The Optics of Strong Lenses
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Introduction
- Characteristics of lenses
- Vertex Distance
- Tilt/Wrap
- Lens Material
- Coatings
- Communication

Characteristics of Lenses
- Plus lens characteristics
- Minus lens characteristics

Prism
- Light strikes a prism
  - light ray is bent (deviated) toward the base
  - image is displaced toward the apex.

- The greater the difference in thickness between the base and the apex
  - Stronger the power of the prism

- Power of prism is referred to as prism diopter
  - 1 Δ will deviate light 1 cm at 1 M
  - 2 Δ will deviate light 2 cm at 1 M
  - 3 Δ will deviate light 3 cm at 1 M
Convex or plus lenses are made up of two prisms placed base to base.
- Converges light rays
- Creates a real image
- **Magnifies image**
- Center thicker than edge
- Weakens as vertex shortens
- Against motion

Concave or minus lenses are made up of two prism placed apex to apex.
- Diverges light rays
- Creates a virtual image
- **Minifies images**
- Thicker at edge than center
- Strengthens as vertex shortens
- With motion

Characteistics of Contact Lenses
- Float on precorneal tear film
- Move with the eye
- NO vertex distance, so image size is almost the same
  - Power needs compensating more frequently for CL’s than for spectacles

Sphero/cylinder lens characteristics
- Unequal powers and the effects on vision

Analyzing & Interpreting The Prescription
- -2.00 – 2.00 X 180
  - Sphere power always relates to the axis and is everywhere on the lens.
  - Therefore
  - -2.00
  - 180
  - Total cylinder power is 90 degrees away from the axis.
  - Therefore
  - -4.00

Power on Lens Cross
- -2.00 – 2.00 X 180
  - Draw a circle around the lens and you will see where it is thick and where it would be thinner.
  - -2.00
  - 180
Consider shapes to affect edge thickness.

Prism

Properties of minus lenses
Unequal Measure
The condition when the two eyes require a different degree of correction (1.00 or more) but the same kind of correcting lens (+ or -)
The condition may cause vertical prism imbalance at near or cause a difference in the retinal image sizes between the two eyes
May cause problems in distance if not centered vertically

Example Rx:
OD –7.00 D. sphere
OS –3.00 D. sphere

Example Rx:
OD +7.25 sphere
OS +5.25 sphere

Antimetropia
Opposite Measure
The condition when the two eyes require opposite kinds of corrective lenses (+ or -)
The condition may cause vertical prism imbalance at near or cause a difference in the retinal image sizes between the two eyes
May cause problems in distance if not centered vertically
Antimetropia

- Example Rx:
  OD +1.75 sphere
  OS −1.00 sphere

- Example Rx:
  OD −2.25 sphere
  OS +1.50 sphere

Visual discomfort due to:

- Unequal retinal image sizes
- Unequal prism differences at near point
- Unequal focus

Aniseikonia

- "unequal images"
- Anisometropia or antimetropia may result in the condition whereby two unequal images are sent by the eyes to the brain
- More prevalent due to refractive surgeries
- Meridional Aniseikonia
  Normal or less aniseikonia in one meridian and more in another due to high anisometropia in that meridian

Fusion creates blurry image

Aniseikonia

- Aniseikonia is caused by a difference in the magnification power of the two lenses resulting in differences in the retinal image sizes between the two eyes

Distortion

- Minus / Barrel
- No Distortion
- Plus / Pincushion
Aspheric Lenses

Conventional lens  Aspheric lens

Using the Rx
O.D.  +3.00
O.S.  +1.00

Looking left will cause base out prism in OD
Looking right will cause base in prism in OD

Horizontal Imbalance Problems

O.D.  +1.00
O.S.  -3.00

Base Directions – Plus Lens

Base Direction – Minus Lens
Vertex Distance

- Effective Power
- Compensated Power

Effective Power
Compensated Power

- Change in vertex distance = change in effective power
- Change in effective power means in that compensated power must be ordered

Vertex Distance - Effective Power

Simple formula
- The simple formula for determining the effective power when moved by millimeters is: diopters squared, divided by 1000. That value is multiplied by the millimeter of change.
  \[ EP = \frac{D^2}{1000} \times \text{mm of change} \]
- Whereby \( EP \) = Effective power
- \( D^2 \) = dioptric power of lens meridian squared

Vertex Power Compensation

Tilt/Wrap

- How it affects the optics of the lenses
- How it affects the wearer
- How to compensate
Tilt/Wrap Example:

- OU -4.00
- 12° tilt and 15° of wrap
- Compensated Rx
- OD -3.46 -0.42 x 039
- OS -3.46 -0.42 x 141

Coatings

- Higher index = more reflections
  - How reflections affect the wearer

Lens Material

- Index of refraction
- Abbe Value
- Impact
- Other factors

Communication

- Explaining the options to your patients

Lens Material Properties

<table>
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<tr>
<th>Material</th>
<th>Index</th>
<th>Specific Gravity (g/ml)</th>
<th>Abbe</th>
<th>Refractive</th>
<th>Transmission UVA (300 – 320 nm)</th>
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Questions/Answers/Comments

Thank You