Principles of **Retinoscopy**

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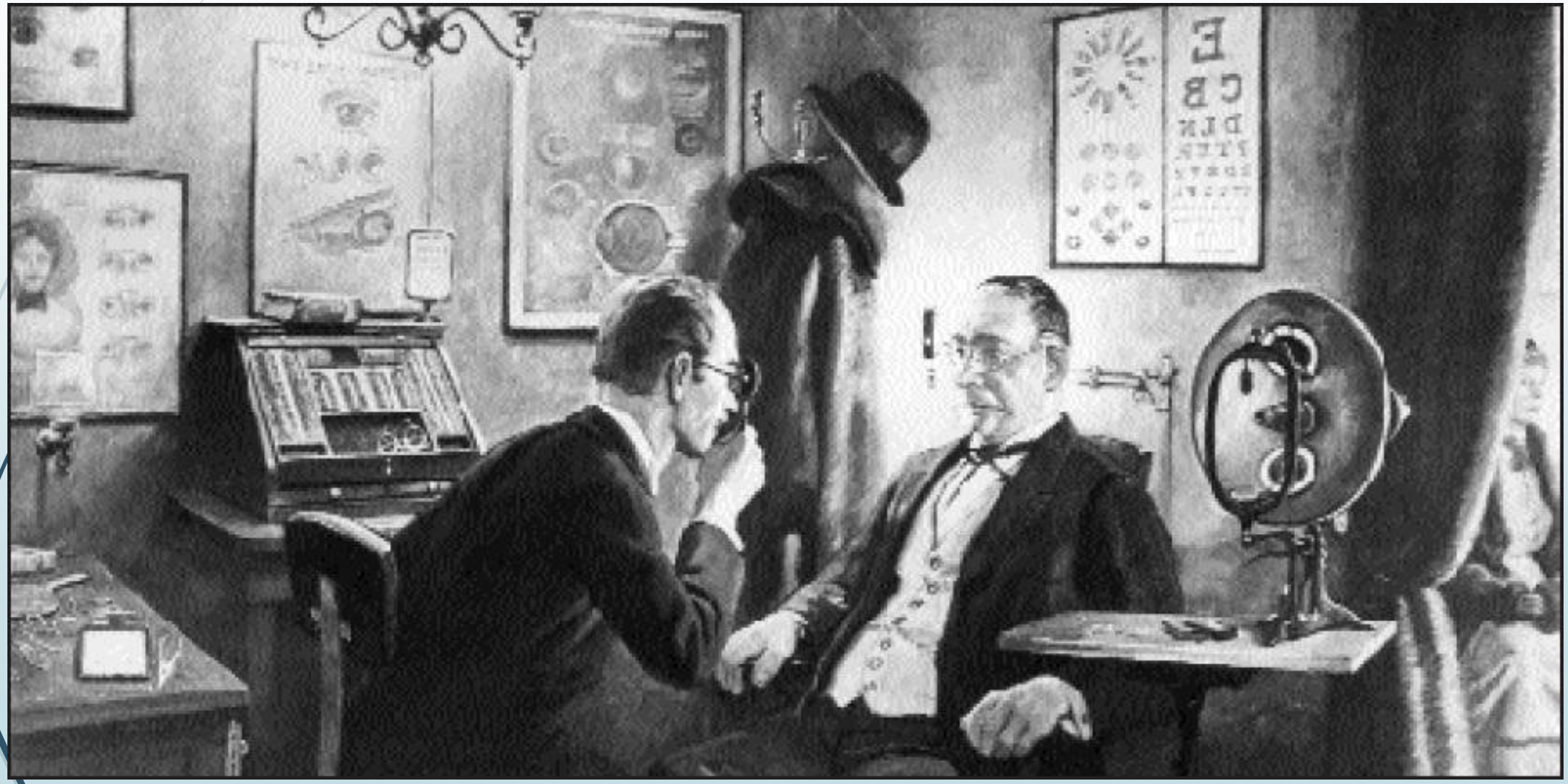
Evolution of Retinoscopy – A brief history

- Refractive errors were assessed by purely subjective methods.
- French ophthalmologist Cuignet in 1873, using a simple mirror ophthalmoscope (which reflected lamplight into the eye). Through the peephole in his mirror, he observed a curious reflex that varied among persons with differing refractive errors.
- When light from the plane mirror was moved across the pupil, the reflection from the fundus moved also; sometimes in the same direction, but often in the reverse direction. The speed of the movement, as well as the size and brightness of the reflex, varied among individuals. Sometimes the direction of movement varied in different meridians.

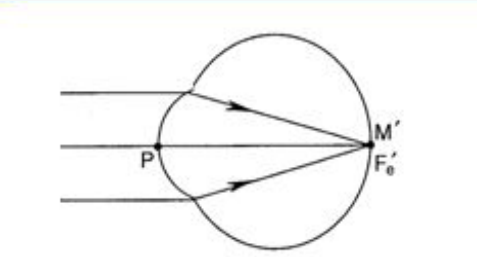
- Cuignet attributed the reflexes he saw to the cornea and called his technique ***keratoscopie***. In spite of his error, he was able with his mirror to *qualitatively* assess refractive errors, classifying them as myopia, hyperopia, or astigmatism. So we honor Cuignet as **the father of retinoscopy**.

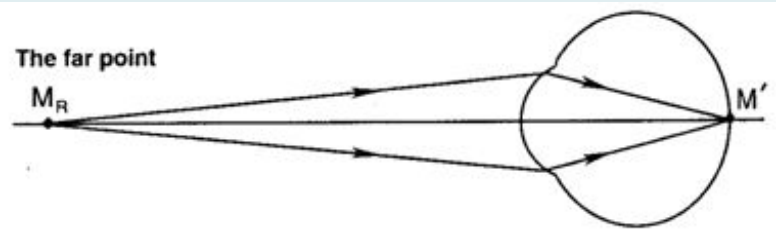


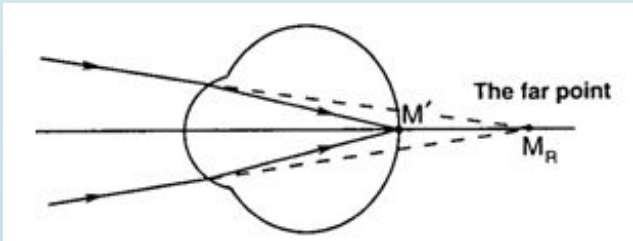
- **Mengin**, student of Cuignet, accepted Landolt's suggestion that the fundus was the actual source of the reflexes.
- **Copeland** invented and teached the streak retinoscopy.
- To emphasize the role of the retina, the term ***retinoscopie*** *was* proposed, but later, at the suggestion of a linguist, chose the term ***skiascopie*** (skia meaning shadow).
- The term *retinoscopy* is usually used in English, but it is imprecise because the retina is transparent and is not actually the source of reflexes seen with the retinoscope. The more correct word, *skiascopy*, is used throughout the rest of the world.

Patient's Far Point

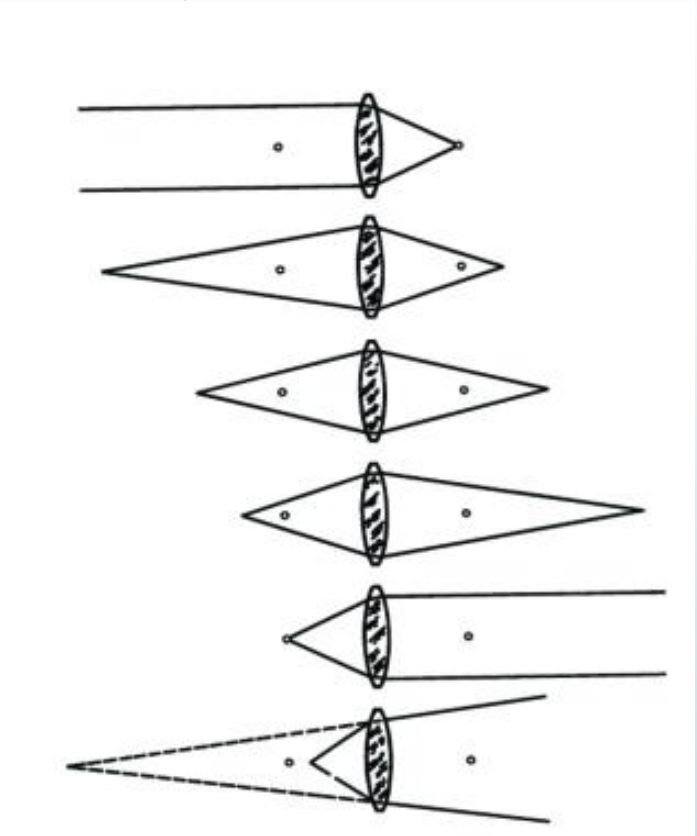
- Point in space that is conjugate to the fovea, when accommodation is relaxed.
- Emmetropes: Far point is at INFINITY.
- Myopes: Far point is BETWEEN infinity and patient.
- Hyperopes: Far point is located BEHIND the patient's retina.
- Astigmats: Have 2 far points, one for each principle meridian.

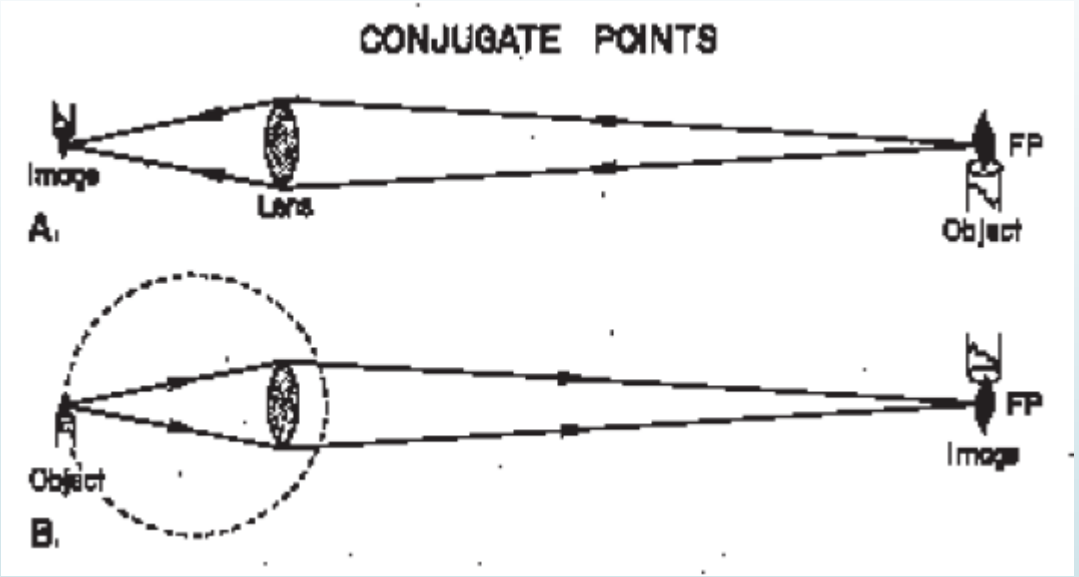






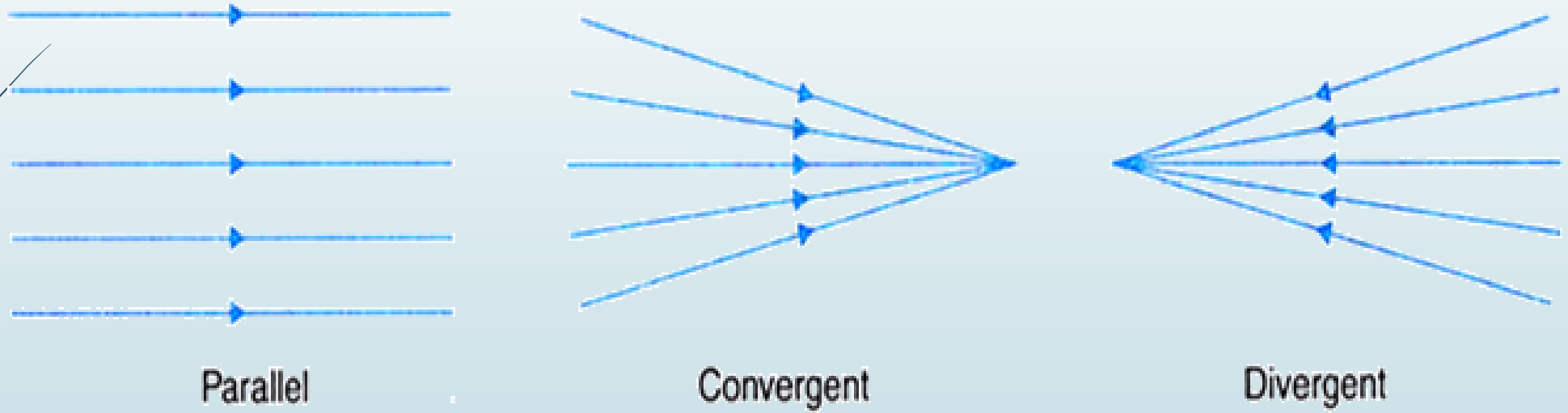
Conjugate points

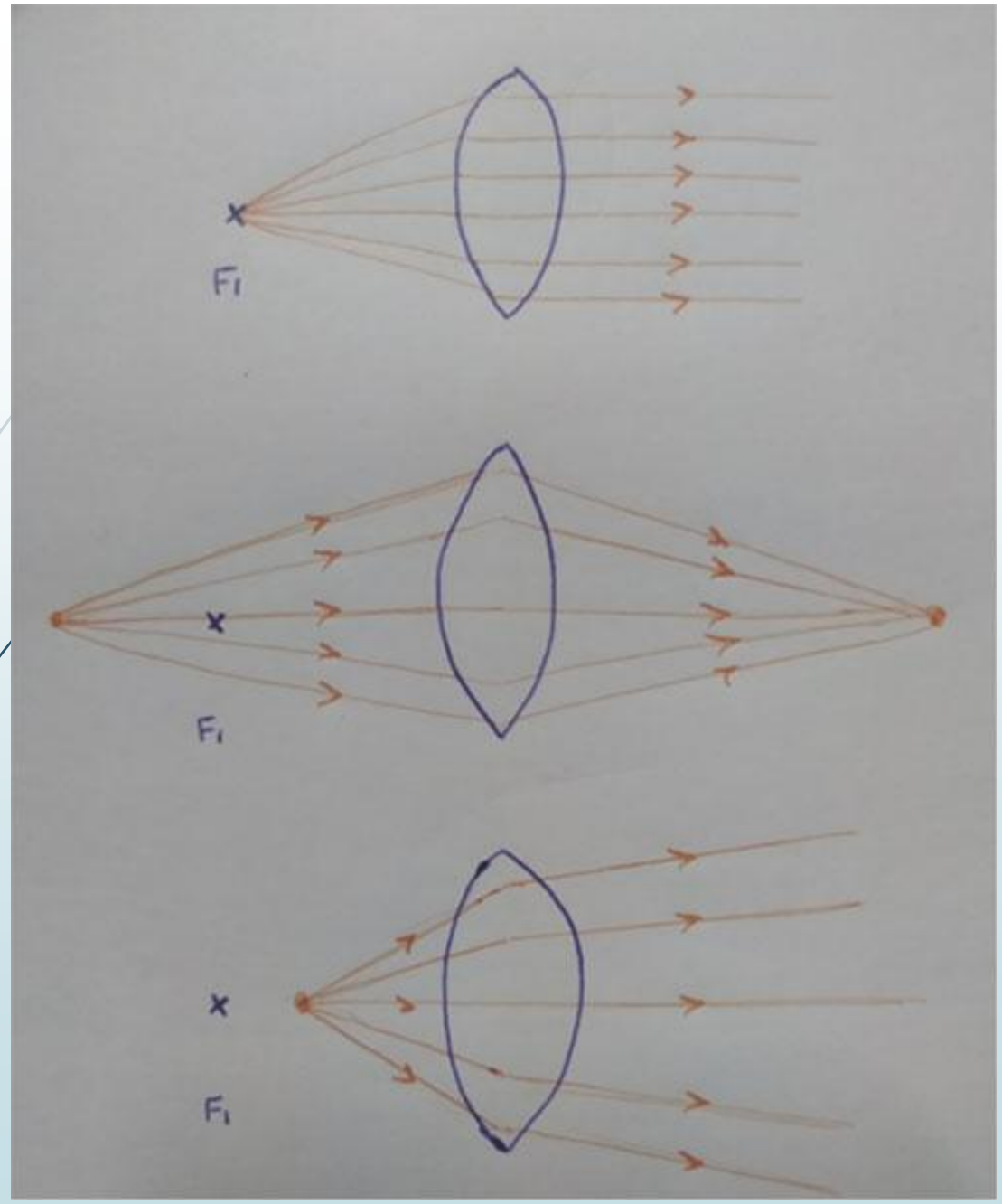




- Rays from a point in object space intersect in a point in image space.

Vergence of light





A convex lens can produce all 3 types of beams depending on the light source position to the focal point.

What is Retinoscopy?

- The **objective** determination of the patient's refractive state by locating the far point of the patient's eye with the retinoscope and using lenses to move the far point to the examiner's entrance pupil.
- We use a retinoscope to illuminate the inside of the eye and to observe the light that is reflected from the retina. These reflected rays change as they pass out through the optical components of the eye, and by examining just how these emerging rays change, we determine the refractive power of the eye.

The Retinoscope

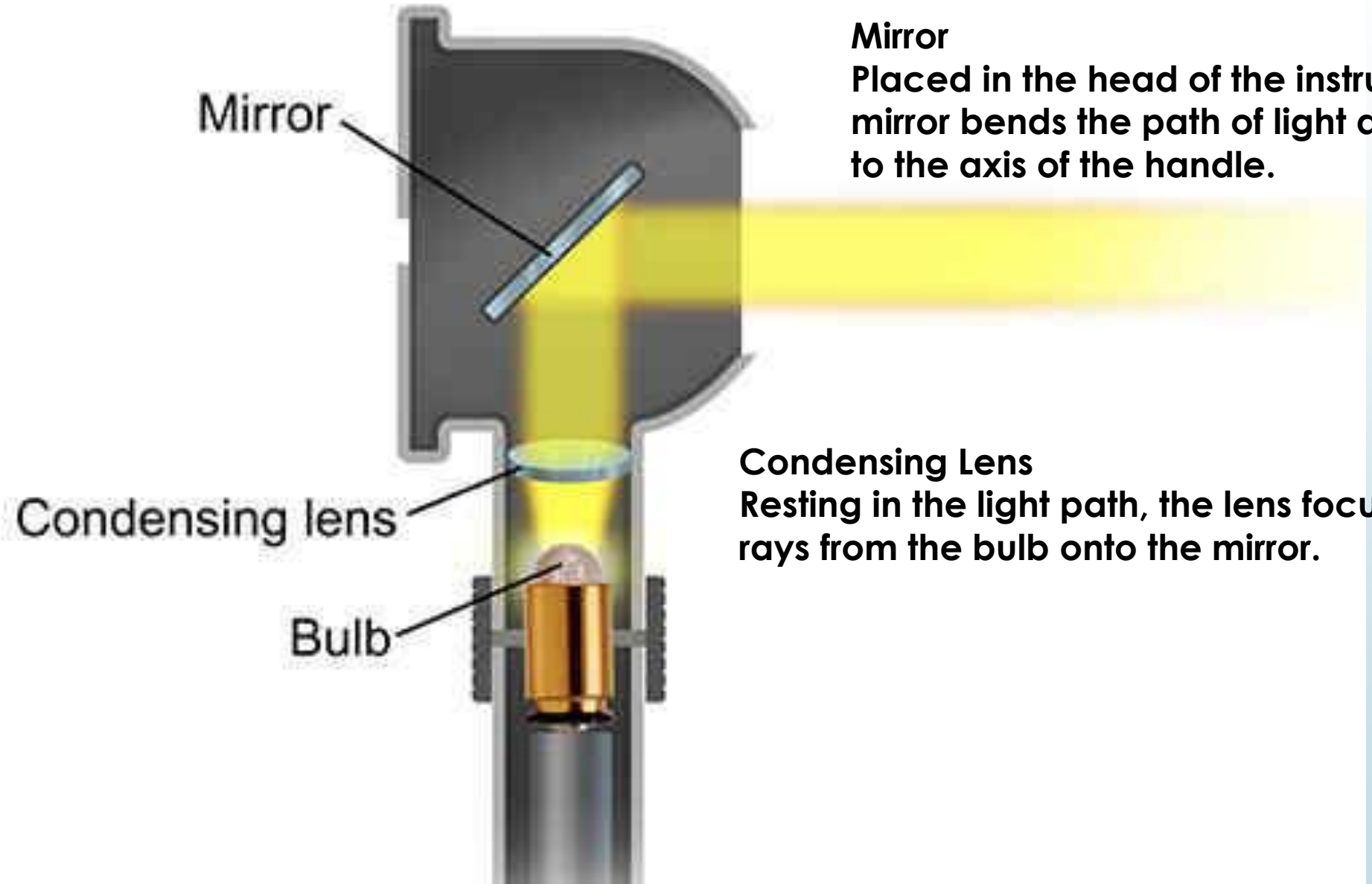
Head:
You look through the peephole along the beam projected out the opposite side of the head.

Sleeve:
Raising or lowering the *sleeve* changes the focus (vergence) of the beam, while turning the sleeve rotates the projected streak.

Handle:
The handle provides the power source.

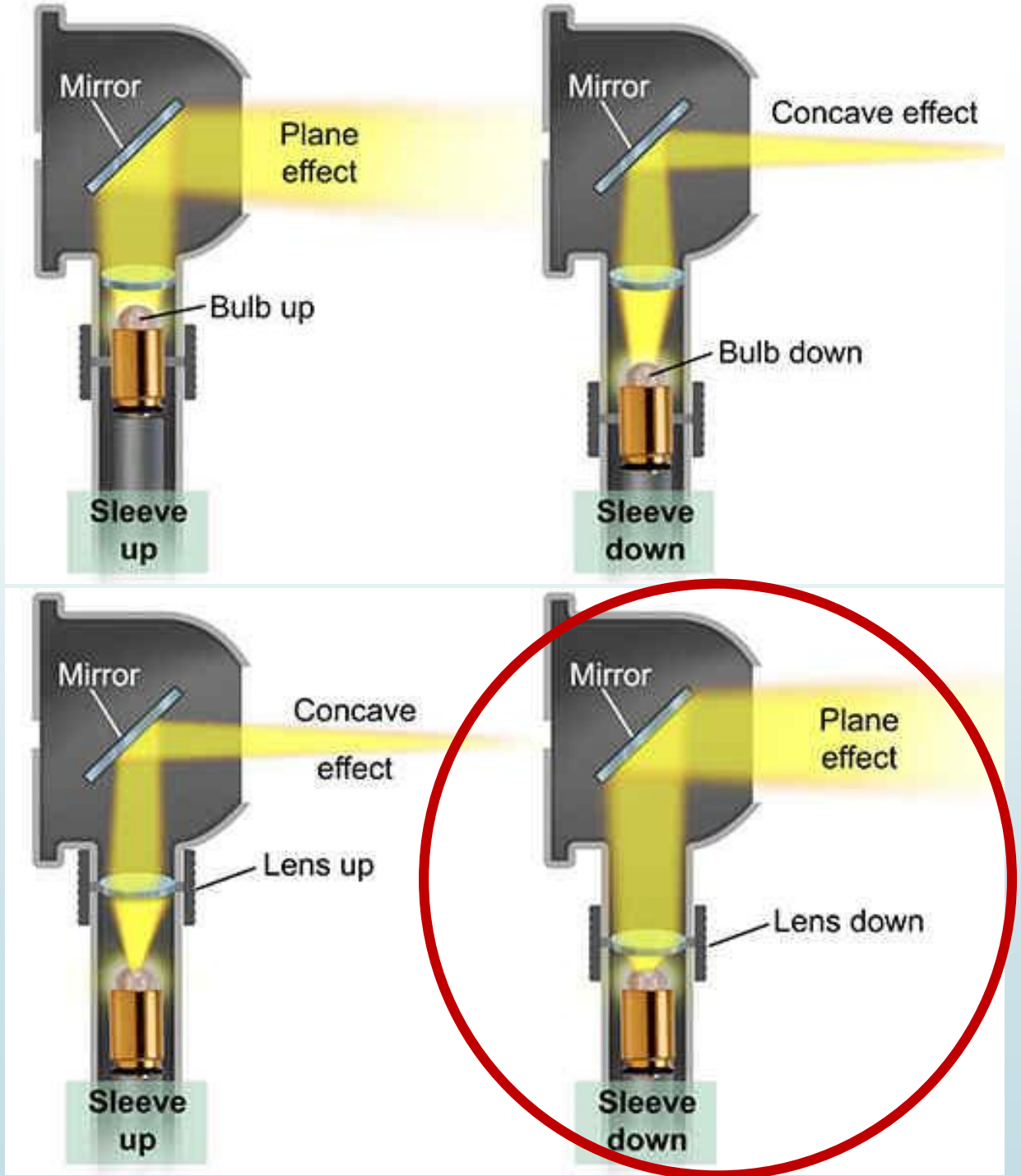
Light Source:
A bulb with a linear filament that projects streak of light. Turning the sleeve on the instrument rotates the bulb, which in turn, rotates the projected streak. This rotating of the light streak we call meridian control.

Projection system



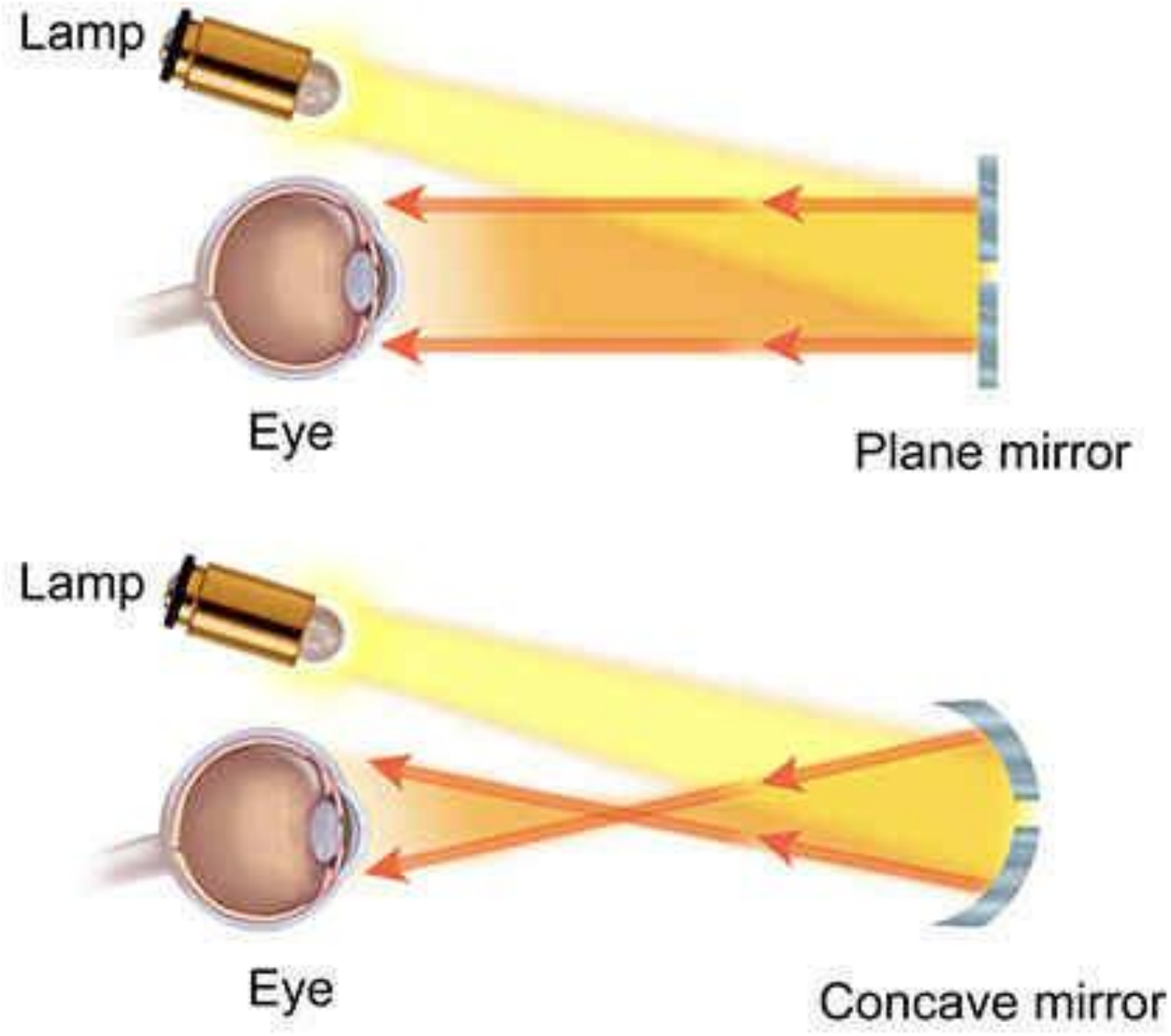
Mirror
Placed in the head of the instrument, the mirror bends the path of light at right angles to the axis of the handle.

Condensing Lens
Resting in the light path, the lens focuses rays from the bulb onto the mirror.



Copeland Retinoscope

Non-Copeland Scopes


Lamp
Eye
Plane mirror
Lamp
Eye
Concave mirror

Types of retinoscopy methods

- **Static Retinoscopy:** The patient is looking at a distant object, with accommodation relaxed
  - Cycloplegic refraction.
  - Dry retinoscopy: (+) 2.00 loose lenses over eye not being refracted to relax accommodation.
- **Dynamic Retinoscopy:** The patient is looking at a near object, with accommodation active. Evaluates the effectiveness of accommodation. (One eye open). Good screen for anisometropia. (Both eyes open).

Cycloplegic Protocol

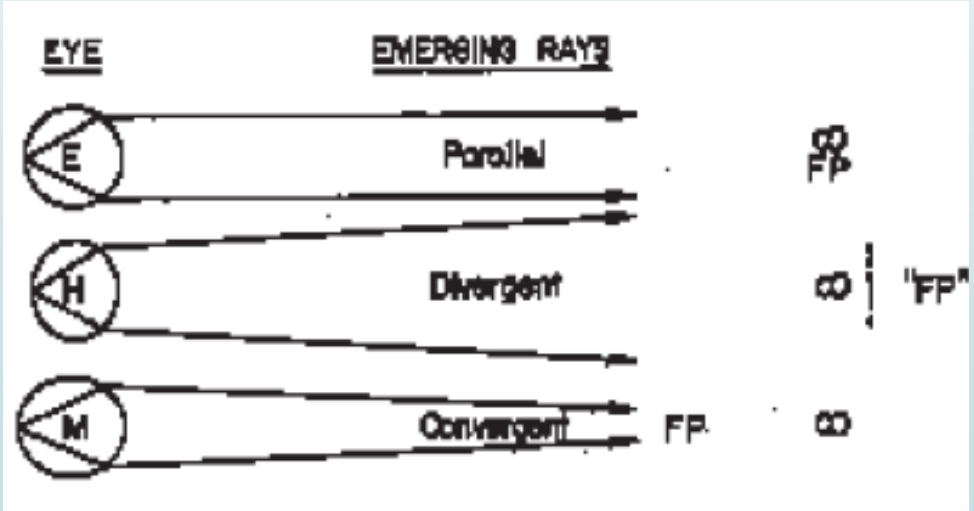
- **Alcaine first!**: Stings less, increases penetration into AC.
- Children: cyclopentolate.
- Adults: Tropicamide 1% (shorter duration).
- Atropine Refraction:
  - When inadequate cycloplegia cannot be obtained in the office.
  - children with a darkly pigmented iris.
  - Protocol: 1 drop OU morning and evening for 2-3 days prior to and the morning of the next visit.

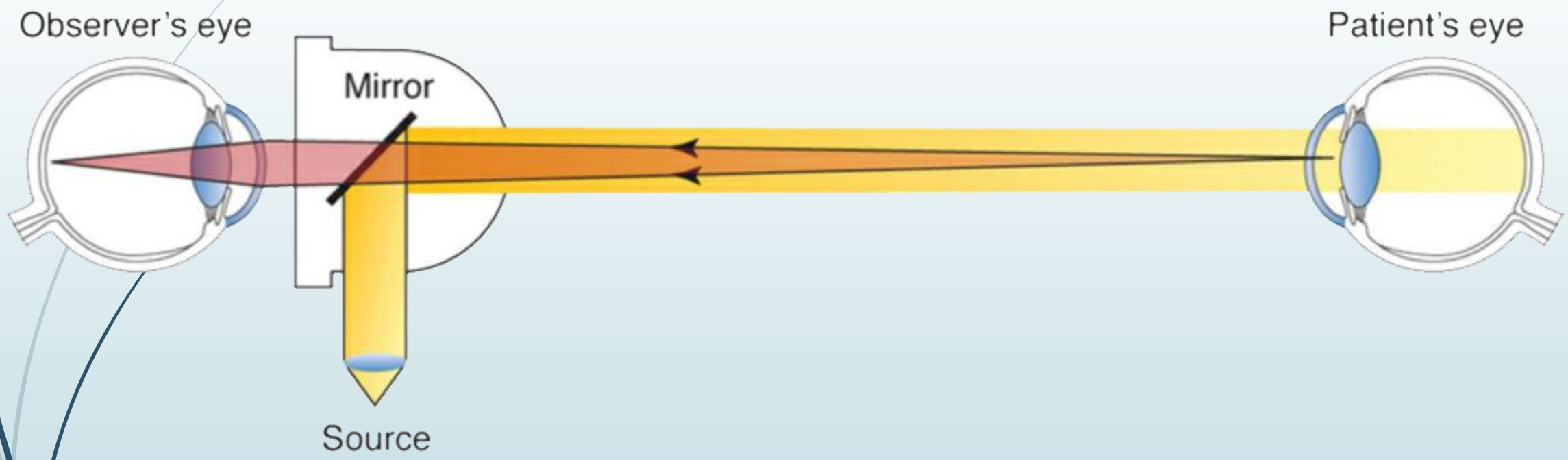
Positioning and Alignment

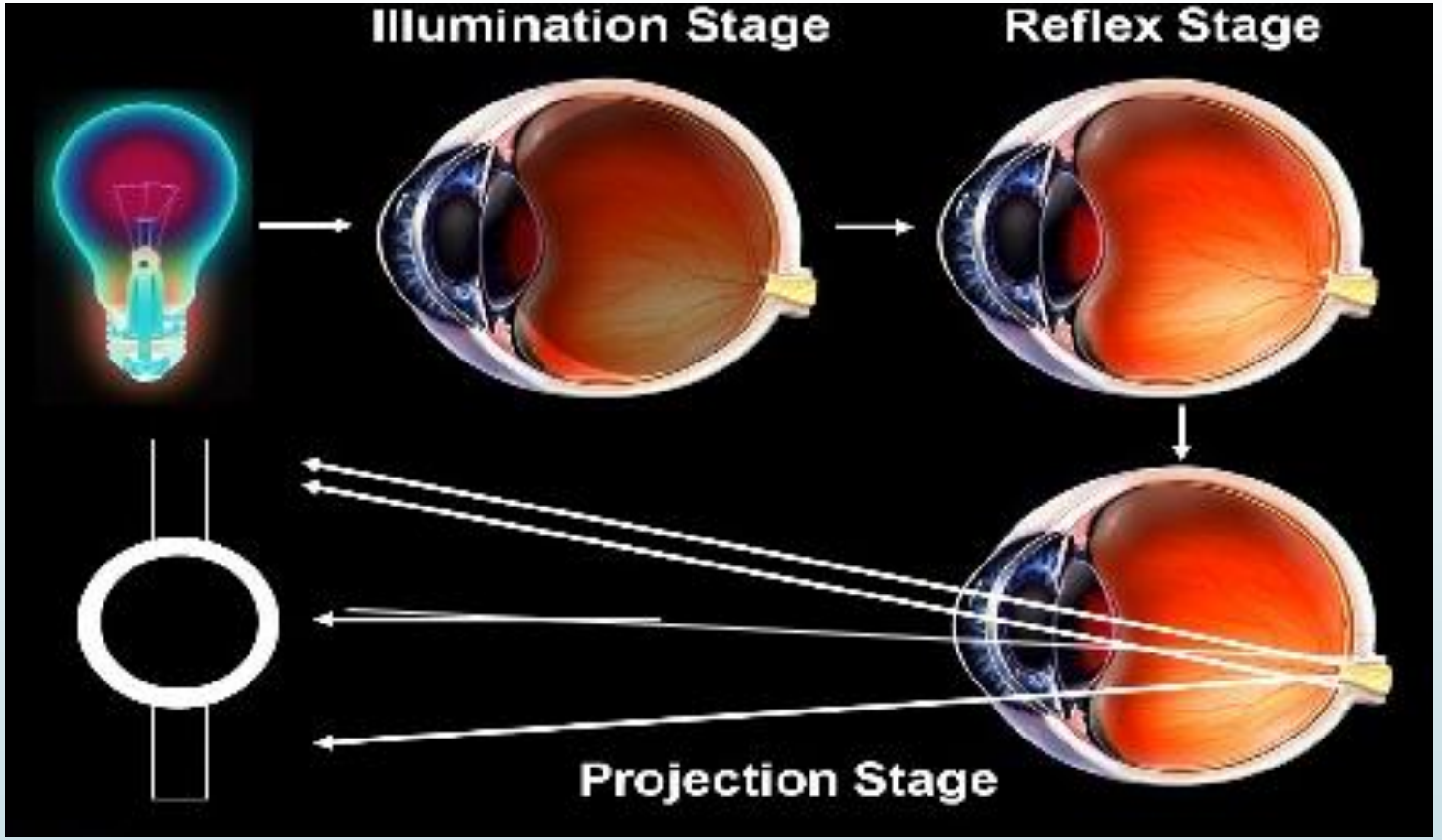
- The patient's accommodation is **relaxed** .
- The patient should fixate at a distance on a **nonaccommodative target** (a large Snellen letter 20/200) .
- Use your right on the patient's right eye, and vice versa.
- Children typically require pharmacologic cycloplegia.
- Keep BOTH of your eyes open.

The Retinal Reflex

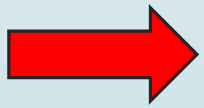
- The projected streak illuminates an area of the patient's retina, and this light returns to the examiner.
- In emmetropia, rays leave parallel.
- In hyperopia, rays leave diverging.
- In myopia, rays leave converging.




Observer's eye
Mirror
Patient's eye
Source

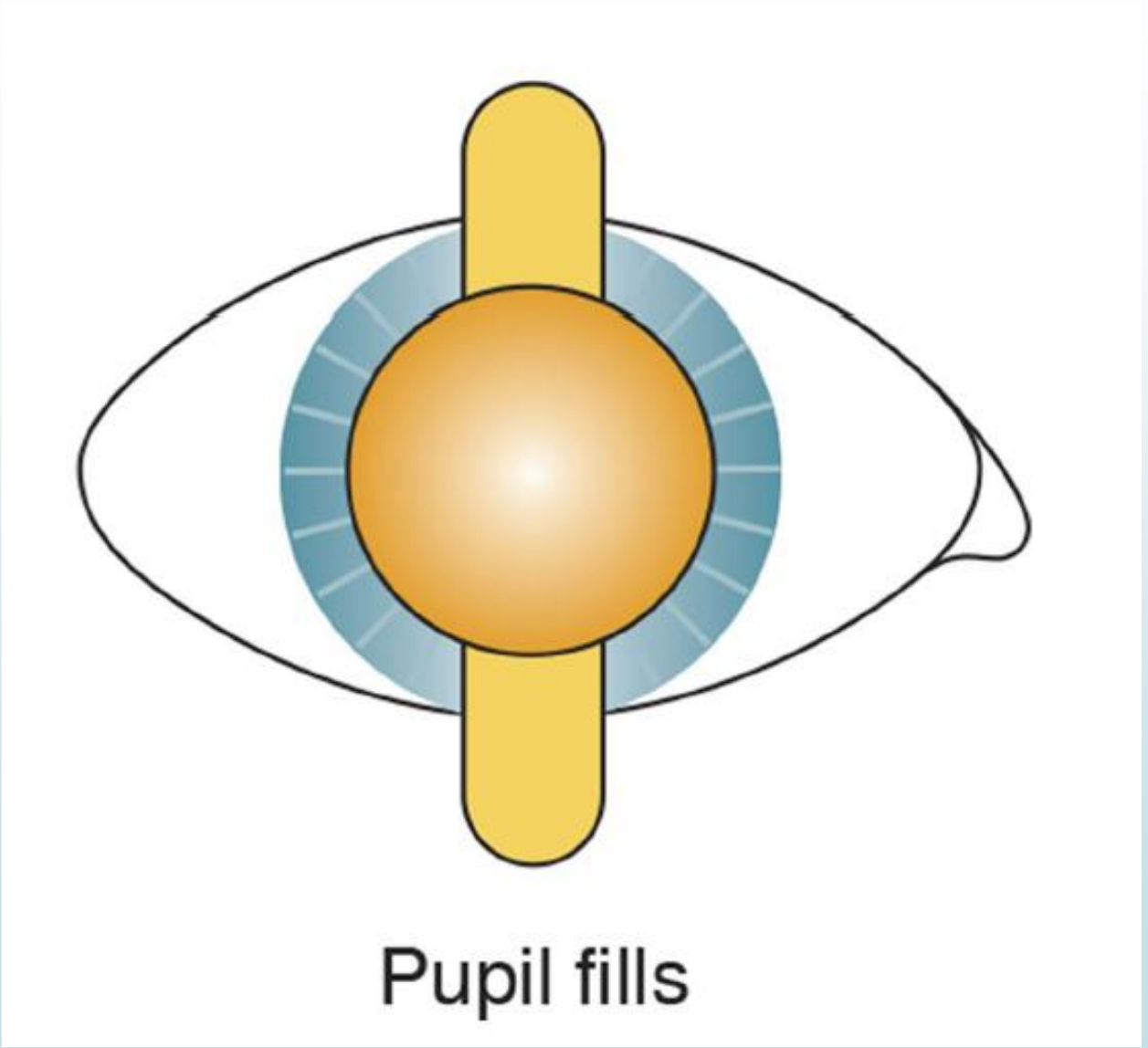

Illumination Stage
Reflex Stage
Projection Stage

- The objective of correction the ammetropic eye is to move the far point to infinity.
- In retinoscopy, the objective is to **move the far point to the peephole of the retinoscope** making all beams leaving the patient's eye gather through the peephole to the examiner's fundus: **PUPILS FILL :**

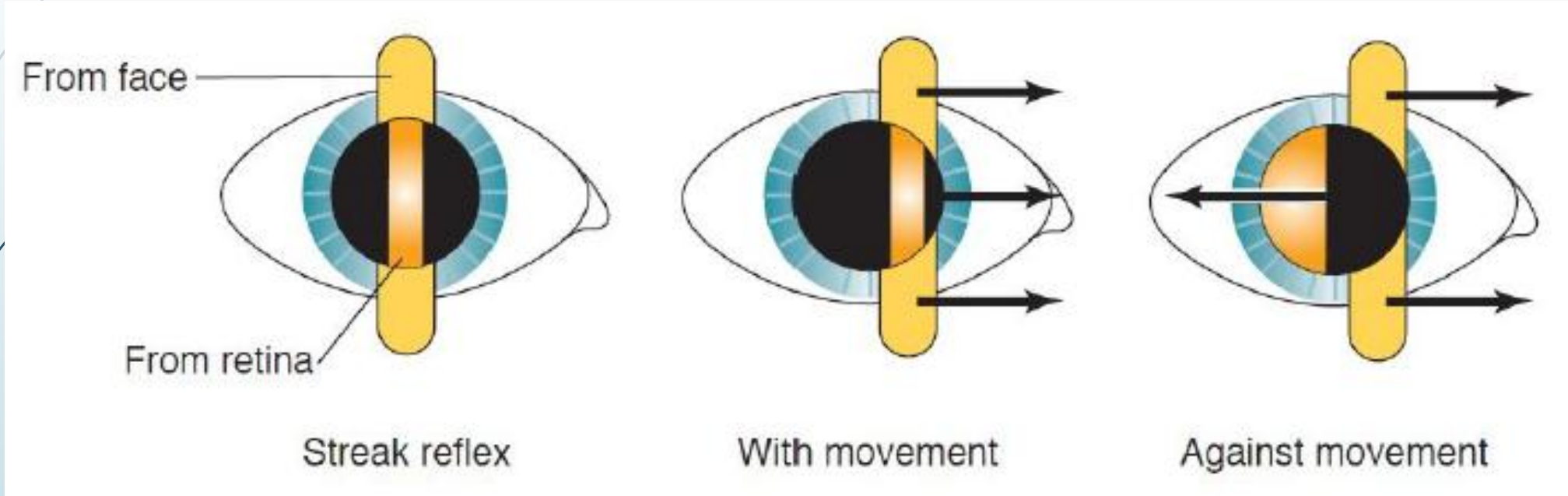


NEUTRALITY

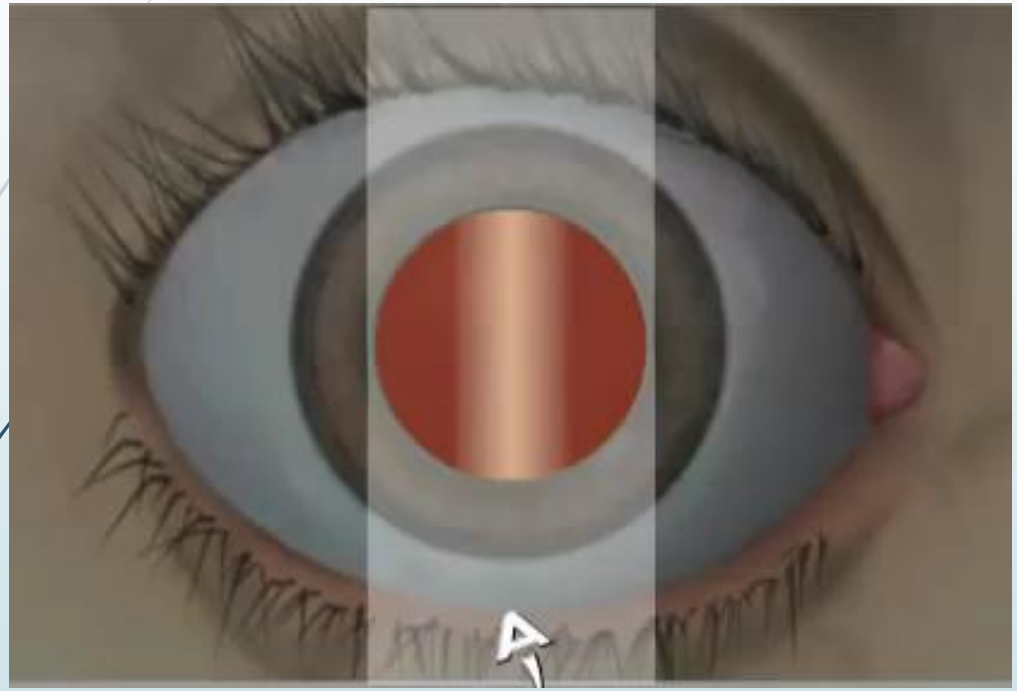
Neutrality reflex: Far point of the eye is conjugate with the peephole of the retinoscope.



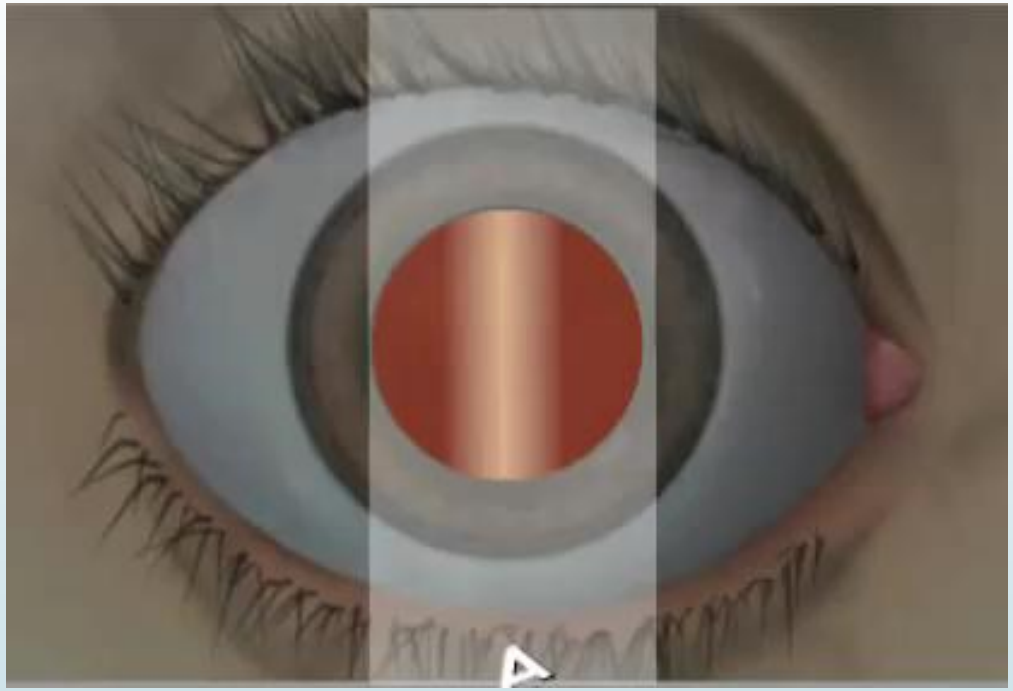
With & Against movement

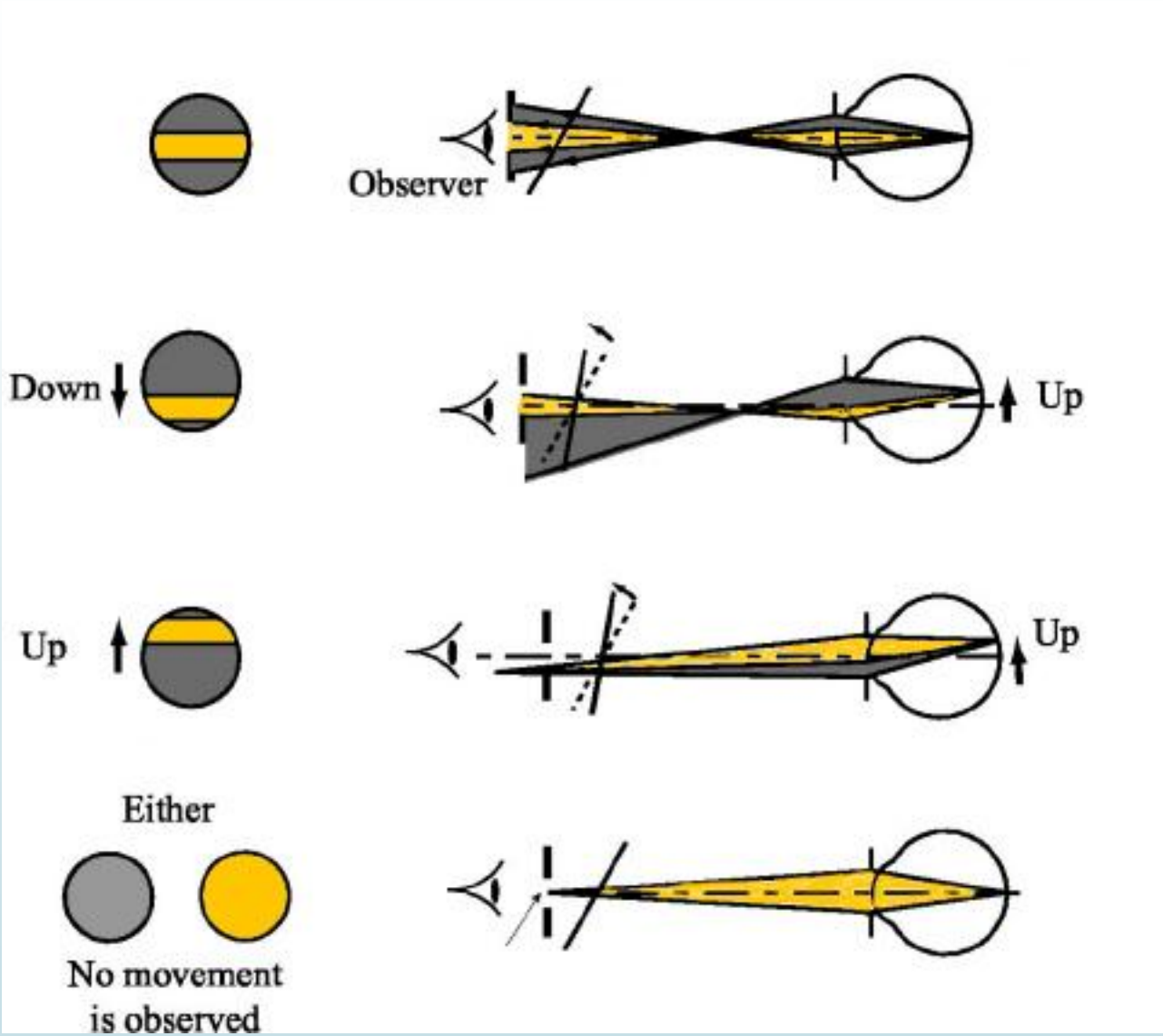


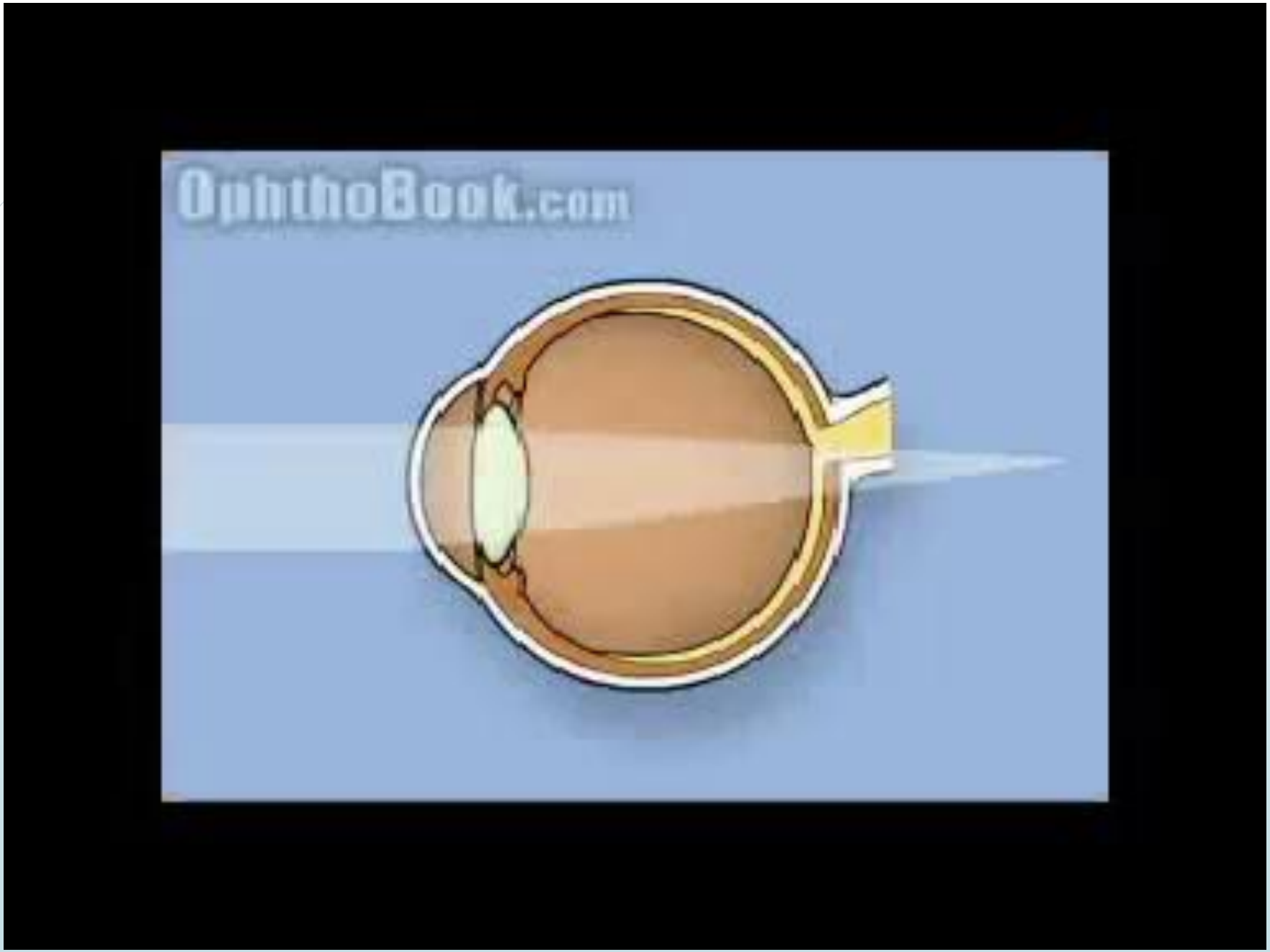
With movement



Against movement

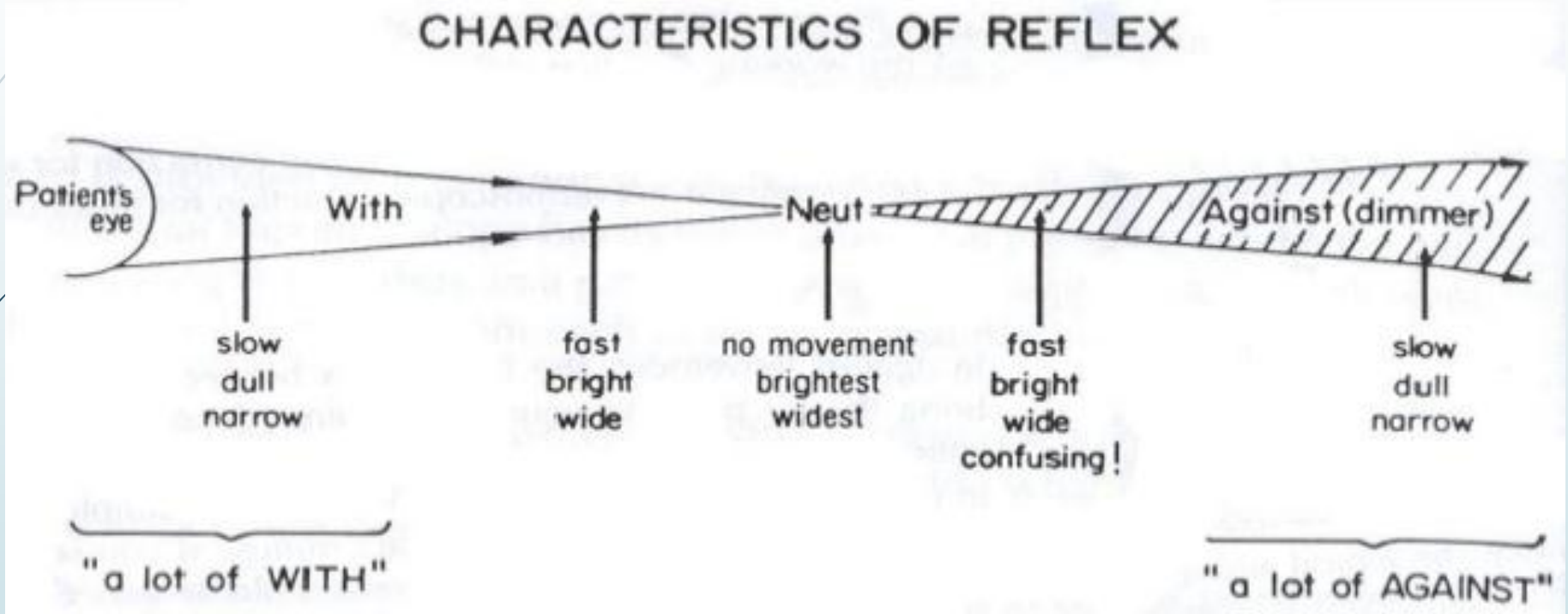



Observer
Down
Up
Up
Up
Either
No movement
is observed

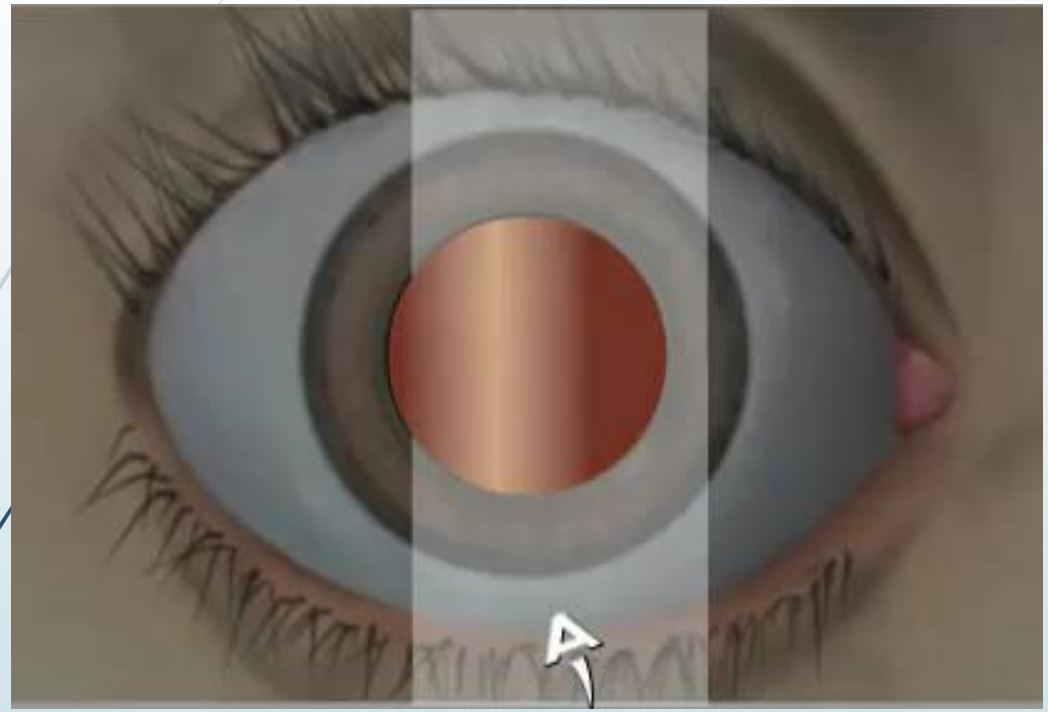

OphthoBook.com

Characteristics of the reflex

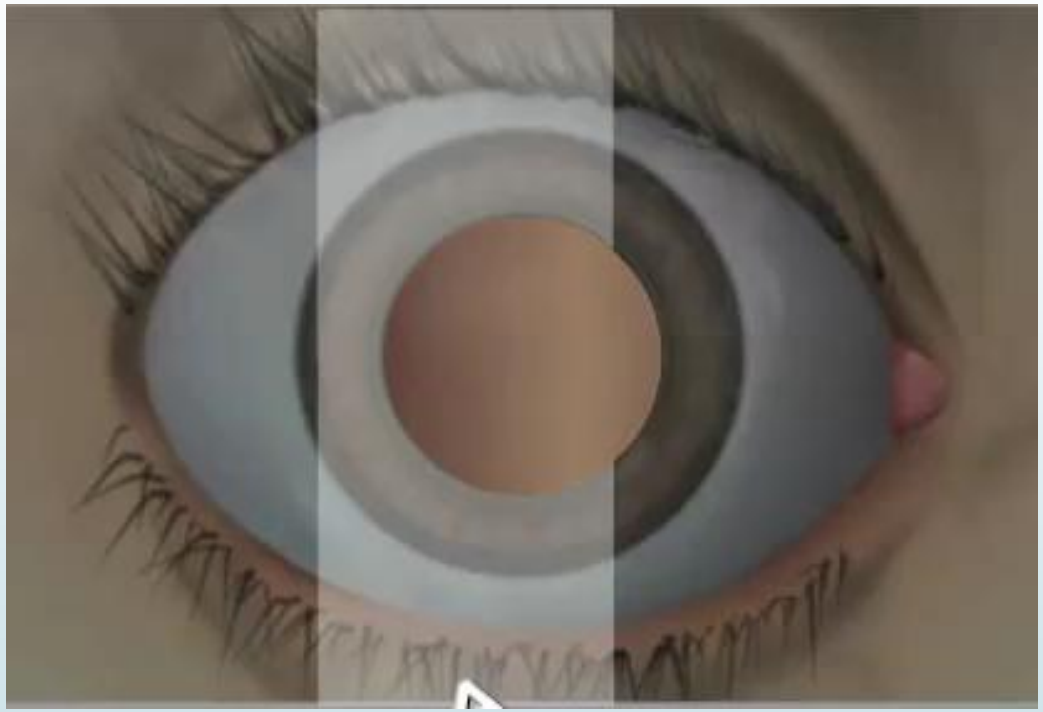
	Small refraction error	Large refraction error
Far point	Close to the examiner	Distant from the examiner
WIDTH	Wide	Narrow
BRILLIANCE	Bright	Dull
SPEED	Fast	Slow


CHARACTERISTICS OF REFLEX
Patient's eye
With
Neut
Against (dimmer)
slow
dull
narrow
fast
bright
wide
no movement
brightest
widest
fast
bright
wide
confusing!
slow
dull
narrow
"a lot of WITH"
"a lot of AGAINST"

Myopes

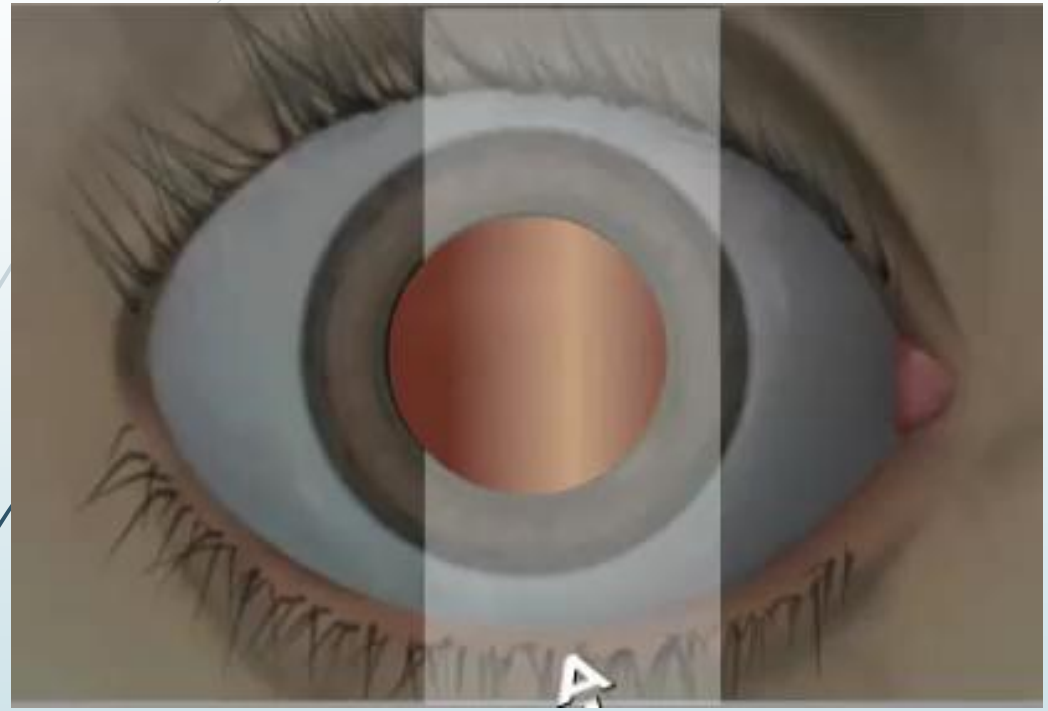


Low myope

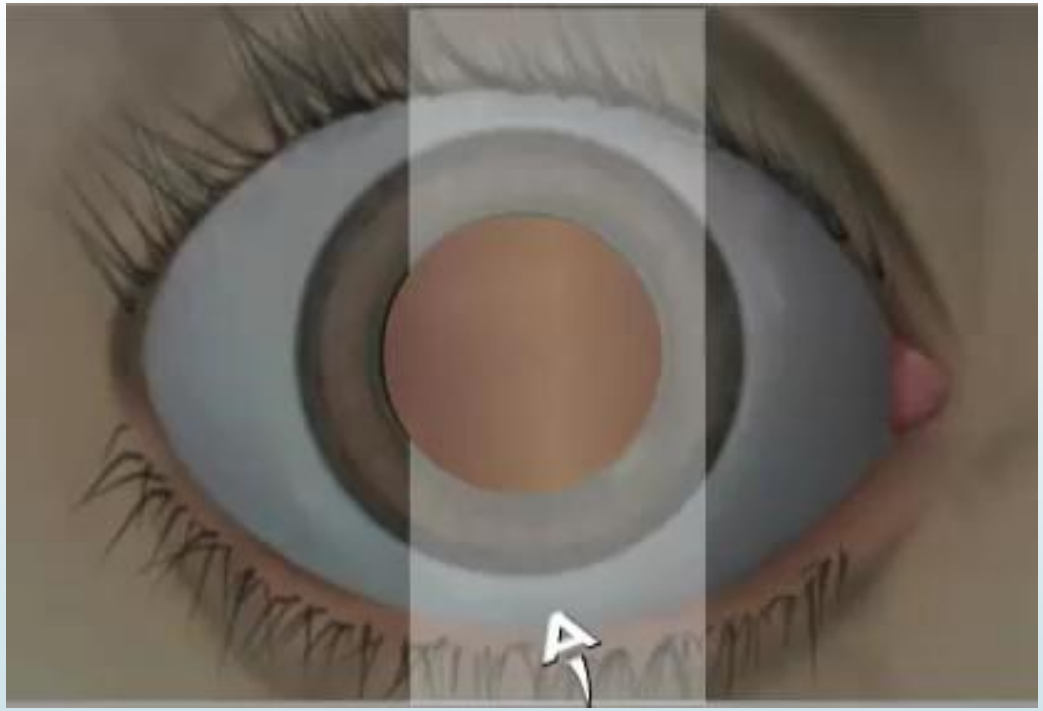


High myope

Hyperopes

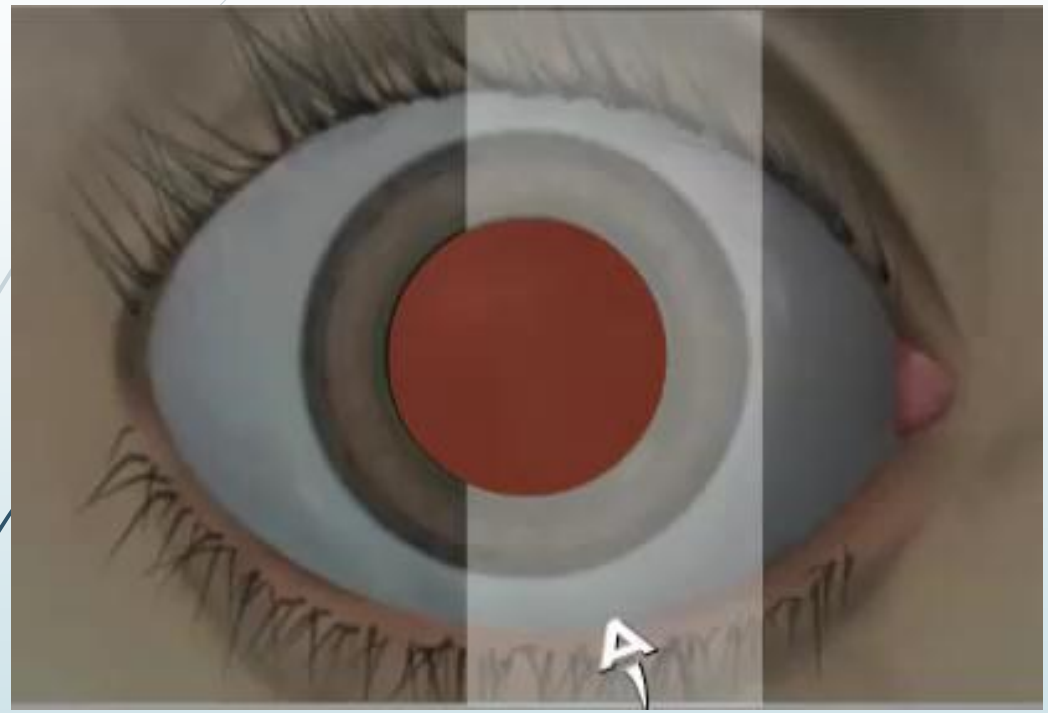


Low hyperope

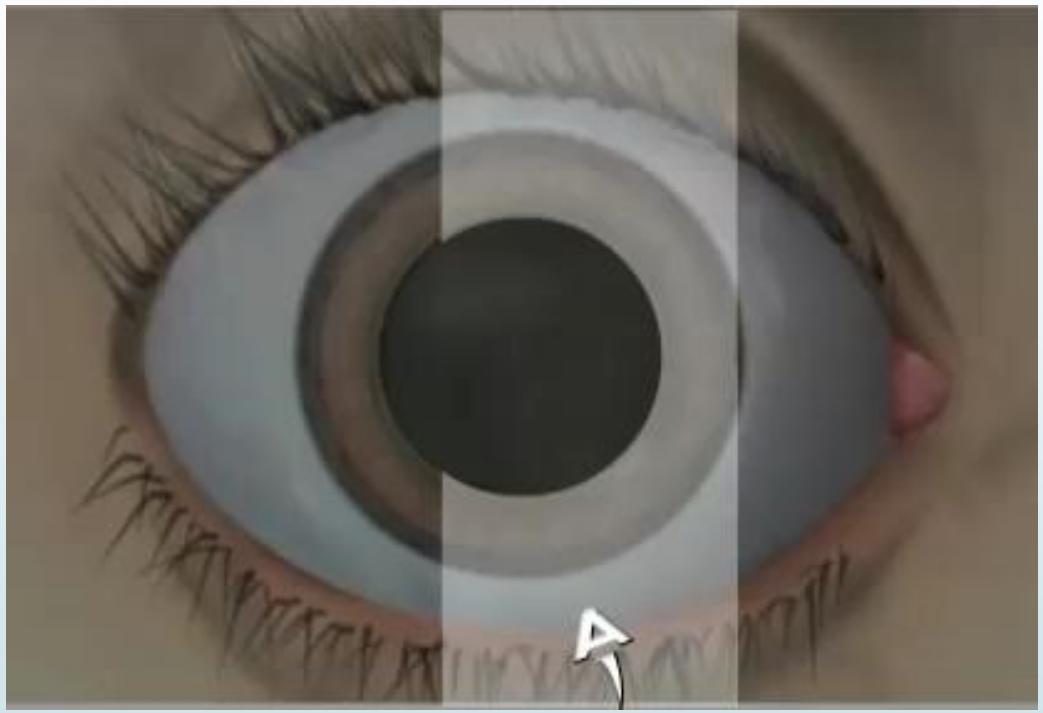


High hyperope

Neutrality vs Very dull reflex



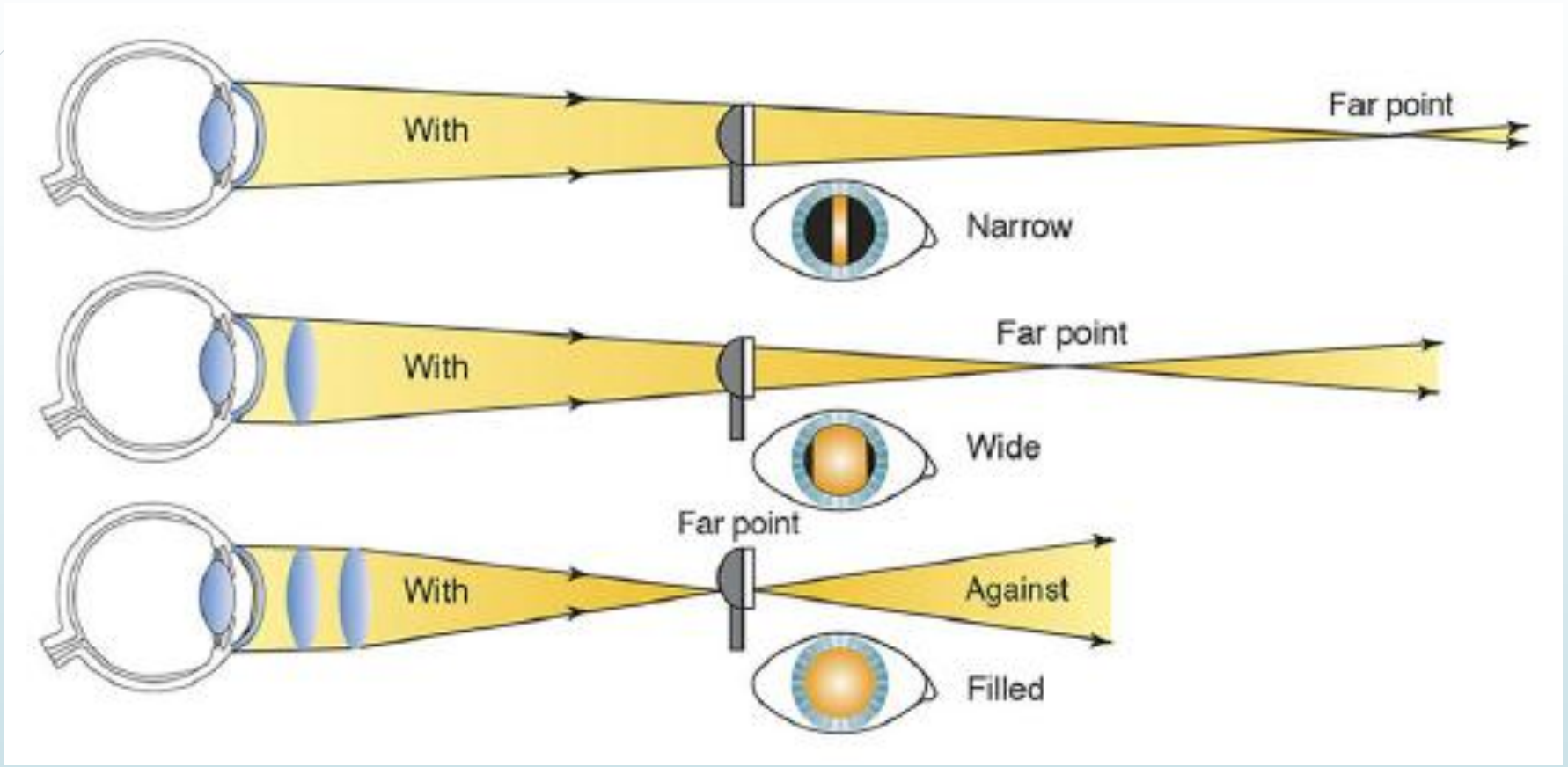
Neutrality



Very high hyperope

Working Distance

Working Distance	Subtracted Dioptres
1 m	-1.00 D
1 arm (67 cm)	-1.5 D
½ m (50 cm)	-2.00 D


With
Far point
Narrow
With
Far point
Wide
Far point
With
Against
Filled

Finding Neutrality with spherical errors

In against movement, the far point is between the examiner and the patient. Therefore, to bring the far point to the peephole of the retinoscope, a minus lens is placed in front of the patient's eye. Similarly, in the case of with movement, a plus lens is placed in front of the patient's eye:

- If with movement is observed, add plus power (or subtract minus power).
- If against movement is observed, add minus power (or subtract plus power).
- Because it is easier to work with the brighter, sharper *with* movement image, one should "overminus" the eye and obtain a *with* reflex; then reduce the minus power (or add plus power) until neutrality is reached.
- When reaching neutrality, rotate the streak 90 degrees to check the other meridian.

Finding Neutrality with spherical errors

- If neutrality is reached in all meridians with the same sphere lens, there's no astigmatism.
- **Gross retinoscopy** is the power of the lens that brings patient's far point to examiner's entrance pupil.
- **Net retinoscopy** is The dioptric equivalent of the working distance subtracted from the power of the correcting lens.

Net = Gross – working distance (D)

Retinoscopy of Regular Astigmatism

- Regular astigmatism has 2 far points; one for each principle meridian.
- The result of the streak of the retinoscope is aligned with the axis of the correcting cylinder being tested.
- In a patient with regular astigmatism, one seeks to neutralize 2 reflexes, 1 from each of the principal meridians.
- First the axes of the meridians must be determined, then the powers in each of the principal meridians can be determined.

Finding the cylinder axis

- Four characteristics of the streak reflex aid in this determination:

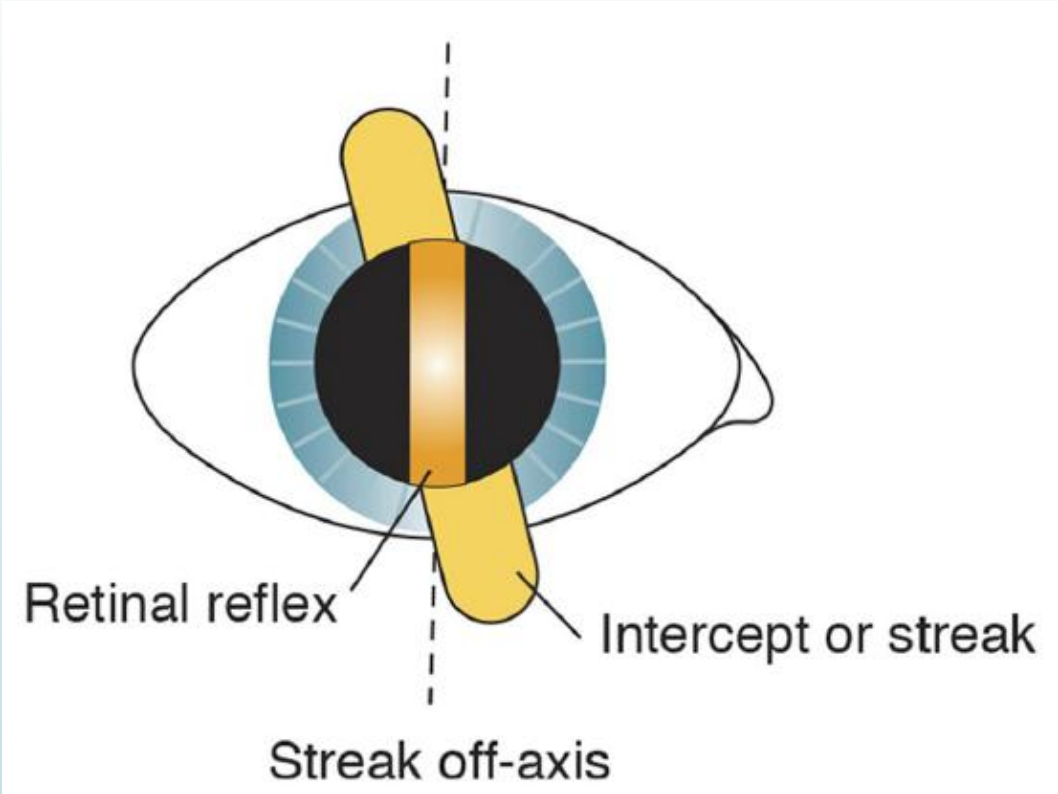
1. **Break**: is observed when the streak is not oriented parallel to 1 of the principal meridians, and the line appears broken. The break disappears when the streak is rotated to the correct axis.

2. **Width**: The reflex appears narrowest when the streak aligns with the axis.

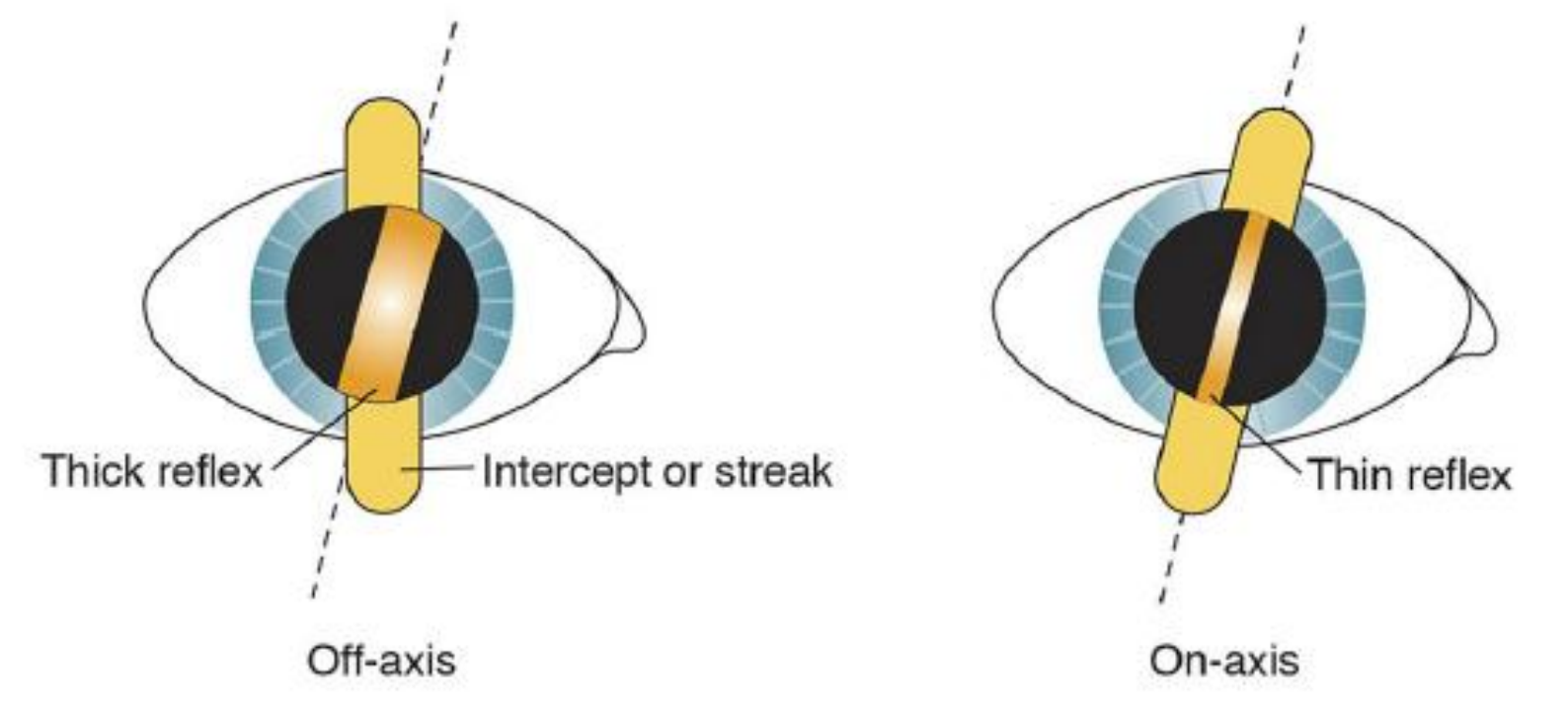
3. **Intensity**: the line is brighter when the streak is on the correct axis.

4. **Skew**: (oblique motion of the streak reflex). If the retinoscope streak is off-axis, it moves in a slightly different direction from that of the pupillary reflex. The reflex and streak move in the same direction when the streak is aligned with 1 of the principal meridians.

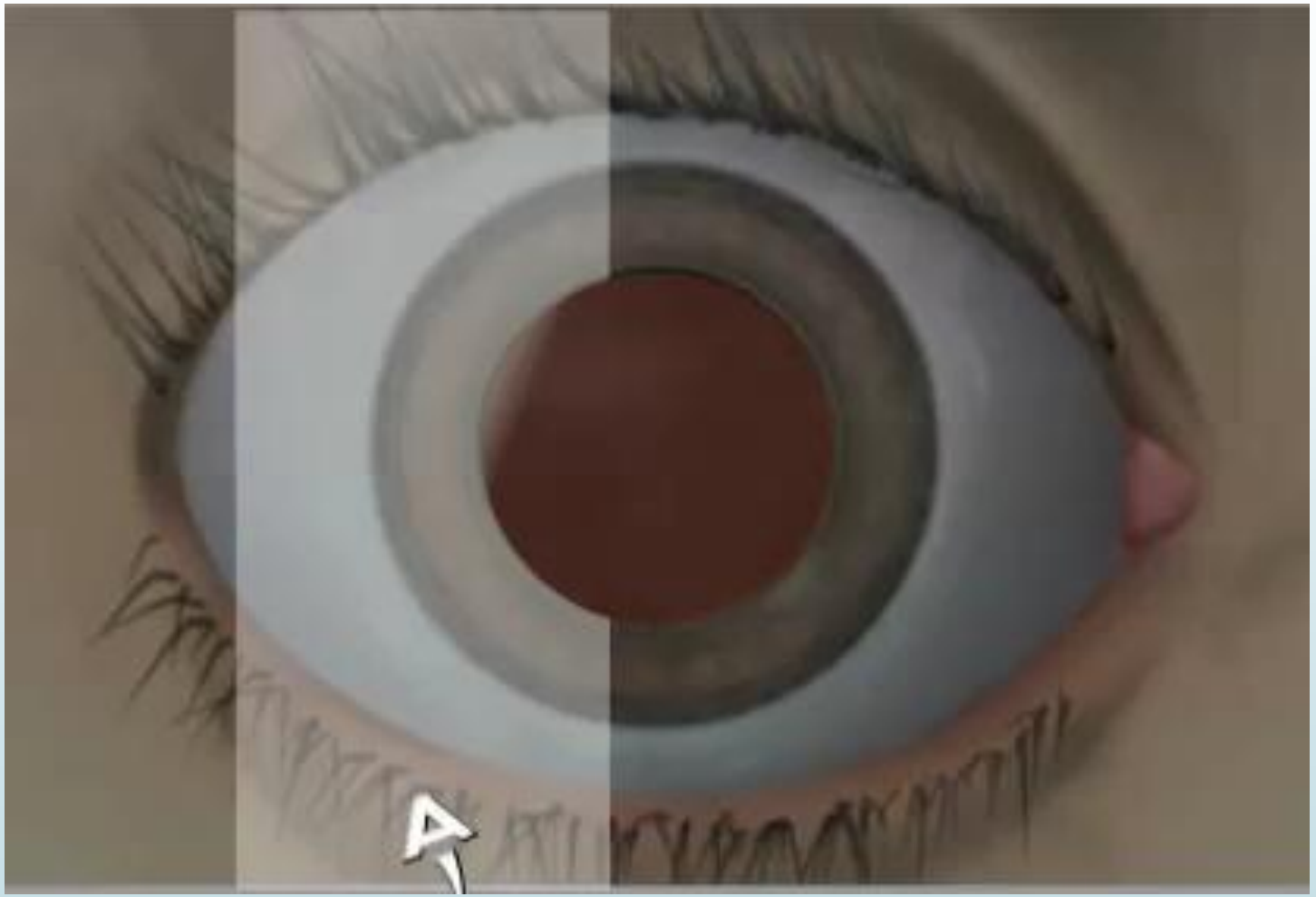
Break



Width


Thick reflex
Intercept or streak
Off-axis
Thin reflex
On-axis

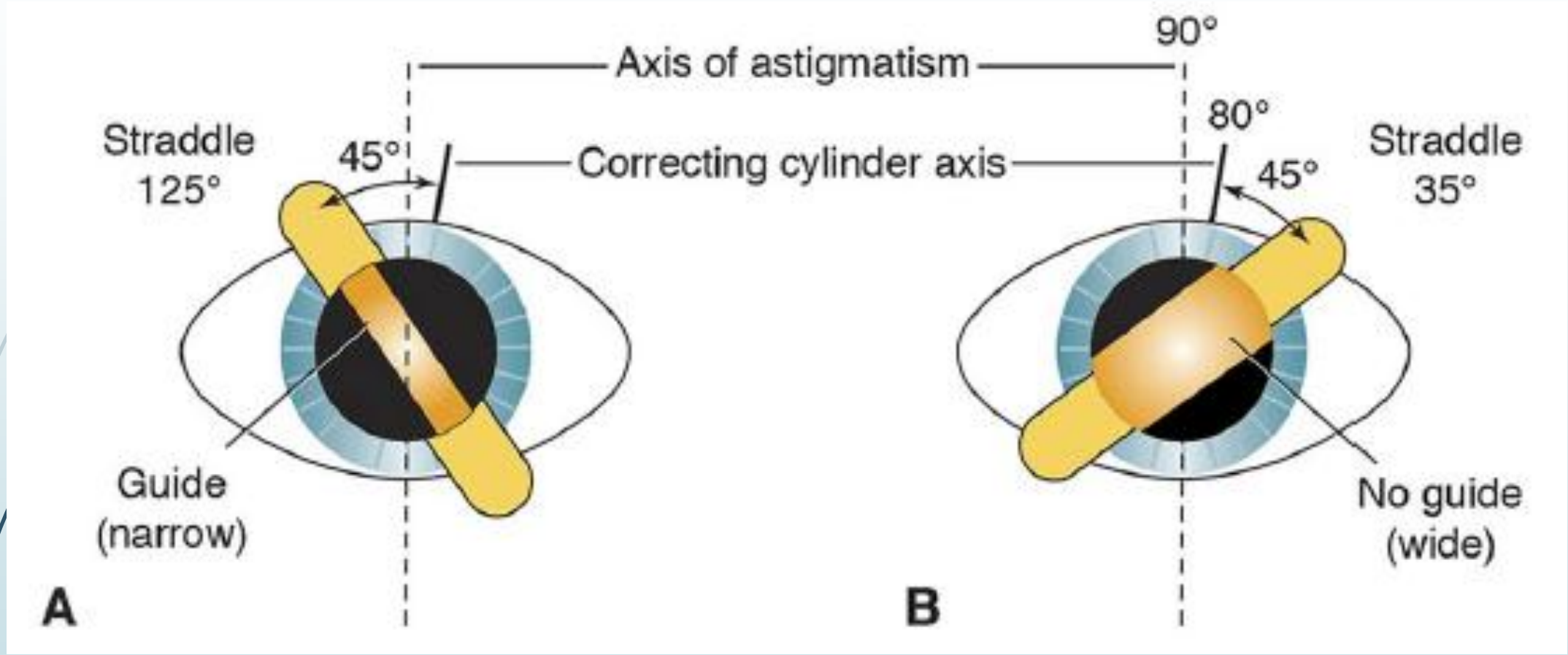
Skew

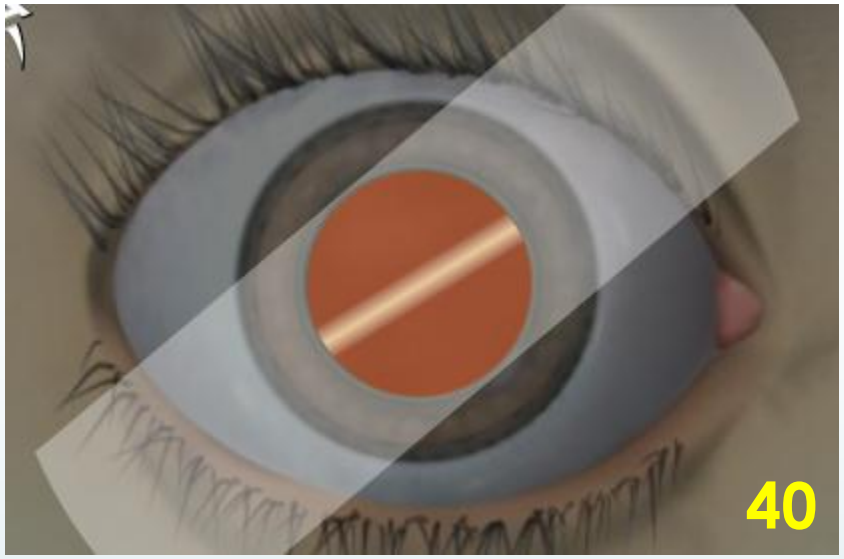


Struddling

- A technique performed to confirm the estimated correcting cylinder in place.
- The retinoscope streak is turned 45deg off-axis in both directions.
- If the axis is correct, the width of the reflex should be equal in both off-axis positions.
- If the axis is not correct, the widths are unequal in these 2 positions.
- The axis of the correcting cylinder should be moved toward the narrower reflex and the straddling repeated until the widths are equal.
- This technique is often more accurate than subjective cross-cylinder axis refinement.

Struddling


90°
Axis of astigmatism
80°
Straddle
125°
45°
Correcting cylinder axis
45°
Straddle
35°
Guide
(narrow)
No guide
(wide)
A
B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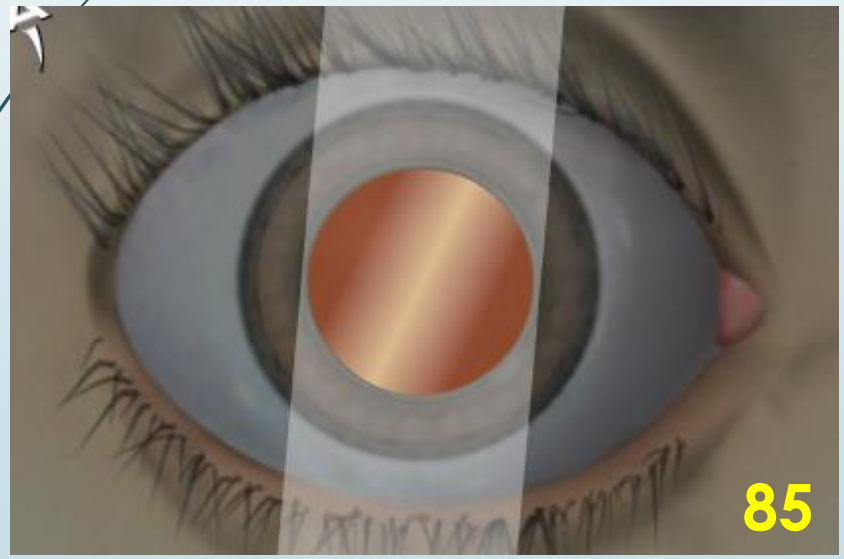
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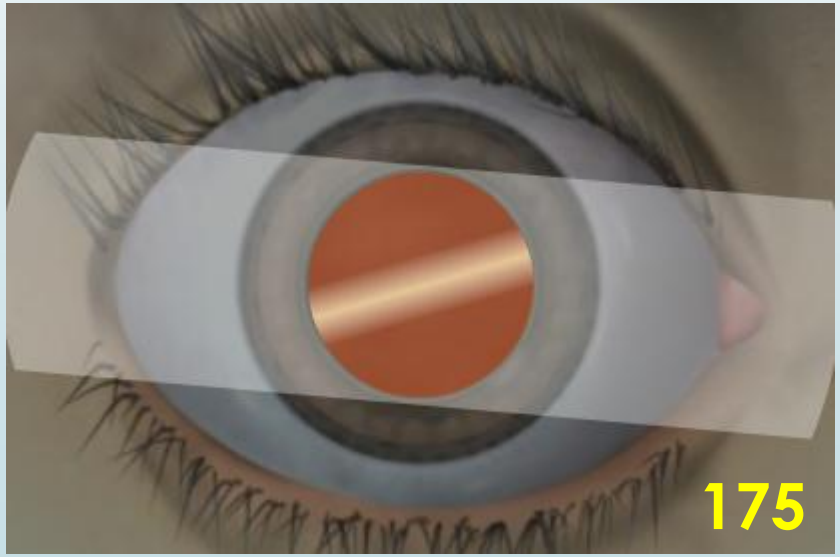
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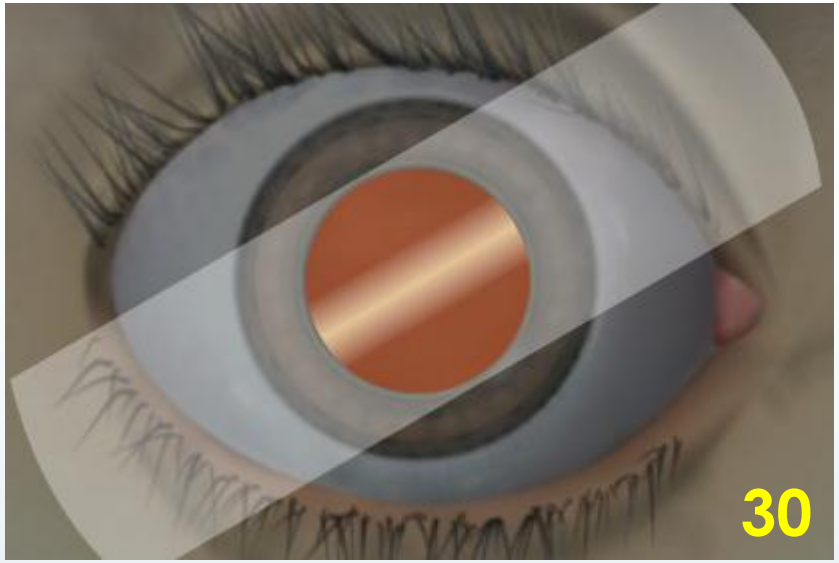
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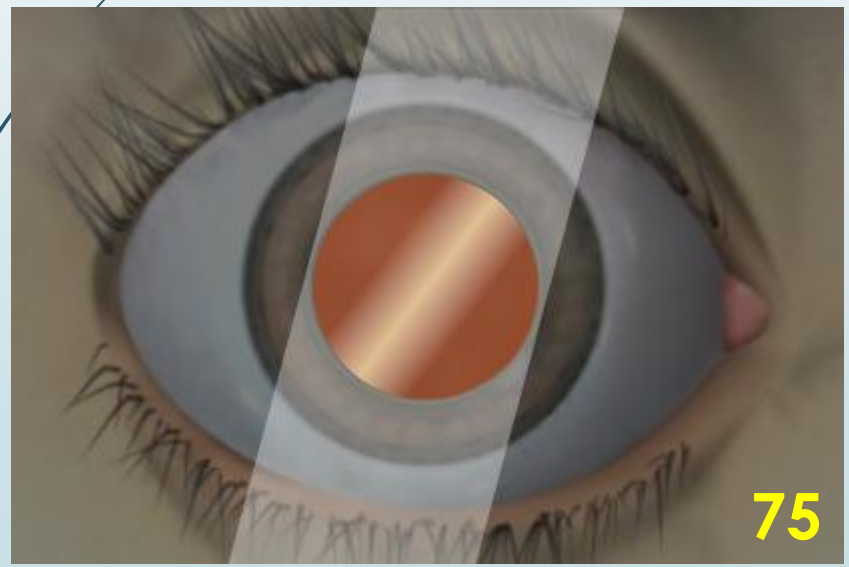
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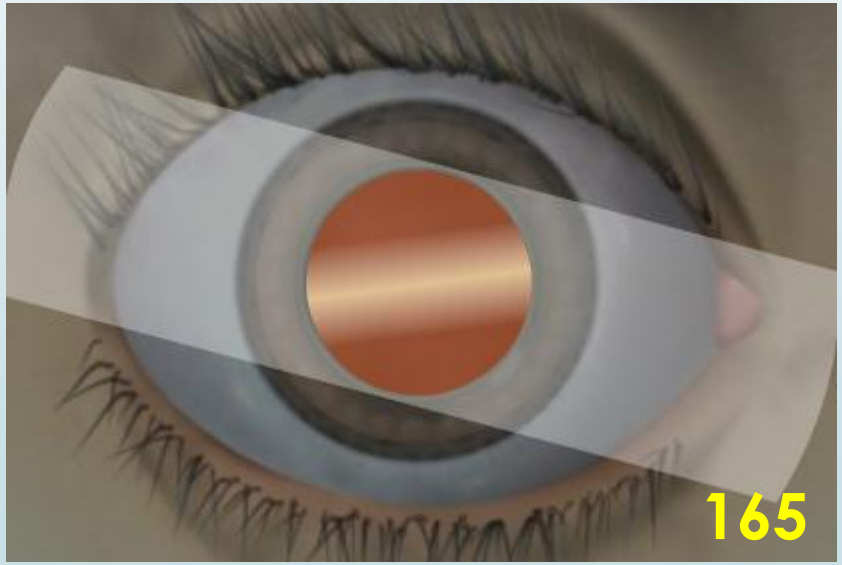
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Finding the cylinder power

With 2 spheres:

- 1- Neutralize 1 axis with a spherical lens;
- 2- then neutralize the axis 90deg away.
- 3- The difference between these readings is the cylinder power.
- For example, if the 70 deg axis is neutralized with a +2.50 sphere
  the 160 deg axis is neutralized with a +3.25 sphere,
  the gross retinoscopy is +2.50 +0.75 x 160.
  or +3.25 -0.75 x 70
  The examiner's working distance (ie, +1.50) is subtracted from the sphere to obtain the final refractive correction:
  +1.75 -0.75 x 70.

Finding the cylinder power

With a sphere and cylinder:

- Neutralize 1 axis with a spherical lens. To enable the use of with reflexes, neutralize the less plus axis first.
- Then, with this spherical lens in place, neutralize the axis 90deg away by adding a plus cylindrical lens.
- The spherocylindrical gross retinoscopy is read directly from the trial lens apparatus.

It is also possible to use 2 cylinders at right angles to each other for this gross retinoscopy.

Aberrations of the Retinoscopic Reflex

With irregular astigmatism, almost any type of aberration may appear in the reflex.

Spherical aberrations:

- Increase the brightness at the center or periphery of the pupil.
- More noticeable in patients with large scotopic pupils.
- The examiner should focus on neutralizing the central portion of the light reflex.

scissors reflex:

- 1 part of the reflex may be myopic, whereas the other may be hyperopic.
- keratoconus, irregular corneal astigmatism, corneal or lenticular opacities, and spherical aberration.

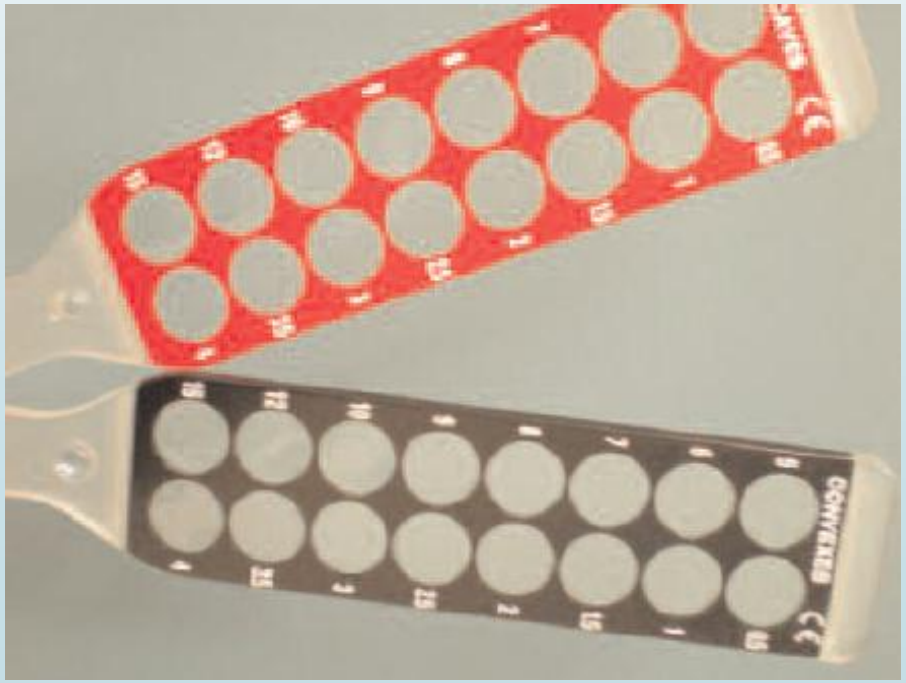
Advantages of retinoscopy

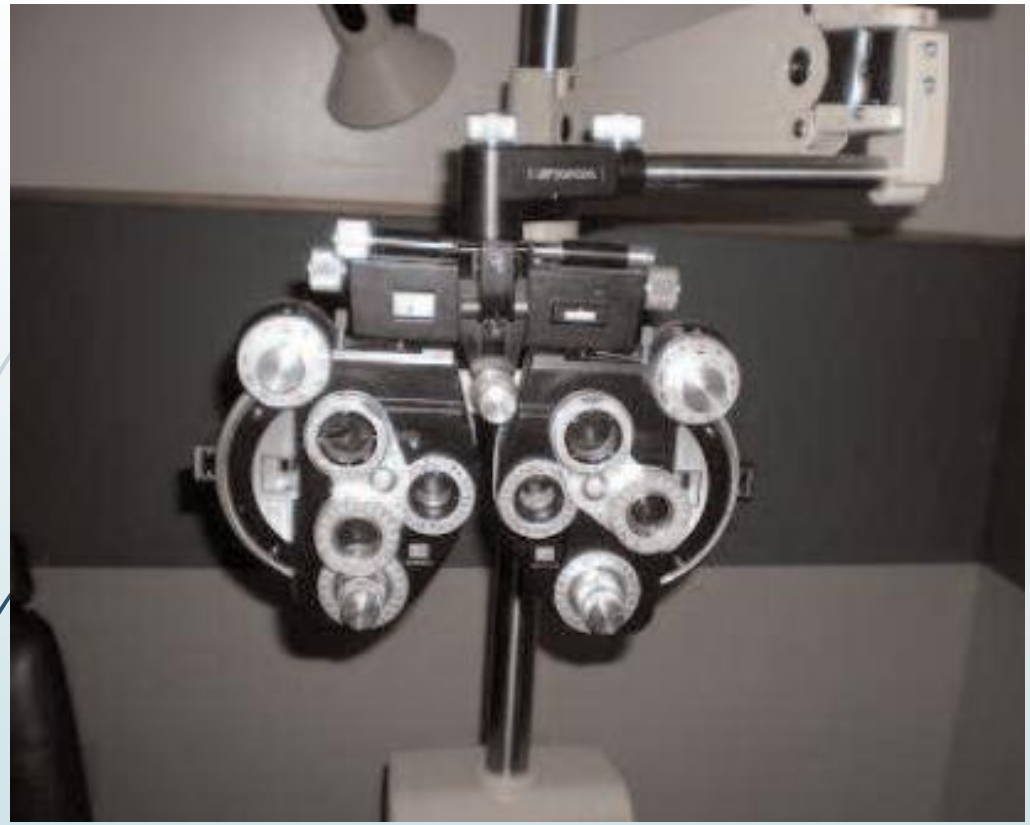
- Extremely Important when communication is difficult or impossible:
  - Retarder, deaf persons.
  - Children, infants .
- Important tool of evaluating refraction errors after Refractive surgery:
  - Lasik; PRK, PK.

Retinoscopy is an art which requires painstaking practice and cannot be learned in one day.

Most common errors

- Perform technique off-axis (you must be aligned with patient's visual axis!).
- Choose wrong target: not far enough, or too small.
- Examiner blocks patient's view of target
- Patient looks at retinoscope light, not at distance target
- Take too long: patient's accommodation will change during the assessment and you will likely: OVERMINUS!
- Creep too close (over plus) or too far away(over-minus) .
- Not accurately determine presence of astigmatism.
- Inaccurately determine the orientation of the main meridians.
- Hold lens rack too far away (changes effective power of lens used to neutralize)
- Incorrectly subtract (or do not subtract) the working distance.
- Report Gross ret when your preceptor asks for your results





The Phoropter

Autorefractor

VS

Retinoscope

Which is more accurate?

Case 1

Sph power (D)	Principle meridian axis

Working distance (in Dioptres) :			
	Sph	Cyl	Axis
Gross retinoscopy			
Net retinoscopy			

Case 2

Sph power (D)	Principle meridian axis

Working distance (in Dioptres) :			
	Sph	Cyl	Axis
Gross retinoscopy			
Net retinoscopy			

Case 3

Sph power (D)	Principle meridian axis

Working distance (in Dioptres) :			
	Sph	Cyl	Axis
Gross retinoscopy			
Net retinoscopy			

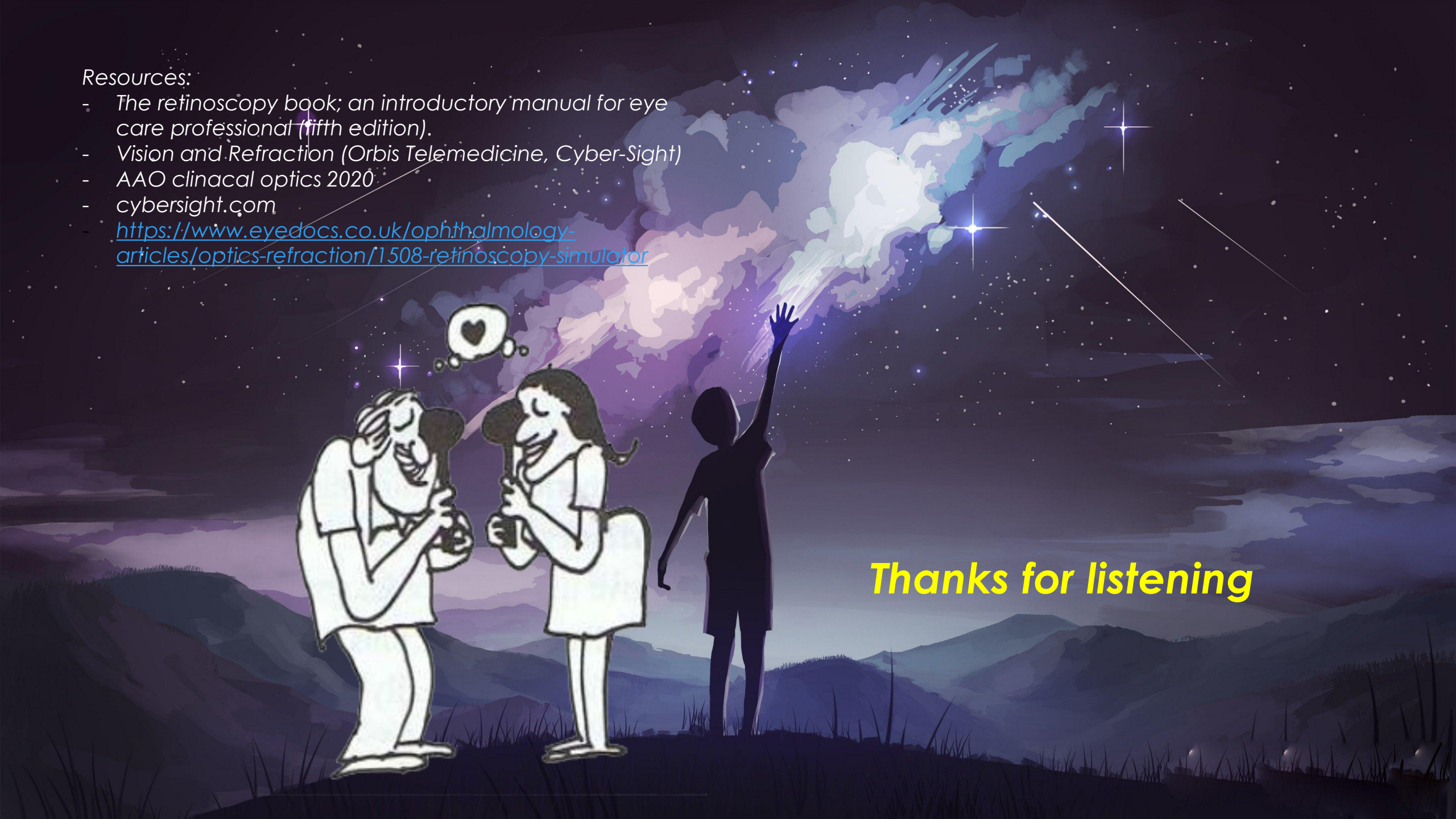
Case 4

Sph power (D)	Principle meridian axis

Working distance (in Dioptres) :			
	Sph	Cyl	Axis
Gross retinoscopy			
Net retinoscopy			

Resources:

- *The retinoscopy book; an introductory manual for eye care professional (fifth edition).*
- *Vision and Refraction (Orbis Telemedicine, Cyber-Sight)*
- *AAO clinacal optics 2020*
- *cybersight.com*
- *https://www.eyedocs.co.uk/ophthalmology-articles/optics-refraction/1508-retinoscopy-simulator*



Thanks for listening