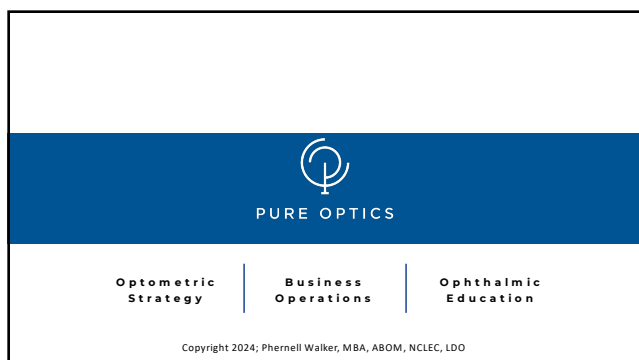




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3

SCAN ME

Contact Information

Phernell Walker, MBA, ABOM, NCLEC, LDO

w: pure-optics.com
e: phernell@pure-optics.com

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Reference Resource

Pure Optics

by
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Agenda

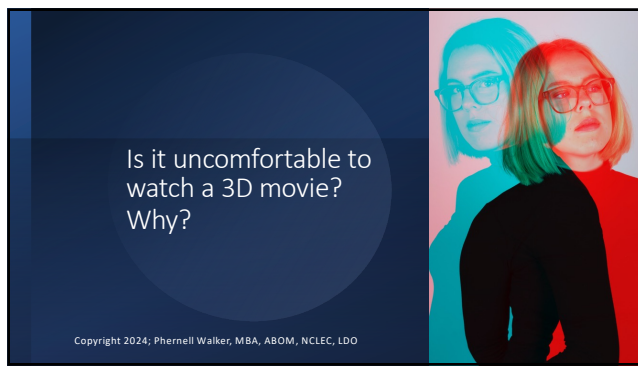
- Components of binocular vision
- Sensory binocular vision
- Binocular vision anomalies
- Treatment options

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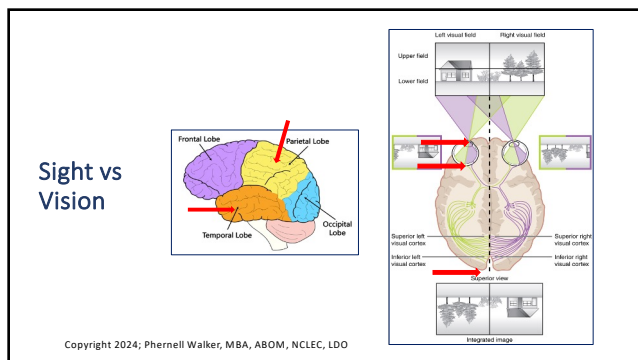
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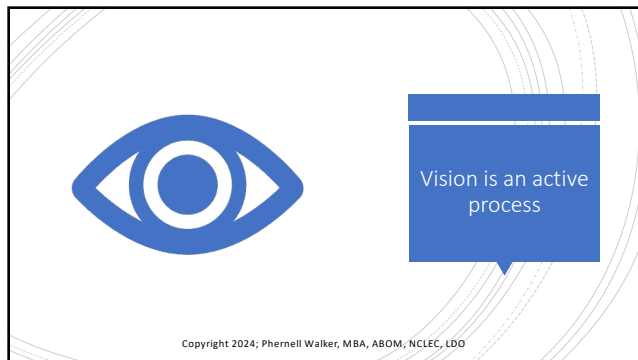
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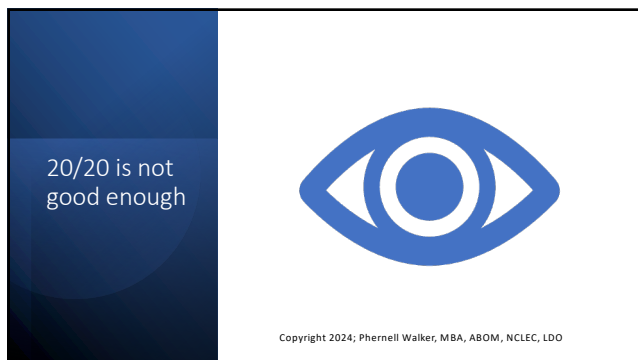
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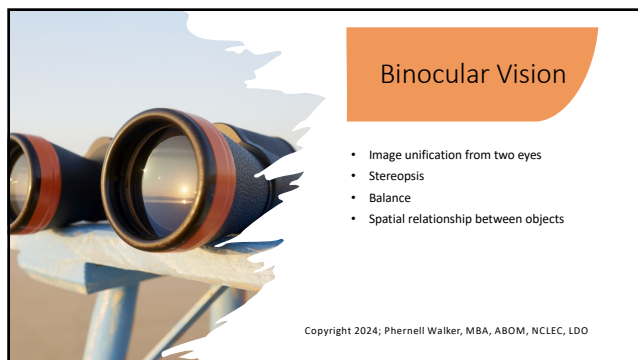
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Two Eyes Are Better than One



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3 Types of Vision

- Monocular:**
Vision with only one eye

- Bi-ocular:**
Vision with 2 eyes
No coordination

- Binocular:**
Vision with 2 eyes
Coordination


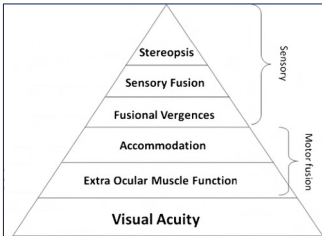
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Normal Binocular Vision



Coordination between the two eyes to produce a single mental impression




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Visual Acuity

A threshold measurement of the eye's ability to distinguish an object correctly.



Level 1





Optical Blur

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4 Basic Eye Movements

Saccades

- Involuntary rapid movement to change fixations
- Conjugate

Smooth Pursuits

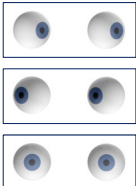
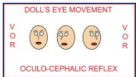
- Voluntary slow tracking movement
- Conjugate

Vergence

- Involuntary/Voluntary slow movement
- Align foveas to target
- Disjunctive

Vestibulo-Ocular


- Reflexive fast stabilizing movements during head movement
- Initiated by semicircular canals

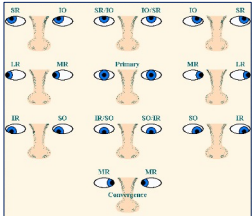
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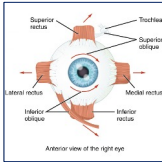
17

Extraocular Muscle Function



Level 2





Anterior view of the right eye

Yoked Extraocular Muscle Movements

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Three Grades of Binocular Vision

Level 5 & 6

Grade 1 Simultaneous Perception: Illustrates a bird in a cage being perceived by both eyes simultaneously.

Grade 2 Sensory Fusion: Illustrates two overlapping images of a cat being perceived by the left and right eyes.

Grade 3 Stereopsis: Illustrates two slightly different images of a tree being perceived by the left and right eyes to create a 3D effect.

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Binocular Field of View

Left eye visual field (60°) and Right eye visual field (60°) are shown overlapping to form a total horizontal visual field of 200°.

The horizontal binocular visual field is shown as a heart shape within a 180° field.

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Binocular Vision Assessment

The diagram shows a pyramid of visual functions divided into Sensory and Motor Fusion.

- Sensory Fusion** (top): Stereopsis, Sensory Fusion.
- Motor Fusion** (bottom): Fusional Vergences, Accommodation, Extra Ocular Muscle Function.
- Visual Acuity** (base): Visual Acuity.

Pre-clinical optometric test grid:


A. Visual acuity	B. Refraction	C. Stereopsis
D. Dissimil eye	E. Fusion test	F. Tropia/Phoria

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Ocular Misalignment

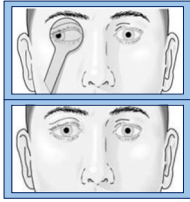
Tropia

- Strabismus, lazy eye, eye turn
- 2-4% general population



Phoria



- Natural resting position
- Under the cover paddle, eye moves to position of rest



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Horizontal Misalignments

Eso = eye(s) turns **in** towards the nose
Exo = eye(s) turns **out** towards the ear



Eso = turns in
Ex. Right Esotropia

- Infantile
- Accommodative
- Sixth Nerve Palsy

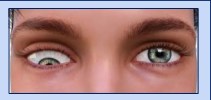
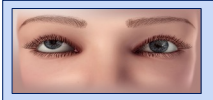
Exo = turns out
Ex. Right Exotropia

- Inherited
- Low Vision
- Stroke

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Vertical Misalignments

Hyper = eye turns **upward**
Hypo = eye turns **downward**





Hyper = Turns Up
Ex. Right Hypertropia

- Congenital
- Traumatic Brain Injury / Concussion

Hypo = Turns Down
Ex. Right Hypotropia

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Binocular Vision Conditions

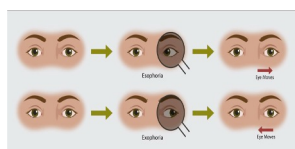



Condition	Treatment
Exophoria	Prism, VT
Esophoria	(+) Lenses, Prism
Vertical Phoria	Prism
Divergence Excess	Prism, VT
Convergence Excess	(+) Lenses, Prism

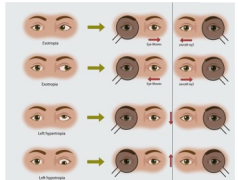
25

Cover Test

Unilateral Cover Test



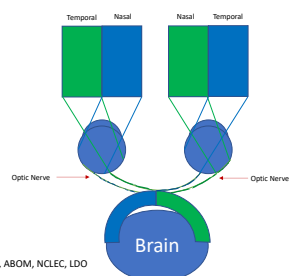
Alternating Cover Test



- **Normal Findings**
 - Distance = 0-2 pd XP
 - Near = 0-6 pd XP
 - Tropias, Eso and Vertical deviations are **not** normal

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Visual Pathway



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Visual Field


- Total area your eyes perceive while fixed on a central target
- Normal visual field
- 90 degrees temporally to central fixation
- 50 degrees superiorly and nasally
- 60 degrees inferiorly

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BV Assessment

- Accommodation
- Convergence
- Depth perception (3D)
- Fusion
- Ocular motility
- Ocular posture
- Review conditions that affect binocular vision
- Spatial awareness / planning




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Binocular Vision Assessment

- Stereopsis
- Tracking
- Working memory Vergence
- Visual acuity
- Visual-motor integration
- Visual perception
- Visual processing speed
- Working memory



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Ocular Motor Pathways

- Saccades
- Pursuits
- Vergence
- Vestibulo-ocular reflex

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Saccades





Fast conjugate eye movements looking back & forth between two objects.
Eye movement aligns the image on fovea centralis to obtain best VA.

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Saccades


-  Normal – “Patient showed accurate saccades with age-appropriate head movement during saccade assessment”
-  Abnormal – “Patient showed undershoots on 4 of 5 trials with excessive head movement for a person of this age.”

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Pursuits

Visual tracking (i.e., pursuits) - the ability to efficiently move the eyes from left to right (or right to left, up and down, and circular motions) or focusing on an object as it moves across a person's visual field.

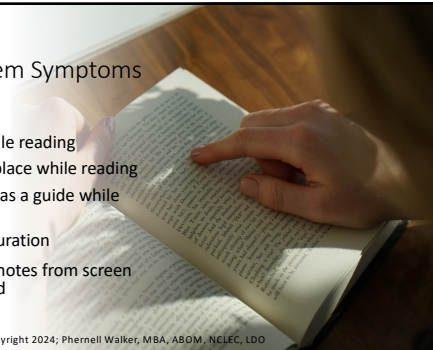


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Pursuit Problem Symptoms


- Skipping lines while reading
- Frequent loss of place while reading
- Using your finger as a guide while reading
- Short attention duration
- Difficulty writing notes from screen or dry erase board




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Documenting Pursuits

 Good Performance - Patient showed smooth tracking without lose of fixation and minimal head and body movement during tracking assessment.

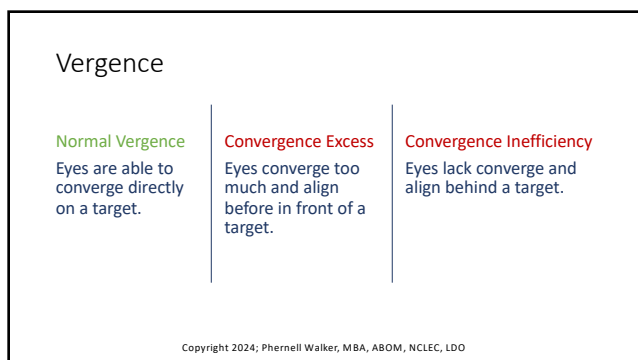
 Poor Performance – Patient showed jerky tracking, with 6 loses of fixation and excessive head movement during tracking assessment.

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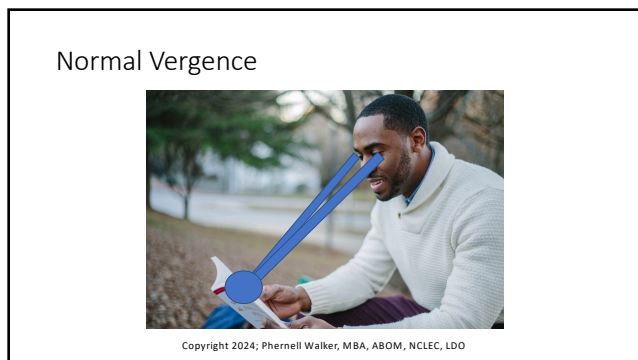
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Convergence Excess



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Convergence Inefficiency



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Eye Teaming

Eye Teaming (aka Vergence) -
The strength and flexibility of
the eye teaming system
should be evaluated.

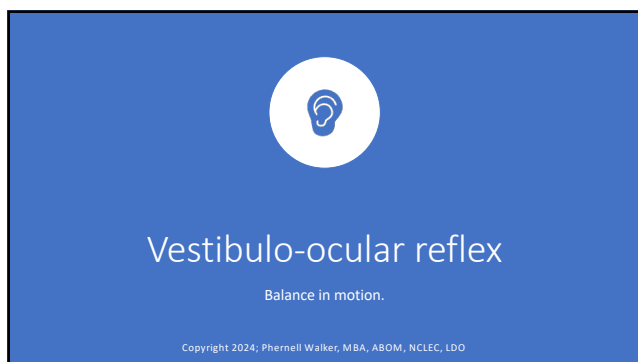
Deficits in eye teaming will
result in double vision,
eyestrain, fatigue, headaches,
or dizziness.

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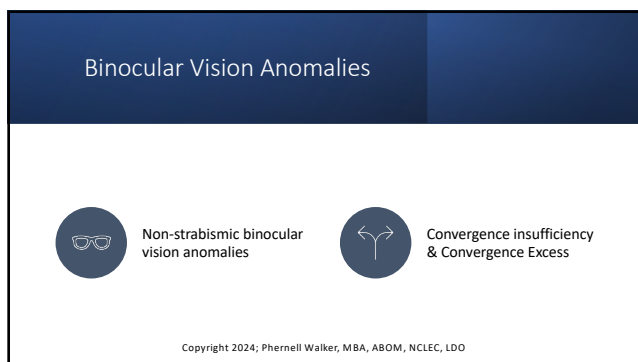
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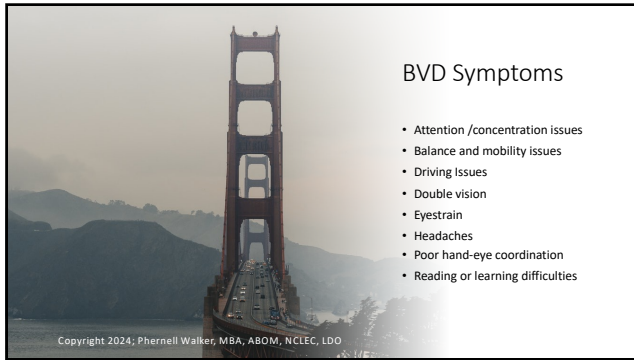
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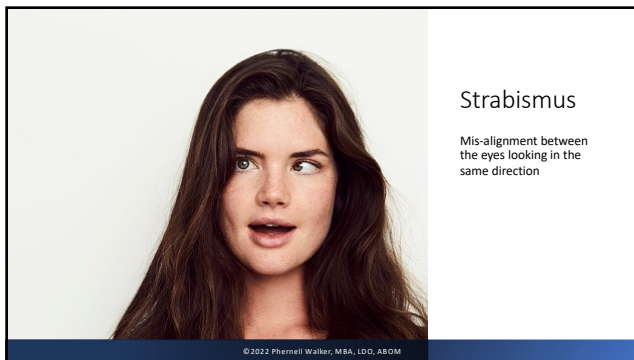
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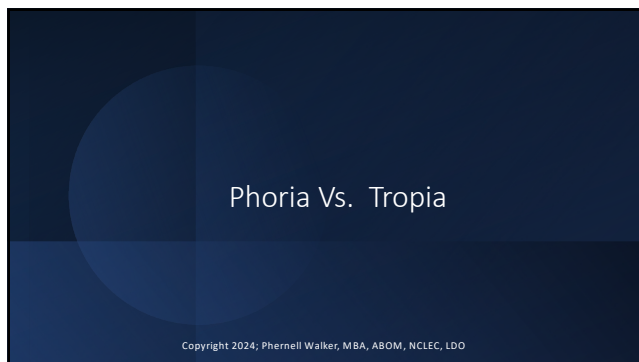
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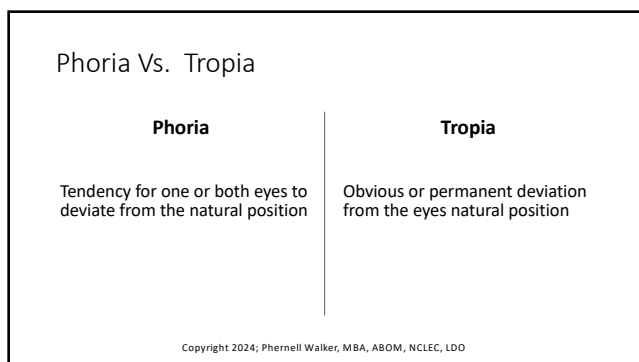
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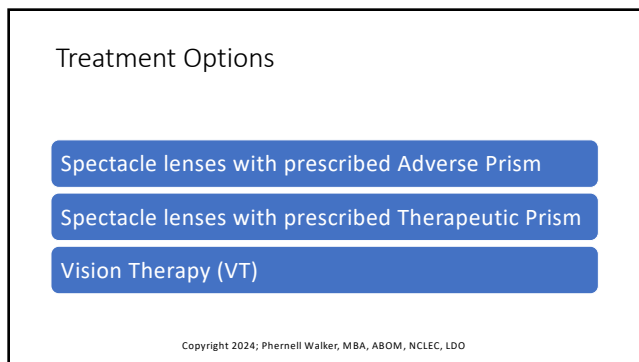
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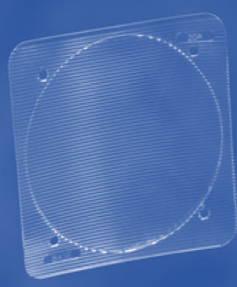
50



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Treatment Options


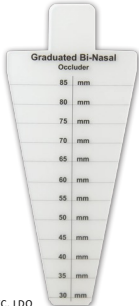
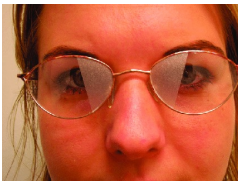
Temporary Testing Prism



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Binasal Occlusion



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Adverse Prism




Prescribed prism – apex over weak rectus muscle

Moving the image in the opposite direction of the eye

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Therapeutic Prism



Prescribed prism – base over weak rectus muscle

Moving the image in the direction of the eye

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Vision Therapy Indicated


- Amblyopia
- Strabismus
- Double Vision
- Depth Perception
- Convergence Insufficiency
- Eyestrain/Stress-Induced Vision Issues
- Neurological Ailments
 - traumatic brain injuries, strokes, multiple sclerosis, cerebral palsy, whiplash and developmental delays
- Eye teaming
- Accommodative dysfunction
- Oculomotor dysfunction

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Cranial Nerves

- CN II - vision
- CN III - eye motility
- CN IV - superior oblique eye muscle
- CN VI - lateral rectus eye muscle
- CN VII - facial and lacrimal gland



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Vision Therapy Indicated

Traumatic Brain Injury (TBI) stroke, automobile accidents, concussions, whiplash, post neurosurgical (e.g., tumor excision, aneurism repair)

80% of TBI patients suffer vision issues

We can use prism to widen a patient's field of view


1.00 diopter is equal to 0.573 degrees

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Diplopia

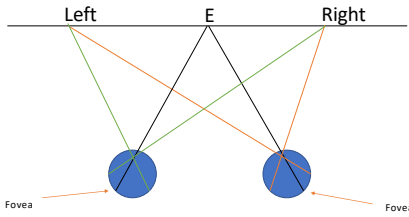
- stereopsis
- walking
- balance
- reading
- visual field loss



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Normal Binocular Vision




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Prism Power

- **Bilateral prism** - splitting prism between both eyes
- **Convergence (ESO)** - bilateral Base Out (B.O.)
- **Divergence (EXO)** - bilateral Base In (B.I.)
- **Right (Hyper)**
 - OD lens = Base Down (B.D.)
 - OS lens = Base Up (B.U.)
- **Left (Hyper)**
 - OD lens = Base Up (B.U.)
 - OS lens = Base Down (B.D.)



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Prism Therapy

Divergence - bilateral Base In (B.I.)

- Advantage - promotes bifocal stimulation
- Disadvantage - reduces (P.F.R.) prism fusional vergence amplitude

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Prism Therapy

Fusional Convergence amplitudes - focus on a accommodative target at near while holding a base out prism bar in front of one eye

Increasing the prism power gradually while maintaining a single image looking through Base Out Prism (B.O.)

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Accommodative Dysfunction

The strength, flexibility, and accuracy of the eye focusing system should be evaluated

Deficits in accommodation will result in blurry vision during near work, blurry vision when transitioning from near to distance tasks (such as copying notes from the board in school), and eye strain or fatigue

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BVD Anisometropia

Power difference of $\geq \pm 1.50$ D between the right and left eye in any meridian

OD: -2.25 -0.50 x 090
OS: -0.50 -0.75 x 090

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BVD Antimetropia

- Form of anisometropia
- Opposite refractive errors between eyes
- Patient is both hyperopic and myopic
- Opposite signs on the Rx

OD: +1.25 -0.50 x 090
OS: -0.75 -0.75 x 090

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What is Aniseikonia?



- Aniseikonia - unequal retinal image size between OD and OS
- Result of anisometropia
- Unequal magnification or demagnification
- Disrupts binocular vision

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Refractive vs. Axial Aniseikonia

- **Refractive** - result of refractive anisometropia
- **Axial** - result of axial anisometropia

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Solutions

- Keratometry or Topography
 - Delta K difference indicates refractive anisometropia
 - Solution = Contact lenses
- Biometry ("A Scan")
 - Significant delta between OD & OS axial length
 - Solution = Iseikonic spectacles vs. contact lenses

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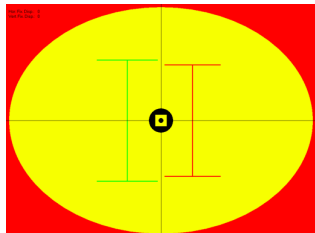
Subjective Tests

- Space eikonometer
- Synoptopore
- Computer simulation (most popular)
- Test Book - S. Awaya (second most popular)
- Maddox rod two pen light test

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Computer Simulation



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S. Awaya



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Oculomotor Dysfunction

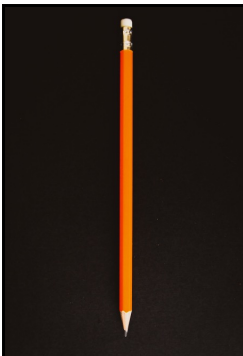
Eye tracking

Quality of your eye movements is related to the neural connections to the brain as well as the integrity of the eye muscles themselves.

Eye movements - used to determination of a central nervous system dysfunction (i.e.; tumors, inflammation, or neurologic conditions)

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Convergence Insufficiency Pencil Push-Up Treatment

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Pencil Push-Up Treatment



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