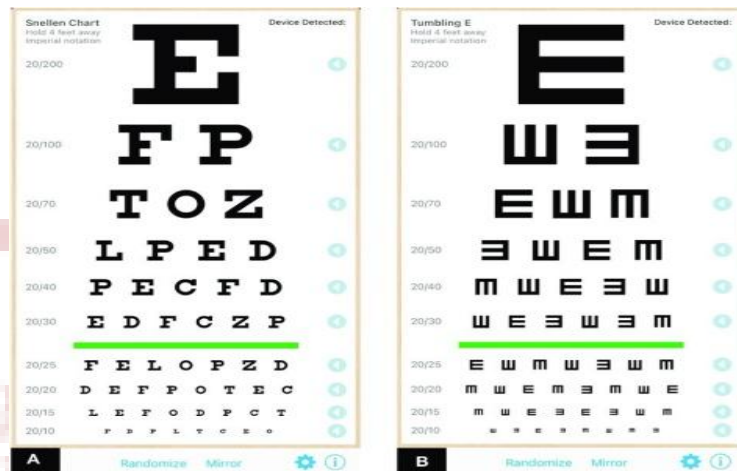

Types of Optical Instruments

There are many optical devices that are used to diagnose eye diseases or the rate of refractive error in the eye. Through this lecture, we shall discuss these optical instruments in detail and learn about their significance, types, and how they are used in various areas of research as well as our daily lives.

- Snellen chart
- Auto refractometer
- Phoropter
- Retinoscopy
- Slit lamp
- Ophthalmoscope
- Fundus Cameras
- Lensmeters
- Manual keratometer
- Tonometry
- Trial box
- Torch Light
- Hand Held Occluder

1. Snellen chart

Is an eye chart that can be used to measure visual acuity. Snellen charts are named after the Dutch ophthalmologist Herman Snellen who developed the chart in 1862. Many ophthalmologists and vision scientists now use an improved chart known as the LogMAR chart but still mostly snellen chart is used in eye OPD's.



2. Auto refractometer

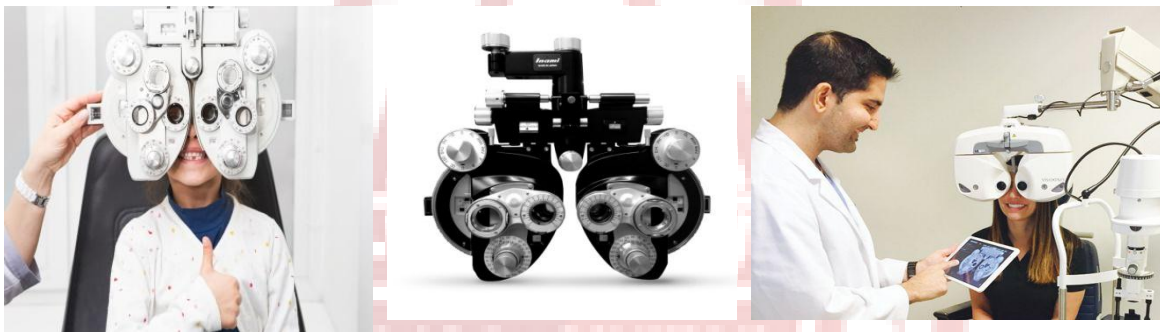
Auto refractometer or Auto refractors An auto refractor or automated refractor is a computer-controlled machine used during an eye examination to provide an objective measurement of a person's refractive error and prescription for glasses or contact lenses. This is achieved by measuring how light is changed as it enters a person's eye.



3. Phoropter

Is an instrument used to test individual lenses on each eye during an exam. If, during an eye examination, your doctor has discovered a vision problem like nearsightedness, farsightedness or astigmatism, it's likely that one of the next steps you'll take will involve a phoropter.

Is an instrument comprised of cylinders, prisms, and lenses that measure the eye's refractive error to help determine and eye prescription.



4. Retinoscopy

Is a technique to obtain an objective measurement of the refractive error of a patient's eyes. The examiner uses a retinoscopy to shine light into the patient's eye and observes the reflection (reflex) off the patient's retina. While moving the streak or spot of light across the pupil the examiner observes the relative movement of the reflex or manually places lenses over the eye (using a trial frame and trial lenses) to "neutralize" the reflex.



5. Slit lamp

Slit lamp an instrument consisting of a high-intensity light source that can be focused to shine a thin sheet of light into the eye. The lamp facilitates an examination of the anterior segment and posterior segment of the human eye, which includes the eyelid, sclera, conjunctiva, iris, natural crystalline lens, and cornea



6. Ophthalmoscope

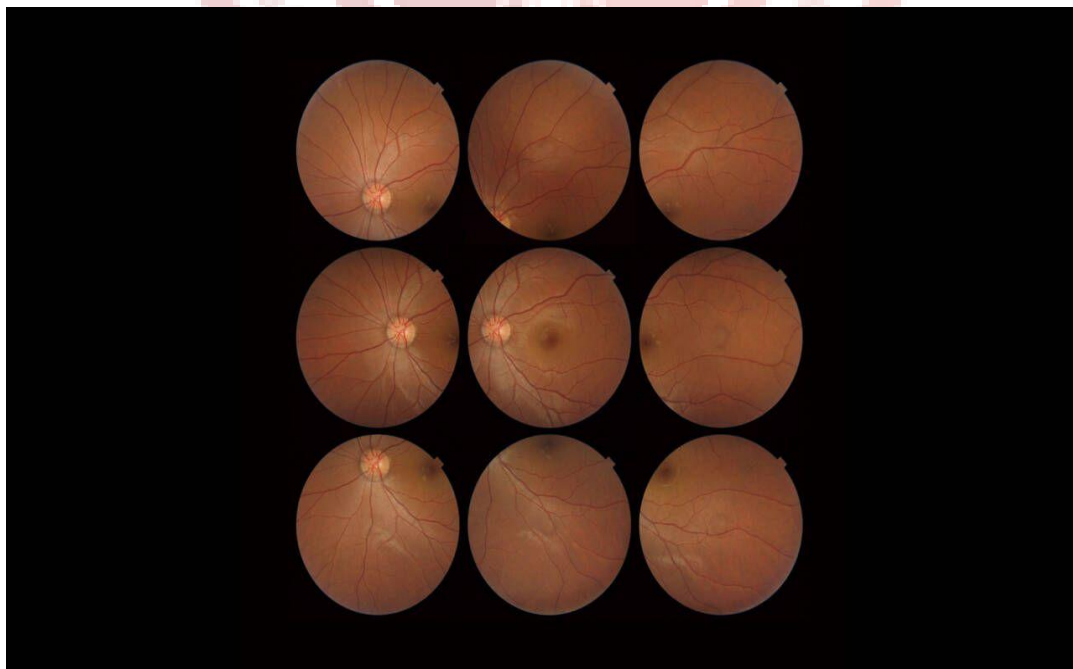
Also called funduscopy, is a test that allows a health professional to see inside the fundus of the eye and other structures using an ophthalmoscope (or funduscope). It is done as part of an eye examination and may be done as part of a routine physical examination. It is crucial in determining the health of the retina, optic disc, and vitreous humor.



7. Fundus Cameras

A fundus camera is a specialized low power microscope with an attached camera. Its optical design is based on the indirect ophthalmoscope. Fundus cameras are described by the angle of view - the optical angle of acceptance of the lens.

A fundus camera used to capture images of the interior surface to the eye to take pictures of the retina. It allows the diagnosis of many eye conditions like diabetes-related retinopathy, glaucoma and macular degeneration



8. Lensmeters

Lensmeters are an optical instrument used in ophthalmology. It is mainly used by optometrists and opticians to measure the back or front vertex power of a spectacle lens and verify the correct prescription in a pair of eyeglasses, to properly orient and mark uncut lenses, and to confirm the correct mounting of lenses in spectacle frames.

Lensmeters can also verify the power of contact lenses, if a special lens support is used



9. Manual Keratometer

This instrument can give a precise examination of the radius of curvature of the anterior corneal surface.

This measurement is used to fit contact lenses and to measure corneal changes.



10. Tonometry

Tonometry is a test to measure the pressure inside your eyes. The test is used to screen for glaucoma.



11. Tonometry

Trial box is a box containing lenses, arranged in pairs, a trial spectacle frame, and other devices used in testing vision. It is also called as trial case.

Uses:

- objective refraction
- subjective refraction

-
- diplopia charting
 - diagnosis of squint
 - assess binocular vision

➤ it is consist of

- trial frame
- trial lens
- prism accessories



12. Torch Light

- Torch light is used for:
 - General eye examination
 - To check pupil reactions



13. Hand Held Occluder

Hand held occlude is used to block light rays to enter into the eye. Uses:

- Used to take monocular vision Used in cover/ uncover test
- Used in alternate occlusion method of binocular balancing



Thank you...

Lecture 3+2 (Decontamination)

General principles and definitions

Decontamination is the removal and elimination of microbes so that equipment is safe for reuse. Proper care and handling of ophthalmic instruments is essential in decreasing the risk of health care-acquired infections

Decontamination is the term used to describe a combination of processes, including cleaning, disinfection and/or sterilization, used to make a re-usable item safe for further use. The effective decontamination of re-usable surgical instruments and clinical devices used in direct contact with tissues is essential in minimising the risk of transferring microorganisms or other contaminants which might lead to infection or other harmful response.

Choosing a method of decontamination

A multitude of different processes are available for decontamination. Choice of the appropriate procedure for a given situation or device needs to take into account factors such as:

- The processes available locally
- Nature and level of risk of harm to patients
- Nature and level of risk of harm to staff using method
- Manufacturer's instructions for decontamination.
- Heat, pressure, moisture and chemical tolerance of the object
- Reliability of method
- Cost effectiveness and practicality of method

Decontamination methods

The reusable medical device life cycle comprises the following processes: acquisition, disposal, cleaning, disinfection, inspection, packaging, sterilization, transportation, and storage, and use.

The three processes included in decontamination are:

1. Cleaning
2. Disinfection
3. Sterilization.



Good practice for ophthalmic theatre instruments

Acquisition and disposal

Manufacturers of re-usable surgical instruments must supply information on the appropriate decontamination process to allow reuse, including cleaning, disinfection and where appropriate the method of sterilization. Theatre staff should ensure that such information is provided and is available for those involved at all stages of the decontamination life-cycle.

All devices should be CE (Conformité Européenne) marked which confirms that they comply with the essential requirements of the relevant European health, safety and environmental protection legislation (product directives) and are fit for the intended use.



Single use instruments

Single use is a useful option for certain ophthalmic instruments, such as those that are difficult or costly to decontaminate safely (e.g., those with a lumen) or those dependent on a cutting edge (e.g., scalpel blades), which can cause transmission of infection..

- Single use devices carry the single use logo



Should never be reused for a number of reasons:

- Inadequate cleaning and decontamination of instrument may occur with reuse due to instrument construction (e.g. small bore), or surface damage, preventing removal of all debris or organisms.
- Component materials may become damaged or brittle leading to the risk of loose fragments entering the eye during surgery.
- Some materials can adsorb or absorb certain chemicals, potentially causing harm

Disposal

Single use instruments are isolated after use and disposed of in accordance with manufacturer's guidance and national healthcare requirements, usually as clinical waste.

Tracking

Reusable surgical devices must be decontaminated with a system that gives total traceability through all the decontamination processes so that the links to patients and clinical staff are identifiable.

Steps to care for instruments

- Cleaning
- Disinfection
- Sterilization
- Inspection
- Packaging
- Transport
- Storage

Cleaning

Cleaning is the most important stage in the decontamination process. Cleaning is a process which removes dust, dirt, excretions, secretions, organic matter and all contamination including harmful and undesirable substances as well as a large proportion of microorganisms which may be present. Manual cleaning includes wiping instruments clean using a sterile, water-moistened sponge. A soft brush or toothbrush can also be used to clean instruments.



Sponge



brush

Disinfection

Disinfection is process that eliminates many or all pathogenic microorganisms on instruments, with the exception of bacterial spores. It is usually use of liquid chemicals.



Sterilization

Sterilization: is the complete elimination or destruction of all forms of microbial life and is accomplished in health care facilities by either physical or chemical processes.

Methods of sterilization

- Chemical methods
- Physical methods

Chemical methods

- Phenols
- Dettol
- Alcohols



Physical Methods

- Heat
- Dry Heat (Red heat, Flaming, Hot air oven, incineration)
- Moist heat
- Radiation
- Filtration
- Ultra-sonication



Red heat



Flaming



Hot air oven



autoclave



Filtration



Radiation



Ultra sonication

Inspection

Inspection of devices should be performed by staff members in the decontamination facility other than those responsible for cleaning them. For fine ophthalmic instruments, it is useful for magnification to be used, using a loupe system or microscope. Instruments that are damaged can be identified, as can those that have been inadequately cleaned. Damaged instruments should be removed for repair or disposal after being decontaminated and inadequately cleaned items are returned to the decontamination cycle for further cleaning.

Packaging

The packaging of an instrument will depend on its size, planned use, and chosen sterilization method. Some instruments will form part of a multiple package and be packed in suitable trays. Others will be individually packed in sealed peel-apart pouches.

Transport

Means transporting the tools to a safe place to be well preserved so that they can be used in good condition, it is essential that transit containers fully protect their contents and individuals handling them. They must be secure, tamper-proof, waterproof, and clearly labelled. In order to avoid damage, clean instruments must be packed by specialty-trained personnel in trays designed for eye instruments.

Storage

Ideally, once ready for use, the instrument trays should then be stored in the eye theatre or clinic area. The storage area should be safe, dry, above

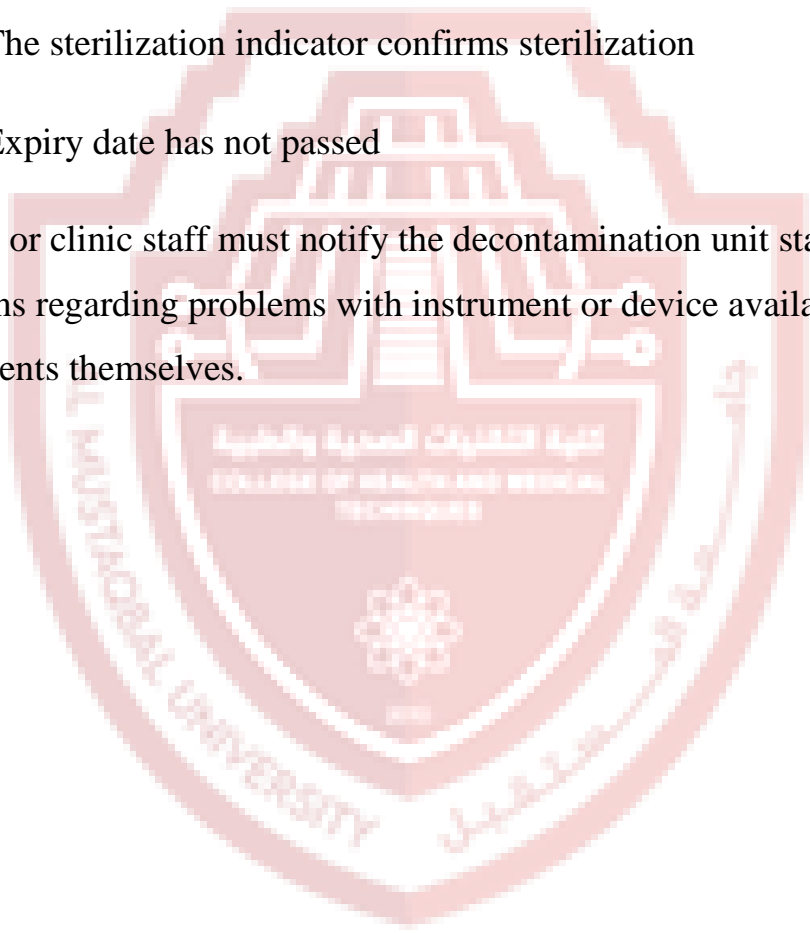
floor level and away from sunlight and water. It is vital that packs are handled carefully in order to prevent damage and loss of sterility.

Use

Before use, packages should be checked to ensure that:

- The package is intact
- The sterilization indicator confirms sterilization
- Expiry date has not passed

Theatre or clinic staff must notify the decontamination unit staff about any concerns regarding problems with instrument or device availability, or the instruments themselves.

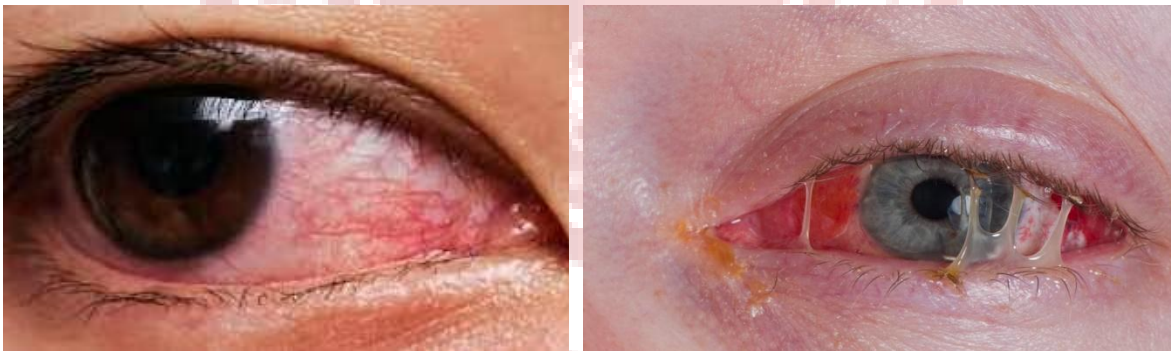


Thank you...

INTRODUCTION:

An eye infection (it is often called Uveitis) is a disease of the eye that gets because of a microorganism like a bacterium, a virus, or a fungus. The most common eye infection is red or pink eye (conjunctivitis). An infected eye may look or feel different than usual. Early signs and symptoms of an eye infection may include:

- Red eyes
- Itching or irritation.
- Eye pain
- Swelling
- Sensitivity to light (photophobia).
- Blurred vision
- Fever

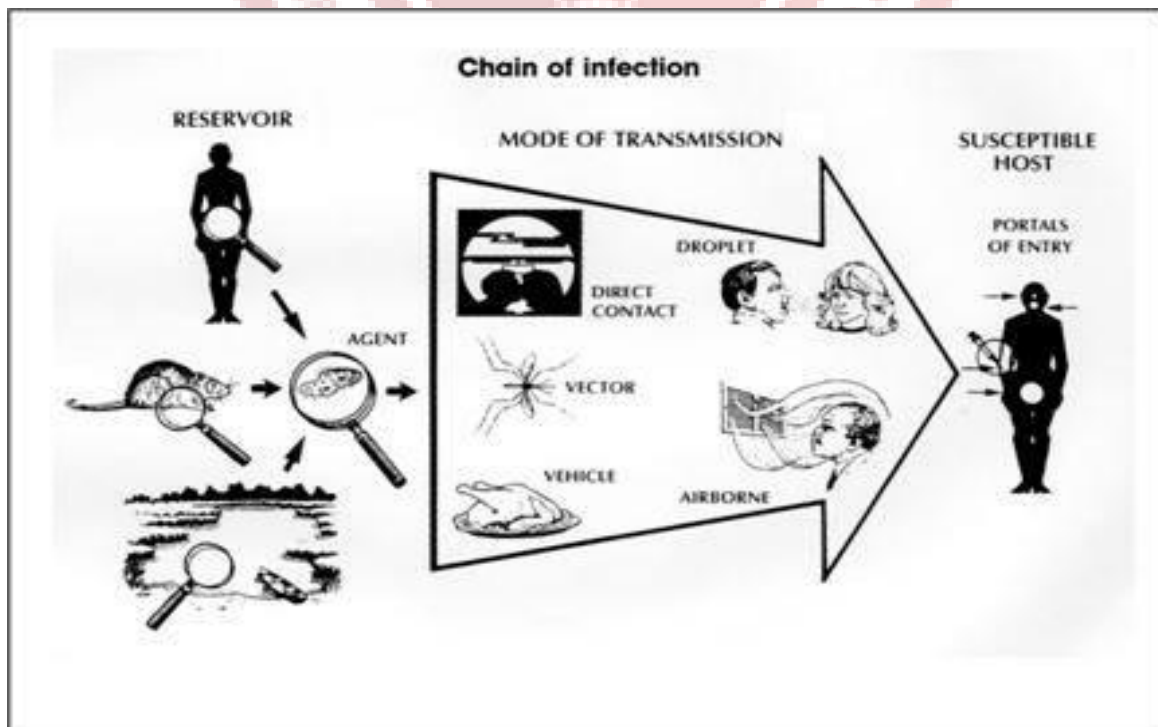


The ophthalmologist's office is an environment with significant potential for the transmission of infections. Pathogens are regularly introduced into the office by patients with systemic or ocular infections and the eye is particularly susceptible to infection with Gram-negative bacilli, adenoviruses, Herpes simplex and fungi, transferred by contaminated ophthalmic instruments.



Infection can be transmitted in a variety of ways, including:

- **Direct contact infections:** spread when disease-causing microorganisms pass from droplet spread or the infected person to the healthy person via direct physical contact with blood or body fluids.
- **Indirect contact infections:** spread indirectly through the air and other mechanisms. For example: (Airborne transmission, contaminated objects, Food and drinking water).



Types of transmitted infection devices:

- Tonometry
- Diagnostic contact lenses
- Contact lenses

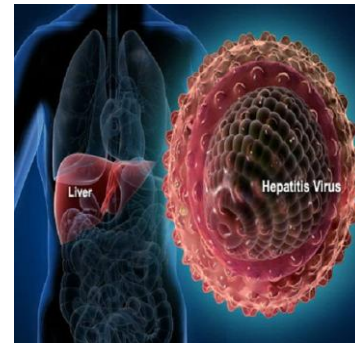
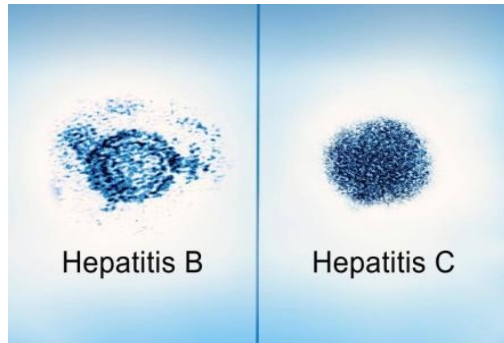
4. Tonometry

Tonometer is important in diagnosing intraocular pressure. Goldmann Applanation Tonometry (GAT) remains the gold standard for IOP measurement owing to its accuracy and consistency. GAT also had potential hazards; commensal bacteria could be directly transmitted from the ocular surface to the tonometer tip, which might result in the cross-patient infection upon the reuse of the tonometer tips, especially for patients with corneal epithelial injuries during the GAT examination. There have been reports that infectious keratoconjunctivitis is transmitted from ocular equipment and GAT prisms act as a vector for infection transmission. GAT tips might play a role in the iatrogenic transmission of Creutzfeldt–Jakob disease due to insufficient sterilization, indicating that a standard sterilization method is required for clinical practice.

Infectious diseases transmitted through the device Tonometry

There was limited evidence available regarding the transmission of:

- Hepatitis B
- Hepatitis C
- Prion diseases
- Human Immunodeficiency Virus (HIV)



Human
Immunodeficiency
Virus
(HIV)

Disinfection Methods for Tonometry

Is Chemical Disinfectants in Eye Care Ideally, the tonometer disinfection process should cover a broad antimicrobial spectrum; should act rapidly; should not damage the tonometer tip; and should be nontoxic to the user, patient, and environment. Three groups of commonly used disinfectants in eye care include alcohols, chlorine, and hydrogen peroxide. Sterilization can also be used at a (temperatures of less than 60°C).



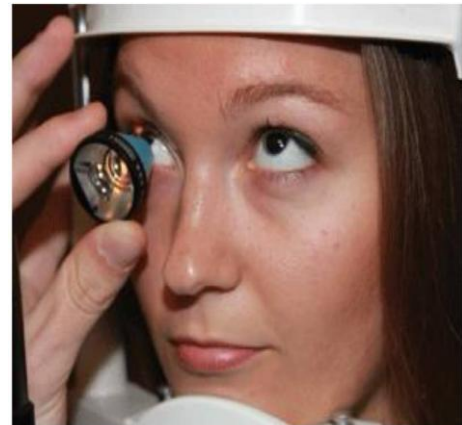
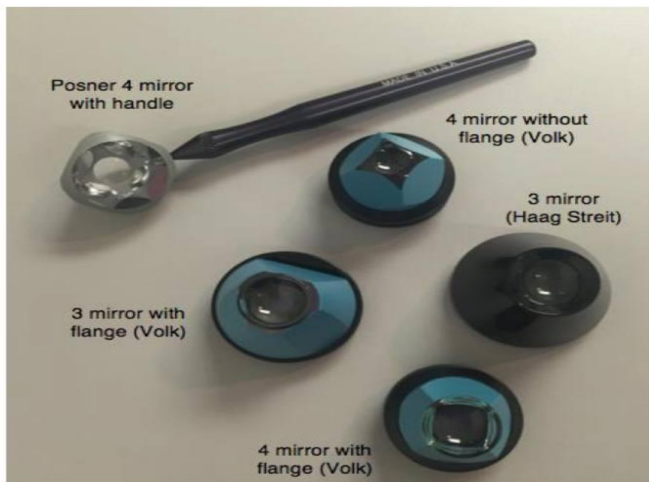
Care Tonometer Prism

- Separate the tonometer probe from the prism holder/ feeler arm.
- Rinse the prism in running cold water for 30 to 60 seconds and wipe clean.
- Place in a disinfectant solution of either 10% sodium hypochlorite or 3% hydrogen peroxide for 10 minutes.
- Remove the probe from the solution and place in a clean container.
- Rinse with cold running water for no more than an hour and no less than 10 minutes.
- Dry the probe. Use a soft, clean tissue and wipe only once in a single direction starting at the probe tip.
- Allow sufficient time for the tip to dry before subsequent use.

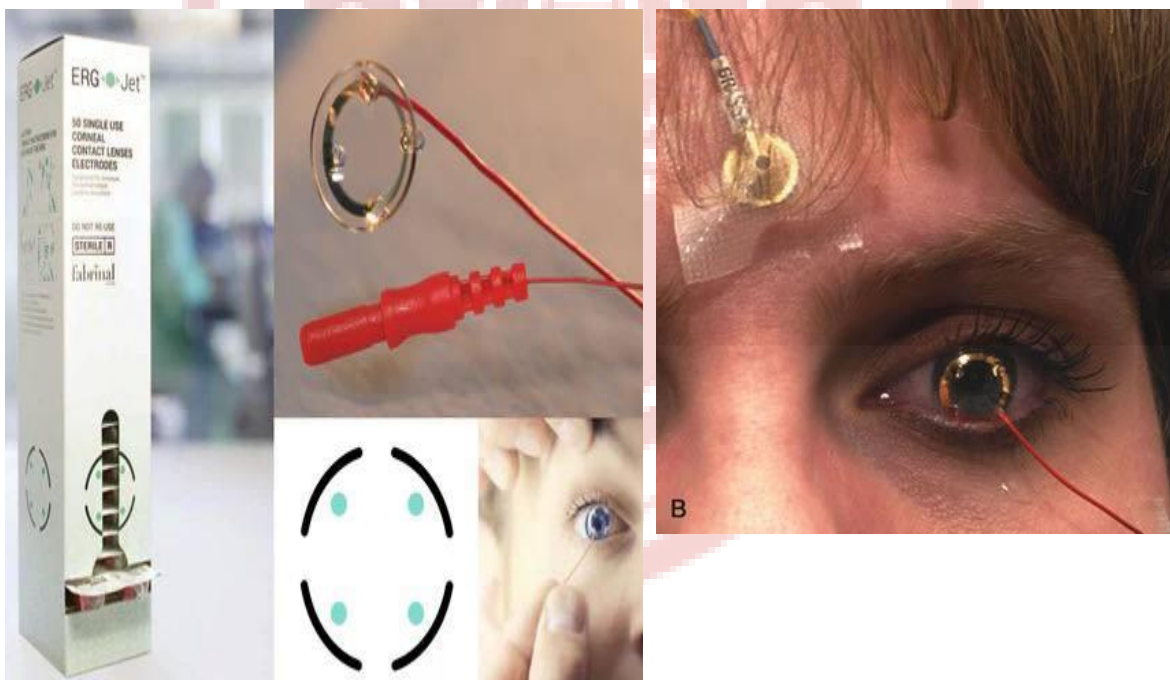


5. Diagnostic Contact lenses

Gonioscopy : us to examine the angle of anterior chamber and forms part of complete ophthalmic examination and it is mandatory for the diagnosis and management of glaucoma. This tool can transmit infection if not properly disinfected.



Electroretinogram (ERG) is a diagnostic test that measures the electrical activity of the retina in response to a light stimulus.



Risks of Diagnostic contact lenses

Diagnostic contact lenses can become contaminated with bacteria or viruses from the eyes of previous patients. If the diagnostic contact lenses are not properly stored, they can become contaminated with fungi.

6. Contact Lenses

The use of contact lenses is very common, they are prescribed for the correction of refractive errors that cannot be treated by glasses such as aphakia, keratoconus and strong anisometropia, or as alternatives to glasses. Contact lenses can cause serious complications that are not always easy for patients to manage



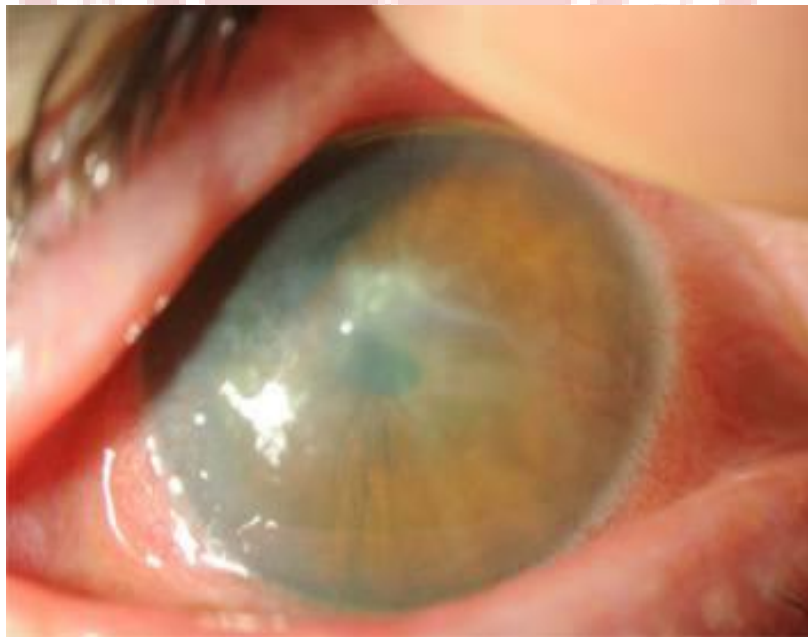
Risks of Diagnostic contact lenses

Contact lens wearers are prone to development of microbial keratitis because lenses are a potential means of transport of microorganisms to the cornea. Contact lenses CLs require occasional handling, for instance for cleaning or the relief of discomfort. During this handling, the CLs come into contact with contaminated objects, such as hands or lens storage cases, resulting in bacterial contamination and adhesion to the CLs. When a lens is put onto the eye, bacteria are transferred to the corneal epithelium, potentially inducing an infection.



Risks of Diagnostic contact lenses

- Bacterial Keratitis
- Fungal Keratitis
- Parasitic/Amebic Keratitis
- Viral Keratitis



Causes

There are a number of things that can cause a contact lens-related infection. Some causes of infection may include:-

- Using extended-wear lenses.
- Sleeping in contact lenses.
- Having microbes build up under the lens (herpes virus, bacteria, fungi, or parasites).
- Not keeping lenses or cases clean.
- Exposing lenses to water.
- Reusing disinfecting solution.

The most common eye infection Keratitis is the most common eye infection from wearing contact lenses. It is when the cornea becomes infected. In some cases, it can scar the cornea, affecting your vision. If the cornea is severely scarred, a corneal transplant may be needed to eliminate damage from the eye infection and have clear vision again.

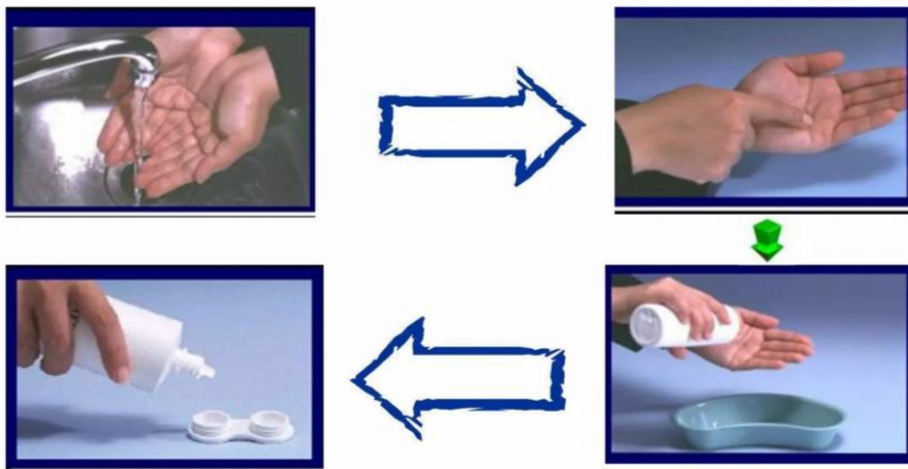
Symptoms

Eye Infection Symptoms Stop wearing contact lenses immediately if patient have these symptoms:

- Blurry vision.
- Redness of the eye.
- Pain in the eye.
- Swelling.
- Light sensitivity.
- Itching, burning, or a feeling that something's in the eye.

Procedures for daily Cleaners

- Wash the hand, Place the lens in the palm of the hand.
- Place 2-3 drops of cleaner on each lens surface.
- Rub with forefinger for about 10-15 sec per side using to and fro and circular action.
- Rolling the fore-finger in both directions.
- Clean lens periphery, Rinse well.



Thank you...

INTRODUCTION:

Attempts to define visual acuity in quantitative terms using eye charts date to the early 1800's in Germany. The term "visual acuity" itself dates to Dondre's in 1861 who defined it as the "ratio between a subject's performance and a standard performance" in distinguishing details of a test pattern. Snellen published his famous eye chart in England in 1862 and only relatively minor variations and improvements have been made since then.

When you visit the eye doctor for a checkup asked to read an eye chart. The chart measures your visual acuity or sharpness of vision.

Visual acuity: The ability of the eye to distinguish single targets and form a clear image of sufficient size on the retina, specifically on the macula. It is measured by using Snellen's test type

It depends on two factors:

1. The size of the object of which an image is formed on the retina.
2. The distance of the body from the eye

In this lecture is meant to provide some guidance in selecting from many charts and devices available to test vision. It is divided into several sections.

1. Snellen Chart
2. Landolt C Chart
3. Tumbling E Chart
4. Lea Symbols Chart

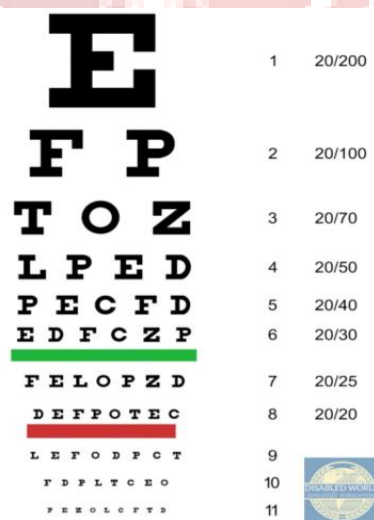
5. HOTV Chart
6. Jaeger Eye Chart
7. Bailey Lovie Chart
8. Etdrs Chart

1. Snellen chart

Snellen chart is a series of letters of different sizes, the top letter is visible to the normal eye at 60 m., and the subsequent lines at 36, 24, 18, 12, 9 and 6 m. respectively. The letters are in lines, each line has types of same size. The top row of types contains large letters and succeeding rows contain gradually smaller and smaller letters

Snellen chart is an eye chart that can be used to measure visual or measures a person’s vision by how well they can read and see detail.

Its name comes from Dr. Hermann Snellen, who invented the eye chart in 1862.



Prior to Snellen’s work, eye charts had used printing fonts. Snellen defined a new font, which he called “optotypes” and which he laid out on a 5 x 5 grid , he defined “standard vision” as the ability to recognize his optotypes from a

distance of 20 feet when they subtended an angle of 5 minutes of arc. The detailed features of his optotypes, one grid element, were then 1 minute by 1 minute of arc for “standard” vision. Standard vision is thus the ability to distinguish features separated by 1 minute of arc; eye charts generally are scaled to be used at a distance of 20 feet.

In 1875 Snellen created a new set of charts that used six meters instead of twenty feet as the “standard” measurement distance. The Snellen fractions were then 6/6, 6/12, and so on. Undoubtedly he was criticized by proponents of the English system of measurement, who fought doggedly against the French-backed metric system, but metric measurement prevailed and 6 meters is the standard in England today while 20 feet is in use in the United States.

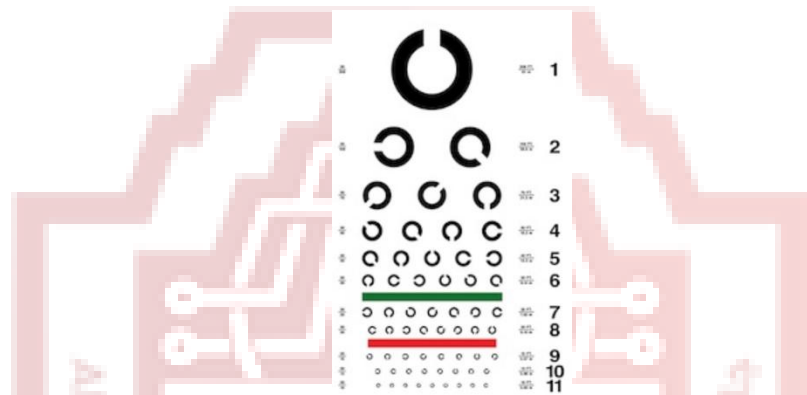
Another equivalent measure of visual acuity is the logarithm of the minimum angle of resolution, LogMAR. This converts the progression of the Snellen chart to a linear scale. 20/20 vision is thus 0.0, 20/40 vision is 0.3, 20/100 is 0.7 and 20/200 is 1.0. The Snellen chart intervals are not a geometric progression (i.e. there is not a constant ratio of letter heights between adjacent lines) so the lines on a typical Snellen chart (20/200, 100, 70, 50, 40, 30, 25, 20, 15, 10) do not produce equal intervals on the LogMAR scale.

Visual acuity scales

Foot	Metre	Decimal	LogMAR
20/200	6/60	0.10	1.00
20/160	6/48	0.125	0.90
20/125	6/38	0.16	0.80
20/100	6/30	0.20	0.70
20/80	6/24	0.25	0.60
20/63	6/19	0.32	0.50
20/50	6/15	0.40	0.40
20/40	6/12	0.50	0.30
20/32	6/9.5	0.63	0.20
20/25	6/7.5	0.80	0.10
20/20	6/6	1.00	0.00
20/16	6/4.8	1.25	-0.10
20/12.5	6/3.8	1.60	-0.20
20/10	6/3	2.00	-0.30

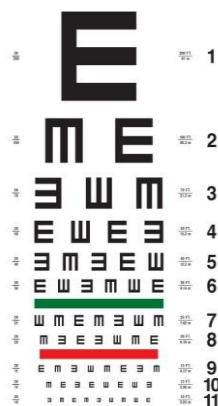
2. Landolt C CHART

Not all of Snellen’s optotypes are equally recognizable. Landolt in 1888 addressed this problem by proposing an eye chart that had only one symbol, a ring with a break at top, bottom, left or right, and 45 degree positions in between, basically the letter C in various orientations. To match Snellen’s results, the “standard” size of the C was 0.35” (which subtends 5 arc minutes at 20 feet) with a gap of 0.07” or 1 arc minute.



3. Tumbling E CHART

E chart: used to measure a patient's visual acuity. In 1976 Taylor created a chart using a single optotype, a stylized letter E. This chart is useful for patients who are unable to read the Latin alphabet – for example, very young children. It is also used in countries where people do not use the alphabet in their native language; this has become standard for testing of illiterates and populations not familiar with the Roman alphabet.

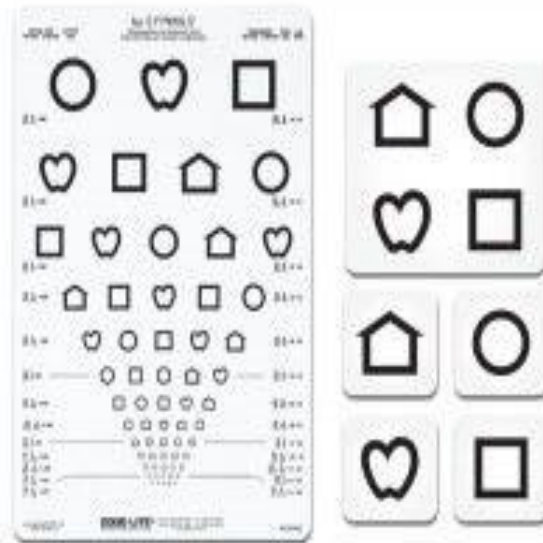


A further study showed that visual acuity thresholds for the Tumbling E were slightly better than the Landolt C, particularly in the presence of any astigmatism. This study concluded that more confidence can be placed in the visual acuity thresholds obtained with the Tumbling E. Hence, of all the eye charts, the Tumbling E is considered the best choice. It has the further advantage of being easy to produce and use.

4. Lea Symbols Chart

The Lea test was developed in 1976 for testing preschool children and is named after the inventor, Lea Hyvärinen of Finland. She used a set of pictorial optotypes that are symbolic outlines of an apple, a house, a square and a circle. Various versions for testing near vision, far vision, contrast sensitivity, amblyopia and brain damage have been used.

This chart was designed for visual acuity screening in children to eliminate the problems of language barriers.



5. HOTV Chart

Another test for preschool children uses the HOTV chart and HOTV cards. A set of four optotypes, sans-serif versions of the letters H, O, T, and V, are used. These optotypes are represented to be equally recognizable and maximally distinguishable. A child is first taught the four symbols using the flash cards and then tested against the eye chart. Clinical tests have shown that the Lea Test and HOTV tests provide similar results for 4 and 5 year old children but that testability was better using the Lea symbols with 3 year olds.



6. Jaeger Eye Chart

The Jaeger eye chart (or Jaeger card), is used to test and document near visual acuity at a normal reading distance. Refractive errors and conditions that cause blurry reading vision include astigmatism, hyperopia (farsightedness) and presbyopia (loss of near focusing ability after age 40).

Read from a distance of 14 inches

No. 1.
.37M

In the second century of the Christian era, the empire of Rome comprehended the fairest part of the earth, and the most civilized portion of mankind. The frontiers of that extensive monarchy were guarded by ancient renown and disciplined valor. The gentle but powerful influence of laws and manners had gradually cemented the union of the provinces. Their peaceful inhabitants enjoyed and abused the advantages of wealth.

No. 2.
.50M

four score years, the public administration was conducted by the virtue and abilities of Nerva, Trajan, Hadrian, and the two Antonines. It is the design of this and of the two succeeding chapters, to describe the prosperous condition of their empire; and afterwards, from the death of Marcus Antoninus, to deduce the most important circumstances of its decline and fall; a revolution which will ever be remembered, and is still felt by

No. 3.
.62M

the nations of the earth. The principal conquests of the Romans were achieved under the republic; and the emperors, for the most part, were satisfied with preserving those dominions which had been acquired by the policy of the senate, the active emulations of the consuls, and the martial enthusiasm of the people. The seven first centuries were filled with a rapid succession of triumphs; but it was

No. 4.
.75M

reserved for Augustus to relinquish the ambitious design of subduing the whole earth, and to introduce a spirit of moderation into the public councils. Inclined to peace by his temper and situation, it was very easy for him to discover that Rome, in her present exalted situation, had much less to hope than to fear from the chance of arms; and that, in the prosecution of

No. 5.
1.00M

the undertaking became every day more difficult, the event more doubtful, and the possession more precarious, and less beneficial. The experience of Augustus added weight to these salutary reflections, and effectually convinced him that, by the prudent vigor of

No. 4.
1.25M

his counsels, it would be easy to secure every concession which the safety or the dignity of Rome might require from the most formidable barbarians. Instead of exposing his person or his legions to the arrows of the Parthians, he obtained, by an honor-

No. 7.
1.50M

able treaty, the restitution of the standards and prisoners which had been taken in the defeat of Crassus. His generals, in the early part of his reign, attempted the reduction of Ethiopia and Arabia Felix. They marched near a thou-

No. 8.
1.75M

sand miles to the south of the tropic; but the heat of the climate soon repelled the invaders, and protected the unwarlike natives of those sequestered regions

No. 9.
2.00M

The northern countries of Europe scarcely deserved the expense and labor of conquest. The forests and morasses of Germany were

No. 10.
2.25M

filled with a hardy race of barbarians who despised life when it was separated from freedom; and though, on the first

No. 11.
2.50M

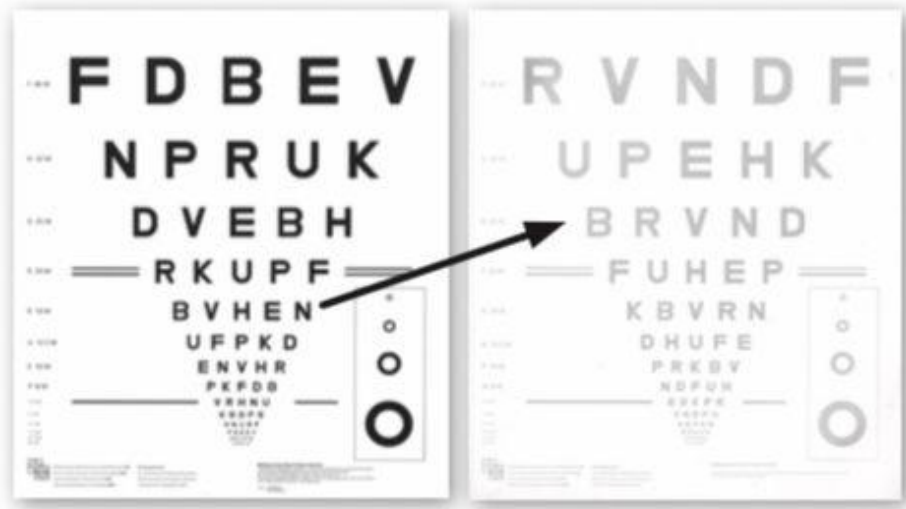
attack, they seemed to yield to the weight of the Roman power, they soon, by a signal

Procedures

1. Hold the test card 37 CM from the eyes. Use a tape measure to verify this distance.
2. The card should be illuminated with lighting typical of that used for comfortable reading.
3. Testing usually is performed with both eyes open; but if a significant difference between the two eyes is suspected,
4. Cover one eye and test each eye separately.
5. Go to the smallest block of text you feel you can see without squinting, and read that passage aloud.
6. Then try reading the next smaller block of text. (Remember: no squinting!)
7. Continue reading successively smaller blocks of print until you reach a size that is not legible.
8. Record the “J” value of the smallest block of text you can read (example: “J1”).

7. Bailey Lovie Chart

The Bailey-Lovie chart determines the distance of visual acuity at normal and low contrast. The lower contrast version is also available.



8. Etdrs Chart

The ETDRS acuity test was developed to aid in evaluating the changes in vision following panretinal photocoagulation in patients with diabetic retinopathy.



Snellen chart Procedure

1. Position the patient sitting 6m from the chart. Note that projecting the chart on a mirror can be a useful way to simulate the 6m testing distance in shorter clinical lanes.
2. Ensure that the room and Snellen chart are adequately illuminated.
3. The patient may wear his/her current corrective lenses to assess for corrected visual acuity.
4. In the absence of corrective lenses, a pinhole may be used, which often resolves the refractive error. This is done by assessing visual acuity while looking through a pinhole.
5. Test the eyes one at a time, beginning with the worse eye while covering the good eye.
6. Ask the patient to begin reading letters from the top.
7. The smallest line read represents the visual acuity.
8. Patients unable to read the large E on the chart, when wearing the best corrective lens have a visual acuity measuring less than 6/60, which is termed "legally blind" in the United States.
9. For patients unable to see the eye chart, check if they can count fingers (CF vision), see hand movements (HM vision), or perceive the light from a flashlight (LP vision). If the patient fails to identify the light, record this as no light perception (NLP).
10. Repeat the procedure to measurement the opposite eye.

Disclaimer

- Eye charts measure only visual acuity, which is just one component of good vision. They cannot determine if the eyes are "working overtime" (needing to focus more than normal, which can lead to headaches and eye strain) or can they determine if the eyes work properly as a team for clear, comfortable binocular vision and accurate depth perception.
- Eye charts also cannot detect serious eye problems such as glaucoma or early diabetic retinopathy that could lead to serious vision impairment and even blindness.
- Only a comprehensive eye exam performed by a licensed optometrist or ophthalmologist can determine if the eyes are healthy and patient are seeing as clearly and comfortably as possible.

The following abbreviations are commonly used in the reporting of visual acuity measurements.

OD: Right eye

OS: Left eye

OU: Both eyes

VA: Visual acuity

DVA: Distance visual acuity

NVA: Near visual acuity

PH: Pinhole

CF: Counting fingers

HM: Hand motion

LP: Light perception

NLP: No light perception

Thank you...

Lecture 7

Trial case, Trial frame

INTRODUCTION:

Trial case it is a box made of wood or plastic and contains a different set of lenses for the purpose of correcting refractive errors in the patient's eyes to achieve good visual acuity. A trial case is essential equipment for optometrists also known as a trial box.

It is a case that contains trial lenses a trial spectacle frame, prisms, filters, occluders, and other accessories. A trial case is used for objective and subjective refraction, diplopia testing, diagnosing strabismus (squint), and assessing binocular vision.

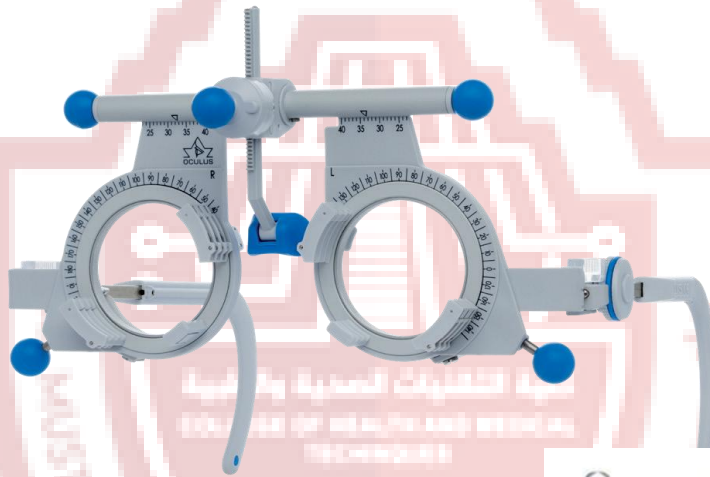


Accessories of Trial Case

1. Trial Frame
2. Trial Lens
3. Prism
4. Other Accessories.

7. Trial frame

Trial frame is an eyeglass frame designed to permit the insertion of different lenses used to correct refractive errors of vision. It is characterized by being lightweight and can be adjusted, and it should be comfortable in the nose resting and readily adjustable and allow accurate centering vertically and horizontally for each eye (allows adjustment for pupil distance and lens height).



Compartments of Trial Frame

The parts are as follows 3-4 compartments

- 1st - High powered lens
- 2nd - spherical lens
- 3rd - cylindrical lens
- 4th - accessory lens & prisms



The trial frame should be easy to adjust for parts including temples, nose pad, temple angle, and interpapillary distance (PD) while providing a sure mounting for the trial lens

Types of frame

Full Aperture Frame

- Accommodates up to five 38mm lenses for each eye
- Independent screw adjustments for PD of 48 to 80mm
- Screw-operated bridge height and projection
- Slides adjustable for length and angle.



Reduced Aperture Frame

- Reduced aperture trial frame
- A very durable lightweight drop cell trial frame.
- It holds up to four 38mm lenses for each eye
- Accessories may be easily inserted and extracted



Half Eye Trial Frame

- Half eye trial frame with nosepiece, child.
- As half eye trial frame with PD of 54 to 58mm.
- Also available with fixed bridge or adjustable nosepiece.
- Available for adults with PD 59 to 67mm



8. Trial lenses

Trial lenses are a set of lenses different in type and power arranged in pairs, they are used by trial and error to test vision and diagnose refractive errors and eye pathology.

Types of trial lenses:

-
1. Optical lenses: - use to correct the refractive errors.
 2. Accessory lenses: - use to diagnose the pathology.



Types of optical lenses:

1. Full aperture lens

- Approximately 38 mm diameter
- do not obscure the patient's face
- Biconvex or biconcave form
- Disadvantage: heavier and thicker large additive errors

2. Reduced aperture lens

- Lenses of 20mm diameter mounted in the metal rim of 38mm diameter
- Plano convex and Plano concave
- Used for refraction and neutralization
- for refraction, curved surface should face the eye
- for neutralization, curved surface of the trial lens is placed against to the curved surface of spectacle lens

a. Spherical lenses

-
- There are 32 pairs of spherical lenses in plus and minus power (a pair of positive lenses ranging from +0.12 to +20.00D and a pair of negative lenses ranging from -0.12 to -20.00D).



Variation:-

- 0.25 to 4.00D in increment of 0.25D
- 4.00 to 6.00D in increment of 0.50 D
- 6.00 to 14.00D in increment of 1.00 D
- 14.00 to 20.00D in increment of 2.00DLaxmi

Uses:

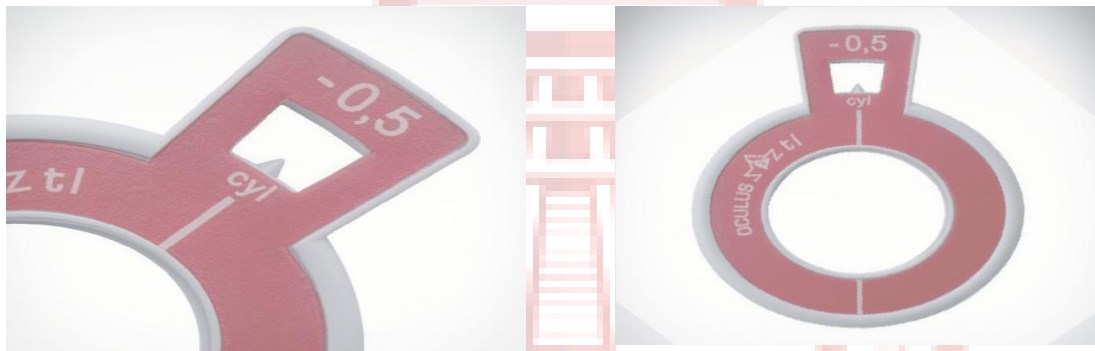
- Checking the refracting error, concave spherical lenses (negative): which are used in the treatment of myopia (nearsightedness), convex spherical lenses (positive): which are used in the treatment of hypermetropia (farsightedness), and presbyopia.

Note

The diopter is the unit of measure for the refractive power of a lens. The power of a lens is defined as the reciprocal of its focal length in meters, or $D = 1/f$, where D is the power in diopters and f is the focal length in meters.

b. Cylindrical lenses

- Negative and positive cylindrical lenses: 19 pairs of CYL lenses Power range in cylinder: Pair of positive lenses ranging +0.12 to +6.00D, Pair of negative lenses ranging -0.12 to -6.00D.
- which are used to for correction of astigmatism, and checking the refractive error differ from the other by the presence of two red lines on both ends of the lens to determine the axis of the lens.



Variations:-

- 0.25 to 3.50D in increment of 0.25D
- 3.50 to 6.00D in increment of 0.50D

9. Prism lens

is a refractive medium having two plane surfaces inclined at an angle and the base of the prismatic lens is thicker than the apex. Prismatic lenses are used in correct and measure strabismus and correction of the angle of deviation.



10. Accessories Lens

Occluder

Is an opaque disc used to close or cover one eye during refraction examination. It blocks one eye vision while performing the test on the fellow eye, so that we can check each eye separately.



Plano Lens

Plano lenses are ophthalmic lenses that do not have any power (zero). Therefore, they do not help correct the vision. It is used to satisfy & identify the malingering patients.



Fogging Lens

Used to relax the muscles especially in patients who have nystagmus, It works like an occlude.



Pinhole Lens

It is a black, opaque circular disc. In its center, there is a hole ranging in diameter (1-2 mm) to reduce the amount of peripheral light entering the eye (allowing only a pencil of light to pass through the corneas).

It is used to help determine whether the decreased vision is due to refractive error or to pathological diseases of the eye, if the vision improves with it, it means that the cause is a refractive error, and if the vision does not improve with it, it means that the cause is an organic eye disease.

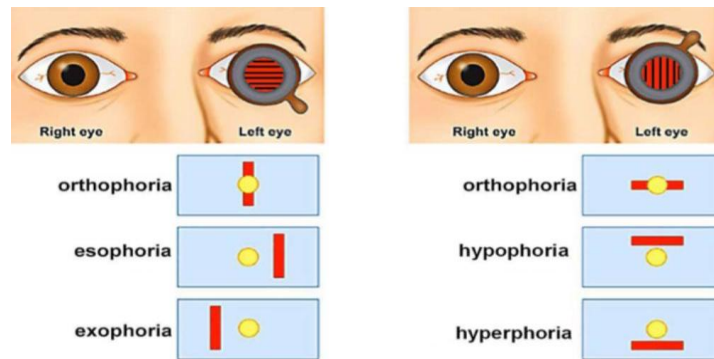


Maddox rod Lens

It is a glass lens made up of several series of high plus parallel cylindrical lines that have several colors, including red, green and transparent.

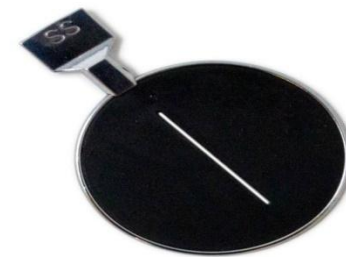


- The purpose of the cylindrical lines is that they convert the point light source into a bright line, and through the direction of the cylinders we can obtain a horizontal or vertical bright line to evaluate the squint on both axes.
- It is used to subjectively detect and measure a latent, manifest, horizontal or vertical heterophoria for near and distance, mainly used for visual acuity.
- Procedures of the Maddox rod. When the Maddox rod is placed vertically over the right eye, the patient should see a horizontal red line and a white light. When the Maddox rod is placed horizontally over the right eye, the patient should see a vertical red line and a white light. If the eyes are aligned, the red line will go through the white light. If the eyes are not aligned, the red light will be deviated in the opposite direction of the eye relative to the white light. For example, with a right hypertropia, the patient will see the red line deviated below the white light.



Stenopic Slit Lens

It is a black circular disc containing a linear slit of width (0.50-1.00 mm) and length (15 mm), it allows strip of light to pass through the corneas. It is used to determine astigmatism by rotating it (horizontal and vertical) after placing spherical test lenses, and asking the patient in which direction the vision is clearer, to find out axis of cylinder + or -.



Red/Green Filter Lens

They are red and green colored lenses and have no optical power. They are used in binocular vision tests. They are also used to check over correction and under-correction of refractive error, color dissociation, to find out suppression of eyes, to find out diplopia and to measure the Fusion, squint..



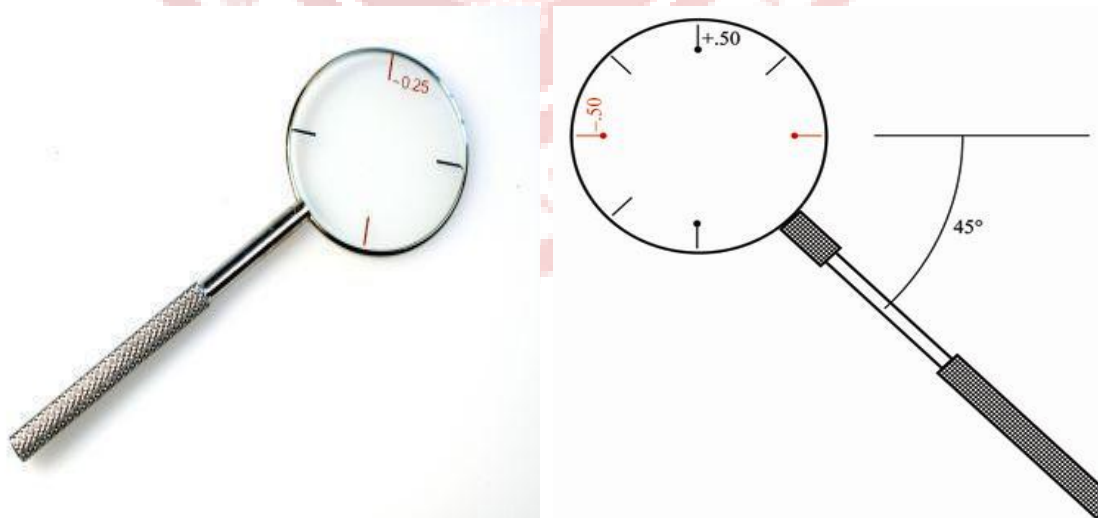
The patient is asked to make a comparison of the recognition through the filter to note the clear of the FRIEND letters on the test chart.

- If the patient says:

- There is no clear difference between the two, it indicates that the correction is optimal.
- When the vision is clearer in red, it means he has nearsightedness and a negative lens can be added until equality is achieved.
- When the vision is clearer in green, it means he has farsightedness and a positive lens can be added until equality is achieved.

Jackson Cross Cylinder Lens

- It is a combination of plus cylinder & minus cylinder 90° apart.
- Handle is located at 45° between two axis.
- Principle: spherical equivalent is zero.
- Used to: determine both power & axis of the astigmatic correction ± 0.25 and ± 0.50 .



Thank you...

Lecture 8 Retinoscope

INTRODUCTION:

Retinoscope is an objective method of measuring the optical power of the eye through illuminate the inside of the eye and to observe the light that is reflected from the retina and determine the refractive error of the eye. The procedure is based on the principle that when light is reflected from a mirror into the eye, the speed with and direction in which the light will be reflected back and move across the pupil (with/against) depends on the eye's refractive error.

Retinoscope it is a device used to shine a beam of light directly into the eye to assess the refractive error and determine the type of eye prescription needed. This technique is especially useful in cases where a patient cannot undergo a subjective refraction because they are unable to judge or respond.

Retinoscopy is the use of a retinoscope to measure a patient's refractive error. Retinoscopy is an objective method of refraction in which the patient does not need to tell the practitioner how they see.



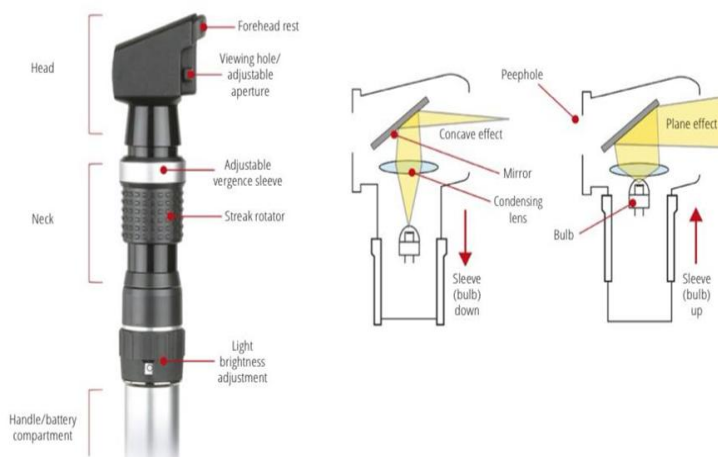
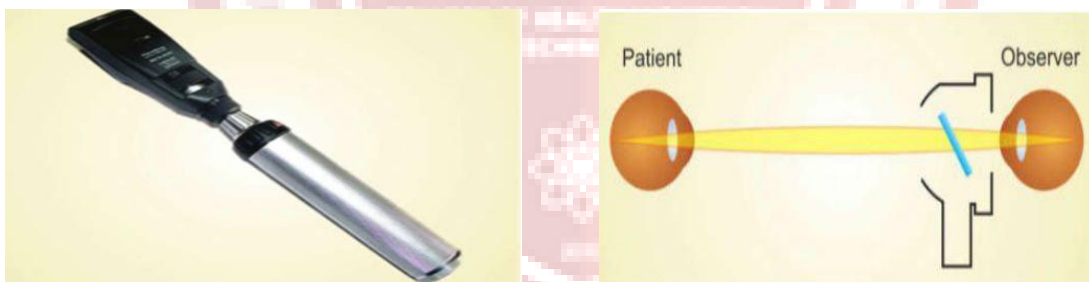
There are two types of retinoscopes:

- Streak retinoscopes
- Spot retinoscopes

Streak retinoscopes

Have a light source that produces a line or streak of light. The streak of light can be changed by moving the slide knob or sleeve. It can be:

- rotated to any axis position (by rotating the sleeve)
- made wider or narrower in width (by moving sleeve up or down)
- Changed from convergent to divergent light (by moving the sleeve up or down) . It is normally used in the ‘down’ position.



Spot retinoscopes

Have a light source that produces a spot of light. The spot of light can be changed by moving its slide knob. It can be:

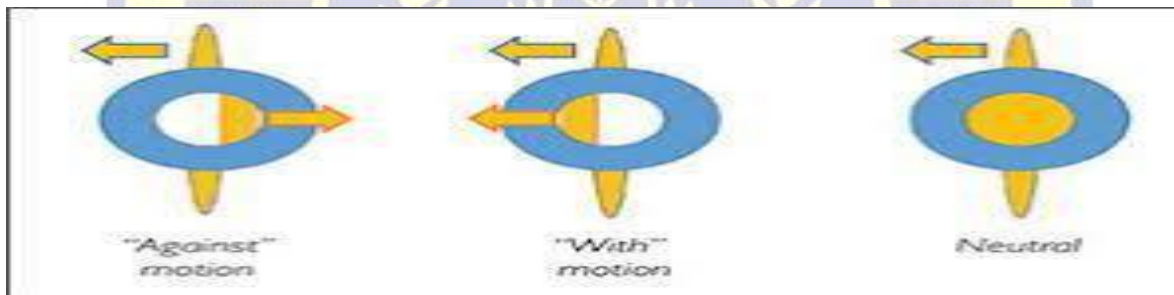
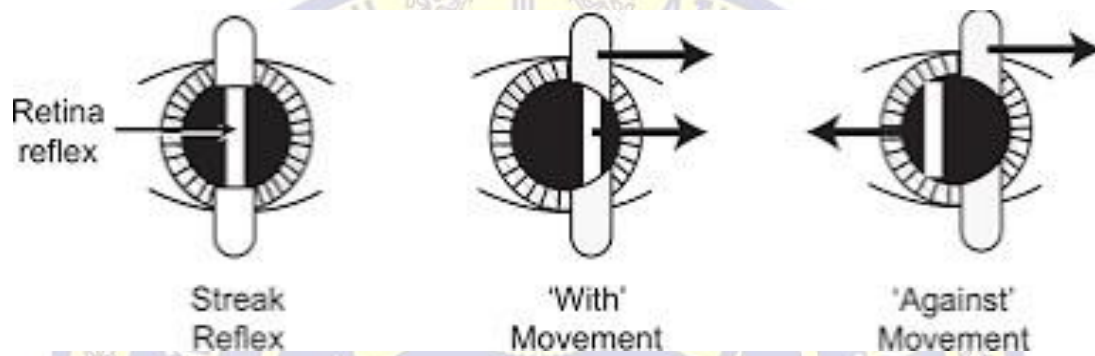
- made larger or smaller in diameter (by moving the sleeve up or down)
- Changed from convergent to divergent light (by moving the sleeve up or down).

The spot light of a spot retinoscope does not need to be rotated (like the streak retinoscope) to examine different axis directions.



The red reflex can be neutralized with plus and minus trial lenses:

- The Plus lenses neutralize a 'with' movement.
- The Minus lenses neutralize an 'against' movement.



Characteristics light of Retinoscope

1. Direction:

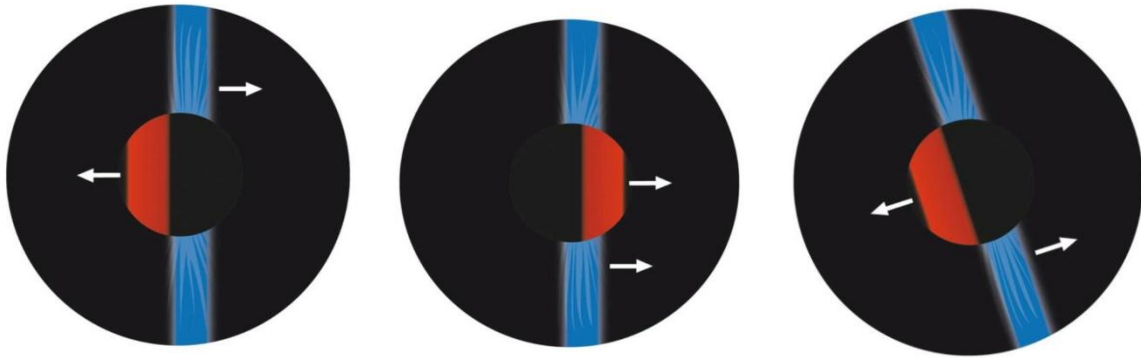
- With or against or neutralized.

2. Orientation:

- Vertical, horizontal or oblique scissor reflex.

3. Brightness and speed:

- bright and fast
- Dull and slow.



Types of Retinoscopy

There are two main types of retinoscopy, static and dynamic.

- **Static retinoscopy** requires the patient have relaxed accommodation which can be achieved by focusing on a distant object or through cycloplegic agents.
- **Dynamic retinoscopy** requires the patient have active accommodation by focusing on a near object and is useful to evaluate the effectiveness of accommodation.

Parts of retinoscope:

- **Projection System:**

The projection system is the one which provides illumination to the retina and involve the following major components.

- Light Source
- Condensing Lens
- Mirror
- Focusing Sleeve

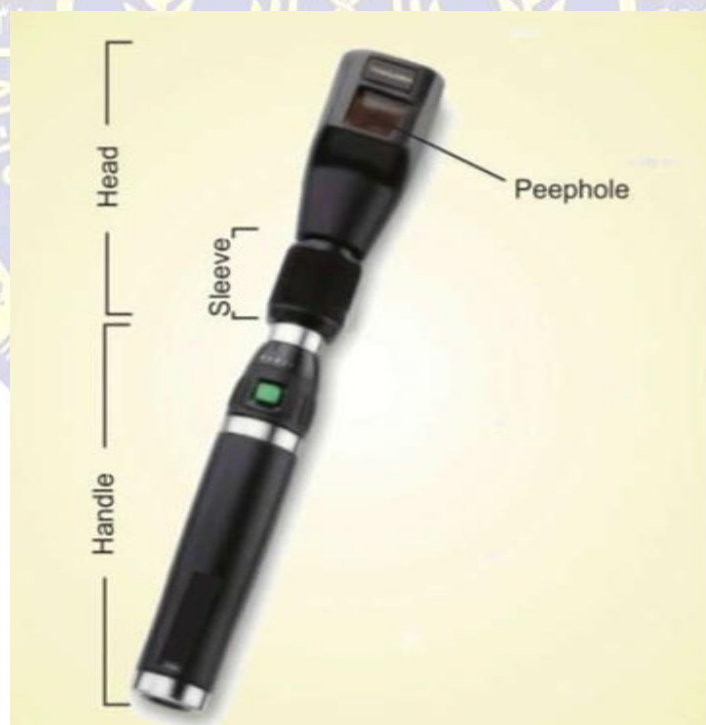
- Electric Current Source

- **Observation System:**

The observation system enables examiner to see the reflex from the retina patient.

- **Optical Head**

The optical head projects a slit beam of light from one side of the head and has an observer window on the other. The light originates from a bulb and passes through a condensing lens. This lens focuses rays from the light source onto a mirror, bending the light beam at a right angle to the axis of the handle so that it is properly projected from the instrument head.



- **Sleeve**

The sleeve lies below the optical head and controls both meridian (and

streak rotation) and vergence (or streak focus). By sliding the sleeve up or down, the distance between the bulb and lens is changed to either converge or diverge the light streak. Different sleeve positions are utilized based on the type of retinoscopy technique used. Rotating the sleeve rotates the orientation of the streak around different meridians.

- **Socket**

For source of illumination, i.e. bulb at its terminal end.

- **Handle**

The handle contains the battery which provides the current source



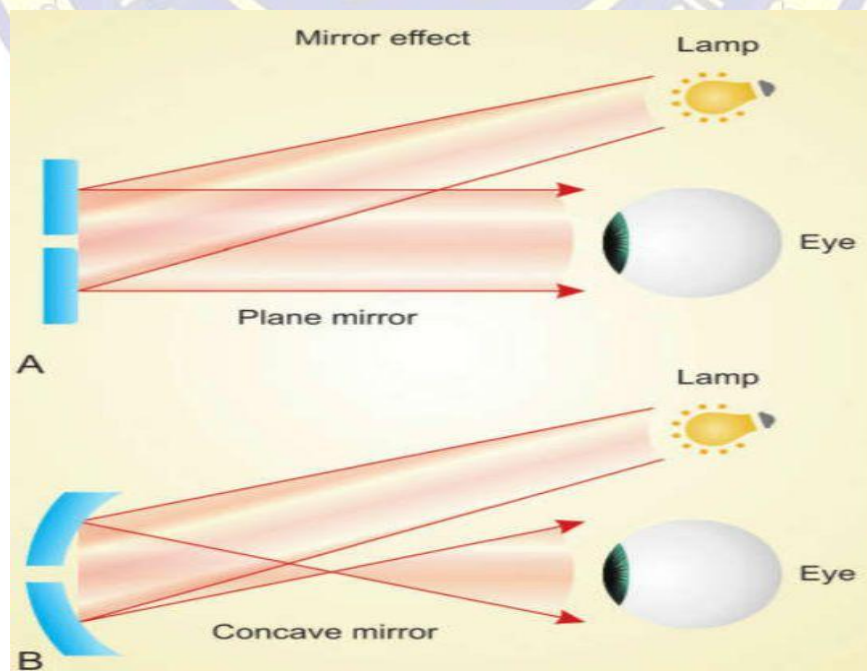
Plane mirror effect:

Apparent light source is behind the retinoscope, creating parallel light rays.



Plane mirror and concave effect using retinoscope

Concave mirror effect: apparent light source is in front of the retinoscope, creating concave light rays



Retinoscopy Technique:

- 1) The retinoscope should be in plano mode with the sleeve down.
- 2) The patient should be instructed to fixate on an appropriate distance target. Both eye wells should be open.
- 3) While standing approximately 15 degrees temporal to the patient's line of site in the right eye, the doctor should aim the streak of retinoscope light into the patient's right eye. Gently sweep the beam back and forth across the pupil to determine the light reflex. Keep in mind, the reflex observed describes the power of the eye in the meridian perpendicular to the light beam.
- 4) Continue gently sweeping the light beam across the pupil while slowly rotating the beam 360 degrees. If the reflex is constant throughout, the patient has a spherical refractive error. If the reflex changes, astigmatism is likely present.
- 5) Neutralize the most minus/least plus meridian if astigmatism is present. If 'with' motion is observed, add plus lenses until 'neutral' is achieved; if 'against' motion is observed, add minus lenses until 'neutral' is achieved. The reflex is 'neutral' when the retinoscope reflex "blinks red" across the pupil.

Note: many practitioners will begin by scoping only the 180 and 90 meridians since the majority of astigmatic patients require cylinder correction in those meridians.

Advantages

- Reduces the refraction time and error

-
- Extremely important when communication is difficult or impossible
 - Retarded, deaf persons
 - Foreigners
 - Children , infants

Key points for Retinoscope

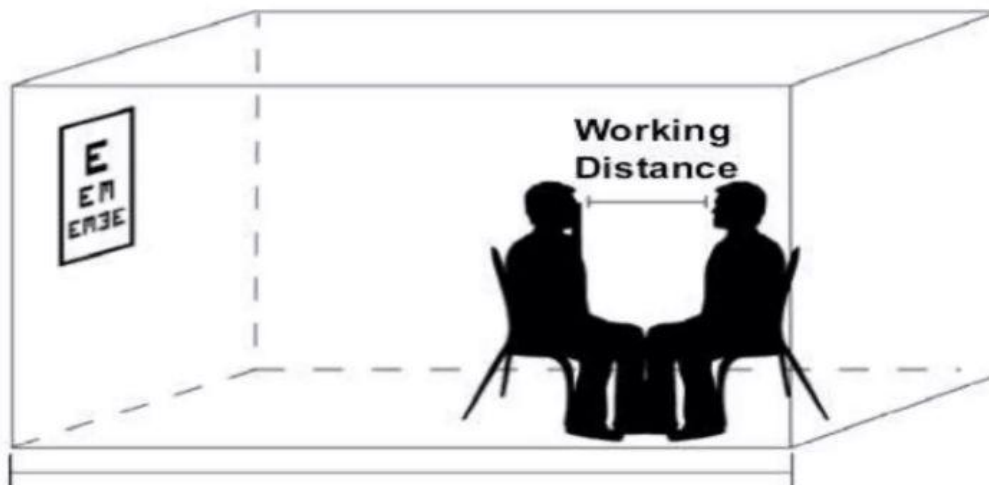
- Establish a dim room.
- Fog (or occlude, if necessary) the fellow eye.
- Scope the patient's right eye with your right eye/right hand.
- Scope the patient's left eye with your left eye/left hand.
- Keep your scope as close as possible to their visual axis, without interrupting continuous distant fixation.
- Correct for working distance
 - Add -1.00 sphere if at 1m.
 - Add -1.50 sphere if at 66 cm.
 - Add -2.00 sphere if at 50 cm.

When we shine light from a retinoscope on the pupil of the eye the light rays emitted from the retina are observed as a red retinal reflex in the patient's pupil.

Working Distance	Dioptric Equivalent
40 cm	+2.50 D
44.4 cm	+2.25 D
50 cm	+2.00 D
57.1 cm	+1.75 D
66.7 cm	+1.50 D
80 cm	+1.25 D
100 cm	+1.00 D

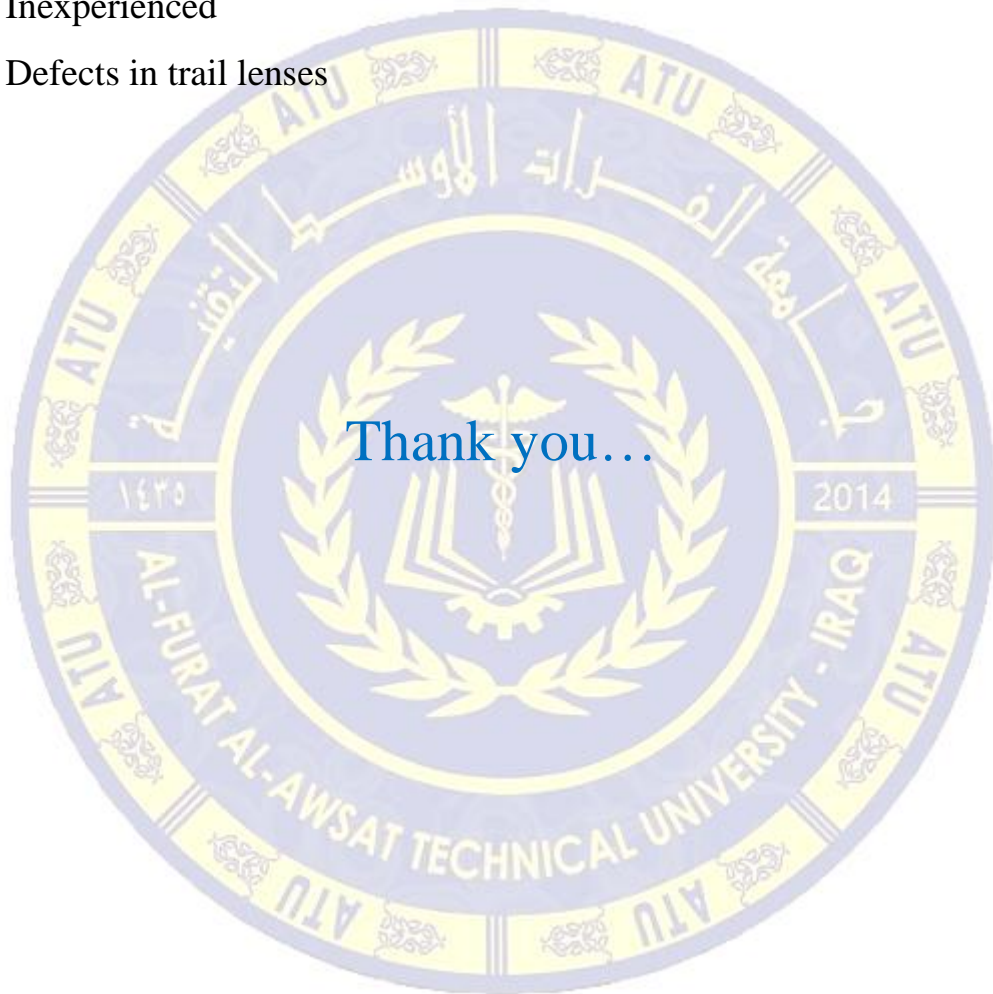
Fixation target

- The target given to the patient should be 20/200 or 6/60 in the Snellen chart.
- It is given to the patient to relax accommodation during retinoscopy.



Sources of error during Retinoscopy

-
- Incorrect working distance
 - Corneal scar
 - Small pupil
 - Uncontrolled accommodation
 - Cataracts
 - Inexperienced
 - Defects in trial lenses



Lecture 9 Autorefractometer

Introduction

Autorefractometer it is a very precise, objective automated electronic method to measure refractive error. They can be operated either manually or in automatic mode. The autorefractometers work on the basic principles of retinoscopy and Badal optometry. The patient is asked to look at a visible coloured fixation target. The refractionist aligns the instrument panel to sharp focus and pushes a button which initiates the process of estimation of refractive error. An inbuilt microprocessor analyses the focal power of emitted rays from the patient's eye and processes it into accurate refractive error correction in diopters in few seconds. Usually 3 readings in each eye are averaged to give a final assessment in a print out. Modern autorefractometers are very quick and accurate.



Autorefractometer or automated refractor is a computer-controlled machine used during an eye examination to provide an objective measurement of a person's refractive error and prescription for glasses or contact lenses. This is achieved by measuring how light is changed as it enters a person's eye.

Parts of Autorefractometers

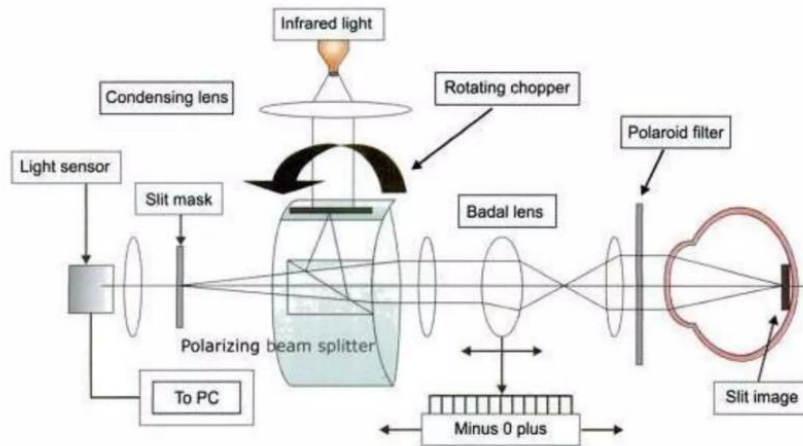
The basic parts of the autorefractometers are shown in the figure below.

- LCD screen, Measure button
- Control stick, Stick locker
- Moving part, Base
- Function switches
- Forehead-rest
- Measuring window, Chin-rest
- Chin-rest knob, Limit screw
- Power switch, Power cord.



Autorefractors basically comprise of an infrared source, a fixation target and a Badal lens (fogging lens). A variety of targets have been used for fixation ranging from less interesting ‘stars’ to pictures with peripheral blur to further relax accommodation. All autorefractors now use the fogging technique to relax accommodation prior to objective refraction.

The majority of autorefractors calculate the vision correction a patient needs (refraction) by using sensors that detect the reflections from a cone of infrared light. These reflections are used to determine the size and shape of a ring in the retina which is located in the posterior part of the eye. By measuring this zone, the autorefractor can determine when a patient's eye properly focuses an image. The instrument changes its magnification until the image comes into focus. The process is repeated in at least three meridians of the eye and the autorefractor calculates the refraction of the eye, sphere, cylinder and axis.



The type of infrared light used in this device is near infrared radiation (NIR) is used due to more reflection from the fundus is happen compare to normal Radiation, and another reason NIR is invisible to the patient so patient does not feel photophobia, pupil constriction and Accommodation is unaffected. Main disadvantage of the NIR is: It is more scattered from the fundus compared to other Radiation. Infrared radiation is used in the range of 780 nm and 950 nm as the primary radiation source.

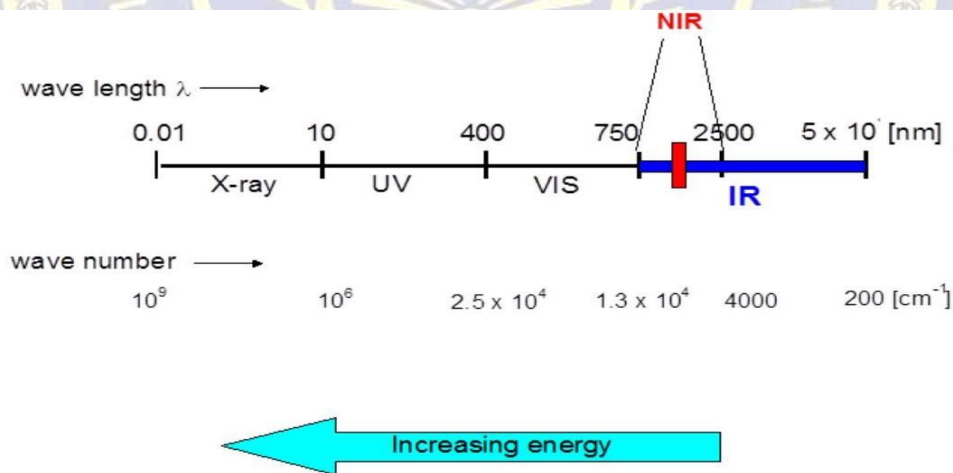
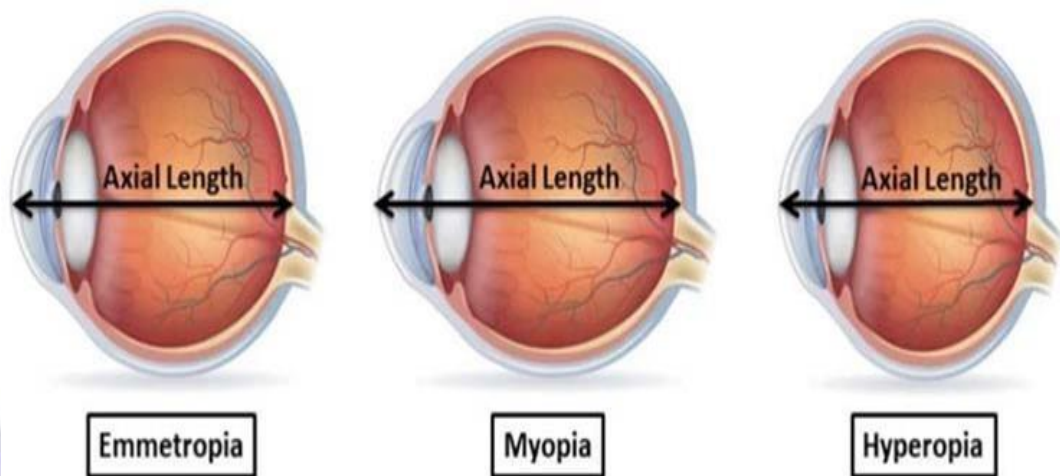


Figure 1: NIR range

Since refraction is all about how the eyes bend (or refract) the light entering the eyes. The way they do this determines where light is focused onto the retina at the back of the eye, and therefore how clearly human can see. How well the eye refracts light is based on three things:

- Axial length, which is the shape of eye (how long or short it is)
- The curvature of cornea.
- The curvature of your lens (the clear lens in the eye that changes shape to help focus the light onto the retina).



Advantages

- It's easy to see how light affects eye movement.
- It's fast, safe, and easy.
- Many pieces of data are recorded, and an average is given.
- Doesn't need the pupil dilation.
- It is possible to print out the prescription.

Disadvantages

- Children can't stay still for long periods of time.
- Because of accommodations, reading is not correct.
- Big size of the auto refractor
- Want to be set up on a table.

Indications

Different signs can show in a patient that they have a refractive mistake.

These signs and symptoms are:

- Blurred/distorted vision
- Myopia.
- Hyperopia.
- Astigmatism.
- Squint of the eyes
- Contact lens prescription.

Main Components

There are three key parts to the auto-refractometer:

- An infrared light source
- A fixation target
- Badal lens system (fogging lens).



Principles of autorefractometers:

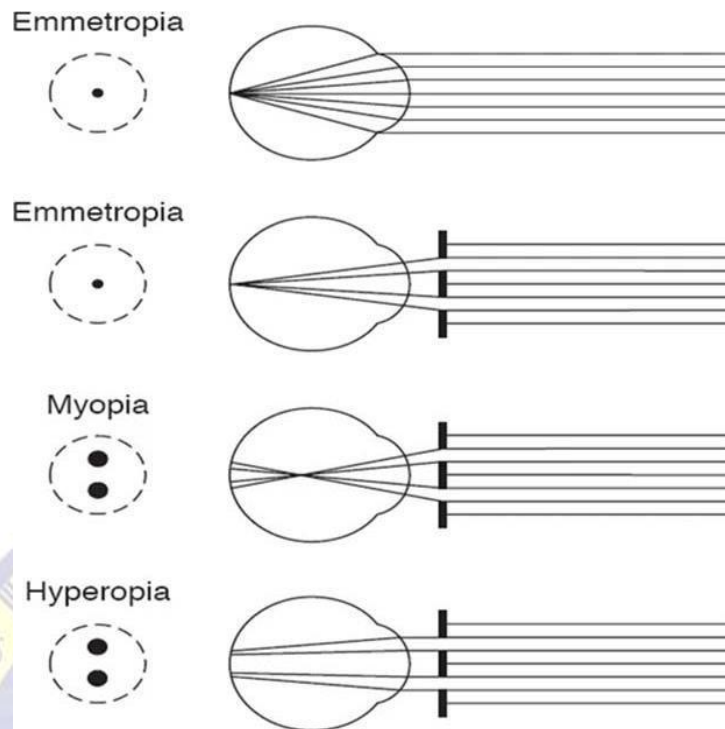
- The Scheiner principle
- The optometric principle (retinoscopy principle)
- The best -focus principle
- The knife – edge principle
- The ray – deflection principle
- The image size principle

The Scheiner's Principle

In 1619, Scheiner found that one can determine an eye's refractive error from dual pinhole apertures before the pupil. His observations are as follows:

When a distant object's parallel light rays enter the eye of an emmetropic patient, they point to the retina. However, the beams get restricted to two tiny bundles when a dual pinhole aperture is placed before the pupil. One can observe two small light spots when the bundle of ray's traverses before touching the retina. This method is quicker and more objective than traditional subjective refraction, where a patient is asked which lens combination provides the clearest vision.

- MYOPIC- bundles cross each other before reaching the retina- two small spots of lights are seen.
- HYPEROPIC-rays are intercepted by the retina before they meet- again two small spots are seen.



The optometric principle (retinoscopy principle):

Here, fundus reflex is being observed. Regarding Fundus Reflex, two characteristics are being seen.

- Direction of the motion of the Fundus Reflex compared to Incident beam.
- Speed of the motion of the Fundus Reflex compared to Incident beam.

Best Focus Principle:

To achieve the Neutralization, here actually highest contrast is being assessed during the target is focused on the Retina.

In case of Emmetropia, the images of a target are focused properly on the Retina and achieved highest contrast. But sometimes, images are focused on the Retina but Contrast level is diminished due to mild defocused on the Retina of the images of an object. By the changes of the vergence of the Incident rays may achieve best focus and highest contrast.

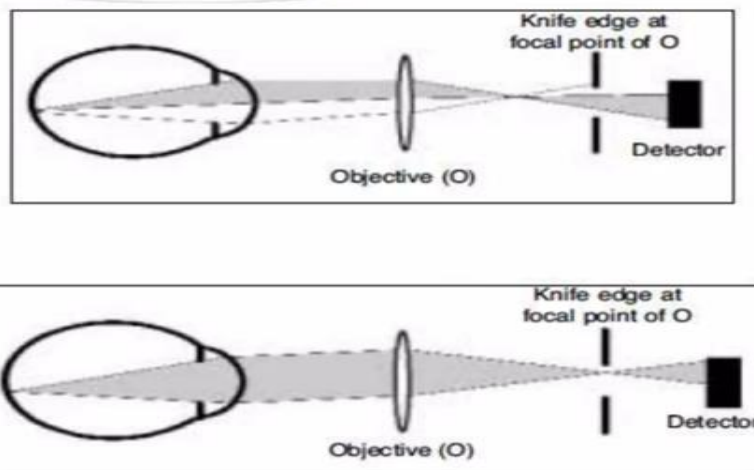
Auto Reflection Based On Image Size of the Fundus Reflex:

Here, fundus image size is measured at three or different meridians and calculates the Refractive error on the basis of ocular magnification and ocular minification compared to Emmetropia.

Knife Edge Principle

This principle is used to assess the Refractive uniformity of the lens. The meaning of the Knife Edge Principle is “Here, the pointed edge is focused at the edge of the linear flat opaque surface and this edge is like a Knife Edge.” When the Knife edge Principle is followed in Auto Refractometer, then two things are present.

- Sharp (like a knife) linear opaque surface is present.
- Mirror



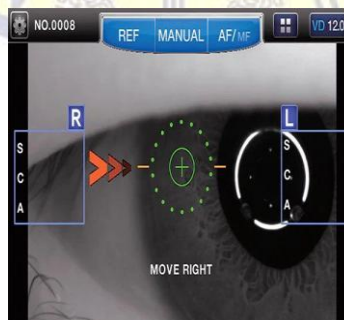
In this case, this knife edge is placed in front of the lens and the mirror is placed at the back of the lens. Here, the knife edge is a source of light. So here, whatever the reflection is created is “Retro Reflection” because the mirror is behind the lens and the light the source is in front of the lens.

Ray Deflection Principle

When NiR are reflected from a patch of fundus source on that time these rays are exist from the eye and it is refracted to the images of the secondary fundus source and along with optic axis of the eye. In case of Emmetropic eye, the exit rays are parallel to each other. In case of myopic eye, the deflection (direction of change) of rays will be in front of the eye, in the far point plane. This deflection (direction change) is looking like; the rays come from the plane which is back of the “Hyperopic eye.” This deflection is compared to collimated (make) parallel rays. This instrument measures the linear deflection fundus images in three or more meridians at a fixed distance from the eye, and trigonometrically (Mathematically) measures the Angular deflection of rays and position of the far points which computes the full Refractive error

Sources of Error

- Poor fixation.
- Corneal, lens and media opacities.
- Small pupil or a distorted pupil.
- Accommodating variations, creating 'over minus' readings.



Contraindications

-
- Patients with mental disabilities
 - Patients suffering from severe poor vision
 - Severe traumatic ocular injury
 - Conjunctivitis, keratitis, uveitis, episcleritis
 - corneal edema
 - Artificial prosthesis
 - Very small children
 - Patients presenting with accommodation anomalies

Procedure:

- For autorefractor testing, ask the patient to be seated on a chair in the diagnostic procedure room.
- The patient's head will then be positioned so that their chin is resting on the chin rest and their forehead is resting on the forehead rest of the autorefractor.
- Then ask the patient to look on the target through right eye.
- Now you have to move the joystick to push the device left/right or up/down or front/back so that the image of the patient's eye that you are viewing in the monitor is focused.
- Once the image is on focus, you must position the square on the center of the monitor at the pupil reflex.
- Once the square is positioned at the corneal reflex and the patient's eye

image is on focus you have to press the capture button on the joystick for three times

- When the capture button is pressed, the machine bounces off infra-red rays from the retina (innermost light sensitive layer of the eye) back to device and takes a series of measurements to determine the patient's refractive power. It will show three different reading of the patient's refractive error and gives the average reading as the final reading for the refractive error.
- Finally, the device will print out the final prescription (average reading from the three readings) of the patient's refractive error
- Repeat the above procedures for left eye.

Autorefractors are particularly beneficial for people who may have trouble concentrating during a longer exam, or have difficulty clearly describing their vision problems (such as small children, people with dementia, or a mental disability). It can give a quick, highly accurate measurement to determine whether any vision correction is needed, with minimal input.

Risks & Complications

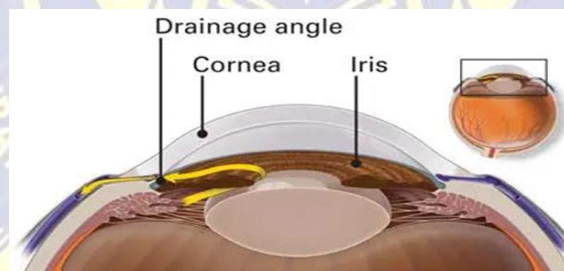
There are no risks or complications associated with this test.

Thank you...

Lecture 11, 12, 13
Tonometer types, contact and non-contact

Introduction

Aqueous humor is secreted by the ciliary process to the posterior chamber and goes through the pupil to the anterior chamber (inflow). It then leaves the anterior chamber through the trabecular meshwork to the venous system (outflow). Normally, there is equilibrium between inflow and outflow that creates normal intraocular pressure (IOP). Any circumstances that affect the formation of aqueous humor or outflow of aqueous humor cause changes in IOP. Local and systemic disorders, medicines, and ocular surgeries affect IOP. Higher IOP levels are associated with ganglion cell and nerve fiber layer loss. The progression of damage eventually involves the optic nerve and irreversible visual loss.



Glaucoma is the second leading cause of blindness worldwide. The only preventable risk factor for the development and progression of glaucoma is IOP. Correctly measuring IOP is very important in diagnosing glaucoma and conducting follow-ups.³ Medical, laser, or surgical treatments of glaucoma concentrate on lowering IOP. Earlier studies have shown that every 1 mmHg drop in IOP decreases visual field damage by 10%. Therefore, precise measurements are very important.

Tonometry

Tonometry is a diagnostic method which, through the use of different tools, allows the evaluation of the pressure existing inside the human eye. It is called intraocular pressure (IOP). Normal intraocular pressure ranges between (11-21 mm Hg). High pressure inside the eye is more than (21 mm Hg), and this indicates a very high probability that the patient will develop glaucoma. The aim of tonometry is to detect the IOP that is measured in millimeters of mercury (mmHg); it is performed through the interaction with the ocular structures and in particular with the cornea.

Risk Factors IOP

An elevated intraocular pressure (IOP) is the main risk factor for the development of glaucoma, an ocular disease that if not properly treated, causes irreversible damage to the optic nerve, visual field changes, external stress and retinal detachment leading to blindness.

Assessment of IOP

Each technique has inherent advantages and disadvantages, none is ideal. Here, we describe different types of tonometer used currently to measure IOP

- ❖ **Non-contact tonometry:** it means don't touch patient's eye (cornea), no need for topical anesthesia.
 - Digital tonometry (palpation method)
 - Air-puff tonometry
- ❖ **Contact tonometry:** it means touch patient's eye (cornea),so need topical anesthesia.
 - Goldman tonometry
 - Perkins tonometry
 - Dynamic contour tonometry
 - Electronic Schiottz tonometer
 - Manometry

Digital tonometry (palpation method)

Intraocular pressure (IOP) is estimated by response of eye to pressure applied by finger pulp.

Digital palpation is a simple technique that can prove very useful for assessing IOP in primary healthcare settings, particularly in the absence of equipment, for example, in healthcare centers located in rural areas or in developing countries. Accordingly, this technique can also aid the diagnosis of high IOP in primary and emergency care settings.

Procedure

- The technique for digital palpation is as follows: The patient closes his/her eyes and looks downward. Using the index finger of both hands, the examiner gently applies pressure to the superior part of closed lids alternately, to estimate the force required to indent the orbital wall.
- If the IOP is raised > fluctuation produced is feeble or absent and the eyeball feels firm to hard.
- If the IOP is very low > eye feels soft like a partially filled balloon.



Air-puff tonometry

Is an appplanation method using a standardized puff of air to flatten the

cornea. This method has the advantage that no topical anesthetic or risk of corneal abrasion is involved.

Air-puff tonometry, as well as other forms of applanation tonometry, are based in theory on the Imbert-Fick Law, which states that the force required to applanate a given corneal area is directly proportional to the IOP .5.9 With air-puff tonometry, the force that produces applanation is provided by a pulse of room air, generated by the pneumatic system of the instrument. The instrument's optoelectronic applanation monitoring system, measures the amount of reflected light off the cornea, and thereby detects the exact moment of applanation.



Procedure

- **Preparation:** You will be seated and asked to place your chin on a rest to stabilize your head. It's important to remain still during the test for accurate results.
- **The Puff:** Once you're positioned, you'll look into the machine at a light or target. The machine will then release a quick puff of air onto your open eye. The sensation can be surprising but it's over in seconds.
- **Measurement:** The machine calculates the IOP by measuring the time it takes for the air to flatten the cornea and the force required to do so.

Advantages

- Screening procedure

-
- Can be operated by non-medical personnel
 - No anesthetic required
 - No direct contact between instrument & eye

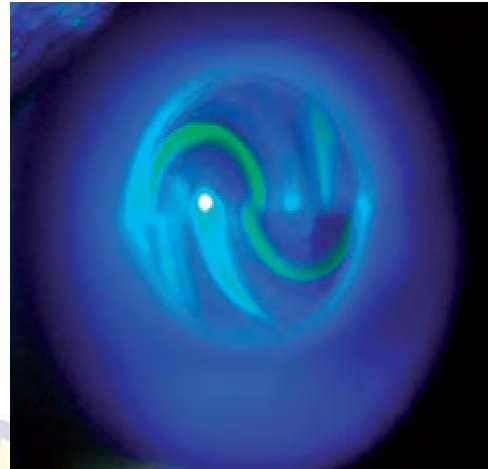
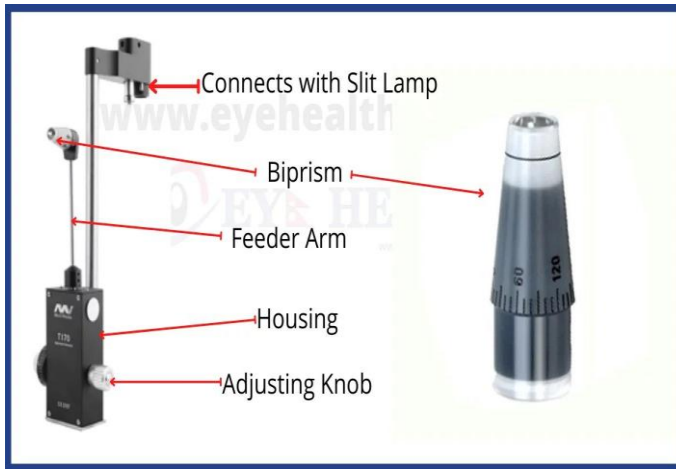
Disadvantages

- IOP is near normal
- accuracy decreases with increase in IOP
- In eyes with abnormal cornea/poor fixation.

Contact tonometry

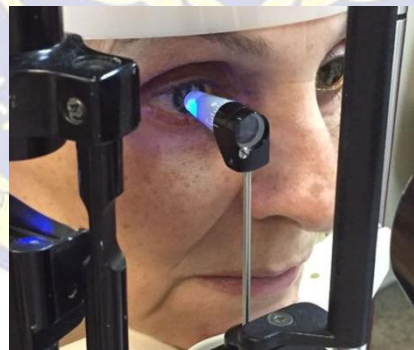
Goldmann applanation tonometer (GAT)

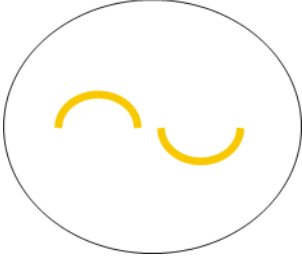
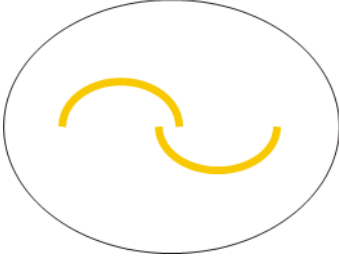
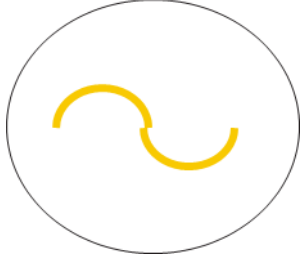
(GAT) is currently considered as internationally recognized gold standard to measure IOP. It uses principal of force required to flatten the cornea, including GAT work based on the ImbertFick principle, which states that the pressure (P) inside a sphere is equal to the force (F) necessary to flatten the surface divided by the area (A) of flattening ($P = F/A$). GAT is widely in use from last seven decades and is largely accepted in clinical practices and also considered as reference standard in various clinical trials. However, there are significant limitations of GAT. Its readings are significantly affected by examiner and patient. It needs topical anesthesia, fluoresceine staining and technical expertise. Also, if it is not properly disinfected, there is risk of transmission of various diseases such as HIV, Hep C.



Procedure

- Topical anesthesia
- Maintaining tear film with fluorescein.
- The cornea and biprisms are illuminated with cobalt blue light.
- Biprism just touches the apex of the cornea.
- At this point, two fluorescent semicircles are viewed through a prism.
- The application force against the cornea is adjusted until the inner edges of two semicircles just touch.



		
<p>High intraocular pressure will result in this image.</p> <ul style="list-style-type: none"> • Turn the calibrated dial on the tonometer backwards to reach the accurate end point. 	<p>Low intraocular pressure will result in this image.</p> <ul style="list-style-type: none"> • Turn the calibrated dial on the tonometer forwards to reach the accurate end point. 	<p>This is the correct end point</p> <ul style="list-style-type: none"> • The inner edges of the semi-circles are just touching. This will give an accurate reading of intraocular pressure.

Advantages

- easy to perform
- Most accurate
- Not much force is applied to the cornea.
- Does not get affected by corneal-scleral rigidity
- Readings are directly from the knob.
- Can be done on post-cases or injury cases

Disadvantages

- Need slit lamp, dark room, fluorescein and topical anesthesia

Sources of Error

- An inadequate amount of fluorescein can lead to inaccurate readings.
- occurs if prism not dried after cleaning
- Tear film thickness can also affect accuracy.
- central corneal thickness and corneal curvature, Corneal edema can affect the accuracy of tonometry

Contraindications

- Active Infection
- Patients with recurrent corneal erosions
- Corneal abrasions that are not totally healed



Perkins tonometer

The Perkins tonometer is similar to the Goldmann tonometer, except that it is portable and counterbalanced, so it can be used in any position.



Procedure

- Sterile probe is propelled forward into the cornea by a solenoid; the time taken for the probe to return to its resting position and the characteristics of the rebound motion are indicative of the IOP and also the biomechanical properties of the cornea)
- Time taken for the probe to return to its resting position is longer in eyes with lower IOP and faster in eyes with higher IOP.

Advantages

Its advantages are that it is portable, can be used on domiciliary (home) visits and being hand-held may be used with the patient either sitting up or lying down. Some patients are less apprehensive with this technique.

Disadvantages

Its disadvantages include that it is less stable, has a fixed low magnification, and does not allow for efficiently examining the cornea.

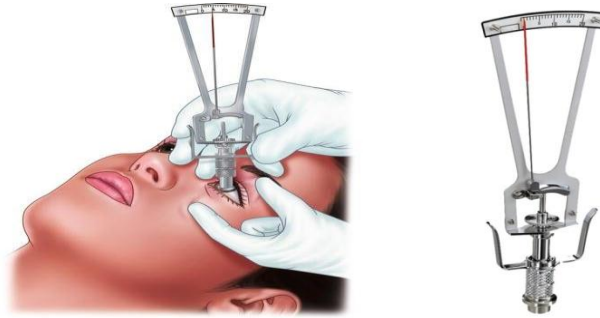
Dynamic Contour Tonometer

The dynamic contour tonometer represents a new technology for non-invasive and direct intraocular pressure (IOP) measurement, and has been proposed to accurately measure the true IOP irrespective of the corneal thickness. This device is also capable of measuring the ocular pulse amplitude, has significance in the diagnosis and management of glaucoma.



Electronic Schiottz Tonometer

The Electronic Schiottz tonometer is an instrument for measuring the intraocular pressure (IOP). Its ease of use and relative low cost. Before using it, you must apply a topical anesthetic to the cornea.



Procedure

- The patient should be anesthetized with 4% lignocaine or 0.5% proparacaine.
- With the patient in supine position, looking up at a fixation target while the examiner separates the lids and lowers the tonometer plate to rest on the anesthetized cornea, the plunger is free to move vertically.
- The scale reading is measured.
- The 5.3 gm weight is initially used. If the scale reading is 4 or less, additional weight is added to the plunger.
- The IOP measurement is repeated until three consecutive readings agree within 0.5 scale units.
- The conversion table is used to derive OP in mm lg from scale reading and plunger weight.

Disadvantages

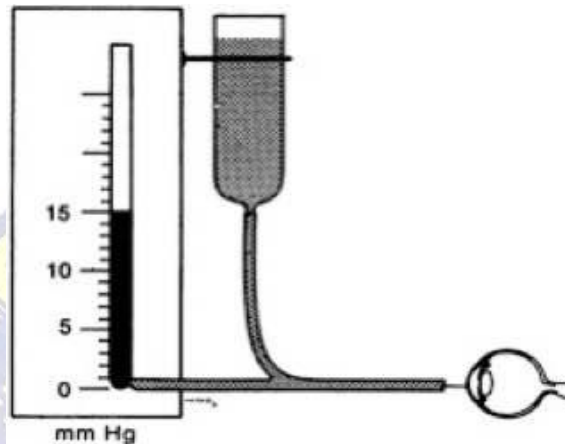
Does not make as precise measurements as other types of tonometer's

Advantages

- it is inexpensive
- simple to use
- durable
- requires little maintenance
- does not have electronics
- does not require batteries
- Can be stored for years between uses.

Manometry

This is used as a laboratory technique to perform continuous pressure measurements over time in the eyes of humans or experimental animals.



Procedure

A hollow needle is introduced into the anterior chamber and connected to a reservoir of isotonic fluid, which is raised just enough to prevent any loss of aqueous from the eye. The height of the fluid column is calibrated in millimeters of mercury to reflect the IOP.

Limitations

- It is not practical for routine examinations.
- If it is utilized in humans, it requires general anesthesia, which itself alters IOP.

Thank you...