MAGNIFICATION



What is magnification ?

Magnification is a method of increasing the size of the image so that enough of the retina is stimulated to send an impulse through the optic nerve allowing an object to be perceived.

There are a number of different means via which this can be achieved:

1. Relative Size Magnification

2. Relative distance Magnification

3. Angular Magnification

Angular : it is the apparent size of the object compared with true size of the object seen without the device.eg. Telescopic system



Angular magnification M = ω / ω

Relative size: by making the object appear bigger (no accommodation required) eg. CCTV



Relative distance: by bringing the object closer (requires good accommodation) eg. magnifiers





Low vision optical devices for near



Useful for near work



- Designed to be held close to the reading material to enlarge the image
- The eye lens distance should be minimum to achieve larger magnification
- Two types:
 - > Hand magnifier
 - > Stand magnifiers.



Hand magnifiers



• Available from + 4.0 to + 40.0 D.

- Available in three designs:
 - > Aspheric reduces thickness and peripheral distortion
 - Aplantic flat and wide distortion free field and good clarity
 - > Biaspheric eliminating aberrations from both surfaces

□ Most patients accept upto 6x magnification



Aspheric

Aplanatic

10X Achromat - Aplanat Harald Schneider since 1949®



Handheld Magnifiers



Advantages

- > The eye to lens distance can be varied
- > Patient can maintain normal reading distance
- > Work well with patients with eccentric viewing
- Some have light source which further enhances vision
- > Easily available, over the counter

Disadvantages:

- > It occupies both hands
- > Patients with tremors, arthritis etc have difficulty holding the magnifier
- > Maintaining focus is a problem especially for elderly
- > Field of vision is limited





Stand magnifiers

The magnifiers are stand mounted



- The patient needs to place the stand magnifier on the reading material and move across the page to read
- ☐ Has a fixed focus



Advantages :

- > They are a choice for patients with tremors
- > Arthritis and constricted visual fields.

Disadvantage:

- > Field of vision is reduced
- > Too close reading posture is uncomfortable for the patient
- > Blocks good lighting unless self illuminated



It is a cylinder reading bar which lies flat on a page.

It elongate the letter but does not separate them

Fresnel type magnifiers

A Fresnel lens magnifier is a thin plastic in which the surface is reproduced in a series of rings or zones



It is produce in an expensive manner in almost any size.

The no. of rings per inches controls the resolution and effective magnification up to high as 19x for ophthalmic purpose

Clip-on Loupes

Loupes are magnifying devices. A clip-on loupe attaches to glasses, and allows a person to be hands free while viewing text, the computer screen, sheet music, or hand work. Stronger loupes (over +10D, or diopters) can be used only with one eye, whereas weaker loupes can be used for both

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- **Some advantages** of clip-on loupes are:
- They allow the person to retain their correction from their prescription glasses while using them. This is especially helpful if the person has strong myopia (nearsightedness) or astigmatism.
- Your hands are free—not needing to hold a magnifier.
- They are convenient and easy to use—flip them up when not using them, bring them down in front of your glasses when you are using them.
- □ They are inexpensive.

Magnifying spectacles

 High plus reading glasses to magnify the images



□ Given as an add to the best distance refraction

Reading distance is calculated by 100 divided by add

□ Magnification is $1/4^{\text{th}}$ the power of the lens.

□ Used for near work

Amount of add needed depends on the accommodation and the reading distance Reading add can be predicted using the Kestenbaum rule i.e. the amount of add needed to read 1M print is the inverse of the visual acuity fraction.

However usually greater add is required than predicted as the patient also has reduced contrast sensitivity

If the patient is monocular, the poorer eye may be occluded if it improves the functioning

When binocular corrections are needed :
Base in prisms are added to compensate for convergence angle.
Optical center may be decent red

• Aspheric lenses may be used to reduce lenticular distortion

Advantages :

- > Hands are free
- > Field of view larger when compared to telescope
- > Greater reading speed
- > Can be given in both monocular and binocular forms
- > More portable
- > Cosmetically acceptable

Disadvantages:

- > Higher the power, closer the reading distance
- > Close reading distance causes fatigue and unacceptable posture
- > Patients with eccentric fixation are unable to fix through these glasses

Telemicroscopic Glasses

Telemicroscopic glasses are telescopes that are adapted and made for tasks at near, rather than at distance, like most telescopes. They are available in many different designs. Telemicroscopic glasses, in contrast to strong magnifying reading glasses, allow a more comfortable working distance when reading, using the computer, seeing sheet music, doing hand work, playing cards, and other tasks.



- Some advantages of telemicroscopic glasses are.
- They provide a more comfortable working distance than magnifying reading glasses or clip-on loupes.
- Your hands are free—not needing to hold a magnifier.
- They usually have excellent optics, and provide an image that is very crisp.

Low vision optical devices for distance





- Work on the principle of angular magnification
- Telescopes with magnification power from 2x to 10x are prescribed
- They can be prescribed for near, intermediate and distant tasks
- Field of view decreases with magnification
- Types:
 - > Hand held monocular
 - > Clip on design
 - > Bioptic design: mounted on a pair of eyeglasses



Principal

> Telescopes consist of two lenses (in practice two optical systems) mounted such that the focal point of the objective coincides with the focal point of the ocular.

Objective lens is a converging lens

Galilean telescope	Keplerian telescope
The eye piece is a negative lens and the objective is a positive lens	Both eye piece and objective are positive lens
Resultant image is virtual and erect	Resultant image is real and inverted. Prisms are incorporated to erect the image
Loss of light reduces brightness of the image	Loss of light is more in this system
Field quality is poor	Field quality is relatively good

- Magnification of a telescope is given by the formula $M = f_o/f_e$
- Telescopes can be used to focus near objects by
 - changing the distance between objective and ocular lens
 - Increasing the power of the objective lens



Keplerian telescope

Objective Eyepiec

Advantages:

> Only possible device to enhance distant vision

Disadvantage:

- > Restriction of the field of view
- > Appearance and apprehension
- > Expensive and costly
- > Depth perception is distorted



Hand-Held Telescopes

A hand-held telescope is called a telescopic "monocular," because it is used with one eye and has a single eyepiece. Generally, it is used for short viewing periods, such as reading a street sign, house number, menu board in the restaurant, aisle number in the grocery store, or white board in school. Some people may also use it for tasks that are fairly close, such as reading the bathroom scale, or a price on a shelf in the grocery store.



Some advantages:

- They can be very helpful for viewing a wide range or items at distance, and even some things fairly close up.
- They are fairly inexpensive and are portable.
- They are available in a range of magnification powers.
- They can be kept on a cord around your neck, in a pocket, or purse, for use when desired for "spot" viewing, such as reading street signs outdoors or aisle numbers in a store.





Spectacle-Mounted Telescopes

Spectacle-mounted telescopes are permanently attached to the lens of your eyeglasses.



Some advantages:

- They leave both hands free, as opposed a monocular telescope.
- Therefore, they can be used for longer viewing periods, like viewing television, a program, ball game, or movie, as opposed to a monocular, which can be tiring to hold and difficult to hold steady.
- They appear to bring things closer and magnify things nicely.
- They can be binocular (for both eyes) or monocular (for one eye).
- They are available in a range of magnification powers.

Bioptic Telescopes

- Bioptic telescopic glasses are a type of spectaclemounted telescopic glasses. They are mounted in the upper part of eyeglass lenses.
- Bioptic telescopes in place on eyeglass lenses



- This placement allows the user to look through the bottom half of the lens while seeing most items at distance, and looking through the telescopes at the top of the glasses to see a magnified image.
- Some states, under strictly specified conditions, allow some persons with low vision to use bioptic telescopes for driving.
- In states where this is not legal, some persons with low vision use bioptic telescopes for reading, doing hand work, or other tasks.

Autofocus Telescopes





It allows 3.5X magnification for distance and 4.7X for reading. It focuses automatically from near to far.

It is more costly

It does not constitute the first choice prescription for children.

Various forms are available

- 1. Powers usually available are +4.0, +5.0, +6.0, +10.0, +12.0, +16.0, 20.0 and +24.0
- 2. Binocular corrections are needed –Base in prisms are added to compensate for convergence angle.

Optical quality of the lens should be an aspheric design to eliminate peripheral aberration and provide reasonable field.

The reading glass should be prescribed as an addition over the distance correction.

Angular magnification

Closed circuit television system-CCTV

 Provides projection magnification along with RDM

 Provides magnified image projected onto a monitor screen.



CCTV

- An electronic magnification system for reading & writing
- Incorporates both projection & RDM
- consists of three major components:
- camera monitor movable reading platform
- Best for pt. Having constricted VF, decreased VA decreased contrast sensitivity secondary to glaucoma, RP, ION.