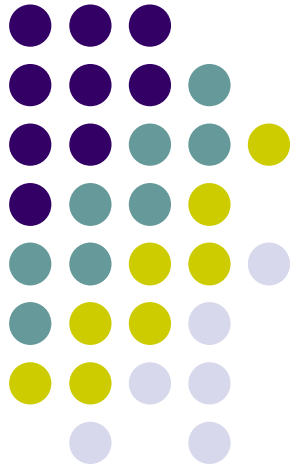
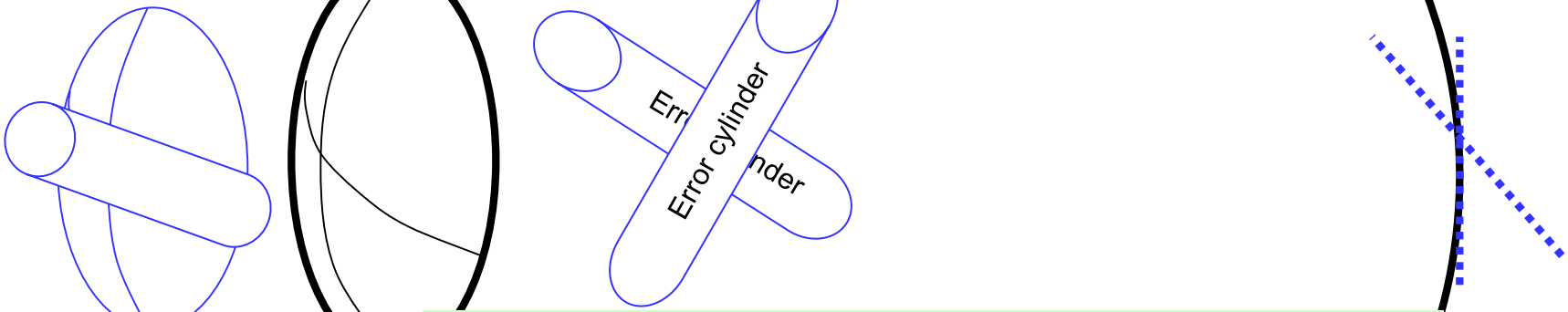
Astigmatic Refractive Correction: *Retinoscopy*

Basic Optics, Chapter 12



Astigmatic Eye Error

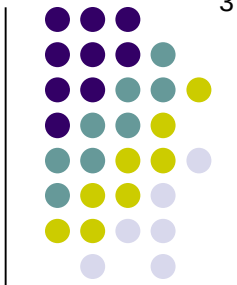
We must use a combo of cylinders--i.e., a *SPHEROCYLINDRICAL LENS*
--to collapse the conoid of Sturm and thereby fully correct an astigmatic refractive error!



Each of the focal lines in the conoid is the result of a cylindrical error lens of a certain power. Each of these 'error cylinders' will require the proper 'corrective cylinder' to offset it. In other words…

In Chapter 11, we saw that astigmatic refractive error results from two cylindrical error lenses, and therefore requires a spherocylindrical lens for its correction.

Astigmatic Correction



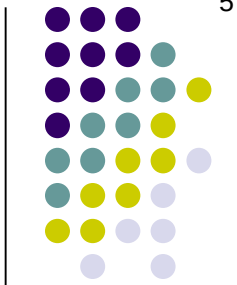
- There are two commonly-used clinical techniques for refracting the astigmatic patient:
  - *Retinoscopic*
  - *Jackson Cross*

Astigmatic Correction

- Both approaches end up in the same place, but differ in how they get there!

	Retinoscopic	Jackson Cross
Step 1	?	?
Step 2	?	?
Result	Conoid collapsed to a point on the retina	Conoid collapsed to a point on the retina

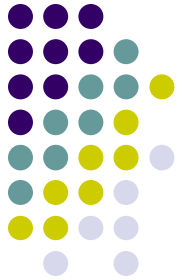
Astigmatic Correction: *Retinoscopy*



- In the *retinoscopic* approach, the focal lines are attacked individually
  - ***First***, sphere power is used to place one focal line on the retina

Note: This chapter will not delve into the specifics of how to perform retinoscopic refraction—just the ideas behind it

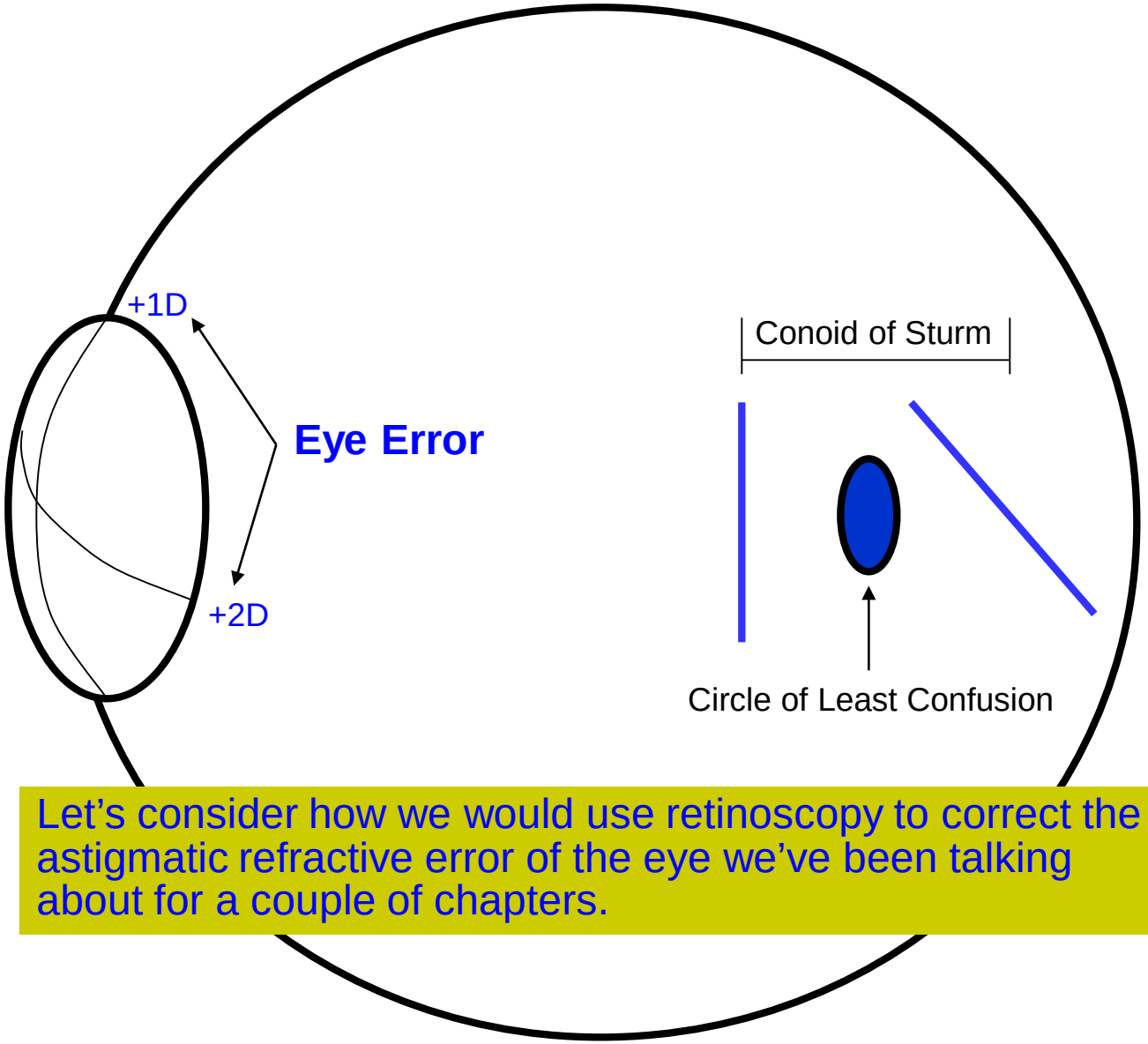
Astigmatic Correction: *Retinoscopy*



- In the *retinoscopic* approach, the focal lines are attacked individually
  - ***First***, sphere power is used to place one focal line on the retina
  - ***Then***, cylinder power is used to move the other focal line onto the retina as well, thereby collapsing the conoid

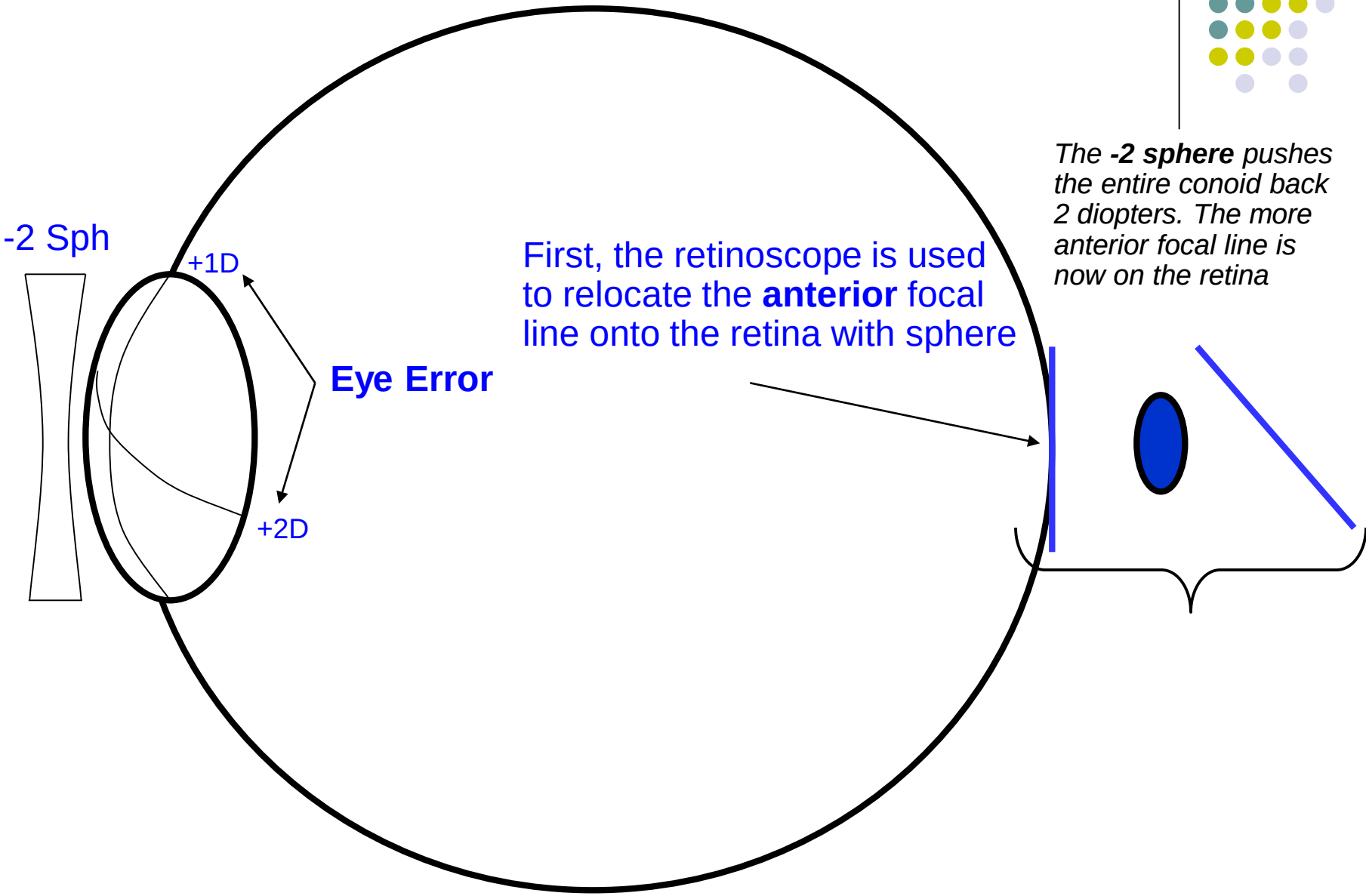
Note: This chapter will not delve into the specifics of how to perform retinoscopic refraction—just the ideas behind it

Astigmatic Correction: *Retinoscopy*



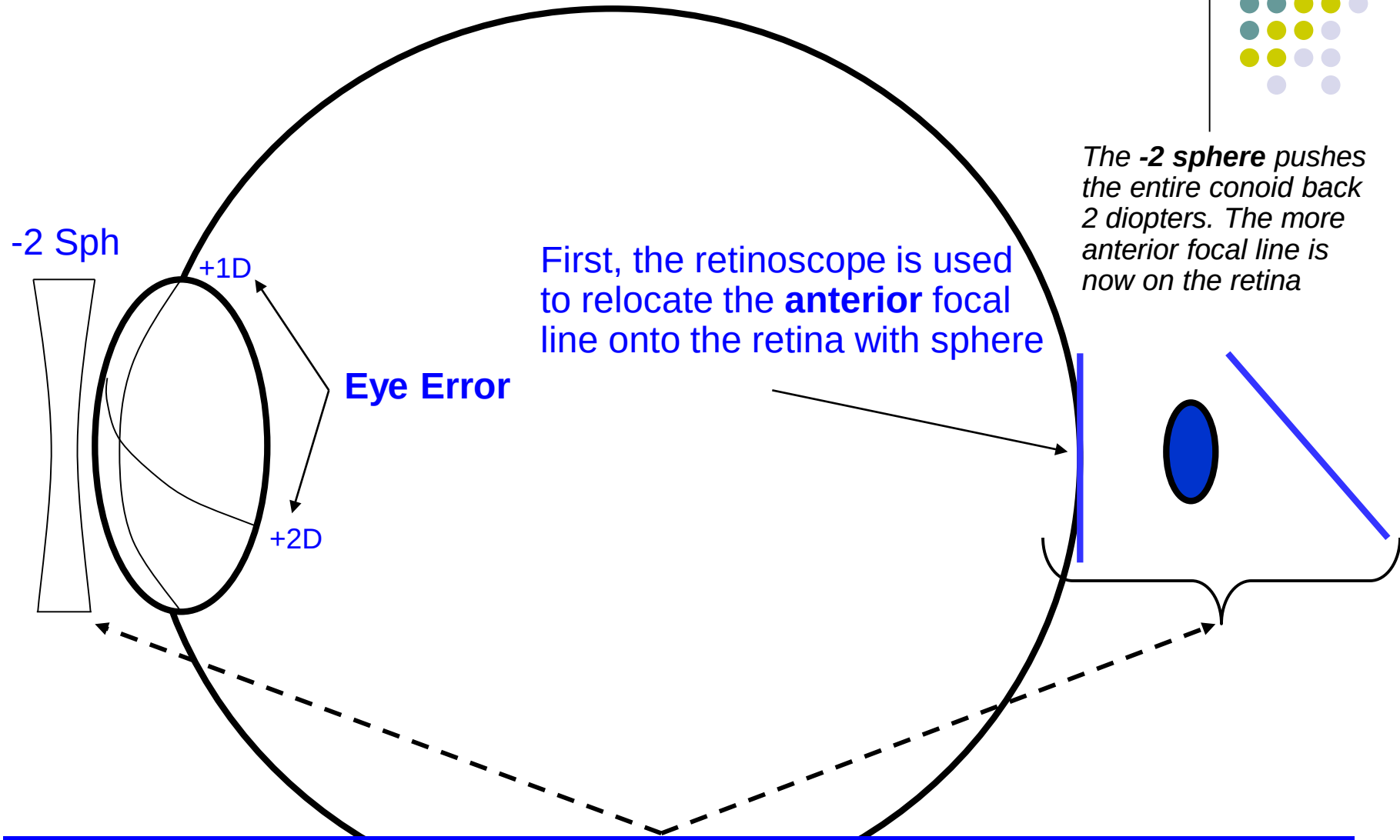
Let's consider how we would use retinoscopy to correct the astigmatic refractive error of the eye we've been talking about for a couple of chapters.

Astigmatic Correction: *Retinoscopy*



*The **-2 sphere** pushes the entire conoid back 2 diopters. The more anterior focal line is now on the retina*

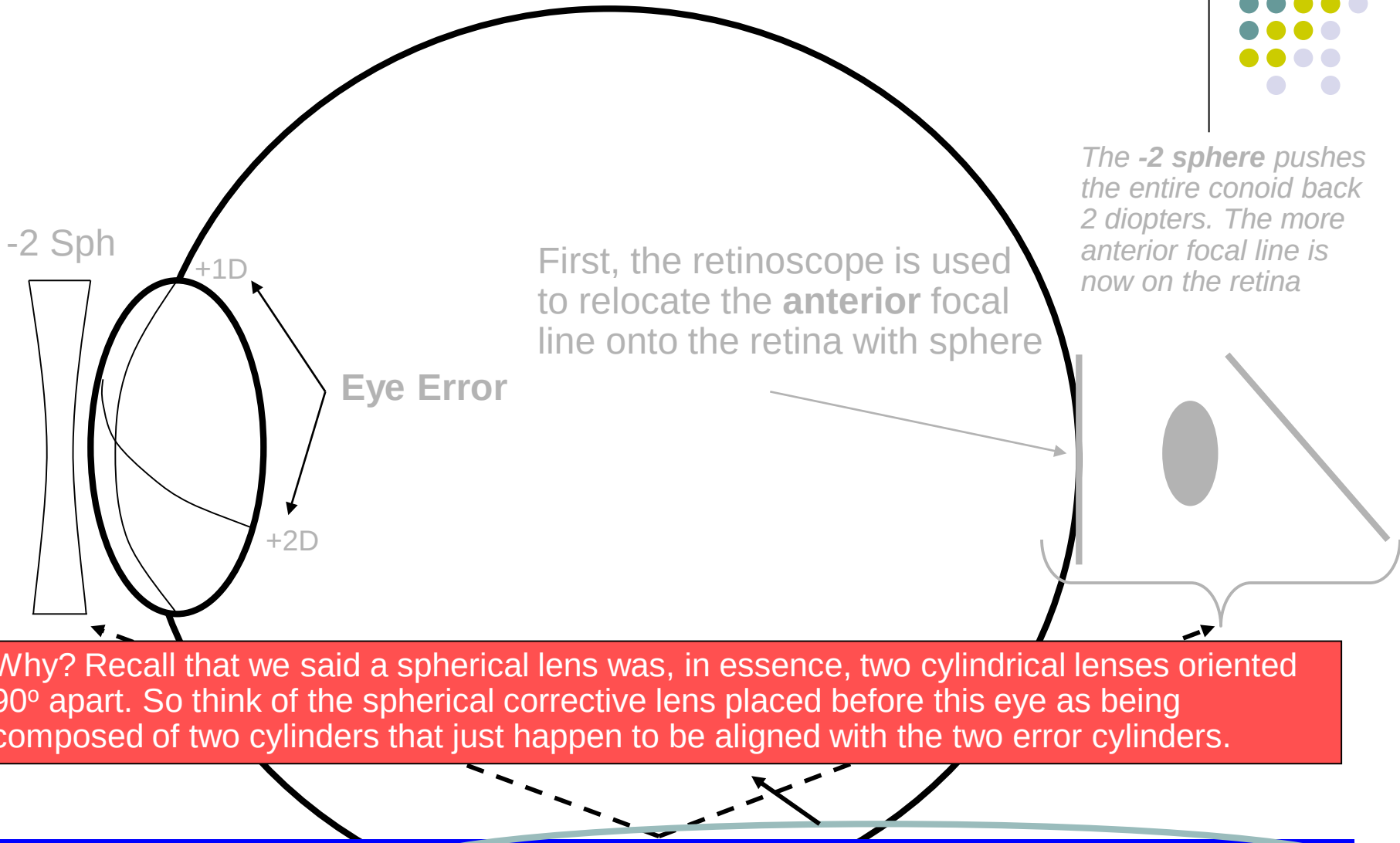
Astigmatic Correction: *Retinoscopy*



*The **-2 sphere** pushes the entire conoid back 2 diopters. The more anterior focal line is now on the retina*

Take note of the fact that a spherical corrective lens moves the ***whole conoid***— a minus lens pushes it back (like here), whereas a plus lens would pull it forward.

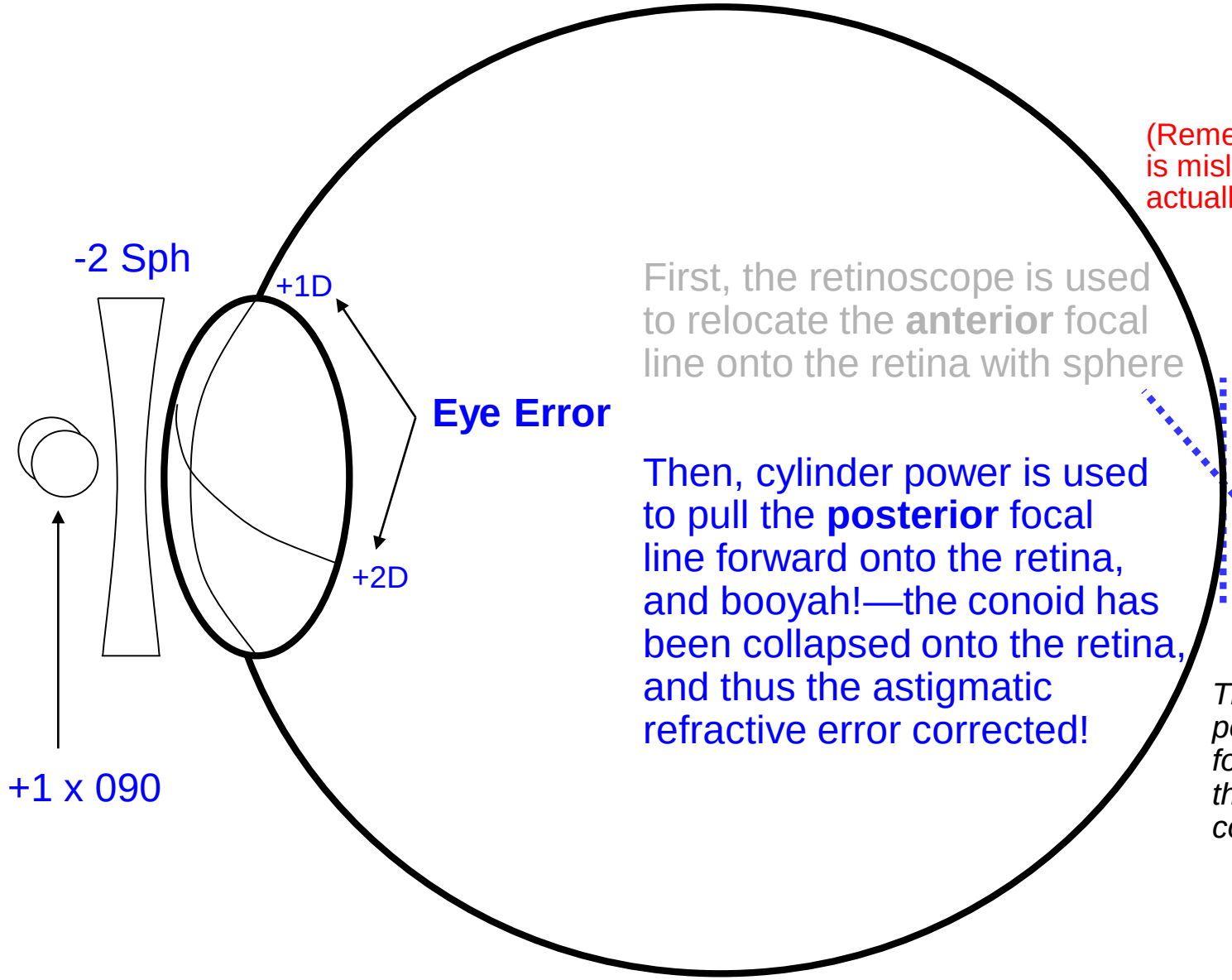
Astigmatic Correction: *Retinoscopy*



Why? Recall that we said a spherical lens was, in essence, two cylindrical lenses oriented 90º apart. So think of the spherical corrective lens placed before this eye as being composed of two cylinders that just happen to be aligned with the two error cylinders.

Take note of the fact that a spherical corrective lens moves the ***whole conoid***—a minus lens pushes it back (like here), whereas a plus lens would pull it forward.

Astigmatic Correction: *Retinoscopy*



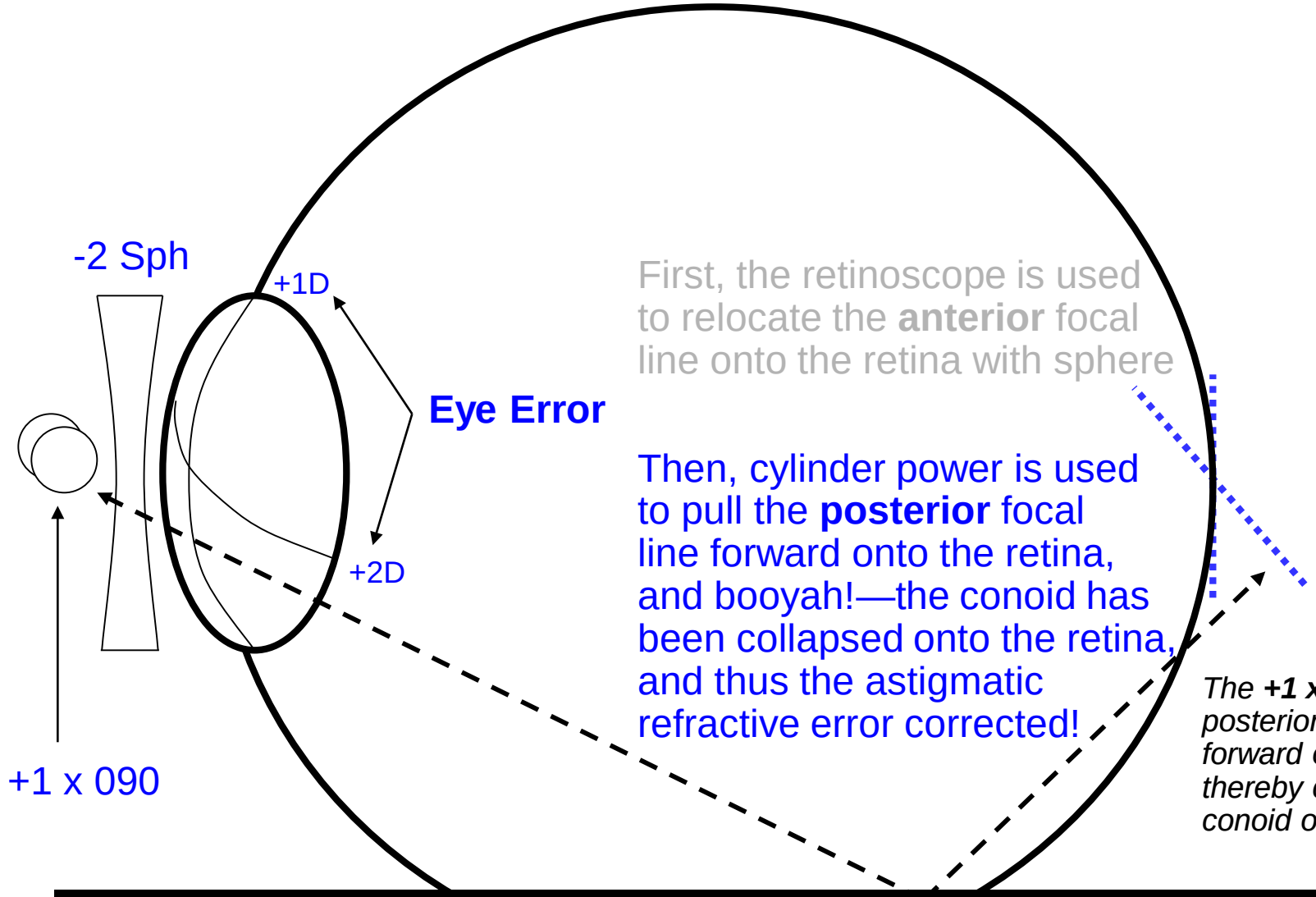
First, the retinoscope is used to relocate the **anterior** focal line onto the retina with sphere

Then, cylinder power is used to pull the **posterior** focal line forward onto the retina, and booyah!—the conoid has been collapsed onto the retina, and thus the astigmatic refractive error corrected!

(Remember, this depiction is misleading—the conoid actually collapses to a **point**.)

*The **+1 x 090** pulls the posterior focal line forward onto the retina, thereby collapsing the conoid of Sturm*

Astigmatic Correction: *Retinoscopy*



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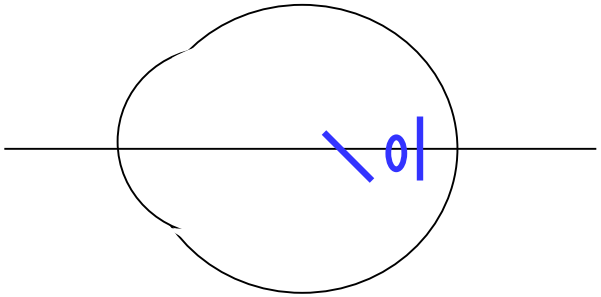
Then, cylinder power is used to pull the **posterior** focal line forward onto the retina, and booyah!—the conoid has been collapsed onto the retina, and thus the astigmatic refractive error corrected!

*The **+1 x 090** pulls the posterior focal line forward onto the retina, thereby collapsing the conoid of Sturm*

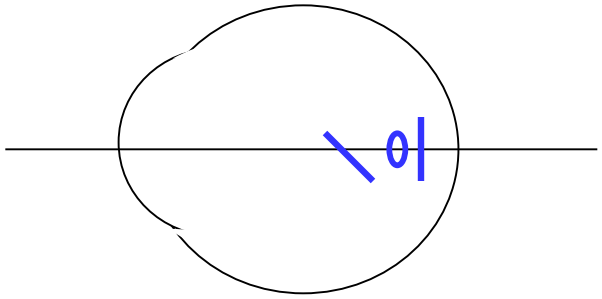
Likewise, the corrective plus **cylindrical** lens, when oriented properly, pulls only the posterior focal line forward (whereas a minus cylinder would push it back).

Astigmatic Correction: *Retinoscopy*



Up to this point, the eye error of an astigmatic eye has been rendered like *this*, with both focal lines located within the confines of the globe. However, this has been for illustrative purposes only; there is nothing special or particularly important about these locations for the focal lines. In fact, there are five sets of locations possible for the astigmatic focal lines. Each set is named with respect to the location of the lines…

Astigmatic Correction: *Retinoscopy*

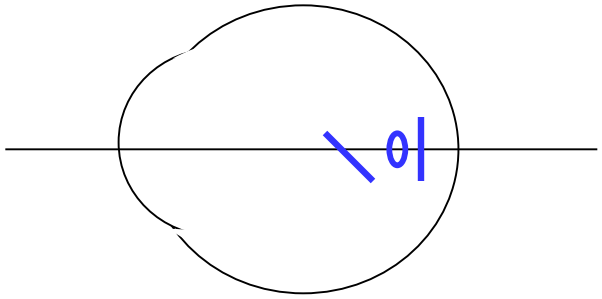


Compound Myopic

(Both focal lines in the vitreous)

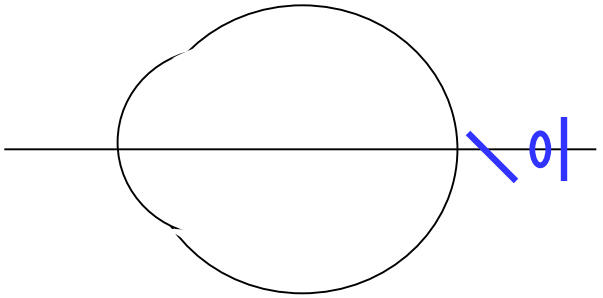
Types of Astigmatism

Astigmatic Correction: *Retinoscopy*



Compound Myopic

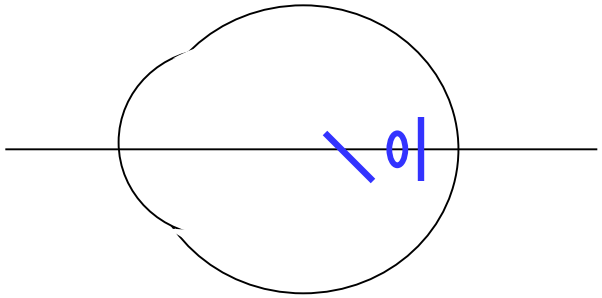
Types of Astigmatism



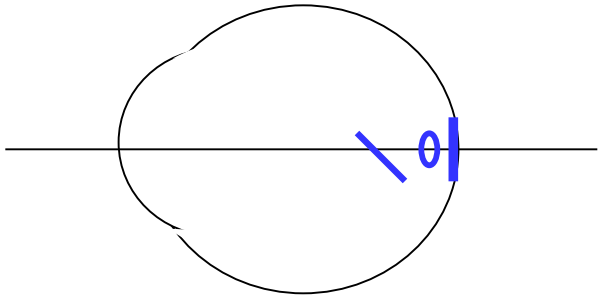
Compound Hyperopic

(Both focal lines behind the eye)

Astigmatic Correction: *Retinoscopy*



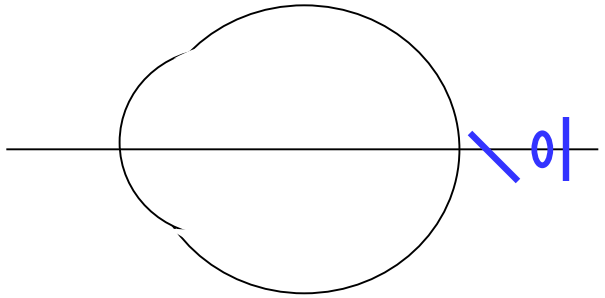
Compound Myopic



Simple Myopic

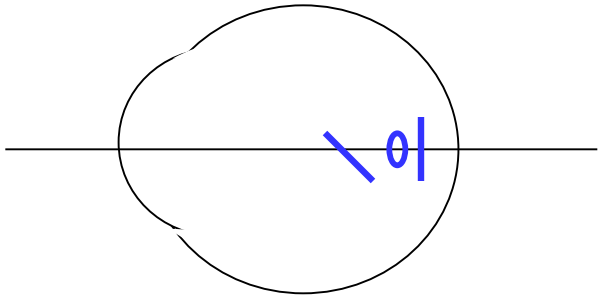
(One line in the vitreous, one on the retina)

Types of Astigmatism

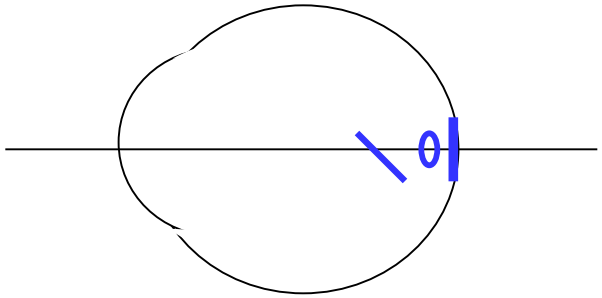


Compound Hyperopic

Astigmatic Correction: *Retinoscopy*

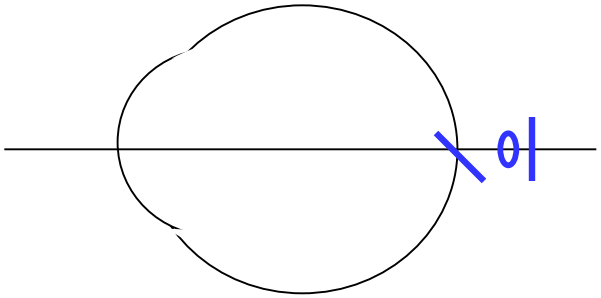


Compound Myopic



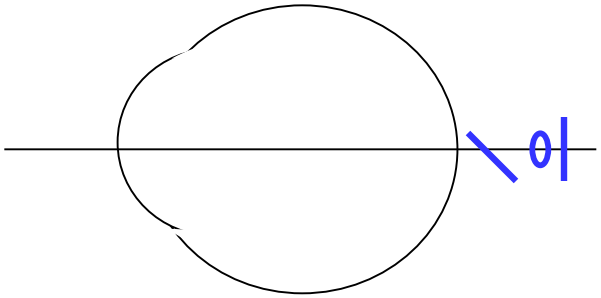
Simple Myopic

Types of Astigmatism



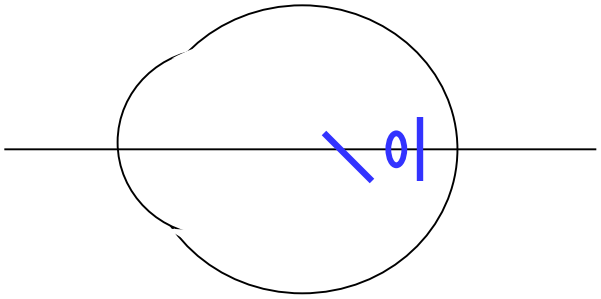
Simple Hyperopic

(One line behind the eye, one on the retina)

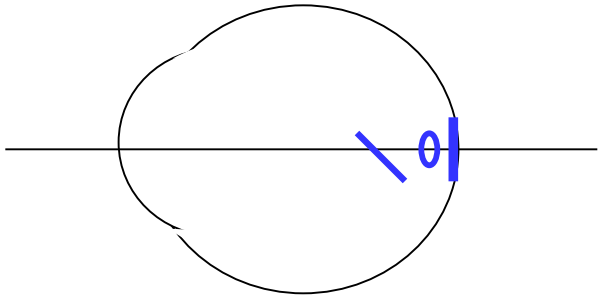


Compound Hyperopic

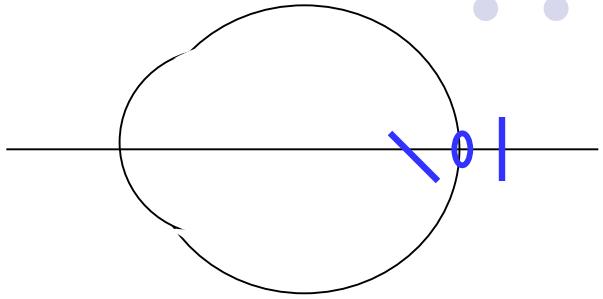
Astigmatic Correction: *Retinoscopy*



Compound Myopic



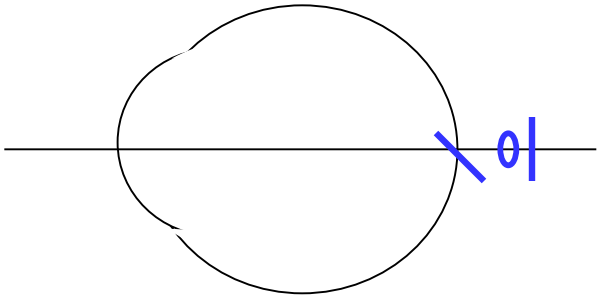
Simple Myopic



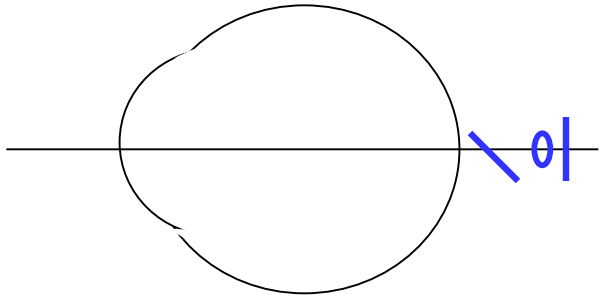
Mixed

(One in the vitreous, one behind the eye)

Types of Astigmatism

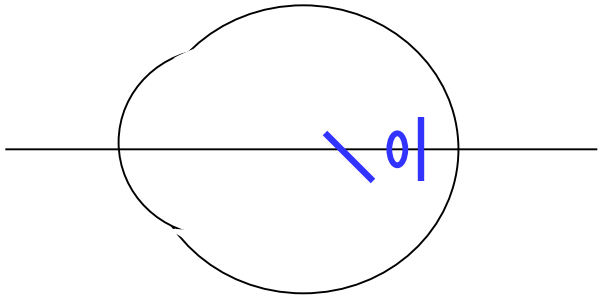


Simple Hyperopic



Compound Hyperopic

Astigmatic Correction: *Retinoscopy*



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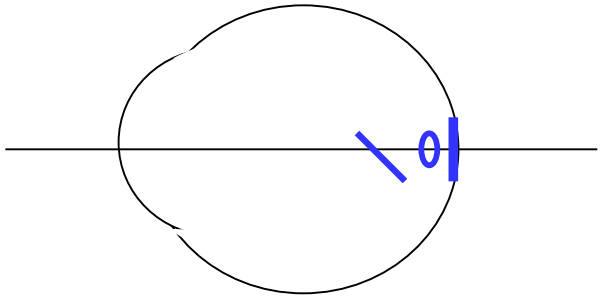
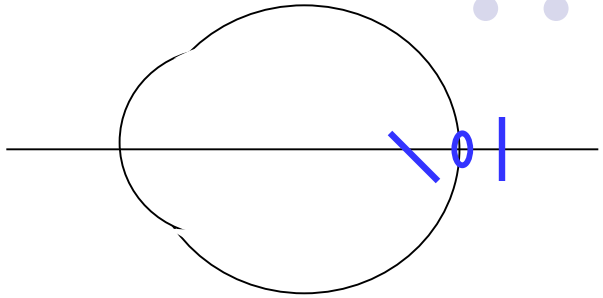


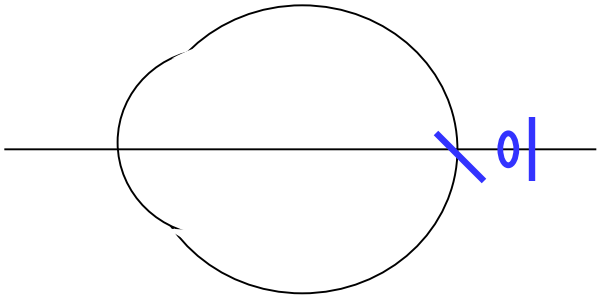
Simple Myopic



Mixed

Note: 'Mixed astigmatism' doesn't require or imply that the CoLC is located precisely on the retina as illustrated here!

Types of Astigmatism



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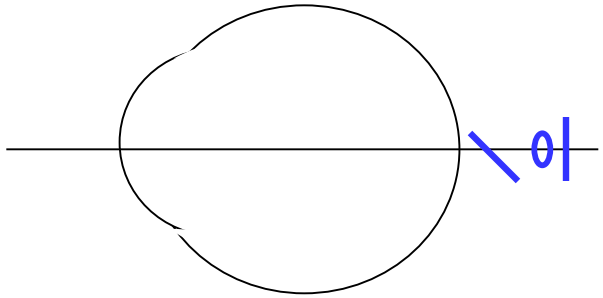
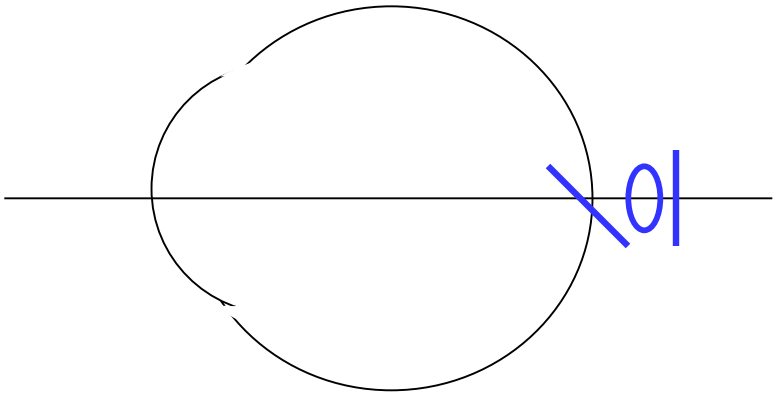


Compound Hyperopic

Astigmatic Correction: *Retinoscopy*

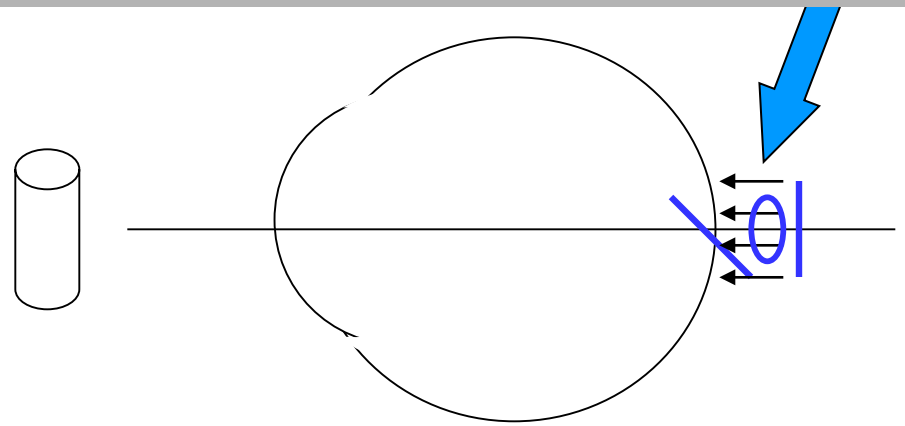


Simple Hyperopic Astigmatism

In describing retinoscopic astigmatic refraction, we said that sphere was used to place the anterior focal line on the retina. Thus, the first step in retinoscopy is to transform the patient's refractive error into simple hyperopic astigmatism. However, *this assumes the refractionist is working in plus cylinder*. That is, if you're working with a plus-cyl phoropter, you want to end up in this position prior to adding cylinder. (Why?)

Astigmatic Correction: *Retinoscopy*

Because plus cyl can only pull a focal line **forward**. Thus, the to-be-resolved focal line must be **behind** the retina.



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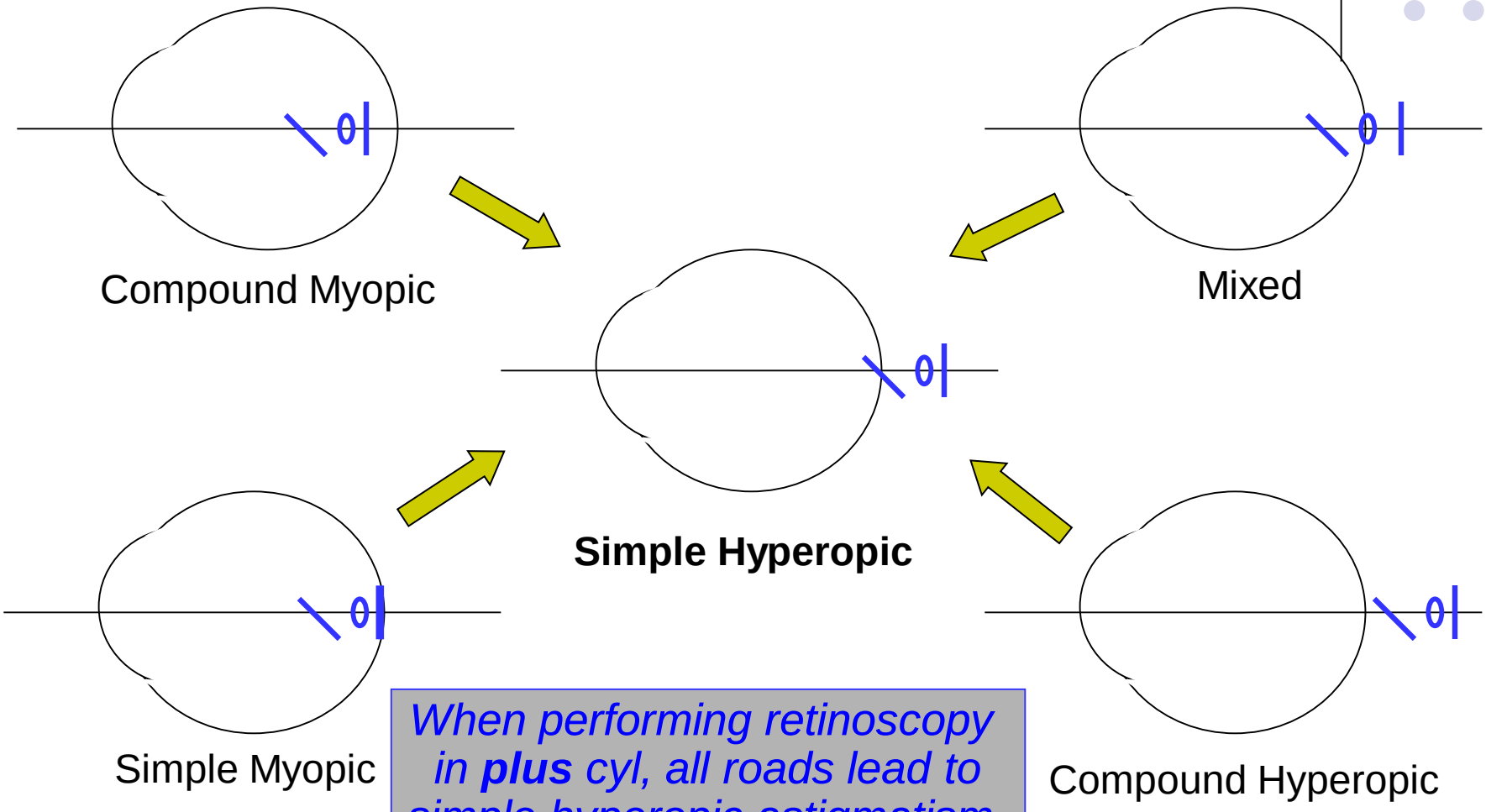
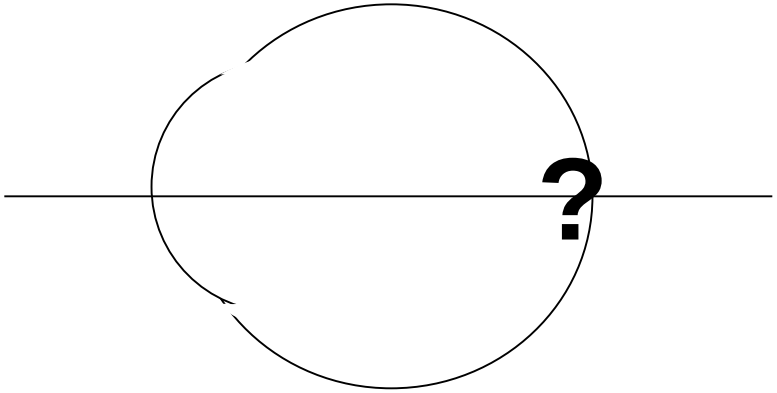
Astigmatic Correction: *Retinoscopy*



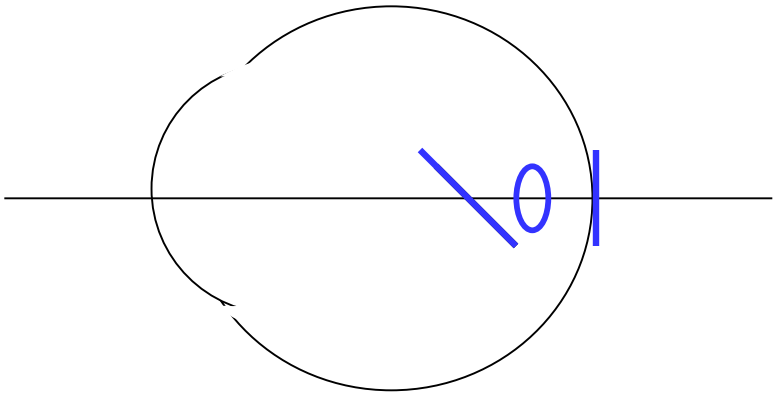
*When performing retinoscopy in **plus** cyl, all roads lead to simple hyperopic astigmatism before cylinder is introduced*

Astigmatic Correction: *Retinoscopy*



But what if you're working in **minus** cylinder?

Astigmatic Correction: *Retinoscopy*

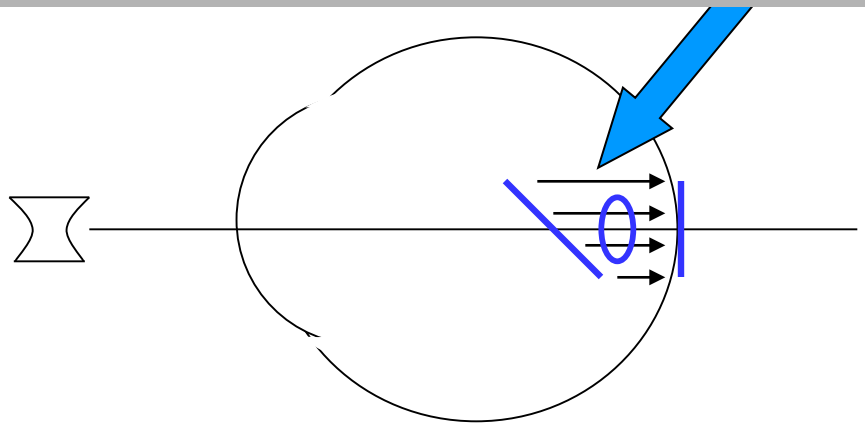


Simple Myopic Astigmatism

If working in **minus** cylinder, you want to end up in **this** position prior to adding cylinder! ***Why?***

Astigmatic Correction: *Retinoscopy*

Because minus cyl can only push a focal line **backwards**. Thus, the to-be-resolved focal line must be **in front of** the retina.



Simple Myopic Astigmatism

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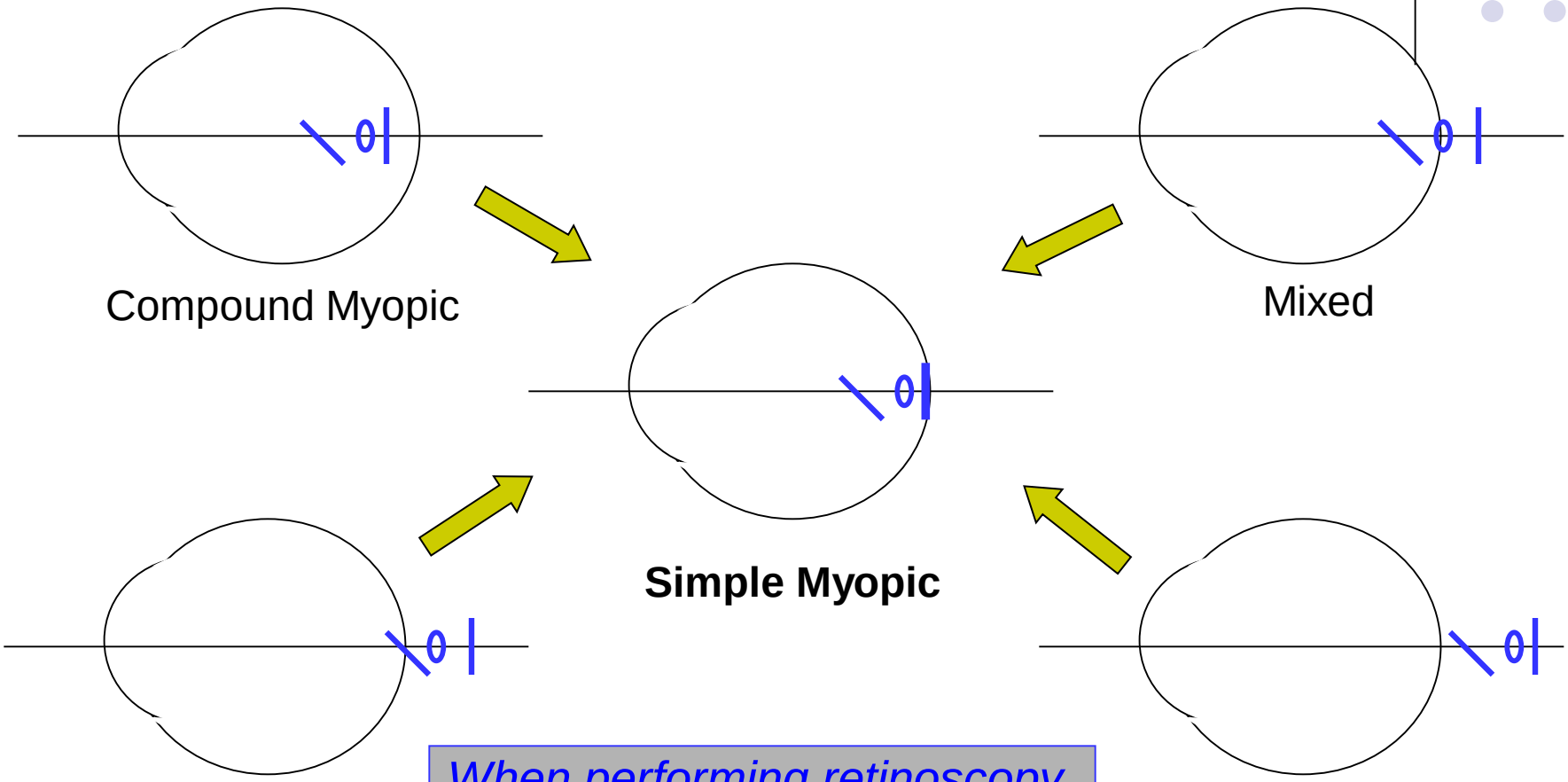
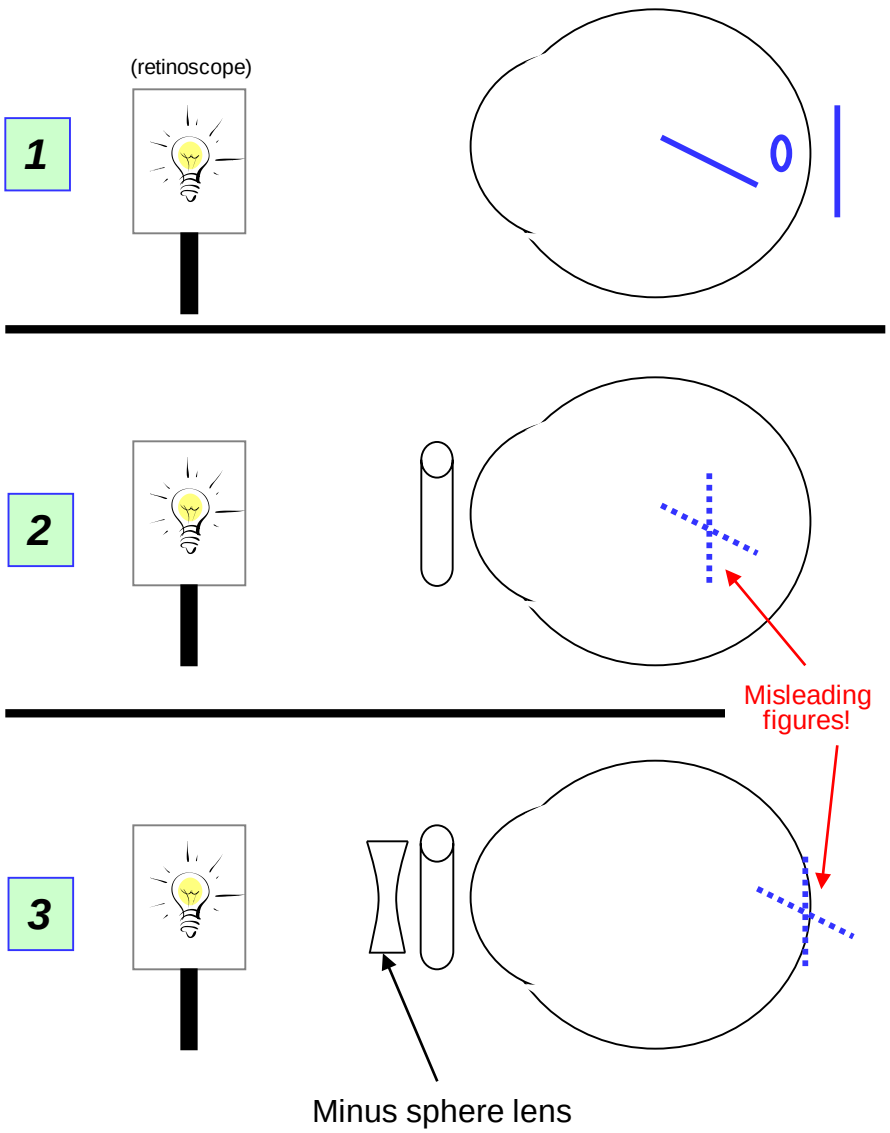
Astigmatic Correction: *Retinoscopy*



*When performing retinoscopy in **minus** cyl, all roads lead to simple myopic astigmatism before cylinder is introduced*

Astigmatic Correction: *Retinoscopy*

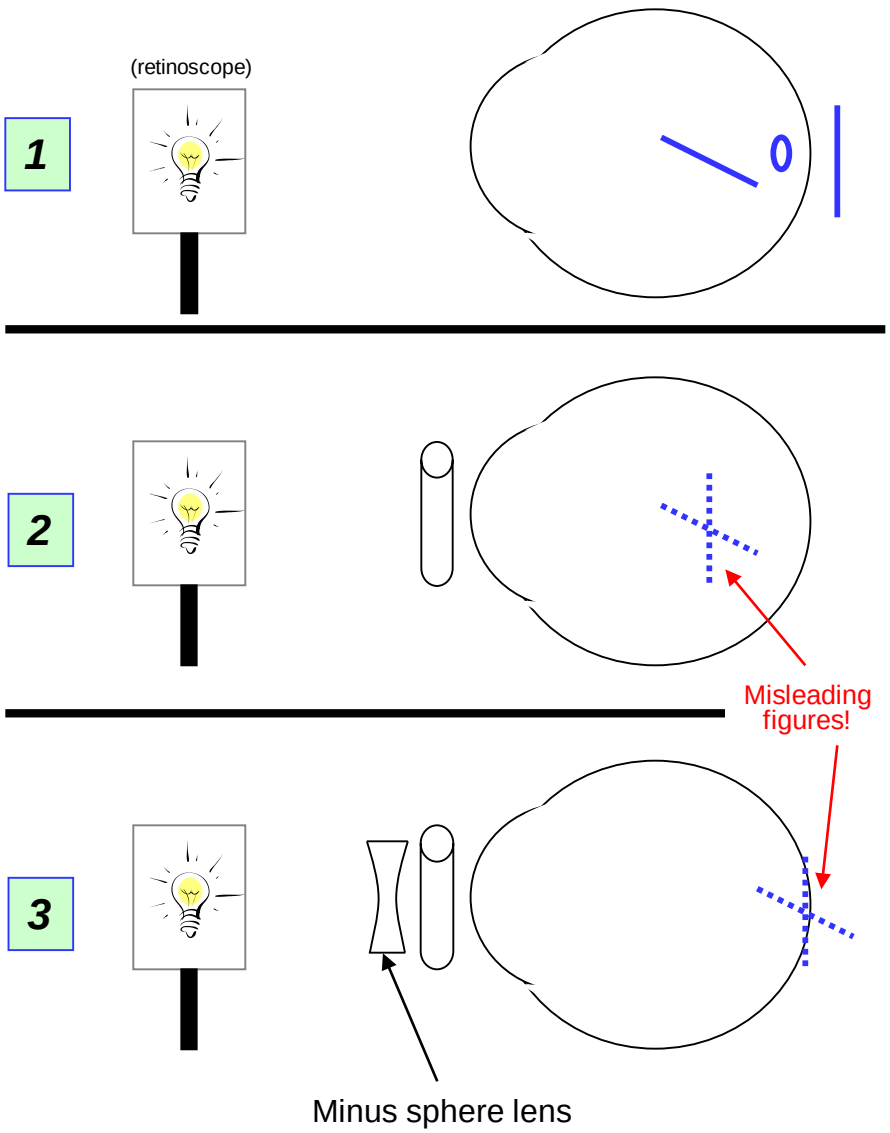


As an aside…

Some clinicians would disagree with the assertion that one must end up in the simple myopic/hyperopic configuration prior to collapsing the conoid with cylinder. They contend that a better approach is to first collapse the conoid **in the vitreous**, then push the resulting focal point back onto the retina.

In this example, plus cyl axis 090 is used to pull the posterior focal line forward until it reached the anterior line, thereby collapsing the conoid (1, 2). Once the conoid is collapsed into a focal point in the vitreous, minus sphere is used to push the focal point backwards onto the retina (3).

Astigmatic Correction: *Retinoscopy*



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Why refract in this manner? To avoid making an error owing to ***accommodation*** on the part of the patient. Any time a focal point (or line) is behind the retina, there is the possibility that the patient might employ accommodation to 'pull it forward' on his/her own. This would leave the patient overminused (i.e., the patient is supplying some plus power, therefore you are supplying too little plus power—which is the same as too much minus power). However, if the focal point/lines are located **anterior** to the retina, accommodation will be suppressed, and the risk of overminusing thereby avoided.

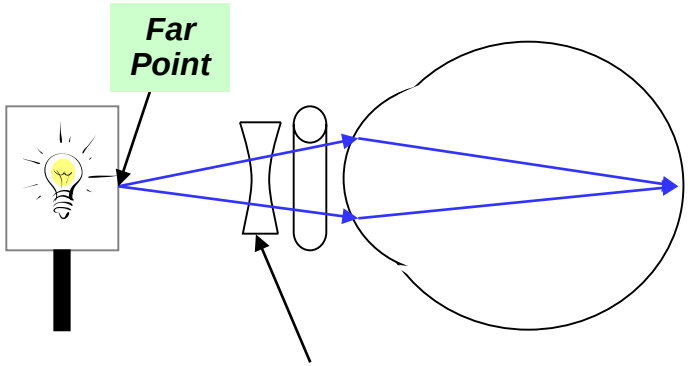
Note that the opportunities for accommodation are greater during plus-cyl retinoscopy than minus-cyl retinoscopy (compare the focal line positions in simple myopic and simple hyperopic astigmatism to see why). This is the main reason many clinicians contend that minus-cyl phoropters are **superior** to plus-cyl phoropters as refractive tools.

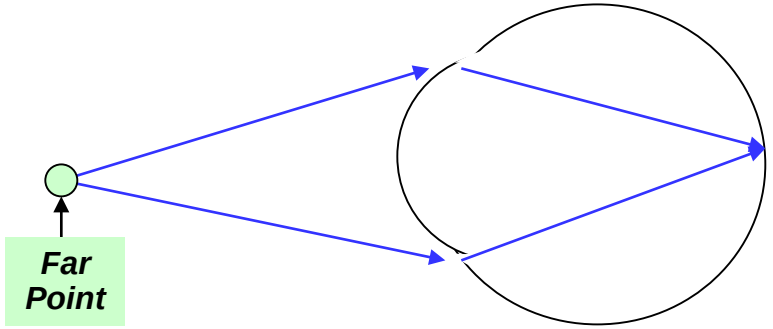
Astigmatic Correction: *Retinoscopy*

As another ***aside…***

Remember that (3) does **not** represent the endpoint for retinoscopic refraction. At this point, the far point is at the peephole of the retinoscope, **not** at infinity. Thus, the lenses currently before this eye would leave the patient quite myopic at distance. (Note how the cartoon of the far point after retinoscopy is similar in appearance to that of the myopic eye and its far point.)

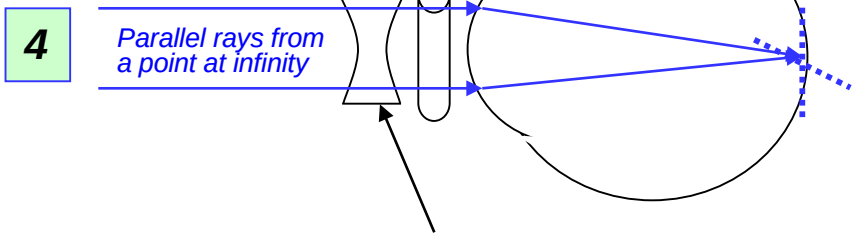
3



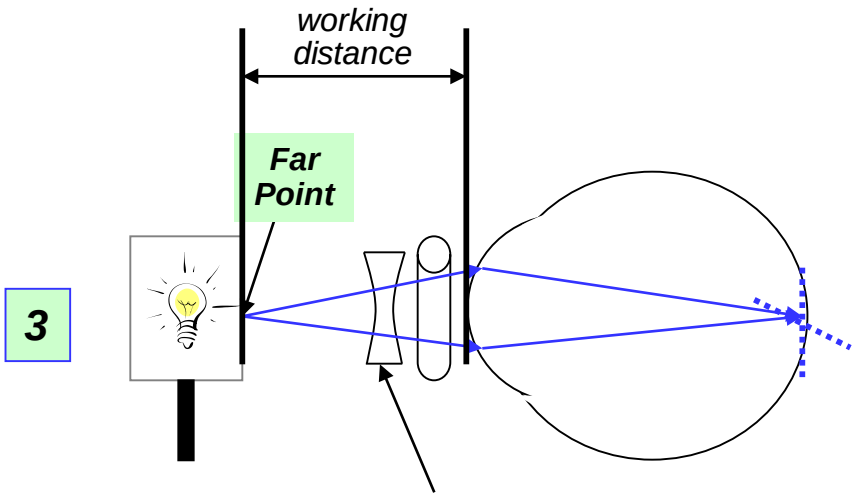


The Myopic Eye and Its Far Point
(from a previous chapter)

Astigmatic Correction: *Retinoscopy*



More minus sphere lens

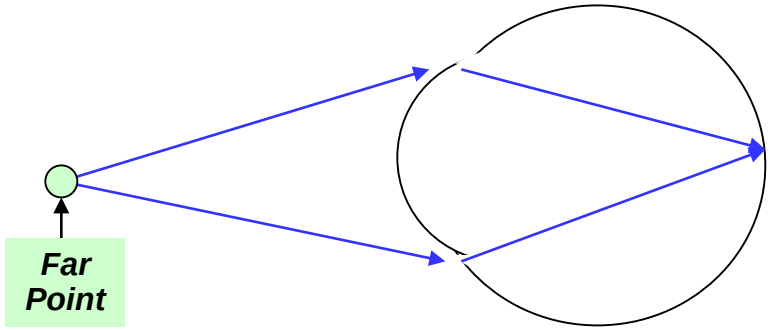


Minus sphere lens

As another ***aside…***

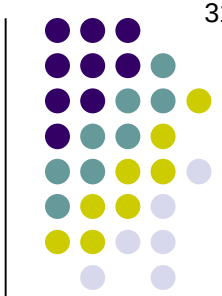
Remember that (3) does **not** represent the endpoint for retinoscopic refraction. At this point, the far point is at the peephole of the retinoscope, **not** at infinity. Thus, the lenses currently before this eye would leave the patient quite myopic at distance. (Note how the cartoon of the far point after retinoscopy is similar in appearance to that of the myopic eye and its far point.)

In order for the patient to enjoy clear vision at distance, the refraction must be adjusted to move the far point from its current location to infinity. This is accomplished by converting the distance from the retinoscope to the eye (known as the *working distance*) into its dioptric equivalent, then subtracting this amount of sphere from the refraction. The working distance is usually dictated by the length of the retinoscopist's arm. Thus, a tall retinoscopist may have to take off only 'four clicks' (i.e., 1.0D) to correct for working distance, while his/her shorter colleagues will have to take off 6 (1.5D), or even more.



The Myopic Eye and Its Far Point
(from earlier in the lecture)

Astigmatic Correction



- So that's how retinoscopic astigmatic refraction works. In Chapter 13 we will turn our attention to the Jackson Cross approach.

	Retinoscopic	***Jackson Cross***
Step 1	Use sphere to place **one focal line** on the retina	***?***
Step 2	Use cylinder to place the **other focal line** on the retina	***?***
Result	**Conoid collapsed to a point on the retina**	**Conoid collapsed to a point on the retina**