The Optics of Strong Lenses

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Introduction

- Characteristics of lenses
- Vertex Distance
- Tilt/Wrap
- Lens Material
- Coatings
- Communication

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Characteristics of Lenses

- Plus lens characteristics
- Minus lens characteristics

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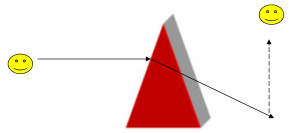
Prism

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



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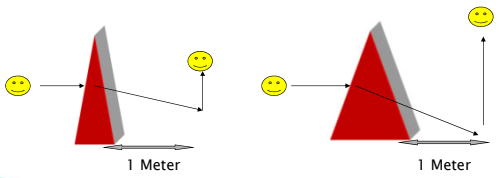
Prism

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



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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

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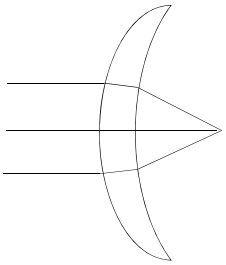
Characteristics of Plus Lenses

- 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



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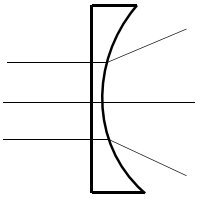
Characteristics of Minus Lenses

- 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



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Characteristics 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

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Characteristics of Lenses

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

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Analyzing & Interpreting The Prescription

-2.00 – 2.00 X 180

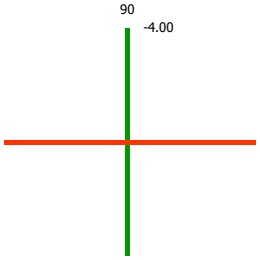
Sphere power always relates to the axis

and is everywhere on the lens

Therefore

Total cylinder power is 90 degrees away from the axis

Therefore



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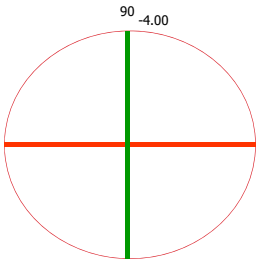
Power on Lens Cross

-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



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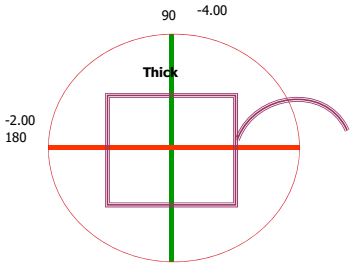
Power on Lens Cross

-2.00 – 2.00 X 180

Consider shapes to affect edge thickness



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Power on Lens Cross

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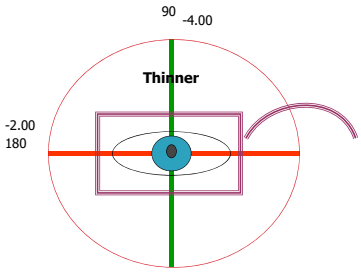

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Power on Lens Cross

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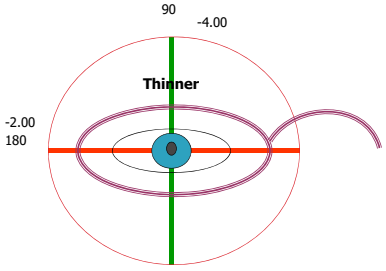
Consider shapes to affect edge thickness



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Consider Decentration Vertical as well as Horizontal

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Prism

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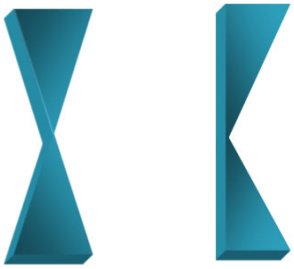
Properties of minus lenses



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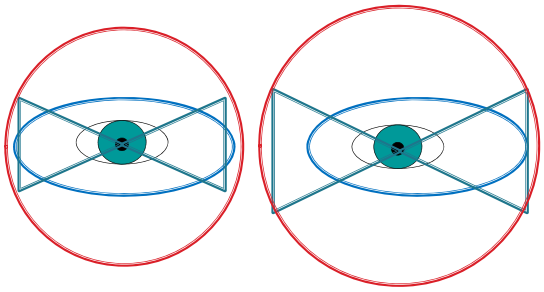
Decentration of minus lenses



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Anisometropia

- 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

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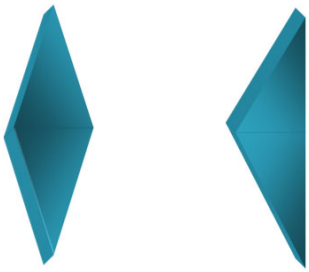
Properties of plus lenses



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Anisometropia

- Example Rx:
  OD −7.00 D. sphere
  OS −3.00 D. sphere
- Example Rx:
  OD +7.25 sphere
  OS +5.25 sphere

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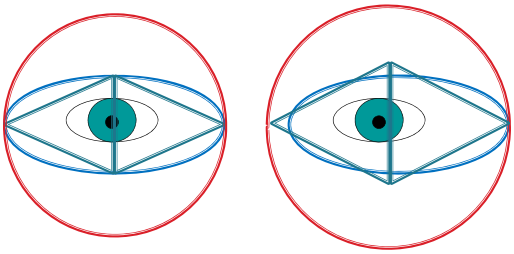
Decentration of plus lenses



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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

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Antimetropia

- Example Rx:
  OD +1.75 sphere
  OS -1.00 sphere
- Example Rx;
  OD -2.25 sphere
  OS +1.50 sphere

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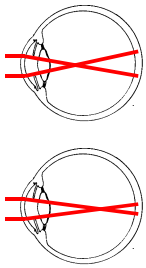
Aniseikonia

- "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 astigmatism in that meridian



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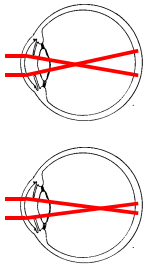
Aniseikonia

- 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



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Visual discomfort due to:

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

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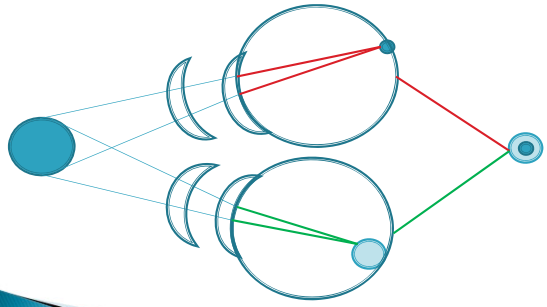
Fusion creates blurry image



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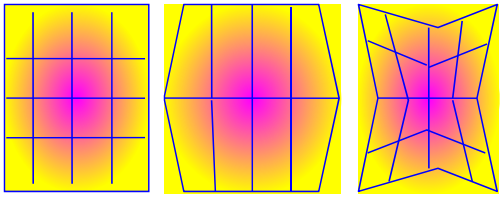
Distortion



Minus / Barrel

No Distortion

Plus / Pincushion

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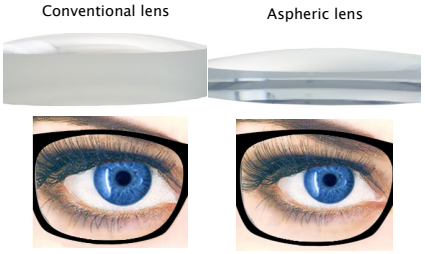
Aspheric Lenses



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Horizontal Imbalance Problems

- 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

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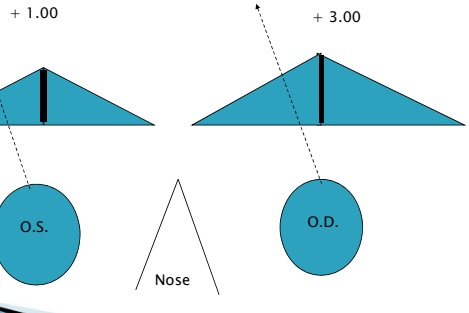
Single Vision Displacement



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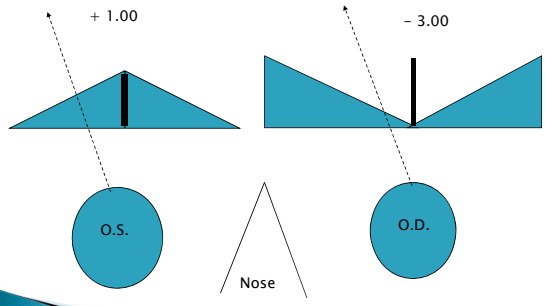
Single Vision Displacement



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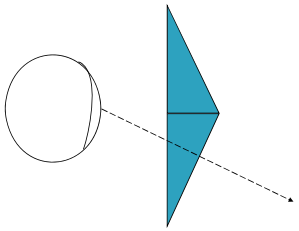
Base Directions – Plus Lens



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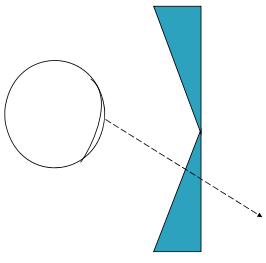
Base Direction – Minus Lens



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Vertex Distance

- Effective Power
- Compensated Power

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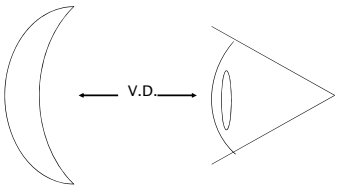
Vertex Distance – Effective Power



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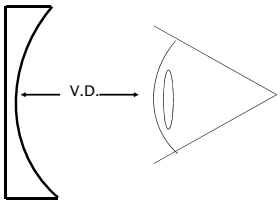
Vertex Distance – Effective Power



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Effective Power Compensated Power

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

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Vertex Power Compensation

- **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.
- $EP = D^2 / 1000 \times$ mm of change
- Whereby EP = Effective power
- D^2 = dioptric power of lens meridian squared

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Tilt/Wrap

- How it affects the optics of the lenses
- How it affects the wearer
- How to compensate

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Tilt/Wrap Example:

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

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Lens Material

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

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Lens Material Properties

Material	Index	Specific Gravity (g/cm3)	Abbe	Reflectance	Transmittance UVA (286 – 320 nm)	Transmittance UVB (320 – 380 nm)
Crown Glass	1.52	2.54	59	4.3	84.3	30.5
CR-39	1.50	1.32	58	4.0	10.3	0.0
Trivex	1.53	1.11	43 - 46	4.4	0.0	0.0
Poly	1.58	1.21	29 - ***32***	5.2	0.0	0.0
1.60 (MR6)	1.60	1.22	42	5.3	0.0	0.0
1.60 Glass	1.60	2.60	42	5.3	39.1	0.1
1.66 (MR7)	1.66	1.35	32	6.2	0.0	0.0
1.67	1.67	1.35	32	6.2	0.0	0.0
1.70 Glass	1.71	3.20	35	6.7	24.6	0.0
1.80 Glass	1.81	3.66	25	8.2	19.5	0.0

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Coatings

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

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Communication

- Explaining the options to your patients

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Questions/Answers/Comments
Thank You

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