RETINOSCOPY PART 2

Procedure

- The patient is made to sit at a distance of 1 m for from the examiner in the dark room.
- For non cycloplegic refraction of patients who are not presbyopic especially if they are myopic it is necessary to fog the fellow eye. This involves placing a + 1.50 or + 2.00 spherical lens on top of the presumed refraction
- The reason why the fellow eye should be fogged is to reduce accommodation

- Ordinarily occlusion should be avoided as it stimulates more accommodation. However occlusion is required in the following situations:
- • when the eye being tested is densely amblyopic.
- • If the patient markedly objects to fogging due to diplopia or asthenopia.
- • If you are unable to estimate acuity and provide an adequate fog lens.

- With cycloplegic refraction typically in children there is no need to fog since the accommodative component is removed by the cycloplegia.
- To begin retinoscopy, with the help of a retinoscope, light is thrown on to the patient's eye, who is instructed to look at a far point to relax the accommodation.
- However when a cycloplegic has been used, the patient can look directly into the light and have the refraction assessed along the actual visual axis.
- Through a hole in the retinoscope's mirror, the examiner observes a red reflex in the pupillary area of the patient which is seen as:
- With spot retinoscope, the whole pupil glows as red reflex.
- With streak retinoscope, red Reflex is seen on a band of light

- Then the retinoscope is moved in horizontal and vertical meridians keeping a watch on the red reflex which also moves when the retinoscope is moved. The characteristics of the moving retinal reflex are noted.
- **OBSERVATIONS AND INFERENCES:-**
- **I. Direction of movement of Red Reflex**
- 1. No movement of red reflex indicates myopia of 1D
- 2. With movement of red reflex along the movement of the retinoscope indicates either emmetropia or hypermetropia or myopia of less than 1D
- 3. against movement of red reflex to the movement of the retinoscope implies myopia of more than 1D

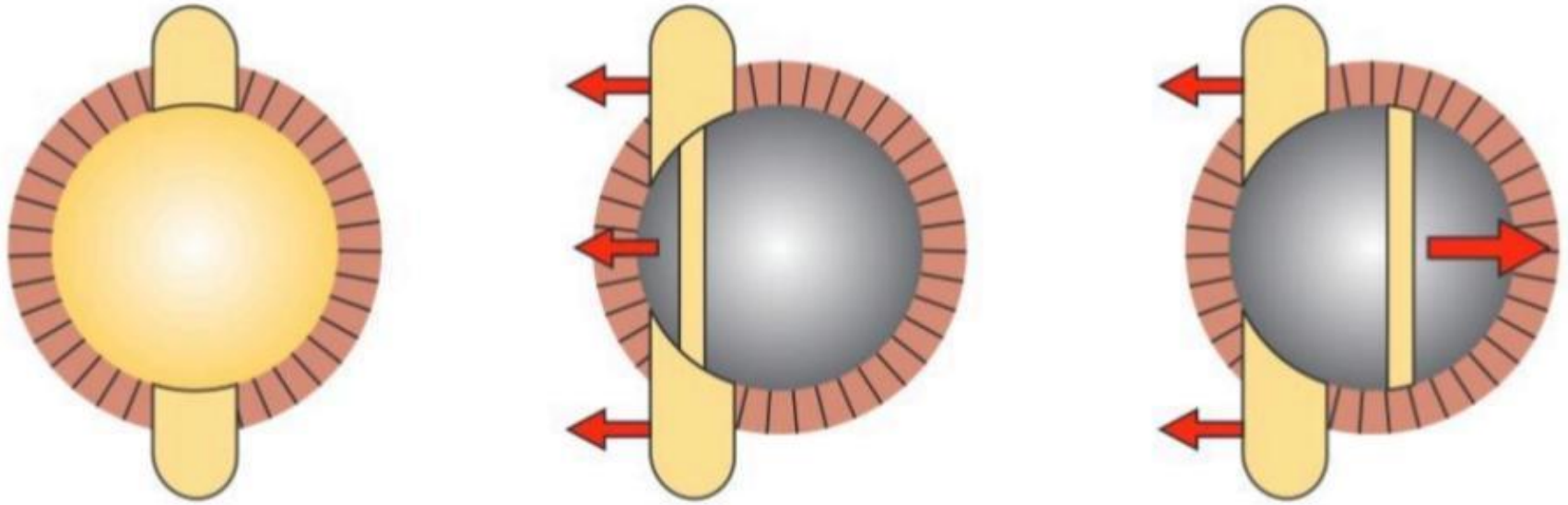
- II. **Brightness and speed of movement of Red reflex**
- • bright and fast shadow red reflex is seen in the pupillary area, which moves rapidly with the movement of the mirror in patients with low degrees of refractive errors.
- • dull reflex, which moves slowly with the movement of the mirror is seen in patients with high degrees of ammetropia.
- III. **Width of Red Reflex**
- width of reflex when using streak retinoscope is narrow in high degree of ammetropia and wide in low degrees of ammetropia. At the neutralization point the entire pupil is filled with light.

- **IV. Orientation of Red Reflex**
- In the presence of astigmatism▫ when the axis does not correspond with the movement of the mirror the shadow appears to swirl around.
- 1. **horizontal and vertical orientation** of the red Reflex is observed when either there is no astigmatism or when the astigmatism is with the rule against the rule.
- In these situations ensure the slit is first vertical and then horizontal by rotating the slit with the help of cuff of retinoscope to neutralize these meridians.

- Oblique orientation with oblique astigmatism the principal meridians are still perpendicular but do not lie vertically and horizontally.
- Therefore when a horizontal scope sweep is made with the slit orientated vertically the orientation of the pupil reflex will be oblique and not lie vertically it will lie between 45° and 90° degrees or 90° and 135 °.
- Similarly▫ if the scope slit was orientated horizontally and a sweep made vertically the orientation of the pupil reflex will again be oblique and not be horizontal it will lie between 0 and 45 degrees or 135 and 180 degrees. For oblique astigmatism the scope slit should be rotated by turning the cuff slightly so the slit is parallel to the pupil reflex to aid subsequent neutralization.
- The perpendicular meridian can then be neutralized by rotating the slit 90 degrees e.g. if one meridian is at 120 degrees the other be at 30 degrees.

- 3.scissor reflex or some other problems may be observed in the red reflex.

Procedure of retinoscopy

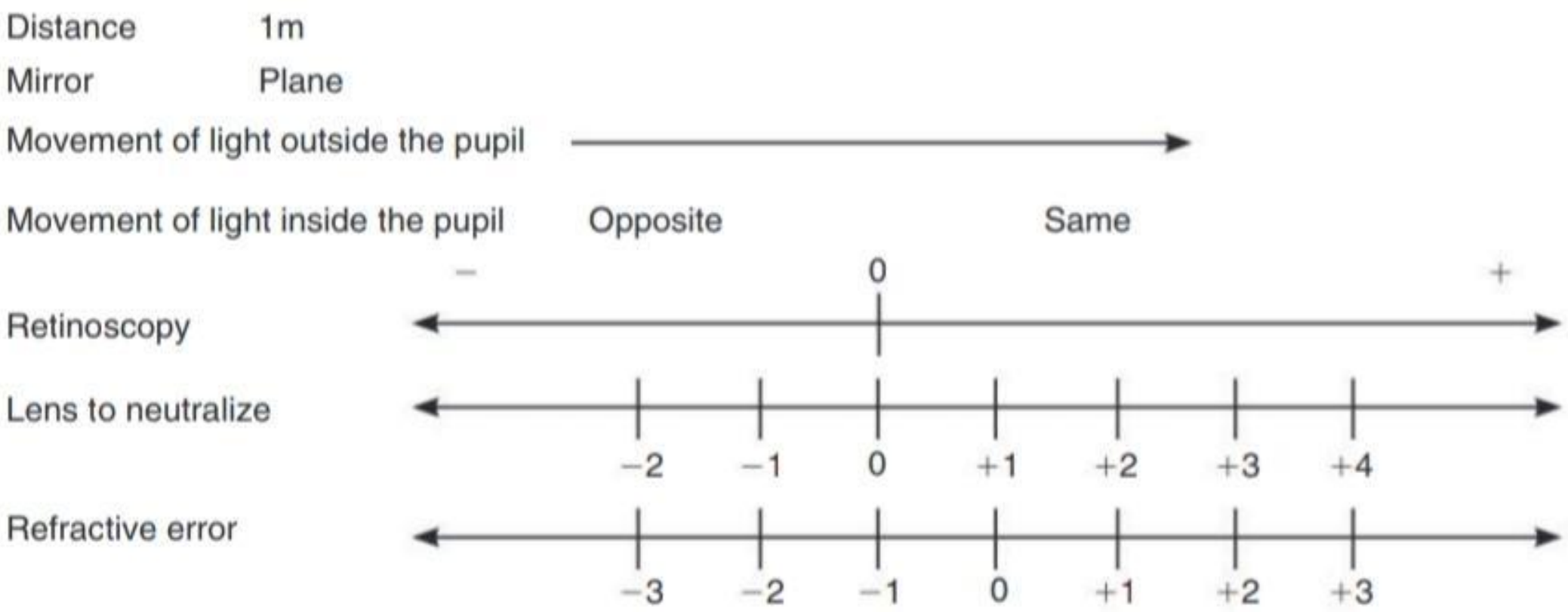


Red Reflex during streak retinoscopy

Neutralization point

With movement

Against movement



Relation of movement of pupillary red reflex with the error of refraction

NEUTRALIZATION OF RED REFLEX

- REFLECTING PLANE MIRROR (SPOT) RETINOSCOPY
- Neutralization
- To estimate the degree of refractive error the movement of red reflex is neutralized by the addition of increasingly convex spherical lenses when the red reflex was moving with the movement of plane mirror or concave spherical lenses when the red reflex was moving against the movement of plane mirror.
- When a simple spherical error alone is present the movements of red reflex will be neutralized in both the vertical and horizontal meridians.

- however in the presence of an astigmatic refractive error the situation is not quite so simple.
- The examiner has to determine not only the different neutralization points of the two meridians but also the orientation of these.
- The relationship of the direction of external movement to that of the reflex has an important bearing on determination of axis of cylindrical error.

Finding the cylinder axis

- The initial examination with retinoscope is always exploratory.
- In the presence of astigmatism with its principal axis , horizontal and vertical, one axis is neutralized with the appropriate spherical lens and the second axis vertical or horizontal still shows the movement of reflex in the direction of axis of astigmatism.
- In the presence of oblique astigmatism close to neutralization point the reflex may alter its plane of movement.
- In such a situation the examiner must again explore different planes of external movement of the light until they correspond to that of the retinoscopy reflexes.

Finding the Cylinder Power

- Once the two principal meridians have been identified each should be neutralized separately to find the cylindrical power by any of the following methods:
- • with a sphere and a cylinder
- • with spheres only
- • with two cylinders

1. With a Sphere and a Cylinder

- First neutralize one axis with an appropriate spherical lens.
- In order to be able to keep working using ‘with reflexes’ neutralize the lens plus axis first.
- Then with this spherical lens in place, neutralize the other axis 90 degrees away with a cylindrical lens at the appropriate orientation.
- The spherical-cylindrical gross retinoscopy may be read directly from the trial lens apparatus.
- The main advantage of using spherocylinder combination over the two spheres is in verifying the position of axis.
- For this purpose the appropriate sphere and a slight undercorrecting cylinder should be put in the trial frame.
- For example if the neutralizing spherocylindrical combination is +2 DS and +3 DC then put +2.0 DS and +2.5 DC in the trial frame.

- In this case on moving the retinoscopic mirror at right angles to the axis of cylinder the reflex should move exactly at right angles to the axis of cylinder representing the +0.5 D of uncorrected hypermetropia.
- If the axis of the cylinder is not proper this Reflex will not move at right angles to the cylinder but markedly obliquely about six times.
- in the above e□ample□ where the correction required is +2 DS and +3 DC at 85 degrees and the examiner wrongly estimates that the direction of axis is 90 degrees.
- In this case when the cylinder is undercorrected by +0.5 D and placed at 90 degrees, on moving the mirror horizontally the reflex will obliquely move along 150-degree axis i.e. 30 degrees oblique.

- Thus the error in axis 5 degrees is multiplied six times.
- Since the obliquity of the shadow multiplies any error in the direction of the axis to such an enormous extent a very small deviation from the true axis is easily detected.
- The angle that the oblique reflex now makes with the axis of cylinder should be assessed and the cylinder rotated through an angle one-sixth of this.
- The procedure should be repeated until the final and correct axis is obtained.
- Sphere and cylinder approach can be used in two different ways:
- • using positive cylinder notation or
- • using negative cylinder notation.

- **1. Using positive cylinder notation**
- This means that your retinoscopy result will be in a plus cylinder format.
- Identify the orientation of the two principal meridians which will be perpendicular to each other.
- The principal meridian that has an against reflex or if both reflexes are with the one having least with reflex which is fastest and brightest is neutralized first with a sphere.
- This will result in the other principal meridian giving a with reflex which is then neutralized with positive cylinder the axis on the lens in the same orientation as the scope slit
- The resultant prescription will be the lenses in the trial frame.

- **2. Using negative cylinder notation**
- This means that your retinoscopy result will be in a minus cylinder format.
- Identify the orientation of the two principal meridians which will be perpendicular to each other.
- First, neutralize the most with reflex with plus spheres, then neutralize the perpendicular against reflex with minus cylinder.
- The lenses in the trial frame will give the retinoscopy result in minus cylinder format which must then be corrected for working distance.

2. With spheres only

- It is possible to obtain an objective refractive result without using any cylindrical lenses.
- first of all identify the two principal meridians then neutralize one of the meridians with a sphere and record the result and orientation of reflex
- following this neutralize the perpendicular meridian with an appropriate sphere and record the result and orientation of the reflex .
- The magnitude of the cylinder is the difference between the two spheres.
- It is better to use a power cross to record the results and generate the resultant prescription.
- for example if the 180 degree axis is neutralized with +2.0 sphere and the 90-degree axis with +3.0 sphere the power cross for gross retinoscopy will be (+2) + (+3).

3. With two cylinders

- Although it is possible to use two cylinders at right angles to each other for the gross retinoscopy, there seems to be no advantage of this variant over the spherocylinder combination.

END POINT OF RETINOSCOPY

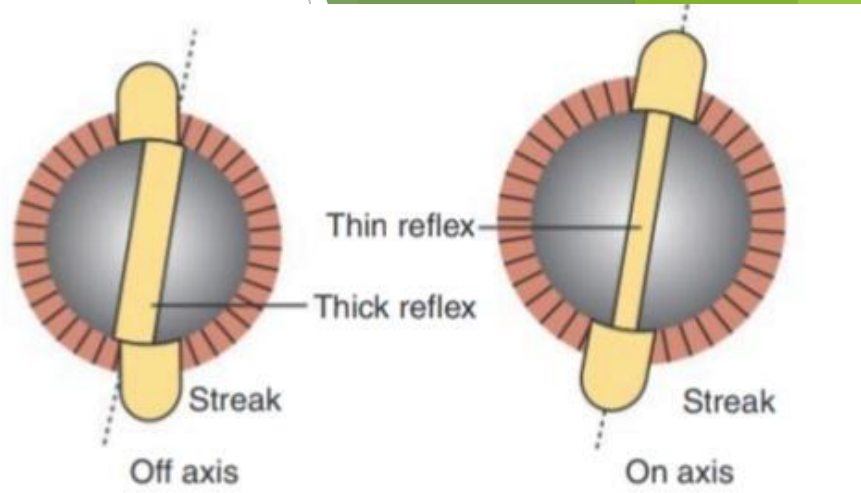
- The end point of retinoscopy using a simple plane mirror retinoscope is neutralization of red reflex i.e. no movement of the reflex in any meridian with the movement of the mirror.
- The end point of retinoscopy can be and should be verified by following maneuvers:
- • Overcorrection by 0.25 D should cause reversal of the movement.
- • On altering the working distance i.e. by slight forward movement of the head the examiner should observe a ‘with’ movement and an ‘against’ movement by slight backward movement.

STREAK RETINOSCOPY

- With streak retinoscope the retinoscopy is performed in the usual way and a band of light appears in the pupillary area which moves ‘with’ or ‘against’ the movement of band of light outside the pupil.
- The movement of the band of light is then neutralized by adding appropriate spherical lenses as described in reflecting mirror retinoscopy.
- When a simple spherical error alone is present at neutralization the band-shaped reflex disappears and the pupil appears completely illuminated or completely dark.
- However in the presence of astigmatism a band-shaped reflex will appear in the meridian still not neutralized.

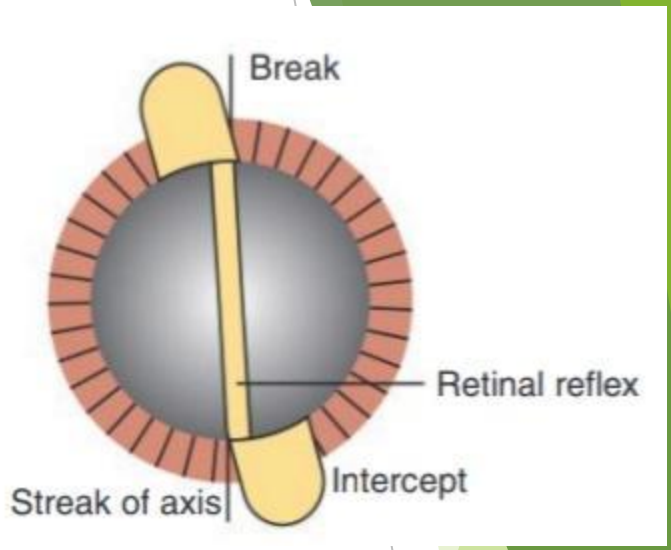
Finding the cylinder axis

- In a patient with regular astigmatism two reflexes one from each of the principal meridians need to be neutralized.
- before measuring the power in each of the principal meridians one must determine the axis of the meridians.
- Characteristics of the streak reflex that can aid in determining the axis are as follows:
- 1. Width of the streak varies as it is rotated around the correct axis.
- It appears narrowest when the streak aligns with the true axis
- 2. Intensity of the reflex and in pupil is brighter when the streak aligns with true axis
- This is a subtle finding useful only in small cylinders.



width of the reflex in the pupil is narrowest when the streak is exactly aligned with the axis: off axis and on axis.

- 3. Break in the alignment between the reflex in the pupil and the band outside.
- It is observed when the streak is not parallel to one of the meridians.
- The band of light in pupillary area lies in a position intermediate between the band outside the pupil and that from axis of the cylinder.
- The axis even in the case of low astigmatic errors can thus be determined by rotating the streak until the break disappears.
- The correcting cylinder should be placed at this axis.

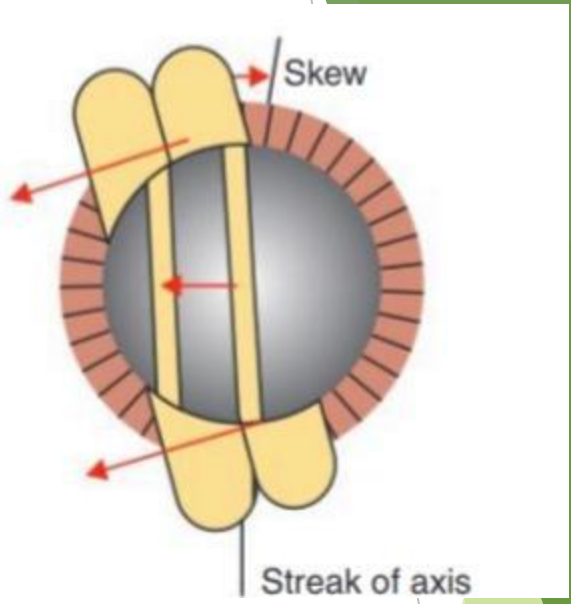


Area in the alignment between the reflex in the pupil and the band outside it when the streak is off the correct axis.

4. Skew (oblique motion of the streak reflex) may be used to refine the axis in small cylinders.

The streak and reflex will move in the same direction only when streak is aligned with one of the principal meridians.

Therefore if the streak is not aligned with the true axis skewing will be observed on movement of the streak



Skewing of the pupillary reflex and the band outside it when the streak is off axis

Confirmation of axis

Finally the axis of cylinder may be confirmed with a technique known as straddling.

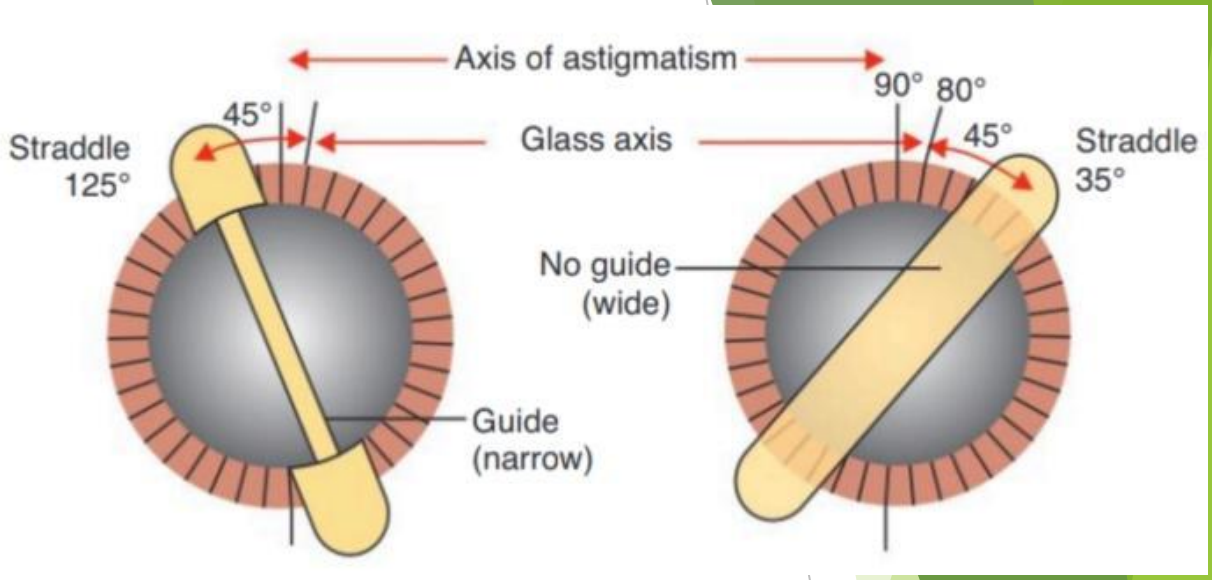
This is performed with approximately the correct cylinder in place.

The retinoscope streak is turned 45 degrees off axis in both directions.

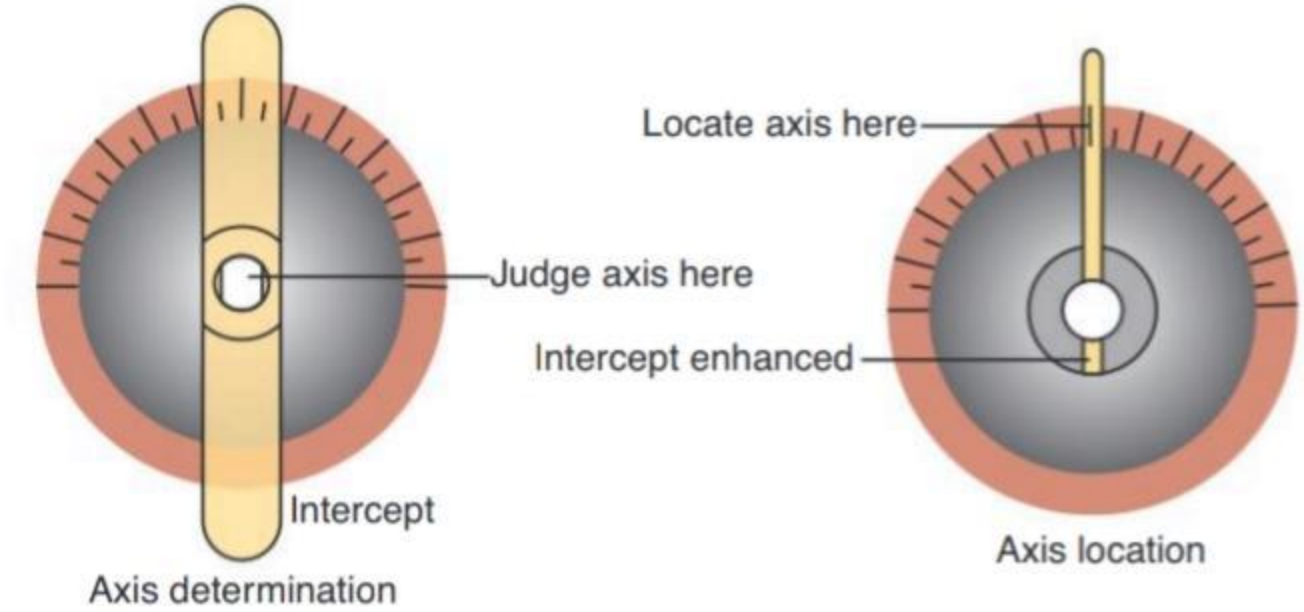
If the axis is correct the width of the reflex should be equal in each of the two positions.

If the axis is not correct the widths will be unequal in the two positions .

In such a situation the narrower reflex serves as the guide towards which the cylinder's axis should be turned



technique of straddling showing narrow reflex (A) when the meridian is 45 degrees off axis towards 125 degrees from 80 degrees and wide reflex (b) when the meridian is 45 degrees off axis towards 35 degrees from 80 degrees. The narrow reflex (A) is the guide towards which cylinder's axis should be turned.



final localization of the axis on protractor.

First the astigmatic axis is determined (A) and then the sleeve of the retinoscope is adjusted to enhance the intercept until the reflex is seen as a fine line pinpointing the axis (b).

Once the axis of cylinder is finally confirmed to pinpoint it on the protractor the sleeve of the retinoscope is adjusted to enhance the intercept until the reflex is seen as a fine line

- **Finding the Cylinder Power**
- Once the two principal meridians have been identified the cylindrical power can be determined in a manner similar to that described in reflecting mirror retinoscopy.
- **End Point of Neutralization**
- When streak retinoscopy is performed the width of the reflex widens progressively as the neutralization is approached and at the end point streak disappears and the pupil appears completely illuminated or completely dark.
- The end point can be verified by the same methods as described in spot retinoscopy.

USE OF CYCLPLEGICS IN RETINOSCOPY

- Cycloplegics are the drugs that cause paralysis of accommodation and dilate the pupil.
- These are used for retinoscopy when the examiner suspects that accommodation is abnormally active and will hinder the exact retinoscopy.
- Such a situation is encountered in young children and hypermetropes.
- When retinoscopy is performed after instilling cycloplegic drugs, it is termed as wet retinoscopy in converse to dry retinoscopy without cycloplegics.

Commonly Employed Cycloplegics

- **1. Atropine**
- indicated in children below the age of 5 years.
- It is used as 1% ointment thrice daily for three consecutive days before performing retinoscopy.
- Its effect lasts for 10-20 days.
- **2. Homatropine**
- used as 2% drops.
- One drop is often instilled every 10 min for six times and the retinoscopy is performed after 1-2 h.
- Its effect lasts for 48-72 h.
- It is used for most of the hypermetropic individuals between 5 and 25 years of age.

- **3. Cyclopentolate**
- It is a short-acting cycloplegic.
- Its effect lasts for 6-18 h.
- It is used as 1% eyedrops in patients between 8 and 20 years of age.
- One drop of cyclopentolate is instilled after every 10-15 min for three times Havener's recommended dose and the retinoscopy is preformed 60-90 min later, after estimating the residual accommodation which should not exceed .
- **4. Only mydriatic 10% phenylephrine** may be needed in elderly patients when the pupil is narrow or media is slightly hazy

S. no.	Name of the drug	Age of the patient when indicated	Dosage of instillation	Peak effect	Time of performing retinoscopy	Duration of action	Period of post-cycloplegic test	Tonus allowance
1.	Atropine sulphate (1% ointment)	<5 years	TDS × 3 days	2–3 days	Fourth day	10–20 days	After 3 weeks of retinoscopy	1 D
2.	Homatropine hydrobromide (2% drops)	5–8 years	One drop every 10 min for six times	60–90 min	After 90 min of instillation of first drop	48–72 h	After 3 days of retinoscopy	0.5 D
3.	Cyclopentolate hydrochloride (1% drops)	8–20 years	One drop every 15 min for three times	80–90 min	After 90 min of instillation of first drop	6–18 h	After 3 days of retinoscopy	0.75 D
4.	Tropicamide (1% drops)	Not used as cycloplegic for retinoscopy; used only as mydriatic	One drop every 15 min for three to four times	20–40 min	Once pupil is dilated	4–6 h	After 24 h	0.5 D
5.	Phenylephrine (5%, 10% drops)	Used only as mydriatic alone or in combination with tropicamide	One drop every 15 min for three to four times	30–40 min	Once pupil is dilated	4–6 h	After 24 h	Nil

Salient features of common cycloplegic and mydriatic drugs

Tonus Allowance

- Tonus allowance is the term used to denote the change in the refractive power brought about by the cycloplegic drug by its effect on accommodation i.e. by relaxing effect on the ciliary muscle.
- The mydriatics should be used with care in adults with shallow anterior chamber, owing to the danger of an attack of narrow angle glaucoma.
- In older people mydriasis should be counteracted by the use of miotic drug 2% pilocarpine.

STATIC VERSUS DYNAMIC RETINOSCOPY

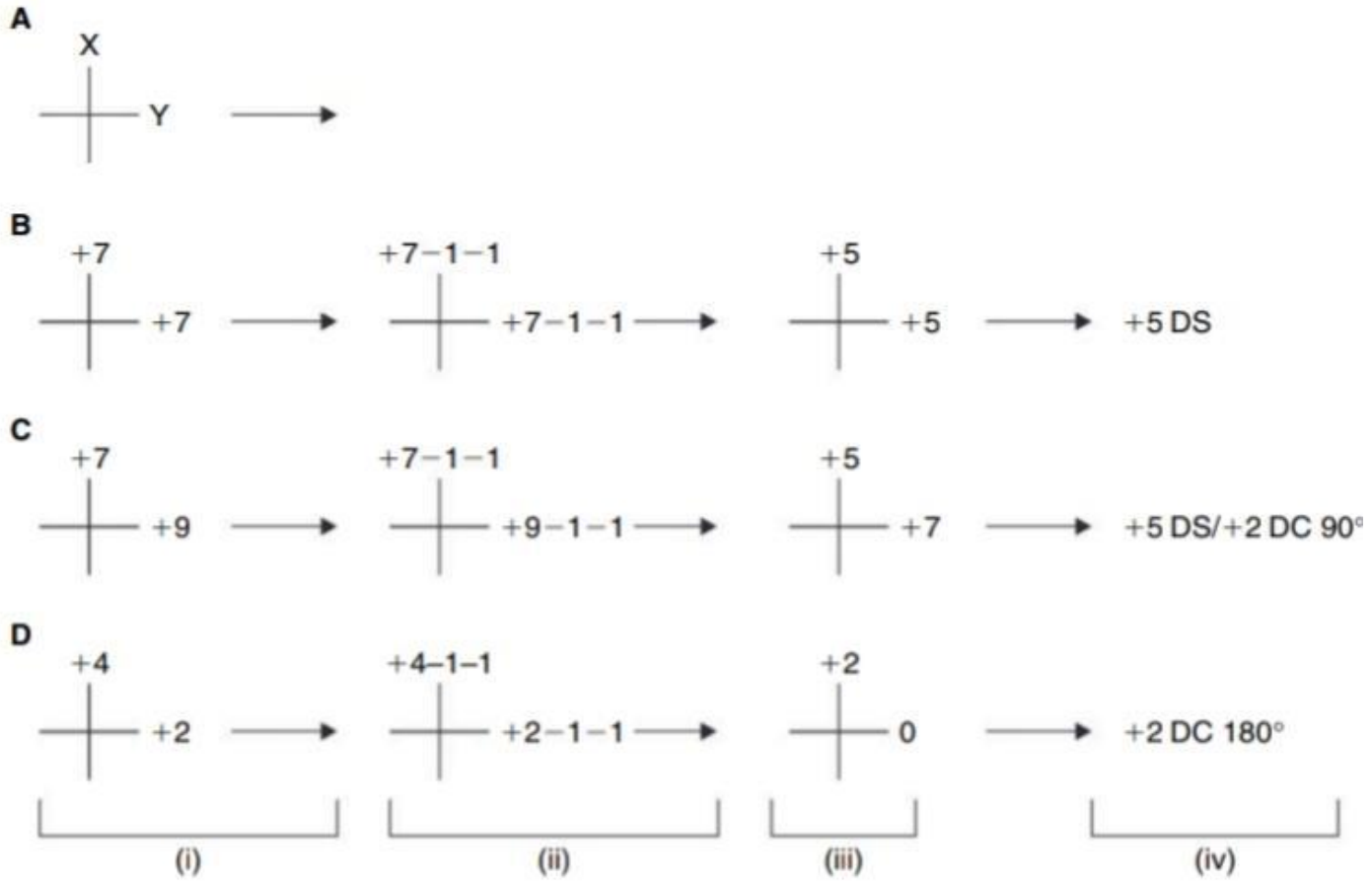
- Static retinoscopy refers to the procedure performed without active use of accommodation
- Dynamic retinoscopy implies when the procedure is performed for near vision with active use of accommodation by the patient.
- However usefulness of performing dynamic retinoscopy has not yet been established in refraction.

ROUGH ESTIMATE OF REFRACTIVE ERROR AFTER RETINOSCOPY

- Objectively, a rough estimate of error of refraction is made by taking into account the retinoscopic findings , deductions for distance e.g. 1D for 1m and 1.5 D when retinoscopy is performed at 2/3 m distance and deduction for the cycloplegic when used e.g. 1D for atropine, 0.5 D for homatropine and 0.75 D for cyclopentolate.
- Amount of refractive error = Retinoscopic findings - deduction for distance - tonus allowance for cycloplegic drug used

Power cross

- It is customary to do retinoscopy both vertically and horizontally and note the values separately .
- In the power cross X denotes retinoscopy value along the vertical meridian and Y denotes the value along the horizontal axis.
- When retinoscopy values along horizontal and vertical meridians are equal then there is no astigmatism and a spherical lens is required to correct the refractive error.
- For example, when retinoscopic finding is +7 DS, with the procedure performed at 1 m distance, using atropine as cycloplegic, then appropriate refractive error will be 7-1 D for distance -1D tonus allowance for atropine = +5 DS
- When retinoscopy values along horizontal and vertical meridians are unequal then it denotes presence of astigmatism which is corrected by a cylindrical lens alone or in combination with a spherical lens



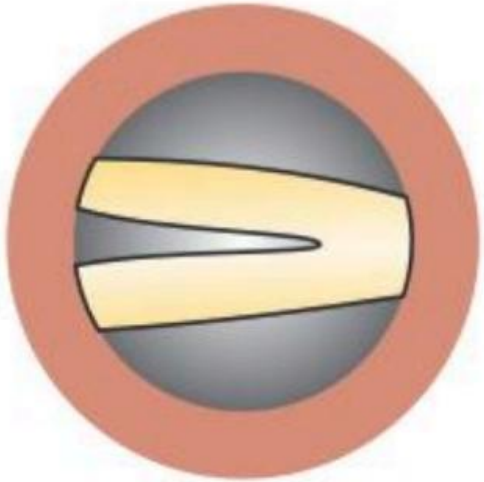
A, customary way of writing retinoscopic findings. B- D , calculation for rough estimate of refractive error: (i) retinoscopic findings when performed at 1 m distance under atropine cycloplegia (ii) deduction of –1 D for distance and –1 D for the atropine from the retinoscopic findings (iii) rough estimate of refractive error along horizontal and vertical meridians and (iv) prescription required.

PROBLEMS IN RETINOSCOPY

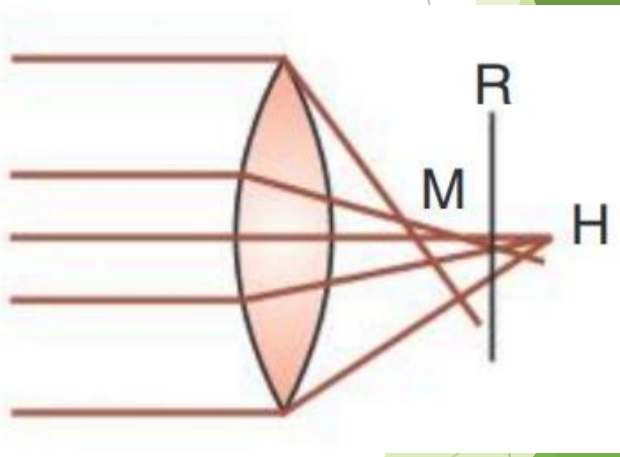
- 1. **Red reflex may not be visible or may be poor**
- This may happen with small pupil hazy media and high degree of refractive error. In most cases this difficulty is overcome by causing mydriasis and use of converging light with concave mirror retinoscope.
- 2. **Changing retinoscopy findings** are observed due to abnormally active accommodation and this is corrected by
- Cycloplegic may be required in young patients to control accommodation.

- **Fogging retinoscopy.**
- In this technique plus lenses much higher than the expected retinoscopic findings are placed in front of both the eyes.
- The patient is instructed to look at a far distance target without making efforts to see clearly.
- retinoscopy is performed and the plus lenses are decreased successively till neutralization is achieved. Care is taken to insert the replacing lens before the replaced lens is removed.

- **3. scissoring shadows** may sometimes be seen in patients with astigmatism
- In such a situation two band reflex appear which move towards and away from each other line the blades of scissors.
- It happens due to mixed aberration so that one-half of the reflex differs in its refractivity considerably in character from the other.
- This diffculty is diminished with the undilated pupil.



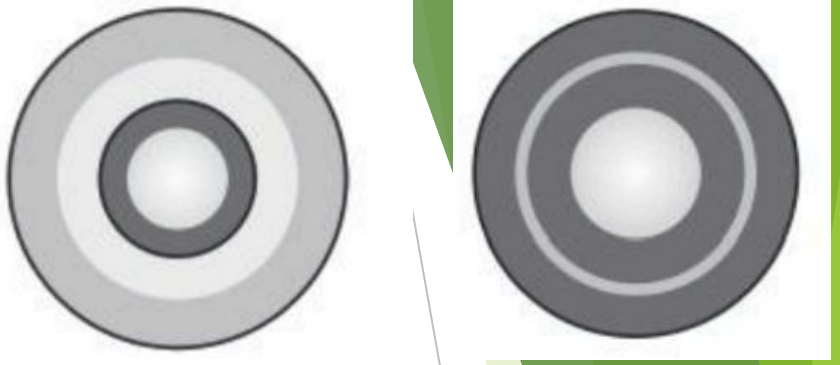
Scissor shadows.



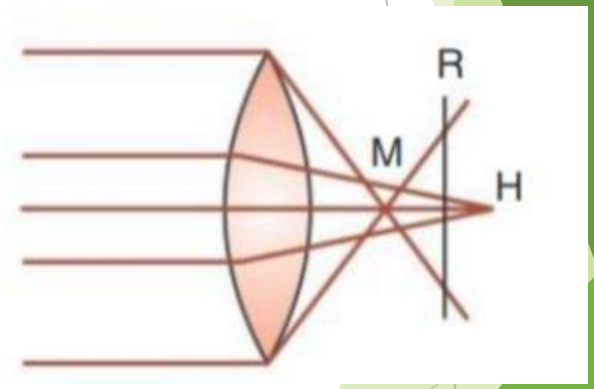
The optics of scissor shadows wherein at the plane of observation (o): one part of the aperture is relatively myopic (M) and the other relatively hypermetropic (H).

4. Spherical aberrations lead to variation of refraction in the centre and periphery of the pupil.

- Such differences are accentuated with dilated pupils.
- The spherical aberrations tend to cause an increase of brightness at the centre or the periphery of the pupillary reflex depending on whether the aberrations are positive or negative .
- The spherical aberrations may be seen in normal eyes but are more marked in conditions like lenticular sclerosis



Positive aberration. Negative aberration



optics of positive aberration.
central part shows myopic refraction (M) and peripheral part shows hypermetropic refraction (H) (R- retina).

- 5. **Conflicting shadows** moving in various directions in different parts of the pupillary area are seen in patients with irregular astigmatism.
- 6. **triangular shadow** may be observed in patients with conical cornea.