needed to erect the inverted image
  – The field, light gathering and optic are often superior to a Galilean system
  – Most prism monocular is focusable, which extends their useful range from infinity to reading distance
• The field of view is widest when the telescope is held as close as possible to the eye

• The light gathering capability of the telescope is in proportion to the diameter of objective lens (the diameter of exit pupil)
  – The image of a 7x50 telescope is brighter than a 7x35 telescope
Advantage of telescope for distance

• The only optical system that provides magnification for distance
• Useful aid for independent travel, television, sporting events, work in school, and CRT screen
Disadvantage of telescope for distance

- Reduced field
- Ring scotoma
- Difficult to find objects and focus rapidly
- Hands are not free
- Extra training required
- Not successful with constricted field
Consideration

• Base on individual’s requirements, skill, and visual field
• Usually not demonstrated until reading aids have been shown
• If pt has specifically requested better distance vision, telescopes are introduced after the refraction
• If the pt has never used a telescope, start with a simple Galilean, 2.5x or 2.8x, which is small and easily focused
• Galilean units magnify from 2.5x to 4x
• Keplerian can be designed in a greater range from 2.75x to 10x
• A person need not be always given maximum magnification to 20/20 vision
  – Most street signs are 20/70 vision
  – A person with 20/100 would need only 2x telescope to achieve 20/50 acuity
望遠鏡

• 最佳矯正視力約在0.2以上者，給與2.5 X 望遠鏡可望提升視力2.5倍，即0.5。
• 視力小於0.2至0.08，可給4X ~6X
• 視力至0.05 ~0.03時就應達8X ~10X
• 當視力差於0.02時，望遠鏡可能不大適用，這些患者可能需要其他的特別輔具或訓練。
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<td>4–6×</td>
</tr>
<tr>
<td>20/300–20/600</td>
<td>8–10×</td>
</tr>
<tr>
<td>≥20/600</td>
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Dealing with rejection

- If the level of distance acuity is very low, or is not adequate for safe traveling
  - Orientation and mobility techniques may have to substituted
  - The pt with a field constricted condition may have difficulty
  - Most low vision pt have difficulty focusing stronger than 10x because of the image magnification and parallax
  - May try binocular telescope with steadily held
Closed circuit television

- The linear magnification is controlled by a zoom lens attached to the camera
  - Magnification up to 60x may be achieved
  - If pt views with 6x from 40 cm wearing 2.5D add, the power is 6x2.5 or equivalent to a 15 diopter spectacle, if pt view closer with 5.00D add at 20 cm, then the power is 6x5 equal to 30 D spectacle
Closed-circuit television

- Pt needs a greater working distance particularly for specific task requirements
- CCTV may be the only choice for pts whose vision is too impaired to benefit from optical aids
- CCTV is often shown at the second visit in the interest of time and pt’s energy
電子擴視系統

- 有多種型態:
  - 桌上型
  - 電子眼
  - 攜帶型
  - 遠近兩用型
Advantage of CCTV

- Magnification from 2x to 60x
- Can obtain high magnification with a more normal reading distance by varying add and the reading distance
- Writing and typing are done more easily
Disadvantage of CCTV

- Reading speed may be slow
- Can nor be carried around
- Need to develop skill for successful use
- expensive
Consideration

• Television is an important aid in vocation and for students and professionals with a great deal of reading to do
  – Can work with computer terminals, some systems offer large print computer programs

• CCTV should not be a pt’s initial experience with aids, even if prescribed, pt may also need other properly optical aids
Absorptive lenses

• Actually are filters, can make a scene appear darker or brighter, provide increased contrast without altering color
  – Color lenses have effect on opposite color, for example, a red lens transmits red light but absorbs or blocks blue and green light
• Neutral density lenses reduce light to the eye without altering color
  – For pt who complain photophobia or intolerance to light
• Yellow, orange, and red lenses I general increase contrast
• For low vision pt the benefits of absorptive lens are
  – Decrease discomfort glare
  – Reduce veiling glare
  – Improve adaptation to change in illumination
  – Improve contrast acuity
非光學輔具

• 大字刊物、有聲書或日用品，閱讀機、語音導引系統

• 對比設計、環境、照明

• 光的控制，如隔柵、閱讀架、遮光板、帽子等
The Weather Bureau forecasts colder temperatures for tonight. Warm weather is expected Thursday. Tonight will be the coldest in the area. Temperatures will hit about 32°F.

**Figure 3.17.** A typoscope not only isolates letters and words but also reduces background glare.