Certified Paraoptometric Technician Review Course
CPOT
The *Self Study Course for Paraoptometric Assistants and Technicians, Self Assessment Examination*, and the AOA PS CPOT Review Course are not prerequisites for taking the paraoptometric certification examination given by the Commission on Paraoptometric Certification (CPC). Using these study materials and/or taking the CPOT Review course does not guarantee passing the paraoptometric certification examination given by the CPC. Attending the CPOT Review Course is not a substitute for studying for the paraoptometric certification examination given by the CPC. This course is designed to review previously acquired knowledge.
This review course is not intended to be a substitute for responsible study and preparation for the CPOT test.
Outline

• Pre-Testing Procedures (20%)

• Clinical Procedures (28%)

• Ophthalmic Optics and Dispensing (20%)

• Refractive Status of the Eye and Binocularity (12%)

• Anatomy and Physiology (15%)

• Practice Management (5%)
Pre-Testing Procedures
(20%)
Case History

Components

- Chief complaint
- Medical and ocular history
  - Patient
  - Family
- Occupation and avocation
- HIPAA
Visual Acuity

Types and charts
- Snellen
- Feinbloom (Low Vision)
- Pre-school and Illiterate
  - Allen picture cards
  - Tumbling E’s
  - HOTV

Courtesy of NEI

Courtesy of Richmond Products
Procedure

Distance w/out RX
Near w/out RX
Distance with RX
Near with RX
Or a variation of the above

Courtesy of Richmond Products
Procedure

Patient unable to see the big “E”
- Count Fingers- CF @ _____ft
- Hand Motion- HM @______ft
- Light Projection
- Light Perception

Courtesy of Richmond Products
Procedure

Amblyopia

- Single line presentation
- Single letter presentation

- Low Vision
  - Feinbloom Low Vision Chart
Pinhole

To determine if reduction in vision is due to refractive error
Procedure

Always observe patient.

No squinting. Why?

When do you obtain pinhole acuity?

Visual acuity better with one eye or two?

Note any consistent pattern in the letters missed by the patient. Why?
## Conversion

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<th>Meters</th>
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<td>6/90</td>
</tr>
<tr>
<td>20/400</td>
<td>6/120</td>
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</table>
Conversion

Feet to meters

Multiply the denominator by .3

Meters to feet

- Divide the denominator by 3
- Add a zero
Visual Skills

Telebinocular
Interpupillary Distance

Distance and near
PD measuring ruler
Pupillometer
Monocular PD measurement

1st measurement 60 mm
Cover Testing

Cover Test
  ▪ Determines if there is a tropia
  ▪ Watch eye that is not being covered

Cover/Uncover Test
  ▪ Determines if there is a phoria
  ▪ Watch eye that is being uncovered

Direction of Deviation
  ▪ Eso (IN); Exo (Out); Hyper (Up); Hypo (Down)
Hirschberg Estimation Test

RET 15 △
Hirschberg Estimation Test

RET 30°
Hirschberg Estimation Test

RET 45°
Maddox Rod

Dissociating test
  - One eye sees a red line, the other a white light
Maddox Rod

Show vertical line when measuring a horizontal deviation
Show horizontal line when measuring a vertical deviation
Maddox Rod

The patient is instructed to look at the light and report where the red line is in relationship to the light. A patient with no deviation will report that the line runs though the light.
Always place rod and correcting prism over the same (deviating) eye. The eye without the Maddox rod is the fixing eye. The amount of prism that causes the line to run through the light is the amount of deviation present.
Eye Movements

- Torsion
  - Rotation of the eye around an anteroposterior axis, such as fixation
- Adduction
  - Rotation of the eye toward the midline
- Abduction
  - Rotation of the eye temporally
Binocular Vision

- Fusion
  - The act or process of blending, uniting or cohering
- Phoria
  - The orientation of one eye in the absence of an adequate fusion stimulus
- Tropia
  - Binocular fixation is not present under normal seeing conditions
Binocular Vision

- Strabismus
  - Tropia-manifest deviation of the eyes
  - Phoria is a latent deviation held in check by fusional vergence
  - Frequency- constant/intermittent
AC/A Ratio

- Accommodative convergence to accommodation
  - Near point of convergence
- Units of prism diopters of convergence over diopters of accommodation
  - Ex: 4 /1D
Near Point of Convergence

Measure of the ability of both eyes to work together

Blur/Break/Recovery

Measured in centimeters from the bridge of the nose to the point of blur/break
Eye Movements

Pursuits

Saccades
Eye Movements

- **Versions**
  - A conjugate (together) movement of the eyes such that their meridians or lines of reference move in the same direction.

- **Vergence**
  - A disjunctive movement of the eyes such that the points of reference move in opposite directions.
    - Ex: convergence
Fusion

- The merging of the images from each eye into a single image
  - 1st Degree- superimposition- overlapping of two dissimilar targets
  - 2nd Degree- Flat- two similar images are seen as a single object
  - 3rd Degree- Stereopsis- perception of depth
Eye Dominance

Eye preference

Eye used for monocular viewing or sighting

Reasons for recording Monovision contact lens
Pupil Testing

Size

Shape

Response to direct light

Response to indirect (consensual) light
Pupil Testing

Relative Afferent Pupillary Defect

Adie’s Tonic Pupil - slow response to light

Argyll Robertson - no reaction to light; reaction to accommodation
Pupil Testing

- Anisocoria- unequal pupil sizes
  - “cor” = pupil
  - “aniso”=difference
- Hippus- “jumping” pupil
  - Most commonly seen in younger patients
Recording

P-pupils
E-equal
R-round
R-react to
L-light and
A-accommodation
-APD/-Marcus Gunn
Color Vision

Types of tests

- Pseudo-isochromatic plates (PIP)
- Farnsworth D-15/100 Hue
- Nagel Anomoloscope

Courtesy of Richmond Products
The software provides capability for data analysis and display.

HMC Anomaloscope controlled by optional keypad and LCD display.

Courtesy of Richmond Products
Color Vision

- Procedure for PIP
  - 30 inches/75cm distance
  - Near Rx
  - Monocular
  - Daylight lamp/Illuminant C lighting
  - Record number of plates correct over number of plates tested (ex: 7/7; 4/7)
Classification of Color Defects

- Trichromat - 3 colors
- Dichromat - 2 colors
- Monochromat - 1 color
- Protan - red
- Deutan - green
- Tritan - blue/yellow
Classification of Defects

- Trichromat- normal color vision
  - Anomalous trichromat
    - Protanomalous- red weak
    - Deuteranomalous- green weak
Classification of Defects

- Dichromat - 2 colors to match
  - Protanope - red deficient
  - Deuteranope - green deficient
Normal

Dichromat
– red insensitivity
Classification of Defects

- Monochromatism
  - Achromatopsia
  - Extremely rare
Significance

8-10% Males

Green defect occurs most frequently

.04% Females
Stereopsis

- Types of tests
  - Stereo Fly
  - Randot
- Procedure
  - Polaroid filters
  - Suppression check
- Recording
  - Seconds of arc
Clinical Procedures
(28%)
Keratometry

- Objective Refraction
- Procedure
  - Focus eyepiece
  - Adjust instrument for patient
  - Alignment
  - Patient instruction
  - Primary meridian-180/secondary-90
  - Take reading
  - Record
Keratometry

- Oval Shaped mires
- Missing (-) sign
  - (-) is the vertical meridian
  - (+) is the horizontal meridian
Endpoint of Manual Keratometry
Astigmatism

With the rule- steeper reading (most power) is in the vertical +/- 30 degrees each side of 90 degrees

Against the rule- steeper reading (most power) is in the horizontal +/- 30 degrees each side of 180

Oblique-steeper reading (most power) is in the diagonal +/- 30 degrees each side of 45 degrees or 135 degrees
Astigmatism

- Corneal - found on the cornea
- Internal - located elsewhere in the eye
- Total - corneal + internal; total for the refraction
- Ex: -3.00-2.00x180
  - K reading - 44.00X180/45.00X090
  - Internal = 1.00 D
Corneal Topography

Measurement of the curvature of the anterior corneal surface.
Pachymetry

A Pachymeter determines thickness of the cornea by use of ultrasound
- Refractive surgery
- Glaucoma diagnosis
Optical Coherence Tomography (OCT)

Used to obtain cross-sectional retinal images
Tonometry

- Instruments
  - Applanation- Goldmann
Tonometry

- Instruments
- Example
  - Perkins Hand-held Tonometer
Tonometry

- Instruments
  - Tonopen
Tonometry

- Instruments
  - Schiotz
Tonometry

- Instruments
  - Non-Contact
    - Air puff

Image courtesy of MARCO
Tonometry

- Procedure
  - Patient preparation
  - Alignment
  - Measurement
- Recording
  - mmHg - millimeters of mercury
Visual Fields

- Types of Tests
  - Confrontation
  - Flat Field Tangent Screen
  - Amsler Grid
  - Perimetry- Goldmann Bowl
  - Automated
Tangent Screen
Goldmann Bowl Perimeter
Visual Fields

- Purpose: determine the extent of the physical space that is visible to an eye in a given position
- Normal Visual Field parameters
  - 60 degrees superior
  - 75 degrees inferior
  - 105 degrees temporally
  - 60 degrees nasally
Procedures

- Enter patient Data
- Determine Visual Fields Type
- Patient Instruction
- Occlude the eye not being tested
- Patient Positioning
- Adjusting instrument
  - Trial lens
- Initiate testing
- Monitor
- Report
Terminology

- Isopter
  - Map of the circumference of a visual field determined by a test object of a certain size
- Physiological Blind Spot
  - 15 degrees temporal to fixation
  - Represents the area in the retina occupied by the optic nerve head
- Scotoma
  - Area of partial (relative) or complete (absolute) blindness within the confines of a normal visual field
Terminology

- Central
  - Involves fixation area
- Pericentral
  - Fixation area clear; field surrounding is deficient
- Paracentral
  - To one side of fixation
- Cecal
  - Involves the area of the blind spot
- Bjerrum
  - Nerve fiber bundle
Terminology

- Hemianopsia- 1/2 of visual field
- Quadranopsia- quadrant
- Homonymous- same side
- Congruous- completely identical
- Incongruous- not identical
- Hysterical- Tubular defect caused by patient’s emotional state
Why Perform Visual Fields?

- To determine area or extent of physical visible space visible to an eye in a given position

- Evaluate for ocular effects of systemic conditions
  - Headaches
  - Stroke
  - Diabetes
  - Macular degeneration
  - Head trauma
## Classification of Visual Defects

<table>
<thead>
<tr>
<th>Nerve Fiber Layer</th>
<th>Optic Chiasm</th>
<th>Optic Tract to Visual Cortex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arcuate Scotoma</td>
<td>Heteronymous Bitemporal Hemianopsia</td>
<td>Homonymous Hemianopsia</td>
</tr>
<tr>
<td>Paracentral Scotoma</td>
<td></td>
<td>Congruent</td>
</tr>
<tr>
<td>Nasal Step</td>
<td></td>
<td>Incongruent</td>
</tr>
</tbody>
</table>
Terminology

- **Perimetry**
  - Visual field testing with eye located at the center of a curved instrument
- **Campimetry**
  - Visual field testing eye located a specified distance from a flat surface
- **Scotoma**
  - Vision entirely absent
- **Blind Spot**
  - Approximately 15 degrees temporal to fixation
- **Isopter**
  - Iso = equal, opter = sight
- **Decibel**
  - Relative unit, 1/10 log unit
Sphygmomanometry

Instrumentation

- Aneroid - Works with a pressure gauge with an indicator on a dial to measure the blood pressure.

Mercury - Uses mercury to measure the blood pressure.
How Is The Test Performed?

Wrap the blood pressure cuff around the upper arm about 1 inch above the bend of the elbow

Place the earpiece of the stethoscope into your ears

Place the head of the stethoscope over the brachial artery but not touching the bag

Make sure that the valve is closed on the cuff.
How Is The Test Performed?

Inflate the cuff to approximately 20-30 mmHg (millimeters of mercury) higher than the systolic pressure

Open the valve slowly

Record the number from the sphygmomanometer when the pulse is first heard

This is the systolic pressure
How Is The Test Performed?

Continue releasing the valve

The pulse will disappear

Record this number

This is the diastolic pressure

Release the rest of the air and remove the cuff
Readings

- **Normal**
  - The “normal” for adults is approximately 120mmHg /between 70-80mmHg

- **Abnormal**
  - Mild Hypertension
    - 145-159mmHg/90-104mmHg
  - Severe Hypertension
    - 160mmHg or more/100mmHg or more
  - Hypotension
    - Below normal blood pressure
Interpretation

- First number = *systolic pressure* (the amount of force on the artery walls when the heart beats)
- Second number = *diastolic pressure* (the amount of force when the heart is at rest)
- Incidence of Hypertension
Abnormal Blood Pressures

- Systolic greater than 140*
- Diastolic greater than 90*
- Difference less than 30 between the Systolic and Diastolic Pressures.*

- These are general guidelines and may differ from the guidelines that the provider you are employed by uses.
"According to recent estimates, about one in three U.S. adults has high blood pressure, but because there are no symptoms, nearly one-third of these people don't know they have it. In fact, many people have high blood pressure for years without knowing it. Uncontrolled high blood pressure can lead to stroke, heart attack, heart failure or kidney failure.”

www.apha.org
Contact Lenses
Hard Contact Lens

Materials

- 1940’s, 50’s, 60’s
  - Polymethylmethacrylate (PMMA)
- 1970’s
  - Rigid Gas-permeable (RGP)
    - Silicone Acrylate
    - Fluoro- Silicone Acrylate
Contact Lenses

- Gas Permeable Lenses
  - Overall Diameter
  - Optical Zone Diameter
  - Back Vertex Power
  - Base Curve Radius
  - Peripheral Curves
  - Edge and Center Thickness
Parameters

- Overall Diameter (OAD)
- Optical Zone (OZ)
- Secondary Curve (SC)
- Peripheral Curve (PC)
- Secondary Curve Width (SCW)
- Peripheral Curve Width (PCW)
Contact Lenses

Materials

- 1970’s
  - Soft Hydrogel (water-absorbing)
  - Silicon Hydrogels
## Comparison of Soft and GP Lens

### Advantages

<table>
<thead>
<tr>
<th>Soft Lens</th>
<th>Gas Permeable</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Good initial comfort</td>
<td>- Clear, sharp vision</td>
</tr>
<tr>
<td>- Variable wearing time</td>
<td>- Less initial comfort</td>
</tr>
<tr>
<td>- Occasional wear</td>
<td>- Long-term comfort</td>
</tr>
<tr>
<td>- Ability to enhance or change eye color</td>
<td>- Stability/durability</td>
</tr>
<tr>
<td>- Stability in sports</td>
<td>- Ease of care</td>
</tr>
<tr>
<td>- Good vision</td>
<td>- Good ocular health</td>
</tr>
<tr>
<td></td>
<td>- Corrects small and large amounts of astigmatism</td>
</tr>
</tbody>
</table>
Contact Lenses

Pre-fit evaluation
- Palpebral fissure size
- Visual Iris Diameter- measure limbus to limbus
- Break up time- BUT- Tear Quality
- Schirmer Tear test- Tear Quantity
- Keratometry, Topography, Refraction
Always consider the lacrimal tear layer, aka the lacrimal tear lens when fitting gas permeable lenses.
# Contact Lens Order Form

**Patient Name:** John Doe  
**Specifications Ordered**  
**Date:** 2/23/01  
**Specifications Verified**  
**Date:** 2/23/01

<table>
<thead>
<tr>
<th>O.D.</th>
<th>O.S.</th>
<th>O.D.</th>
<th>O.S.</th>
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<tr>
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<td>7.81</td>
<td>B.C.R</td>
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<td>I.C.R./W</td>
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<td></td>
<td>I.C.R./W</td>
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<td>108.3/.3</td>
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<tr>
<td>Power</td>
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<td>-2.50</td>
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<td>C.T.</td>
<td>.16</td>
<td>.16</td>
<td>C.T.</td>
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<tr>
<td>Blend</td>
<td>Med</td>
<td>Med</td>
<td>Blend</td>
</tr>
<tr>
<td>Tint</td>
<td>Blue</td>
<td>Blue</td>
<td>Tint</td>
</tr>
<tr>
<td>Dot O.D.</td>
<td></td>
<td></td>
<td>Dot O.D.</td>
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<tr>
<td>Additional Information</td>
<td></td>
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</table>

- **Accepted**  
- **Rejected**  
- **Returned for Credit**  
- **Date Returned**
### CONTACT LENS ORDER FORM

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<td>I.C.R.W</td>
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<td>P.C.R.W</td>
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<tr>
<td>Tint</td>
<td>Blue</td>
<td>Blue</td>
<td>Tint</td>
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**Additional Information**

- **Verified by:**

- **Accepted** □  **Rejected** □  **Returned for Credit** □  **Date Returned** □
### Ordering Procedures

<table>
<thead>
<tr>
<th>Eye</th>
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<tr>
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<td>14.0</td>
<td>Ciba Toric</td>
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</tbody>
</table>
Contact Lenses Verification

Lensometer

- Measures the vertex power
Contact Lenses Verification

Radiuscope
  ▪ Measures the base curve
Contact Lenses Verification

- Hand Magnifier
  - Measures
  - overall diameter (OAD)
  - optic zone (OZ)
  - peripheral curve widths (PCW, SCW)

- V-Gauge or Slot Gauge
  - measures the overall diameter (OAD)
Contact Lenses Verification

Shadowgraph
  - magnifies and projects the contact lens
Care and Handling – Soft Contact Lens

- Hygiene!!!!
- Evaluate lens
  - Tears
  - Inverted
  - Lint

Store in conditioning solution
Solutions

Soft contact lens solution for soft contact lenses

Hard contact lens solution for RGP’s
Lens Care Regimens

Soft lens care systems
- clean
- rinse
- disinfect & store
- protein removal

Gas Permeable care systems
- clean
- rinse
- disinfect & store
- protein removal
Placement of Soft Contact Lens

- Hygiene
- Placement
- Place lens on finger tip
- Inspect lens
- Manipulate lids for widest aperature
- Place lens on eye
- Release lower lid, then upper lid
Removal of Soft Contact Lens

- Hygiene
- Pull lower lid down
- Pinch lens off the white part of eye
- Remove
- Reverse had positions for second eye
Placement of Hard Contact Lens

- Hygiene
- Place lens on moistened finger tip
- Position head down
- Lift upper lid with forefinger
- Pull lower lid down
- Place lens on center of cornea
- Remove lens finger
- Release lids
Removal of Hard Contact Lens

- Open eyes are wide as possible
- Place fingertip at lateral canthus
- Pull lid laterally
- Blink
- Catch lens in other hand
Contact Lenses Wearing Schedules

Soft Lenses
- 4-6 hours plus 2 each day to full time wear

Gas Permeable
- 4 hours plus 1-2 each day to full time wear
What is “Normal” Adaptation?

- Tearing is natural with initial lens placement
- Awareness, improving with continued wear
- Intermittent blur (due to excess tears)
- Increase photophobia
- Minor irritation to wind, smoke, dust
- Mild redness
What are “Abnormal” Symptoms

- Sudden pain or blurring
- Severe or persistent haze or halo
- Severe redness or irritation
- Spectacle blur for one hour or more after contact lens removal
Adaptation

Wearing Schedules
- Soft lenses- 4-6 hours plus 2 each day to full time wear
- Gas Permeable lenses- 4 hours plus 1-2 each day to full time wear
In office

- Cleaning /disinfection of patient lenses
- Inventory of lenses
- Preparation of rgp’s to be dispensed
On “K” - same Rx
Flatter than “K” - Less minus; more plus
Steeper than “K” - More minus; less plus
K Reading  45.00 @ 180/ 45.00@ 090
Patient Rx -3.00
Base Curve  44.50
Lens Power_______
Special Lens Designs

- Bifocal
- Toric
  - Front
  - Back
  - Bitoric
- X-Chrome- color vision
- Rose K- keratoconus
- Orthokeratology
  - CRT- Corneal Refractive Therapy
Special RGP Designs

- Aspheric
- Concentric
- Translating
Progress Evaluation

- History
- Visual Acuity
- Over-refraction
- Slit Lamp examination

Evaluate lens for
- Fit
- Movement
Modification

- Polishing
- Blending Peripheral Curves
- Edge Shaping and Polishing
- Adding Minus Power
- Removing Scratches
Modification

- Overall Diameter
- Optic Zone
- Peripheral Curve Width
- Power Change
- Surface and Edge Polish

OAD = OZ + 2SCW + 2PCW
Contact Lens Complications

- GPC - Giant Papillary Conjunctivitis
  - Contact Lens Induced Papillary Conjunctivitis

- Keratitis - inflammation of the cornea

- Abrasion - rubbing off of the superficial layer

- Acanthoamoeba

- Pseudomonus
Vision Therapy

Convergence Insufficiency - difficulty turning eyes in

Convergence Excess - Esophoria at near/orthophoria at distance
Vision Therapy

- Accommodative Excess
  - Too much accommodation to maintain a sharp image

- Accommodative Insufficiency
  - Not enough accommodation to maintain a sharp image, usually at near
Vision Therapy

Suppression
  > The lack of perception of a normally visible object

Diplopia
  > A single object is perceived as two objects
  > Double vision
Amblyopia

- Strabismic
  - Due to an eye turn (tropia)

- Refractive
  - Due to an uncorrected refractive error

- Ex Anopsia
  - Non use or prolonged suppression

*National Eye Institute image*
Vision Therapy Equipment

- Haidinger Brushes

- Vectograms
  - Polarized stereogram; one image seen with one eye; the other with the other eye
Vision Therapy Instruments

Tranaglyphs
- Trade name for red-green targets used for vergences and to eliminate suppression
Vision Therapy

Eccentric Fixation

Anomalous Retinal Correspondence
First Aid/CPR Emergencies

- Non-ocular involvement
  - Fainting, seizures, CPR
- Ocular involvement
  - Triage
- Certification of Health Care Providers
Low Vision

- Classification
  - Legal Blindness
    - >20/200 BCV in the better eye or <20 degree visual field in the best eye
  - Low Vision
    - Individuals can be helped significantly by vision enhancement aids.
- Goals are the key to success
- Goals should be task oriented
Low Vision Aids

- Head Borne Microscope
  - Large field of view, hand free

- Hand Held Magnifier
  - Portable

- Stand Magnifier
  - Stable

Images courtesy Eschenbach
Low Vision Aids

- CCTV’S
  - Electronic magnifier
- Telescope
  - Magnify objects at distance
- Non-Optical
  - Large print books, clocks, etc.
  - Modified lighting

Image courtesy National Eye Institute
Patient Instructions

- Establish reasonable goal
- Familiarize patient with 1-inch working distance
- Move hands in parallel fashion in front of eyes to practice
- Use materials larger than patient’s ultimate goal size
Patient Instructions

- Place materials at 1 inch from device
- Perform activities to train eye-to-hand movements
- Practice
- Trains successfully on devices one at a time
Special Procedures

- Ocular Photography
- Ultrasound
  - A-Scan
  - B-Scan
- Potential Acuity Meter
- Contrast Sensitivity
- Biomicroscopy (Slit Lamp)
- Surgery
Ocular Photography

Fundus Camera
Ophthalmic Ultrasound

A – Scan
B - Scan

Images courtesy of Sonomed
Potential Acuity Measurement
Contrast Sensitivity

Images courtesy of Vector Vision
Biomicroscopy
Surgical Procedures

Cataract
Refractive
Glaucoma
YAG

Phacoemulsification
Cataract
Refractive Surgery

- LASIK
  Laser In-Situ Keratomileusis

- LASEK
  Laser Epithelial Keratomileusis

- PRK
  Photo Refractive Keratomileusis

Epi-LASIK is not commonly used anymore

Images courtesy of EYEmaginations
Glaucoma

- Trabeculectomy
  - Selective Laser Trabeculoplasty (SLT)
  - Argon Laser Trabeculoplasty (ALT)
  - Iridomoty
  - Iridectomy
- Aqueous Shunt
- Cyclocryotherapy

One use for a YAG laser in surgery is to punch a hole in the iris to relieve increased pressure within the eye from acute angle-closure glaucoma.

There are other kinds of YAG laser surgery for the eye (e.g., for cataracts) and other areas of the body including the skin (e.g., to remove birth marks).
Ophthalmic Optics and Dispensing (20%)
Visible wavelengths extend from 400-740 nanometers (nm), 400nm being violet and 740nm being red.

A change of wavelength is perceived as color change.
Reflection

A rebounding of light by the surface of a medium such that it continues to travel in that medium but in an altered direction.
Reflection

Reflection is associated with mirrors.

- Concave mirror has plus power, e.g. dish antenna
- Convex mirror has minus power, e.g. passenger-side mirror
- Plano mirror has zero power, e.g. wall mirror
Refraction

The altering of the pathway of light from its original direction as a result of passing through one refractive medium to another with a different index of refraction
Snell’s Law

Angle of Incidence
Angle of Refraction

\[ n \sin i = n' \sin I' \]
Focal Length Calculations

\[ F = \frac{1}{f'} \]

- \( F \) = power in Diopters
- \( f' \) = focal length in meters
Prescriptions

Components

- Sphere, cylinder, axis
- Add power
- Prism
- Prism base direction
Major Reference Point

Line of sight (LOS) vs Frame PD
Prism

- Has two flat surfaces which are not parallel
- Has two purposes
  - Deviation
  - Dispersion
Deviation

Bending of light
Light is deviated towards the base
Deviation

To an observer, the object seen through a prism appears moved towards the apex of the prism.
Dispersion

- The breaking down of white light into the component colors
- Mnemonic - ROY G. BIV
  - R - Red
  - O - Orange
  - Y - Yellow
  - G - Green
  - B - Blue
  - I - Indigo
  - V - Violet
A lens may be thought of as two prisms base to base (plus lens) or apex to apex (minus lens) that have been rounded off to produce a clear point focus.
Ordering should include:

Whether on order form or online ordering

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<th>CYL</th>
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Optical Cross

To take an RX off the Optical Cross in Minus Cylinder Form:
Start with the most plus sphere power (use your number line)
Your axis is “married” to your sphere
Your cylinder is the distance traveled between the sphere and number 90 degrees away

These are two different lenses
Optical Cross

Diagram that denotes the dioptric power in the two principal meridians of a lens

Front surface power + back surface power equals the power of the lens

The purpose of the optical cross is to understand the concept of the lensometer, transposition and the make up of the lens
Transposition

Combine the sphere and cylinder power mathematically

Change the sign of the cylinder

Change the axis by 90 degrees
EX: +2.00+1.00x080
   +3.00-1.00x170

The purpose of transposition is to change the same prescription into a different form.
Prescriptions: Decentration

Decentration calculations
- Eye size plus distance between lenses minus patient’s PD divided by 2.
- Example:
  - Eye size = 58 + 16 = 74
  - Patient’s PD = 62
  
  - 74 – 62 = 12
  - 12 divided by 2 = 6
Terminology

- Equivalent power
  - Add half of the cylinder to the sphere power
- Refractive power
  - Power of the lens
- Effective power
  - Back vertex power
- Vertex distance
  - Distance along the line of sight from the back surface of the lens to the cornea
Instruments used for Verification

Lensometer
- Lens power and axis location
- Presence, amount and direction of prism

Caliper
- Lens thickness
Spectacle Rx  -5.00 –1.25 x 180

Vertex adjusted CL Rx  -4.75 –1.00 x 180
Take the “add” portion of the prescription and algebraically combine it to the sphere of the Rx

Keep the cylinder and axis the same
Ex.  -3.00 -1.00 x 090
     -2.00 -0.75 X 180
          Add power +2.25
Reading Rx:
     -0.75 -1.00 X 090
     +0.25 -0.75 x 180
Spherical Equivalent

Half the cylinder and add algebraically to sphere

Drop the cylinder and axis and write sphere only

EX. -2.00 -0.50 X 145
(half the cylinder) -0.25
(add to sphere) 0.25 + 2.00
Answer:
-2.25 Sph
A distometer is used to determine the vertex distance, which is the distance from the anterior cornea to the back of the lens.

More plus power is required as a lens comes closer to the retina.
Vertex Distance- distance between the ophthalmic lens and the front of the patient’s eye

Effective Power- change in the prescription when the distance varies from the normally refracted 13.5mm distance to where the patient wears the RX.

Concerned with high Rx’s (-/+ 4.00)
Lenses

- Smaller the frame, thinner the lens
- Impact Resistant
  - Heat or chemical
  - Dress vs. Occupational
- Fitting Lenses
  - Progressive 24mm high
  - St. Top – Round Top
  - Executive
  - Occupational
Lens Materials: Glass

Crown glass  n: 1.52
Flint glass   n: 1.65
Hi-Index glass  n: 1.9

Advantages: More scratch resistant, clearer optics
Disadvantages: Heavier, less impact resistant
Lens Materials: Plastic

CR-39
Hi-Index plastic

n: 1.49  n: 1.54-1.60

Advantages: Lighter weight, more impact resistant compared to glass, easily tinted
Disadvantages: More prone to scratches, less ultra-violet (UV) protection on untreated lens
**Lens Materials: Polycarbonate**

**Polycarbonate**  

**n:** 1.54-1.60

**Advantages:** Lighter weight, more impact resistant compared to plastic, naturally filters UV light.  
**Disadvantages:** More prone to scratches, chromatic aberration
Lens Materials: Trivex™

Trivex™ \(n: 1.53\)

**Advantages:** Lightest material available; less distortion; as impact resistant as polycarbonate, highly resistant to cracking around holes when used in drill mount frames; quality optics; natural UV protection.

**Disadvantages:** Cannot be tinted darker than #2
Lens Form

Convex

Concave
Spherical Lens

A lens with the same curvature across the surface
A lens that differs in curvature across the surface

Flat Meridian

Steep Meridian
Single - Bifocal - Trifocal Vision

Single

Bifocal

Trifocal
Multifocals

A lens that has more than one focus distance

- Fused multifocals
- One-piece multifocals
Progressive Add Lenses (PAL)
Special Prescription Considerations

Aphakic
High minus
Industrial/Occupational
- ANSI standards
- Occupational bifocals
Other
Base Curve

The measure of the general shape of the lens
Use to determine lens power
Tints and Coatings

Colors
- Tint #1 – 65-80 light transmission
- Tint #2 – 45-60 light transmission
- Tint #3 – 15-40 light transmission

Mirror

Edge Coating
Sun and Glare Protections

Polarized Lens

Photochromatic
Ophthalmic Lens Coatings

Scratch Resistant

Anti-Reflective

Ultra-Violet
Lens Enhancements

Scratch resistant

Anti-reflective

Ultraviolet

Mirror

Sports Coating

Tints: pink, yellow, gray, brown, green

- Tint #1 – 65-80 light transmission
- Tint #2 – 45-60 light transmission
- Tint #3 – 15-40 light transmission

Photochromatic
Index of Refraction

Speed of light in air (in a vacuum)
- 186,000 mps

Index of Refraction (n) of materials
- Air \( n=1.00 \)
- Resin (CR-39) \( n=1.49 \)
Prentice’s Prism Formula – if the patient is not looking through the optical center of the lens that has power, they are looking through prism.
Prescriptions: Prentice’s Formula

Prism = Power x Decentration in cm

Prism = lens power (in diopters) multiplied by d in cm
(Where d = amount the patient PD varies from the major reference point in cm)

EX: -4.00(power) x .5cm (decentration in cm) = 2 prism diopters
Frame Selection

Materials

Styling
Frame Materials

Materials
- Zyl
- Metal
  - Stainless Steel
  - Memory Metals
Frame Measurements

The BOXING System

- A
- B
- DBL
- ED

Frame size
Front, Bridge, Temples
Dispensing

Fitting
Standard alignment

Adjustment
- Pliers
- Pad angling
- Needle nose
- Round-flat jawed angling
Adjusting Pliers

Nose Pad Adjusting Pliers
Needle nose
Half round/ Flat jawed
Angling
Adjustment Problems Crooked Frames

One eyewire higher: bend the temple up on that side to lower

One eyewire lower: bend the temple down on that side to raise
Common Frame Adjustment Problems - Vertex Distance

Increase vertex- bend both end pieces in

Decrease vertex- bend both end pieces out

Increasing vertex distance effectively raises multifocal height and vise versa
Frame Tilts

Pantoscopic

Retroscopic

4 mm
OPTICAL CENTER
Nosepad Adjustment

As viewed from front of frame

- **Vertical Angle**
  - Bottoms of pads angled toward frame front

- **Frontal Angle**
  - Tops of pads angled inward approximately 15 degrees

- **Splay Angle**
  - Edge of pads angled inward approximately 15 degrees
Frame Adjustment - Pantoscopic Angle

Increase panto - bend both temples down

Decrease panto - bend both temples up

Increasing panto will raise the frame front height on the face; however, it will effectively lower the multifocal and vice versa.
Patient Instructions

Frames
- Place and remove eyewear with two hands
- Temples should be folded and stored in frame case
- Frame should be cleaned daily with mild soap and water

Lenses
- Cleaned as often as necessary with recommended solutions
Frame Repair

Eyewire Screw replacements

Nylon Chord replacements

Realignments
Refractive Status of the Eye and Binocularity (12%)
Refractive Errors

Refractive causes of myopia, hyperopia and astigmatism refer to the fact that the “error” lies within the shape of the cornea and/or the lens.

Axial causes refer to the length of the eyeball itself being the cause of the “error”
A bulging cornea or elongated eyeball often increases the refracting power of the eye, leading to the formation of images in front of the retina.
Hyperopia or Farsighted

Axial Hyperopia: Axial length of the eye is too short, causing the rays of light to come to a point after hitting the retina.
Astigmatism

**Simple**- one ray is focused on the retina; the other is focused either in front of (myopic) or behind (hyperopic)

**Compound**- both rays are focused in front of (myopic) or behind (hyperopic)

**Mixed**- one ray is focused in front (myopic) and one ray is focused behind (hyperopic)
Presbyopia

Reduction in the ability to accommodate
Occurs normally with age
- Reduction in lens elasticity
- Reduction in strength of the ciliary muscle
Refractive Conditions

Aphakia
Pseudoaphakia
Anisometropia
Aniseikonia
Amblyopia
Aphakia

Absence of the crystalline lens

Cataract
  ▪ Most common cause of surgical removal of the lens

Correction
  ▪ Intraocular lens implant (IOL)
  ▪ Contact lenses
  ▪ Spectacle lenses
Anisometropia

Condition of unequal refractive state of the two eyes
An- not; iso- same; metric- measure
Aniseikonia

Difference in the size of the two retinal images
Inherent and acquired
Amblyopia

Reduced Visual Acuity
- No Apparent Cause
- Not Correctable With Refractive Means

Strabismic- Amblyopia Ex Anopsia
- Abnormal binocularity, resulting in suppression of one eye

Refractive
- Uncorrected refractive error that remains uncorrected for a significant period of time

Image courtesy of National Eye Institute
Versions

Pursuits
- Movement of the eyes while following a moving target

Saccades
- Jumping movements from one target to another

Rotations
Near Point of Convergence

Measure of the ability of both eyes to work together

Blur/Break/Recovery

Measured in centimeters from the bridge of the nose to the point of blur/break
Binocular Vision

Result of both eyes working as a team; when both eyes work together smoothly, accurately, equally and simultaneously
Binocular Vision Deviations

Phoria
- Tendency of the eyes to deviate when fusion is suspended

Tropia
- Denoting a manifest or observable deviation from normal of the axis of the eyes
Accommodative Mechanism

Ciliary Body

Zonules

Crystalline lens
AC/A Ratio

The amount of accommodative convergence per unit of accommodative response
Anatomy and Physiology
(15%)
Anatomy and Physiology
Orbital Bones

Frontal bone
Ethmoid bone
Palatine bone
Zygomatic bone
Lacrimal bone
Maxillary bone
Sphenoid bone  (Located further behind the zygomatic bone-hidden from view)
Extraocular Muscles

- Superior Rectus
- Superior Oblique
- Trochlea
- Medial Rectus
- Lateral Rectus
- Inferior Rectus
- Inferior Oblique
Extraocular Muscles

Superior Oblique
- Rotates the top of the eye toward the nose; moves eye down

Inferior Oblique
- Rotates the top of the eye away from the nose; moves eye up
Extraocular Muscles Primary Actions

Medial Rectus
- Toward the nose (adduction)

Lateral Rectus
- Away from the nose (abduction)

Superior Rectus
- Up - towards the nose (elevation)

Inferior Rectus
- Down - away from the nose (depression)
# Secondary and Tertiary Actions

<table>
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<tr>
<th>Muscle</th>
<th>Secondary Action</th>
<th>Tertiary Action</th>
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<td>Lateral Rectus</td>
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<td>Abduction</td>
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<tr>
<td>Inferior Oblique</td>
<td>Adduction</td>
<td>Extortion</td>
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Glaucoma

Increased intraocular pressure
Increased cupping (cup to disc ratio)
Decrease in peripheral vision

Image courtesy of National Eye Institute
Cataracts

Eyemaginations image

Courtesy: National Eye Institute, National Institutes of Health
Corneal Problems

Foreign Body
Abrasions
Dystrophy
Keratoconus
Ulcer
Retinal Problems

Diabetic Retinopathy
Retinal Tears/Detachment
Retinitis Pigmentosa
Macular Degeneration
Hypertensive Retinopathy
Retinopathy of Prematurity
Occlusions
Cytomegalovirus
Toxoplasmosis
Histoplasmosis
Conjunctivitis

The “infamous” pink-eye
Numerous causes:

- Bacteria
- Viruses
- Allergies
- Toxic Reactions (chemicals)
- Often difficult to diagnose exact etiology

Image courtesy of Eyemaginationa
Uveitis

Inflammation of the anterior uvea structures
• Iris
• Ciliary Body

• Symptoms
  • Inflammation
  • Pain
  • Tearing
  • Blurred vision
1. Upper eyelid
2. Lower eyelid
3. Lateral canthus
4. Medial canthus
5. Caruncle
6. Limbus
7. Iris
8. Pupil
9. Puncta
10. Sclera
11. Plica Semilunaris
Visual Pathway

Retina
Optic nerve
Optic chiasm
Optic tracts
LGB
Optic radiations
Visual cortex

Image courtesy of Posit Science
Dry Eye

Keratitis sicca

- Can be associated with systemic inflammatory disorders, such as arthritis and lupus
  - Sjogren’s Syndrome

Treatment options

- Eye Drops (artificial tears, cyclosporine)
- Punctal Plugs
- Cautery of punctae
Pharmacology

Diagnostic
- Used to diagnose a condition

Therapeutic
- Used to treat a condition
Phenylephrine (Neo-Synephrine, Mydfrin)

- Strength: 2.5%, 10%
- Effective: 4-6 hours
- Systemic Side Effects:
  - Irregular heart beat, headache, hypertension, cardiac arrest (very rare)
- Action: Stimulates the iris dilator muscle
Tropicamide (Mydriacyl)

- Strength: 0.5%, 1%
- Effective: 5-6 hours
- Systemic Side Effects: Uncommon
Cyclopentolate (Cyclogel)
- Strength: 1.0% and 2.0%
- Effective 24 hours
- Side Effects: Dry mouth, excitation, facial flushing, tachycardia, angle closure due to dilation
- Action: Paralyzes the sphincter muscle of the iris (dilation) and the ciliary muscle (prevent accommodation)
Pharmacology: Diagnostic Agents Stains

Fluorescein
- Strips
- Mixed with anesthetic
- Injected (angiography)

Rose Bengal
Pharmacology: Anesthetics

Commonly used anesthetics:
- Proparacaine 0.5%
- Tetracaine 0.5%
- Lidocaine 1.0%-5.0%
- Benoxinate plus fluorescein (Fluress)
- Proparacaine plus fluorescein (Fluoracaine)
Miotics

- Action: contraction of the iris sphincter muscle (pupil constriction)
- Use: lowering of intraocular pressure by improving drainage of the aqueous humor through the trabecular meshwork.
Examples of Therapeutic Agents

Corticosteroid

Antibiotic

Allergies
Pharmacology: Therapeutic Agents

Glaucoma Treating Drugs

- Prostaglandins
  - Xalatan
  - Lumigan
  - Travatan Z
  - Rescula
- Beta Blockers - Adrenergic-blocking agents
  - Timoptic
  - Istalol
  - Betoptic
  - Levobunolol
Pharmacology: Therapeutic Agents

Glaucoma Treating Drugs

- Adrenergic agonists
  - Lopidine
  - Alphagan

- Carbonic Anhydrase Inhibitors
  - Diamox
  - Neptazane
  - Daranide
Pharmacology: Therapeutic Agents

Glaucoma Treating Drugs

- Hyperosmotics
  - Isosorbide
  - Glycerine
  - Mannitol
Pharmacology: Therapeutic Agents

- Antibiotics
- Antivirals
- Antifungals
- Corticosteroids
- Non-steroidal Anti-inflammatory Drugs (NSAIDS)
- Decongestants
- Antihistamines
- Mast Cell Stabilizers
- Lubricants
Pharmacology: Techniques

Punctal Occlusion
Practice Management
(5%)
Practice Management

Office Management
Professional Issues
  - Professional and Paraprofessional Functions
  - Liability and Malpractice
  - Conduct, Confidentiality & Ethics
Hygiene and Infection Control
  - OSHA
  - Universal Precautions
Government Rules and Regulations
Office Procedures

Office Procedures Manual

- “Official rulebook of the practice”
- Used to clarify the policies of the practice
What is HIPAA?

- Health Information Portability & Accountability Act
- Minimum Necessary Principle
  Requires office to take reasonable steps to limit the use or disclosure of, and request for, PHI to the minimum necessary to accomplish intended purpose

Confidentiality
Safeguards
Release of records
Legal Record of ownership
Release of records
Computer Use
Hygiene and Infection Control

Asepsis
- Hand washing
- Instrument disinfection
- Contact lens disinfection

Cross-contamination

Sterilization
Conduct, Confidentially, and Ethics

To Keep the patient’s visual welfare uppermost at all times
To Strive to See That no person shall lack for visual care
To Conduct ourselves as exemplary citizens
To Promote and maintain cordial and unselfish relationships with members of our profession

Excerpts from “Code of Ethics” adopted by the House of Delegates of the AOA June 28, 1944, Modified in 2005
Recommended Books

“Self Study Course for Optometric Assisting” by AOA Paraoptometric Section

“The Ophthalmic Assistant” by Stein & Slatt (8th Edition-Stein, Stein & Freeman)

“System for Ophthalmic Dispensing” by Brooks and Borish

“Dictionary of Eye Terminology by Cassin & Solomon
Questions?

Study Materials
The AOA Paraoptometric Section (PS) may assist with questions concerning PS Membership, staff development, and study materials 800-365-2219 ext. 4108

Certification
The Commission on Paraoptometric Certification (CPC) may assist with questions concerning examinations, certification, and re-certification 800-365-2219 ext. 4210
What’s Next?

Today

- Lightly review the material
- Get a good night’s sleep
- Arrive a little early to test

Future- after CPOT certification

- Look for details about the CPOT Practical. Request a copy of the Practical Examination Video from the CPC
- Start finding sources for continuing education. AOA Paraoptometric Section provides opportunities for six hours of CE each year with membership.
The person who makes a success of living is the one who sees his goal steadily and aims for it unswervingly. That is dedication.

Cecil B. DeMille

(1881 - 1959)