


Advanced Anatomy and Physiology of the Eye



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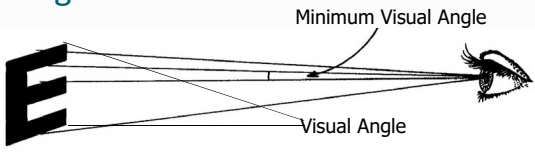
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Introduction

- Terminology
- Anatomy
- Refractive Errors
- Spherical Correction
- Cylindrical Correction
- Presbyopia
- Muscle Imbalances
- Unequal refractive errors
- Visualizing the Rx

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Visual Angle and Minimum Visual Angle



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Subtend

- To extend under or to be opposite to
- The angle which is opposite the object being observed

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Minimum Detail

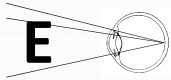
- The detail that must be detected on an object to positively identify or distinguish the object



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Resolution

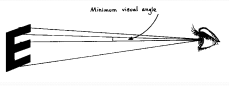
- The ability to detect minimum detail
- The resolving power of the normal eye is a minimum visual angle of 1 minute
- The minimum visual angle of the letter is 1 minute
- The visual angle of the letter is 5 minutes



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Visual Acuity

- The measure of the angle subtended by the outer limits of rays of light coming from the minimum detail of an object as they enter the eye
- 20/20 or 6/6



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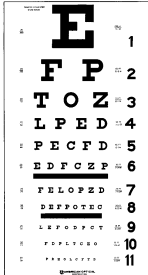
Snell's Law of Refraction

- $n_1 \sin i = n_2 \sin r$

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The Snellen Fraction

- The distance at which the test is made divided by the distance at which the smallest letter read subtends an angle of 5 minutes



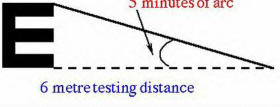
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Snellen Letters



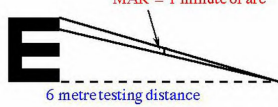
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Snellen Letters

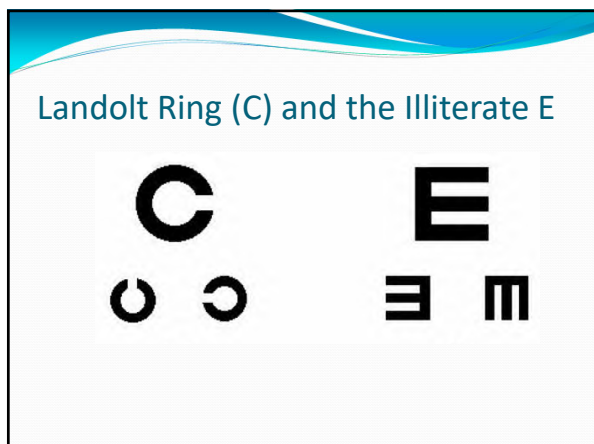


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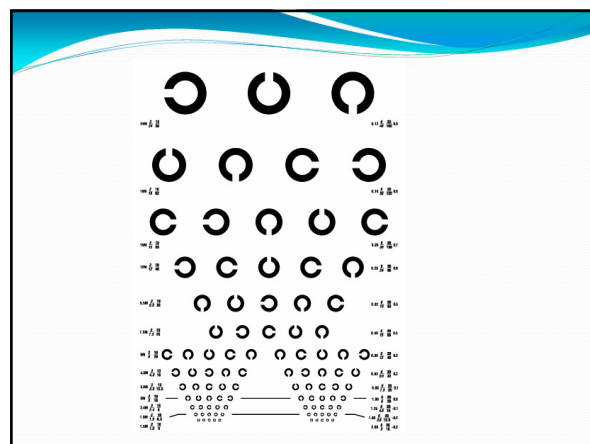
Minimum Angle of Resolution



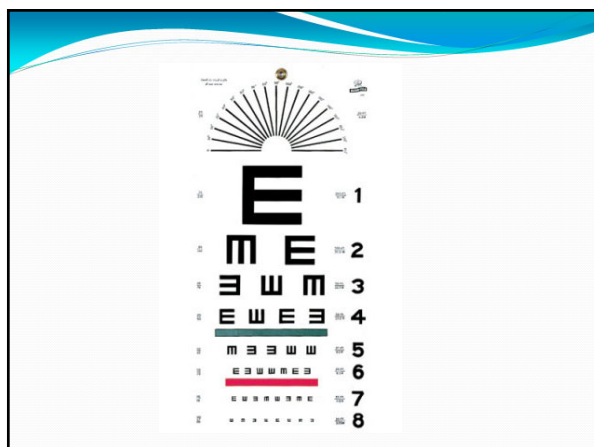
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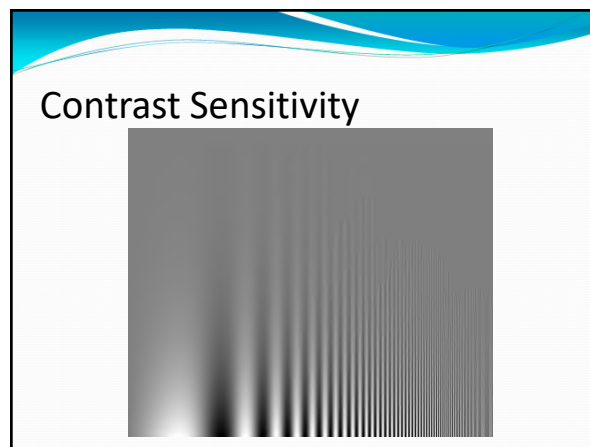
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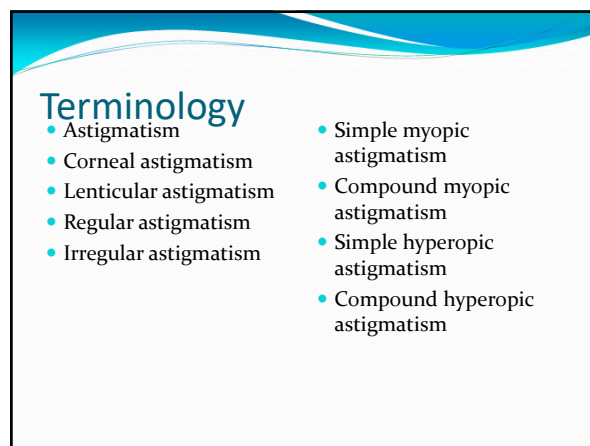
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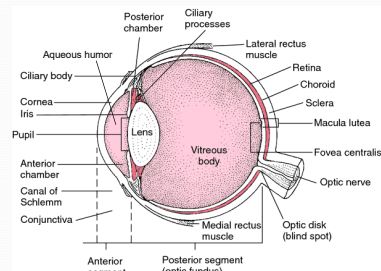
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Terminology

- Presbyopia
- Greek
 - Presby = Old
 - Opia = Sight

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Anatomy



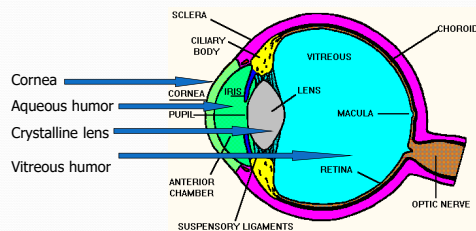
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Four Refractive Mediums of the Eye

- The cornea
- The aqueous humor
- The crystalline lens
- The vitreous humor

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Anatomy



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Index of Refraction

- Cornea = 1.37
- Aqueous humor = 1.33
- Crystalline lens = 1.42
- Vitreous humor = 1.33

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Dioptric Power

- Cornea
 - +42.00D to +45.00D
 - Performs about 80% of the refraction or bending of light rays within the eye
- Crystalline Lens
 - +12.00 to +15.00D
 - +20.00 D
- Depending on textbook

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Refraction

- The “bending” of light as it passes obliquely between two different refractive mediums
- A beam of light that enters a refractive medium perpendicularly is not refracted, but merely slowed down and the path of the beam is unchanged

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Emmetropia

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Ametropia

- Myopia
- Hyperopia or Hypermetropia
- Astigmatism

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Myopia - Near Sighted - Short Sight

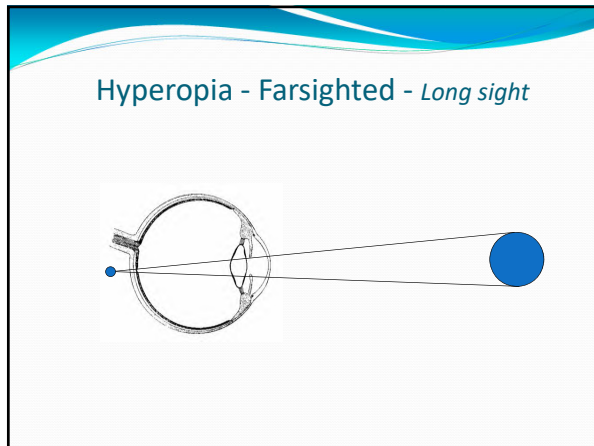
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Myopia - Near Sighted - Short Sight

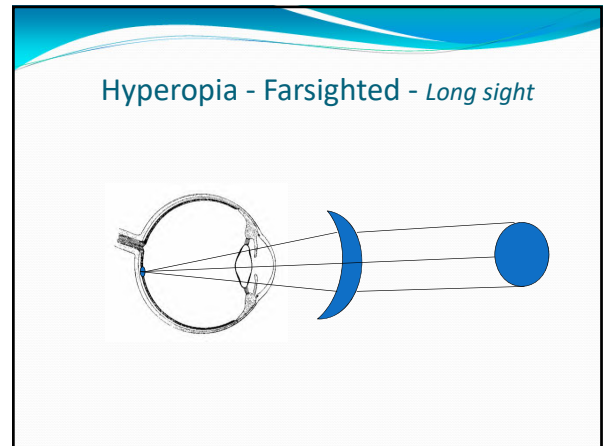
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Myopia - Near Sighted - Short Sight

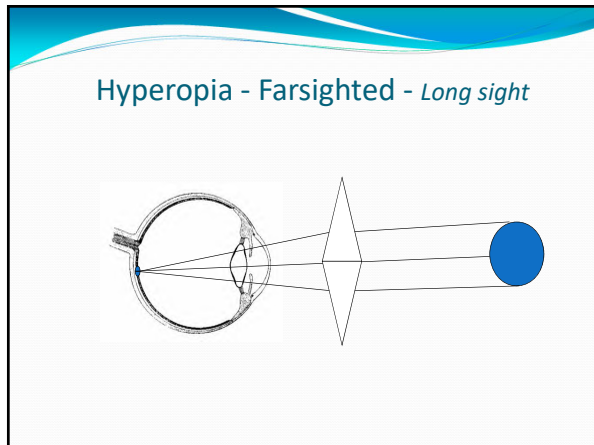
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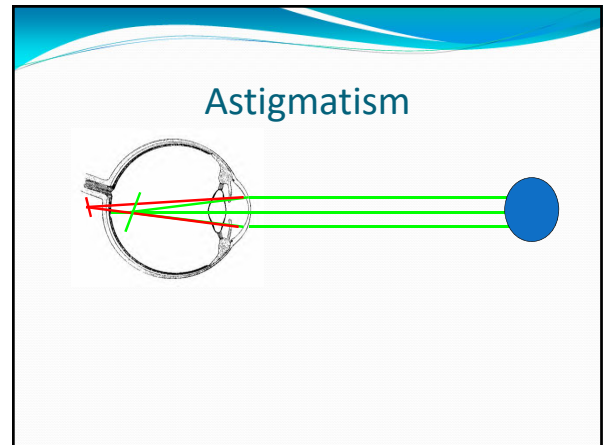
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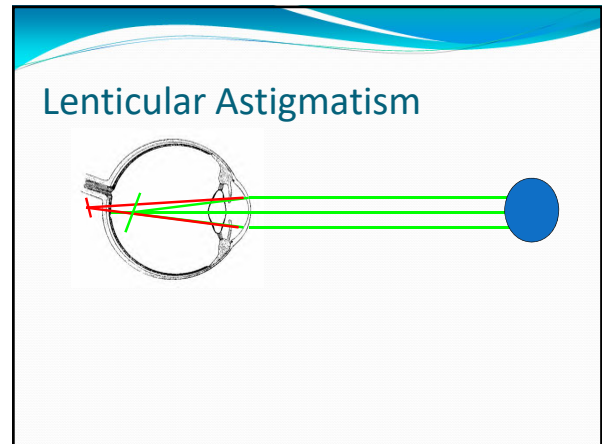
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- Astigmatism
- Corneal astigmatism
 - Lenticular astigmatism
 - Regular astigmatism
 - Irregular astigmatism
 - Simple myopic astigmatism
 - Compound myopic astigmatism
 - Simple hyperopic astigmatism
 - Compound hyperopic astigmatism
 - Mixed astigmatism

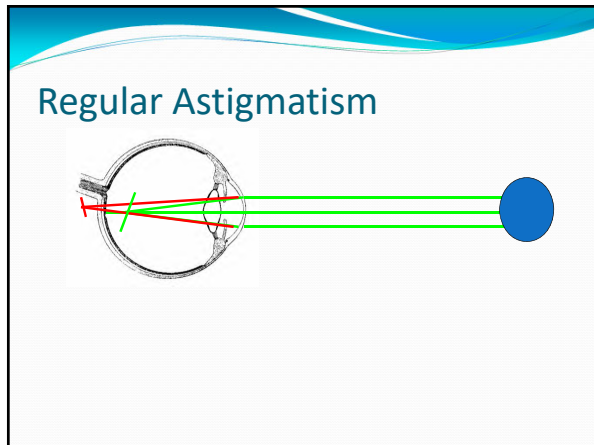
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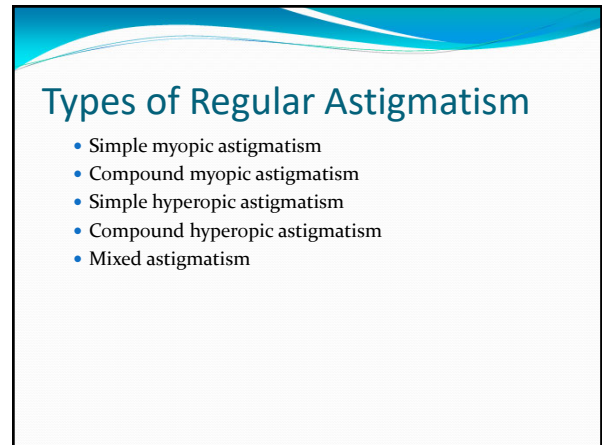
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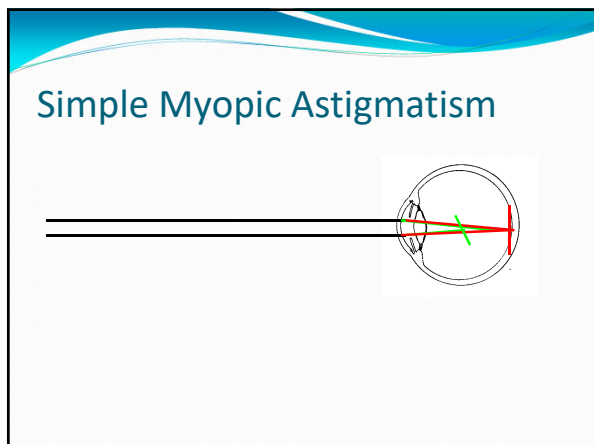
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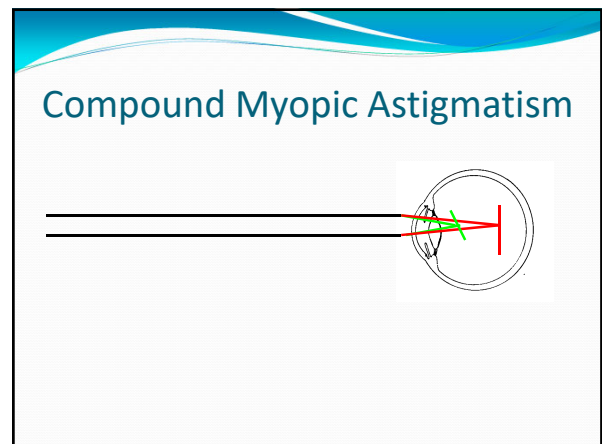
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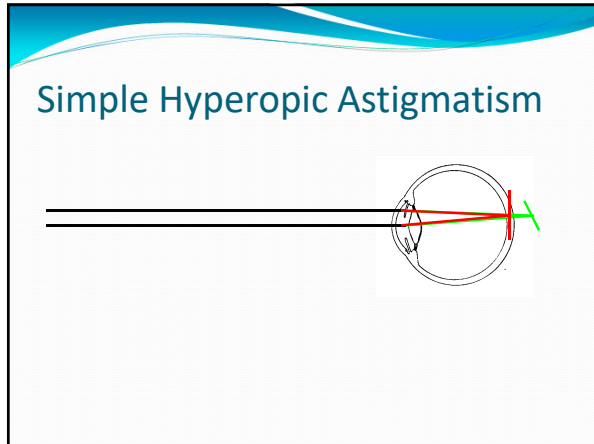
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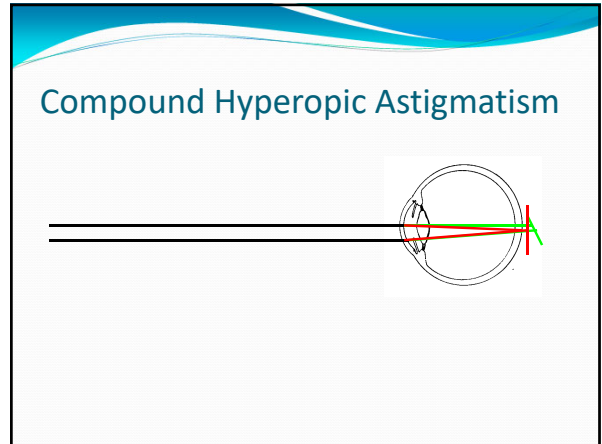
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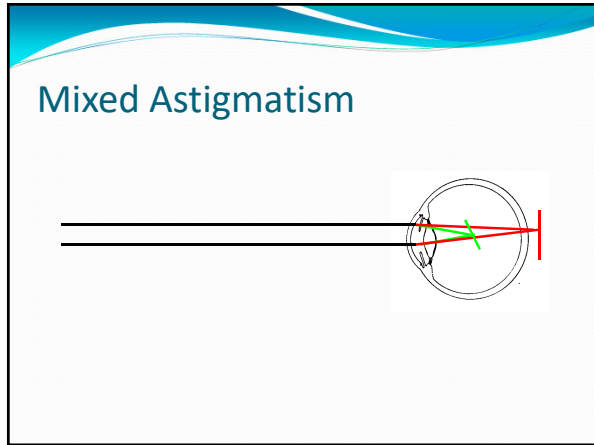
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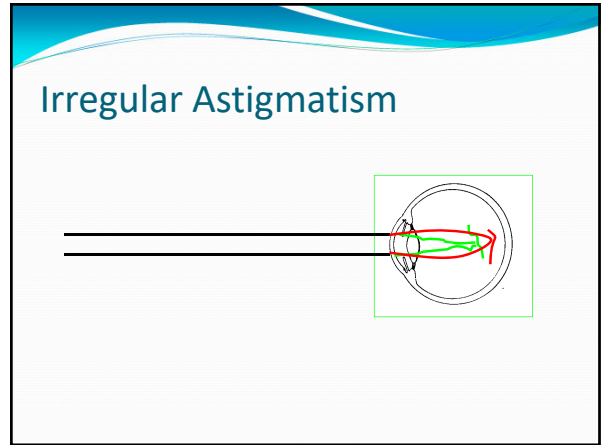
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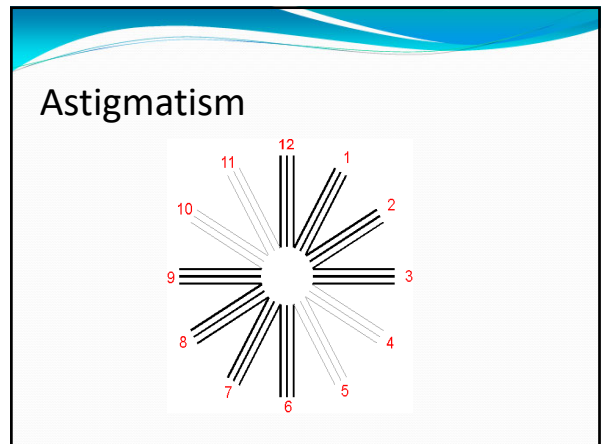
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Cylindrical Lenses

- Cylinder Lenses
- Toric Lenses
- Sphero-Cylindrical Lenses
- Flat and Toric Transposition
- Spherical Equivalent
- Contact Lenses

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Terminology

- Presbyopia
- Greek
 - Presby = Old
 - Opia = Sight

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Presbyopia

- Causes
- Treatment
 - Spectacles
 - Contact Lenses

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Understanding Presbyopia

- Age-Related Vision Changes
 - As we age, our visual system undergoes major changes*
- Decline of accommodation
- Senile miosis
- Loss of visual acuity
- Lowered contrast sensitivity
- Increased lighting sensitivity
- Slower speed of visual processing

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Change in the Mean Amplitude of Accommodation With Age

Age (Years)	Amplitude (Diopters)
10	10.6 - 13.5
15	10.1 - 12.5
20	9.5 - 11.5
30	6.6 - 8.9
35	5.8 - 7.3
40	4.4 - 5.9
45	2.5 - 3.7
50	1.6 - 2.0
55	1.1 - 1.3
60	0.7 - 1.0

Measured by moving the target toward the subject until first blur is reported (Borish 1970; Turner 1958)

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Corrections for Presbyopia

- Rx reading glasses
- OTC readers
- PAL's
- Segmented lenses
- Contacts (*Soft and Rigid*)
 - Mono
 - Bifocals
 - Modified
- Surgery
 - Explain limitations to your patients
- Others

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Muscle Imbalances

- Terminology
- Muscles of the Eye
- Possible Corrections

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The bony orbit

- Quadrilateral pyramid
- Influenced by age, trauma, as well as chronic sinus infections.
- Bed ridden, non-mobile person
- Contain the muscles of the eye

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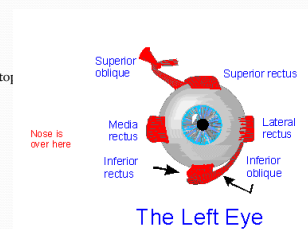
Extraocular Muscles

- **Medial rectus (MR)**—moves the eye toward the nose
- **External rectus (ER)**—moves the eye away from the nose
- **Superior rectus (SR)**—primarily moves the eye upward and secondarily rotates the top of the eye toward the nose
- **Inferior rectus (IR)**—primarily moves the eye downward and secondarily rotates the top of the eye away from the nose
- **Superior oblique (SO)**—primarily rotates the top of the eye toward the nose and secondarily moves the eye downward
- **Inferior oblique (IO)**—primarily rotates the top of the eye away from the nose and secondarily moves the eye upward

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Extraocular Muscles

- Superior Rectus
 - Moves the eye up
- Superior Oblique
 - Rotates the eye so that the top moves toward nose
- Medial Rectus
 - Moves eye toward nose
- Lateral Rectus
 - Moves eye away from nose
- Inferior Rectus
 - Moves the eye down
- Inferior Oblique
 - Rotates the eye so that the top of eye moves away from nose



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Muscle Imbalances - Terminology

- Eso-
- Exo-
- Hyper-
- Hypo-
- -phoria
- -tropia

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Muscle Imbalances - Terminology

- Tonicity
- Fusion
- Diplopia

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Muscle Imbalances - Terminology

- Orthophoria
- Heterotropia
- Strabismus - Can lead to Lazy eye or Amblyopia


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Treatment

- Glasses
- Patching
- Surgery
- Vision Therapy


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Esotropia (convergent squint) Eye turned in Cross-eyed Boss-eyed




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Exotropia (divergent squint) Eye turned out Wall eyes



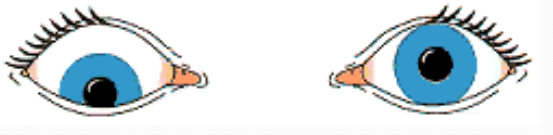
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Hypertropia (vertical) Eye turned up



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Hypotropia (vertical) Eye turned down



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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

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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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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

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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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Iseikonic lenses

- A lens or pair of lenses used to correct aniseikonia
- The following variables are used:
 - Base curve
 - Thickness
 - Vertex distance
 - Index of refraction

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Analyzing and Interpreting the Rx

- Concave Lenses
- Convex Lenses
- Contact Lenses

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Visualization of Rx

- What we see
- What the patient sees

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Your Prescription

	Sphere	Cylinder	Axis	
OD	-2.25	-1.50	180	
OS	+3.75	+1.50	090	
ADD OU +2.25				

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Conclusion

Thank you

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