Introduction to Plus Cylinder Retinoscopy

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Objectives:
To learn a bunch of stuff about retinoscopy. Things like...
- the ability to explain hyperopia, myopia and astigmatism
- an understanding of the mechanism and functioning of the streak retinoscope
- the various types of behaviors of the retinoscopic reflex and transpose those results into spherocylinder form
Cool!

History
1859 - Sir William Bowman - the initial idea
1920’s - Jack Copland - mastered it like no one since

Retinoscopy
- a hands on art form
- an objective method of measuring the optical power of the eye
- controls the wild red reflex!
- we can detect the type of refractive error by observing the direction the light moves across the back of the eye
  - intercept - on the face of the instrument
  - reflex - what bounces off the back of the eye
  - if the reflex and the intercept move in the same direction, this is with motion and is a hyperope
  - if they move in opposite directions, this is against motion and is a myope
- we can detect the relative amount of refractive error by observing the quality of the light as it moves across the back of the eye
  - higher refractive errors have a slow moving and dim reflex
  - lower refractive errors have a faster moving and brighter reflex
- we can measure the precise amount of refractive error by changing the quality of the light entering the eye until there is no motion - neutral - the refractive error is then balanced by the neutralizing lenses and the retinoscope light
- why do retinoscopy
  - to measure the amount of refractive power in the eye of the non-verbal patients
  - saves time in the subjective process, gets them close
  - tells us a lot about pathology in the eye

Optics Review (Yeah Optics!! Optics rocks!)
diopters and focal lengths

diopter = 1 / focal length in meters

patient reads at 50cm, power needed is...?
x diopters = 1 / 0.5meters
2.00 diopters

you scope a patient from 66cm, how much power is that at the patient?
x diopters = 1 / 0.66meters
diopters = -1.50
a few common distances and diopters

<table>
<thead>
<tr>
<th>diopters</th>
<th>distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1.5</td>
<td>0.66 meters (26 inches)</td>
</tr>
<tr>
<td>2</td>
<td>0.5 meters (20 inches)</td>
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<tr>
<td>2.5</td>
<td>0.40 meters (16 inches)</td>
</tr>
<tr>
<td>4</td>
<td>0.25 meters (10 inches)</td>
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</tbody>
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toric transposition
the method of changing a prescription from a plus cylinder to a minus cylinder and back
3 steps
- add the cylinder to the sphere to get the new sphere
- change the sign of the cylinder
- change the axis by 90 degrees
example: +3.00 -4.00 x 180
+3.00 + (-4.00) = -1.00 new sphere
-4.00 becomes +4.00
axis changes by 90 180-90 = 90
045 + 90 = 135
New form = -1.00 +4.00 x 090
-1.50 -1.00 x 135

spherical equivalent
the average power of an astigmatic eye or a toric lens
SE = sphere power + 1/2 of the cylinder
example: -2.00 +4.00 x 180
1/2 the cylinder is +2.00
add the sphere +2.00 + (-2.00) = plano
great spherical equivalent, horrible refractive outcome

Circle of Most Least Confusion
the area within an astigmatic image where the defocused meridians produce the
smallest, clearest image (well duh)
- more curvature means more power, more + power means it focuses closer than less
curvature (less power)
- natural light travels vibrating in all directions, looking at it on end look like an * not a .
- an infinite number of points on a surface bending an infinite number of light waves
- thick of a tall can: vertically, no curvature, no bending of light; light hitting the surface
  horizontally hits a curved surface and bends; one wave hitting the infinitely lowest
  point on the can comes to a point focus, the light hitting the highest point bends and
  comes to a focal point; and all of the light between does the same, this collection of
  point focused light forms a line
Now if the can had some bend in the vertical, but less than the horizontal the same thing would happen forming a horizontal line of focal points but further back.

The best area of average, non-corrected focus, the spherical equivalent, located at the circle of least confusion!

**Basic lens behavior**
- Plus lenses converge, like prisms base to base
- Minus lenses diverge, like prisms apex to apex

**Refractive errors**
- Myopia - nearsighted, able to see near, minus Rx
- Hyperopia - farsighted, able to see far, plus Rx
- Astigmatism - 2 focal lengths, sphere and cyl in Rx (and axis!)
- Presbyopia - unable to see near assuming not myopic, lack of accommodation

**Terms**
- Emmetropia - no refractive error
- Ametropia - does have one, think a = without and metropia = focus
- Anisometropia - unequal refractive errors
- Antimetropia - opposite refractive errors
- Aniseikonie - different retinal image sizes
- Anisocoria - different pupil sizes

**Causes of myopia**
- Light focuses in front of retina
  - Axial myopia - eye is too long for the power
  - Refractive myopia - eye is too strong for the length
causes of hyperopia
- light would focus behind the retina
  - axial hyperopia - length is too short for the power
  - refractive hyperopia - power is too weak for the length

astigmatism
- light has 2 focal planes (remember the circle of least confusion?)
- types
  - simple myopic astigmatism, one meridian focus on the retina, one in front of it
    plano -1.00 x 180 or -1.00 +1.00 x 090
  - simple hyperopic astigmatism - on focus on retina and one “behind” it
    plano +1.00 x 090 or +1.00 -1.00 x 180
  - compound myopic astigmatism - both meridians in front of retina
    -2.00 +1.00 x 090 or -1.00 -1.00 x 180
  - compound hyperopic astigmatism - both would focus behind the retina
    +1.00 +1.00 x 090 or +2.00 -1.00 x 180
  - mixed astigmatism - one behind and one in front
    -0.50 +1.00 x 090 or +0.50 -1.00 x 180 (cyl will always be > sph)

forms of astigmatism
- regular - meridians are at 90 degrees to each other, can be corrected by glasses
- irregular - meridians are not perpendicular to each other, not completely correctable by glasses
- with the rule - plus cyl axis is at 90 (give or take 30 degrees)
  - eye has steeper power vertically, needs more + horizontally, to get power horizontally, the axis is vertical
- against the rule - plus cyl axis is at 180 (give or take 30 degrees)
- oblique astigmatism - axis is somewhere between horizontal and vertical

retinoscope
- parts
  - light source
  - condensing lens
  - mirror
  - focusing sleeve
  - power source
- usage
  scoping right eye, use your right eye and hold in right hand
  try to keep both eyes open (most of the time)
  maintain working distance
  Copland scopes - keep the sleeve up, everything else, sleeve down
- what are we looking for? the relationship of the reflex to the intercept
  intercept - on the face of the instrument
  reflex - within the pupil
- with motion
  easiest to see
  reflex and intercept go in the same direction
  neutralized with plus lenses
- against motion
  - hardest to appreciate
  - intercept and reflex go in opposite directions
  - neutralized with minus lenses
- end point - neutralization
  - when the pupil fills with light

how do we get to neutral - be watching the quality of the reflex and adding lenses
higher corrections have a slower and dimmer quality
the closer to plano you get, the faster and brighter the reflex is
if you see with motion, add plus
if you see against, add minus
if you aren’t sure what you see, add something, and lots of it until you do see something
once you have neutral, make sure you have checked all the meridians - astigmatism!

once neutral, add back in the working distance, usually -1.50 and 6 clicks up
this is the power coming from the retinoscope at 66cm