

**ADVANCED REFRACTIVE TECHNIQUES**

DAO OPHTHALMIC TECHNOLOGY MEETING  
FRIDAY, MARCH 10, 2023

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**INSTRUCTIONAL OBJECTIVES: UPON COMPLETION OF THIS COURSE THE PARTICIPANT SHOULD BE ABLE TO:**

- Describe the use of the binocular balancing.
- Explain use of auxiliary cylinder in the phoropter.
- Describe over refraction with contact lens patients.

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**INTERVIEW THE PATIENT**

- Patient history
  - Chief complaint
  - Age
  - Ocular history, including last exam (refractive history)
  - Medications
  - Medical history
  - Family medical history
  - Allergies
- Current Rx
- Visual Acuity



- Choose your starting point
  - Current Correction
  - Auto-Refracton
  - Keratometry
  - Retinoscopy
  - Estimate sphere according to VA

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### INSTRUCT AND POSITION

- Instruct the patient
  - Keep instructions simple
  - "Which is clearer, lens #1 or #2, or are they about the same?"
  - Tip: patience and reassurance!
- Position the patient behind the phoropter with the correct starting point dialed in.
  - Level the phoropter
  - IPD adjustment
  - VD setting 13.75mm
  - Display a row of letters that is easy for the patient to see
  - For EVA charts, dim the room lights
  - Occlude the eye not being tested
    - You may fog the patient to relax accommodation, to prevent giving too much minus, by placing enough plus power in front of the eye to blur the vision.




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### REFRACTOMETRY STEPS "SAPAS"

1. Interview the patient and choose a starting point
2. Instruct and position
3. Check sphere power
4. Cylinder axis
5. Cylinder power
6. Refine cylinder axis (only if any cylinder power has been added!)
7. Refine sphere power

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### SPHERE POWER

- Change the lenses in the plus direction first, to make sure that the patient is not accommodating
  - find the greatest plus lens that would give your patient the best vision.
- If the patient prefers more minus, ask them if the letters are becoming smaller and darker or sharper and clearer.
  - If the letters are smaller and darker and further away, the patient is accommodating or "eating" minus.
- For every 0.50D change in the minus direction the patient should see one line better on the chart to "earn" their desired minus power.

Tip: Reverse the order of lens choices to check if patient is giving consistent responses.

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PRESENT LENS CHOICES ACCORDING TO VISUAL ACUITY

- 20/40 or better = 0.25D D steps
- 20/100-20/40 = 0.50 D steps
- 20/100 or worse = 0.75 D steps

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CYLINDER AXIS (+CYL.)

- Increase the optotypes to two lines larger than the smallest line the patient can see
- "straddle the axis"
- Flip the JCC to present the two choices, have the patient identify which one is sharper and clearer
- Shift the axis towards the **white dot**
  - Shift axis in larger steps for low-power cylinders
  - Shift axis in smaller steps for high-power cylinders
- Repeat until the vision is equal between the lens choices
- Tip: Do NOT fog patient, the cross cylinder will blur him/her



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BASED ON THE PATIENT'S VA CHOOSE THE CORRECT POWER OF JCC TO WORK WITH:

- 20/40 or better = 0.25 D JCC
- 20/100-20/40 = 0.50 D JCC
- 20/100 or worse => 0.75 D JCC

Tip: never set the axis exactly where you think it is, have the patient lead you to it.

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### CYLINDER POWER (+CYL.)

- Rotate the JCC to align it with the "power" in line with the cylinder axis
- Flip the JCC to line up the red dot with the cylinder axis as one choice, then flip to line up the white dot with a second choice
- Subtract +0.25D cyl power if the patient prefers the red dot
- Add +0.25D cyl power if the patient prefers the white dot
- Continue until the patient does not see a difference between the two choices, or when both choices are equally blurred
- Endpoint of refinement for cross-cylinder (axis/power) when two choices are equal




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### CONSIDERATIONS FOR CYLINDER POWER

- If the patient is undecided between 2 cylinder power lenses, give less cylinder power.
- For every 0.50D change in the cylinder power, the sphere power should be changed in the opposite direction by 0.25D.
  - To maintain the spherical equivalent of the refraction

**Tip:** Adjust the sphere power as soon as the cylinder power has been changed by +0.50D, do not wait until the end!




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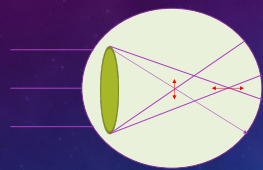
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### ASTIGMATISM – 2 LINES OF FOCUS 90° APART




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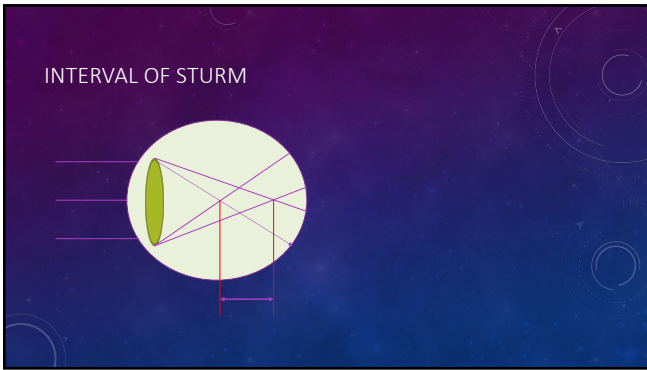
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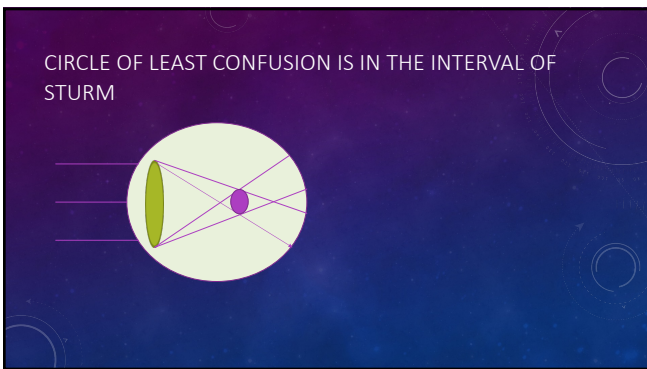
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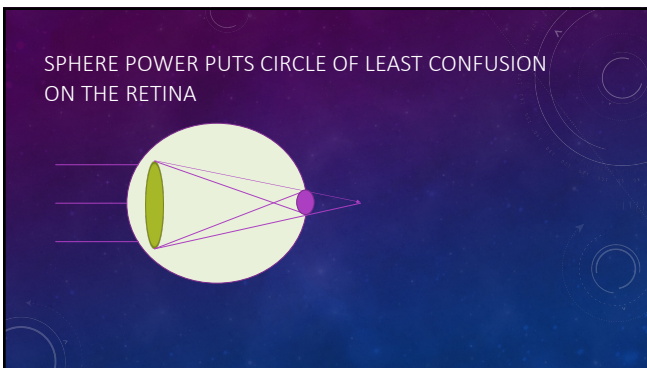
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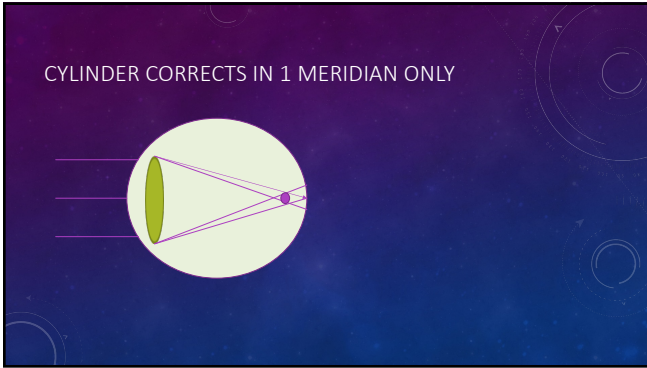
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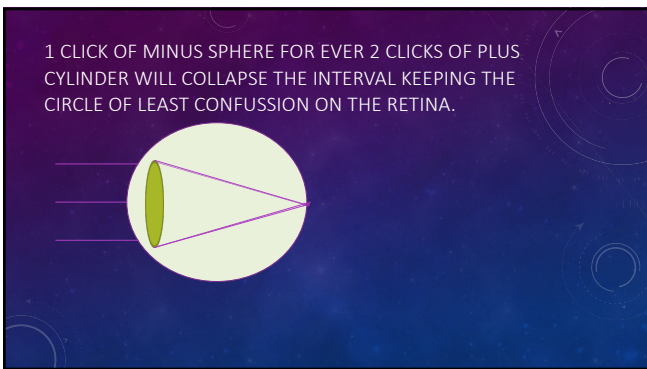
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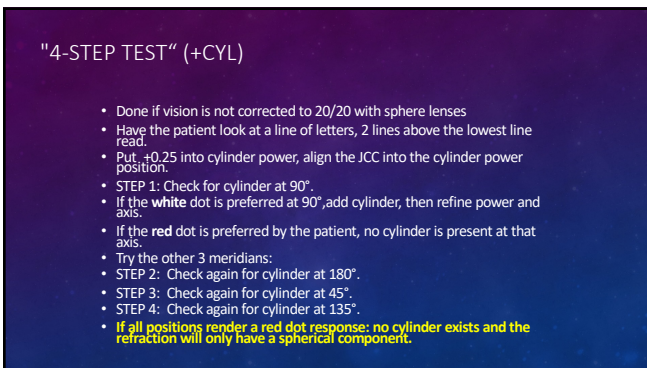
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### REFINE THE CYLINDER AXIS

- This is ONLY done if cylinder power has been changed by more than 0.50D
  - Straddle the axis
  - Shift the axis towards the white dot in small steps
  - Shift axis in larger steps for low-power cylinders
  - Shift axis in smaller steps for high-power cylinders
  - Repeat until the vision is equal between the lens choices

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### REFINE THE SPHERE POWER

- This is ONLY done if cylinder power or axis has changed
- Change sphere in the plus direction first by 0.25 D
- If the patient does not like more plus, go in the minus direction by 0.25 D. Make them earn minus by having them prove improvement in vision
- Record results and patient's visual acuity!

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### RECORDING YOUR RESULTS

OD: -2.00+2.00x090° DVA: 20/20+2  
OS: -2.50+2.50x087° DVA: 20/15-2  
OD: ADD: +2.50 NVA: J1+  
OS: ADD: +2.50 NVA: J1+

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### MANIFEST/CYCLOPLEGIC

- Refractometry can either be done:
  - MR: Manifest Refractometry (without cycloplegic drops)
  - CR: Cycloplegic Refractions (using drops to dilate and relax the ciliary muscle and accommodation)
    - If results are inconsistent or variable
    - Myopic patients under 40 years of age
    - Overactive accommodation
    - Infants
    - Esotropic children
    - High myopic patients (> -10.00D)
    - High hyperopic patients (+5.00D) with esotropia
  - PCR: Postcycloplegic Refraction
    - If there is a lot of disparity between MR and CR




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### DILATION VS. CYCLOPLEGIA

- Sympathomimetic/Mydriatic Drop – does not affect accommodation (stimulates dilator muscle of the pupil)
  - Phenylephrine (Neosynephrine) 2.5%
- Parasympatholytic/Cycloplegic Drops: Affect the muscles of accommodation (paralyzing the sphincter muscles of the iris)
  - Atropine (strongest)
  - Scopolamine
  - Homatropine
  - Cyclopentolate (Cyclogyl)
  - Tropicamide (Mydracil) 1% (weakest)

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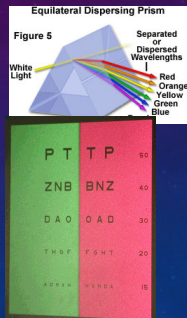
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### DUOCHROME TEST

- Can verify the sphere endpoint – helps prevent giving too much minus
- Based on chromatic aberration not color discrimination
  - Red has a longer wavelength and is refracted less.
  - Green has a shorter wavelength and is refracted more.
- Technique:
  - Get final distance correction
  - Occlude one eye
  - Add +0.50D over the final sphere power to relax accommodation
- If letters are sharper on the red side: add minus lenses. (RAM)
- If letters are sharper on the green side: add plus lenses. (GAP)
- Goal: letters to be equally clear on both panels
  - Maximum Plus for Maximum visual Acuity




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### DUOCHROME TEST

- Test monocularly
- Present optotypes at least 2 lines larger than the best acuity within the Red/Green chart
- Ask: "Are the letters clearer on the red or on the green side of the chart?"
- If equal: no change is made, the patient is not accommodating
- Works on color-blind patients
  - Ask if the letters are clearer on the left or right side
- Does not work on aphakic patients
- Does not work well on patients with overactive accommodation
- Does not work well for patients with VA's worse than 20/30 (the 0.50D difference between the 2 sides is too subtle for them to distinguish)

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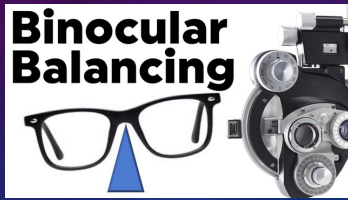
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### THE USE OF THE BINOCULAR BALANCING.



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### BINOCLULAR BALANCING – ALTERNATE OCCLUSION

- Purpose
  - To ensure that accommodation is relaxed equally in each eye
  - Perform ONLY in patients with good and equal vision in each eye



- Eliminates effect of monocular dark adaptation
- Not for hyperopes, anisometropes, nystagmus patients
- Binocular refraction works best for those patients

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### BINOCULAR BALANCING – ALTERNATE OCCLUSION

- Technique:
  - Both apertures open, patient to look at 20/50 line
  - Blur the patient by adding (+0.75D to +2.00)\* to each eye
  - Alternately occlude one eye, then the other
  - Ask "which is clearer, the left (occlude OD) or the right (occlude OS)
  - Add +0.25 D to the clearer eye
  - Make the eyes most equally clear
  - Reduce plus spheres slowly in 0.25 D's (2 to 3 sec's each) until the BCVA is read again
  - \* Sources vary.

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### BINOCULAR BALANCING \*– FOGGING #1

- Technique:
  - Both apertures open
  - Blur the patient by adding +2.00D to each eye
    - VA should be reduced to (20/200-20/100)
    - If they eye is over-minused or under-plussed, the patient will read farther down the chart (20/70-20/50). Reconsider refraction endpoint.
  - Alternately place -0.25Dsph over one eye and then the other
  - The patient should be able to identify which is the clearer image.
  - If the eyes are not in balance, sphere should be added or subtracted until balance is achieved.

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### FOGGING TECHNIQUE #2 \*

- Blur with plus sphere
- Slowly take away plus, stop as soon as the smallest line is read.
- This will be your final refraction.



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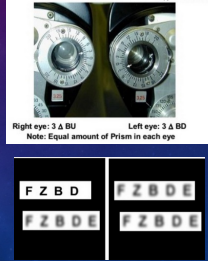
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### BINOCULAR BALANCING: PRISM DISSOCIATION

- Isolate line of letters about 2 lines above lowest line read
  - Fog patient using a +1.00 D<sup>s</sup> sphere OU
  - Place a 3ΔBU OD and 3ΔD BD OS (or Δ 6 BU monocular)
  - Have patient compare both images OD = lower, OS = upper
  - If both are blurred, each eye is balanced
  - If not, add +0.25 D sphere to the clearer eye until both equally blur
  - Remove prisms
  - Remove the +1.00 D of sphere (0.25D at a time) after both images are equally blurred
  - Recheck acuity allowing patient to decide which lenses "feel" best as well as provide BCVA
- Hint: If not able to balance, make the dominant eye more clear




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### DID YOUR PHOROPTER REACH ITS LIMIT?

- What if your patient is a -22.00sph?
  - Trial frames- stack lenses
- What if your patient is -4.00+7.50x090?
  - Add auxiliary cylinder lens to phoropter
  - Trial frames
- Most phoropter's range from +15.75 to -19.75 sph, and 6.00 cyl.




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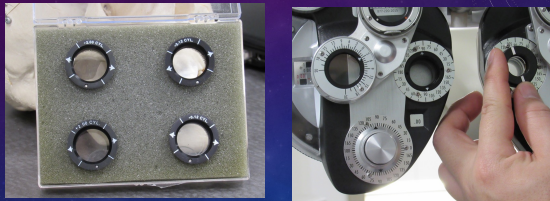
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### AUXILIARY CYLINDER IN THE PHOROPTER




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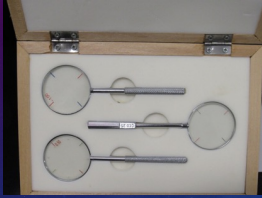
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### USE APPROPRIATE LENSES FOR LEVEL OF VISION



- The worse the vision, the larger the lens choice needs to be
- VA 20/80? Use 1/2 - 1 D changes.
- Hand held Jackson cross cylinder come in +/- 0.25, +/- 0.50, +/- 0.75, +/- 1.00 Diopter lenses

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### OVER-REFRACTION

- Loose lenses
- Halberg trial clips
- Phoropter in front of patient's glasses
- Auto refractor
- Soft toric contact lenses
- Scoping over current glasses in children

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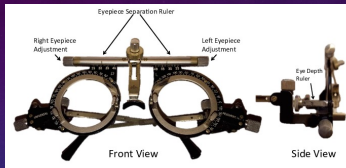
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### TRIAL FRAMES

- First prescription
- Large prescription change
- High prescriptions
  - Aphakia
  - High Myopia
- Compare new Rx with the old one
- Special near vision requirements
- Head tilts
- Head tremors



**Tip: adjust trial frame to the patient's face!**

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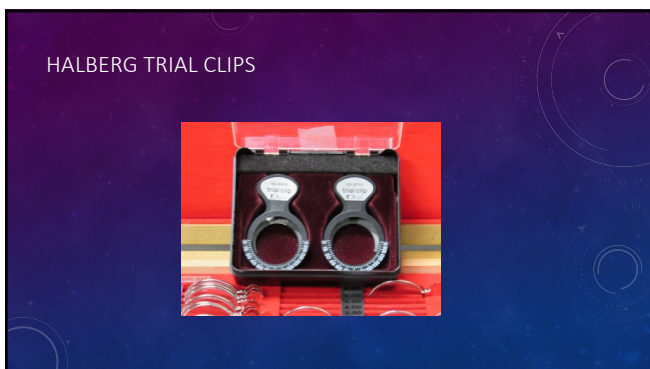
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### IS YOUR PATIENT A CONTACT LENS WEARER?

- Myopic creep
- Corneal hypoxia
- Irregular astigmatism

Unless performing an over refraction, contact lens wearers should not wear their lenses on the day of their refraction, or at least take them out 1 hour prior to the refraction.



All contact lens wearers need glasses

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### OVER REFRACTION WITH CONTACT LENS PATIENTS.

#### • Spherical vs. Spherocylindrical Over-Refraction

- Most contact lens over-refractions will be spherical (or nearly spherical).
- Cases where a SCOR may be appropriate include:
  - Over a scleral or gas-permeable (GP) lens where BCVA is not achieved with spherical power only
  - Over a scleral or gas-permeable lens if it is the intention to change from a spherical to a toric lens
  - In rare cases, over soft contact lenses.

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### LOOSE LENS VS. PHOROPTER

- Contact lens over-refraction is commonly completed with loose lenses in free space.
- In cases where a patient is happy and seeing well, the most efficient mode of over-refraction is with loose lenses or a flipper containing various low-powered loose lenses.
- In cases where vision is not optimal, or a SCOR is expected, an over-refraction using the phoropter is more efficient than flipping through many loose lenses.




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### WHAT IF YOU CAN'T REFRACT TO 20/20?

- Pinhole vision
  - No improvement: then that's as good as it gets with a refraction
  - Improvement: you should be able to improve acuity with the correct lenses




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### CONSIDERATION FOR ADD POWER

- Stronger adds allow wearer to hold objects close, but also create a shorter focal depth (amplitude)
- Consider the distance at which the patient is comfortable reading at
- Do not assume all patients want to read at 14-16 inches.
- Consider the patient's profession, hobbies and everyday visual needs.
- Give the least amount of plus possible or patient will complain of having to hold reading material too close.




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### FINDING ADD POWER

- Place the estimated add power on top of the distance prescription
- Have the patient hold a reading card at their regular reading distance (12-16"). The amount of near add is then adjusted to position that patients habitual reading distance in the middle of the range of clear vision.
- Add +/- 0.25 D sphere to move focus in or out respectively




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### RANGE OF CLEAR VISION

- If range is too far to patient:  
Add +0.25DS in steps

The diagram illustrates a range of clear vision. A pink smiley face is on the left. A vertical dashed line is at 30CM. A white rectangular target is at 40CM. Another vertical dashed line is at 70CM. A yellow double-headed arrow spans from 30CM to 70CM. To the right, a man in a white shirt is leaning over a laptop, looking at the screen.

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### WHAT CAN HINDER YOUR RESULTS?

- Cataracts – can give myopic shift
- Glaucoma
- Macular Degeneration
- Diabetes – Can cause shift
- Diabetic retinopathy
- Pregnancy
- Keratoconus
- Dry Eye
- Orbital mass, macular swelling, corneal edema – can give hyperopic shift
- Tonometry, A-scan, B-scan, Pachymetry

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### NYSTAGMUS

- Rapid, involuntary movement of eyes
- Occlusion may make nystagmus worse
- Fog with +3.00sph instead of occluding
  - Checking vision
  - Refractometry

The slide includes two illustrations: one of a pair of eyes with horizontal lines through them, and another of a person's face with a neutral expression.

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DON'T LET COMMUNICATION BARRIERS AFFECT YOUR RESULTS!

- Language barrier
  - Have a professional interpreter
  - Speak directly to the patient
  - Pause for interpretation
- Stroke/Aphasia
  - Health Aide
  - Blink response
- Deaf/mute
  - Have a professional interpreter
  - Look directly at the patient while speaking – some can read lips!

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HOW TO "CHEAT" AND HAVE A FIGHTING CHANCE

- Pay attention to what the patient tells you about their eyes.
- Read the patient's glasses!
- Be thinking about the "guesstimate" when you test your patient's vision.

A patient with myopia of... sees... has a NPA of... (reads print at)

-1.00	20/80	40"
-2.00	20/200	20"
-3.00	20/400	13"
-4.00	<20/400	10"

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How To "Cheat" And Have A Fighting Chance

- Take keratometer readings before you do refractometry.
- "K" readings will tell you:
  - If your patient has astigmatism (and approximately how much);
  - Where that astigmatism is (the axis) so you know where to look for it when you scope.



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OTHER CONSIDERATIONS

• Vertex Distance

- Should be measured on every refraction over +4.00 or -4.00
- The distance between the back of the glasses lens and the front of the eye, measured with a distometer
- The stronger the Rx, the more important the VD
- Can use a conversion scale to covert VD from a trial frame to the new glasses frame
- Ex: +12.00sph, may need +14.00 in CL's
- Ex: -12.00sph, may need -10.00 in CL's.

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OTHER CONSIDERATIONS

• Prism

- Used to redirect the line of sight in patient's with constant diplopia.
- May have horizontal, vertical or combined prism
- Press on – Fresnel
  - If recovering from a palsy (something temporary)
- Ground in
  - Permanent diplopia

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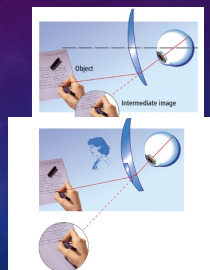
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OTHER CONSIDERATIONS

• Slab-off (bi-centric lens)

- Useful in anisometropia – to avoid diplopia in near vision
- To make the slab-off, the portion of the near vision segment is ground away
- This moves the optical center of the reading segment closer to that of the upper distance segment




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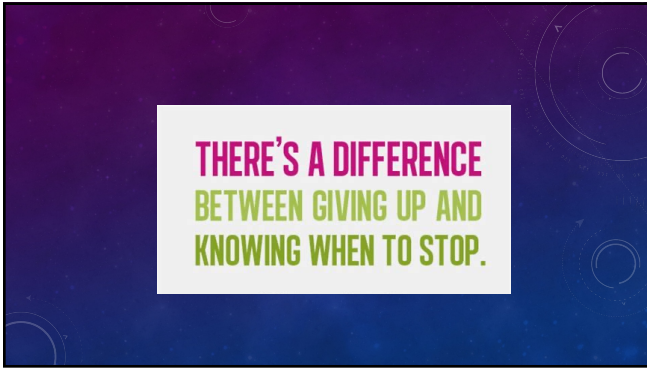
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