**Slide 1**

Phernell Walker, MBA,ABOM

Binocular Vision Dysfunction;
Vision Therapy and Ophthalmic Lenses

1

**Slide 2**

PURE OPTICS

| Optometric Strategy | Business Operations | Ophthalmic Education |

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

2

**Slide 3**

### Phernell Walker, MBA, ABOM, NCLEC, LDO

- ❖ Owner | Pure Optics LLC
- ❖ Author | Pure Optics
- ❖ American Board of Opticianry | Board of Directors
- ❖ Pacific University College of Optometry | Past Adjunct Professor
- ❖ Master in Business Administration (MBA)
- ❖ Master in Ophthalmic Optics (ABOM)
- ❖ Licensed Dispensing Optician (WA-LDO)
- ❖ National Contact Lens Examiners Certified (NCLEC)
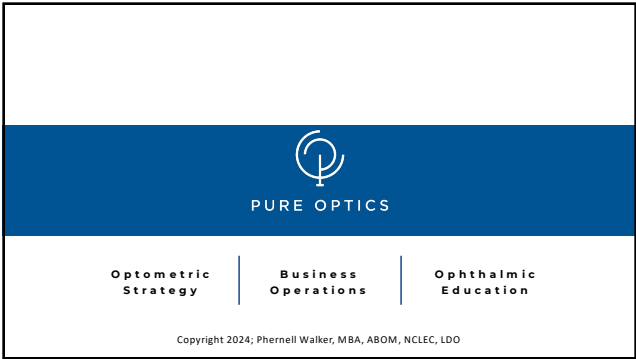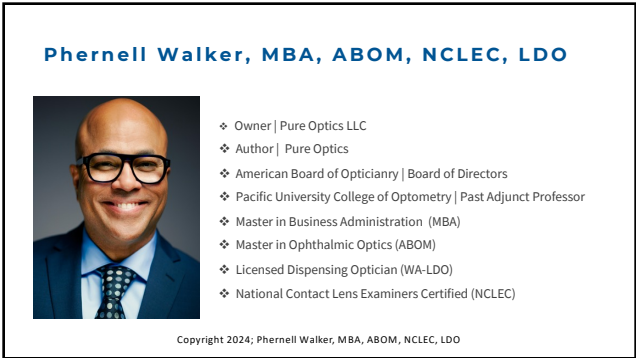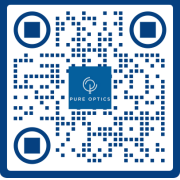
Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

3

SCAN ME

Contact Information

Phernell Walker, MBA, ABOM, NCLEC, LDO

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

4
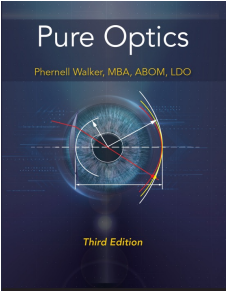
Reference Resource

Pure Optics

by

Phernell Walker, MBA, ABOM, LDO
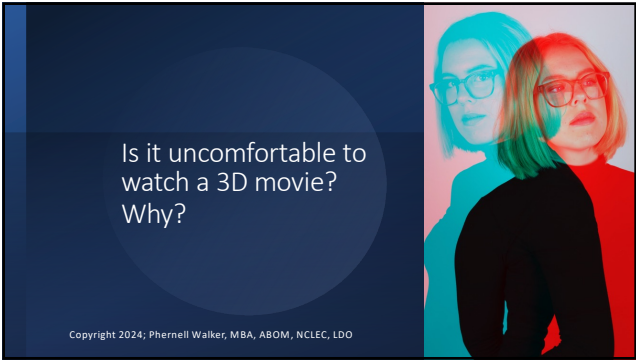
Pure Optics

Phernell Walker, MBA, ABOM, LDO

*Third Edition*

5

Agenda

Components of binocular vision

Sensory binocular vision

Binocular vision anomalies

Treatment options

6

### Have you seen a 3D movie?

7

### Is it uncomfortable to watch a 3D movie? Why?

8

### Vision occurs in the brain

9

Vision is an active process
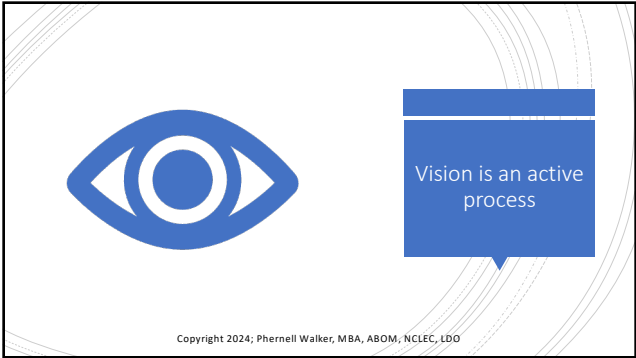
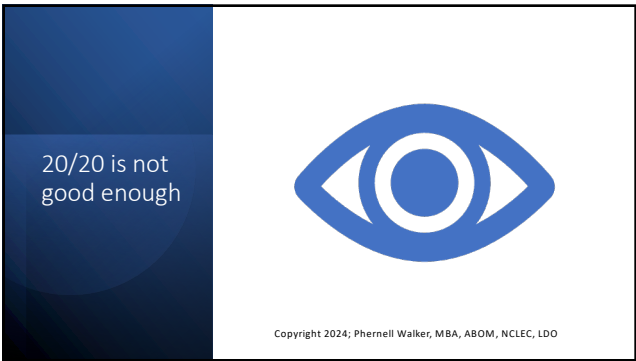10

20/20 is not good enough
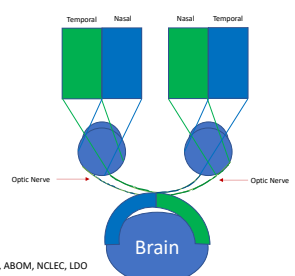
11

Two Eyes Are Better than One
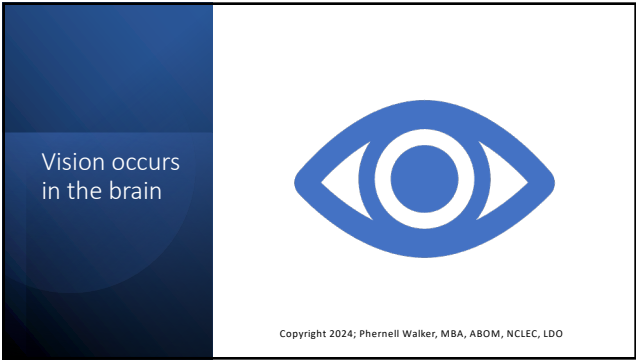
12

## Binocular Vision

- Image unification from two eyes
- Stereopsis
- Balance
- Spatial relationship between objects

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

13

## Visual Pathway

Temporal   Nasal     Nasal   Temporal

Optic Nerve          Optic Nerve

Brain

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

14

## 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

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

15

## BV Assessment

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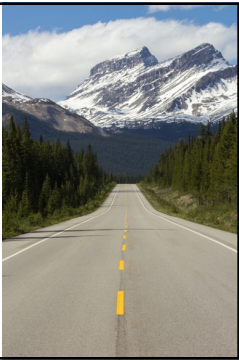- Spatial awareness / planning

16

## Binocular Vision Assessment

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

17

## Ocular Motor Pathways

- Saccades
- Pursuits
- Vergence
- Vestibulo-ocular reflex

18

## Saccades

Fast conjugate eye movements looking back & forth between two objects.

Eye movement aligns the image on fovea centralis to obtain best VA.

19

## 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."

20

## 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.
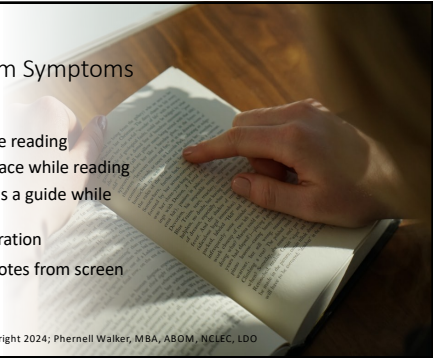
21

**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

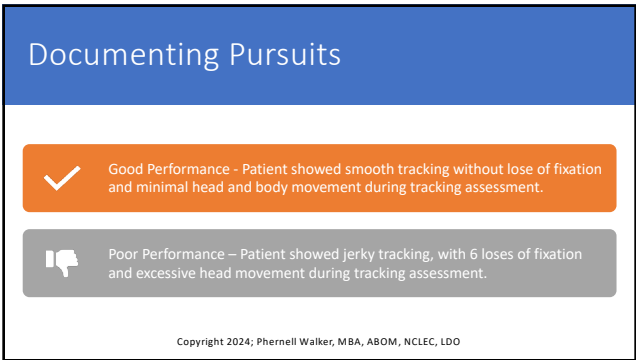22

---

**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.

23

---

**Pursuits**
**Practice Makes Perfect**

24

---

## Vergence

**Normal Vergence**
Eyes are able to converge directly on a target.

**Convergence Excess**
Eyes converge too much and align before in front of a target.

**Convergence Inefficiency**
Eyes lack converge and align behind a target.

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

25

## Normal Vergence



Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

26

## Convergence Excess



Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

27

**Convergence Inefficiency**

28

**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.

29

Vergence
Practice Makes Perfect

30

## Vestibulo-ocular reflex

Balance in motion.

31

## Binocular Vision Anomalies
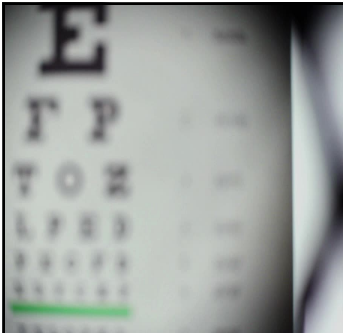
Non-strabismic binocular vision anomalies

Convergence insufficiency & Convergence Excess

32

## Visual Acuity

- Clarity of vision
- Foundation of binocular vision

33
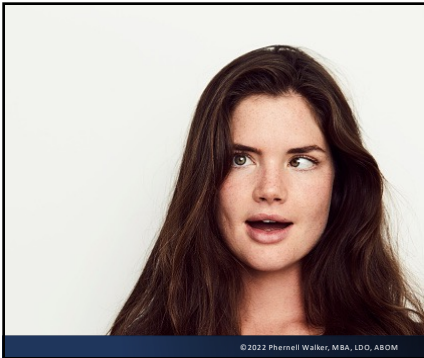
## BVD Symptoms

- Attention /concentration issues
- Balance and mobility issues
- Driving Issues
- Double vision
- Eyestrain
- Headaches
- Poor hand-eye coordination
- Reading or learning difficulties

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

34



## Strabismus

Mis-alignment between the eyes looking in the same direction

©2022 Phernell Walker, MBA, LDO, ABOM

35



Strabismus

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

36

## Phoria Vs. Tropia

37

## Phoria Vs. Tropia

| **Phoria** | **Tropia** |
|---|---|
| Tendency for one or both eyes to deviate from the natural position | Obvious or permanent deviation from the eyes natural position |

38

## Treatment Options

- Spectacle lenses with prescribed Adverse Prism
- Spectacle lenses with prescribed Therapeutic Prism
- Vision Therapy (VT)
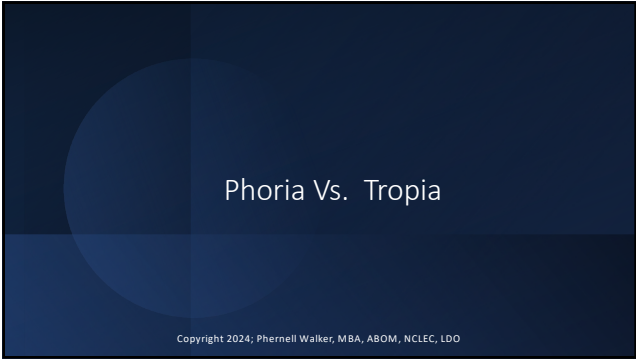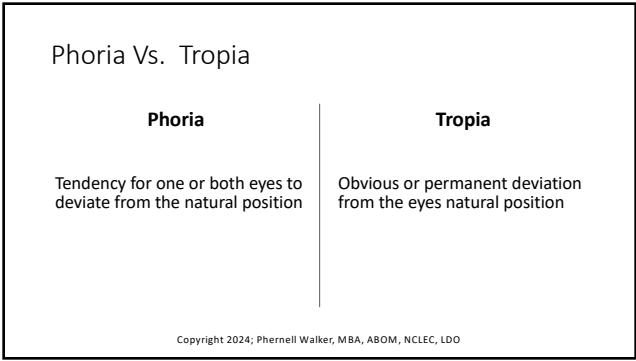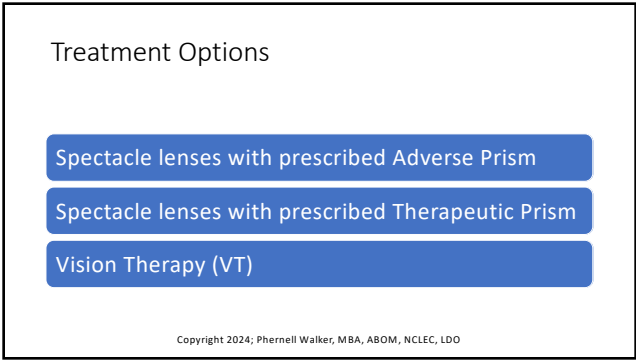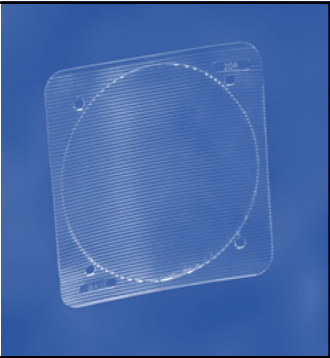
39

## Treatment Options
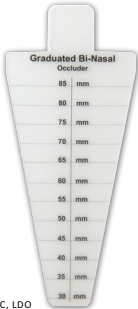
### Temporary Testing Prism

40

## Binasal Occlusion

Graduated Bi-Nasal Occluder

85 mm
80 mm
75 mm
70 mm
65 mm
60 mm
55 mm
50 mm
45 mm
40 mm
35 mm
30 mm

41

## Adverse Prism

Prescribed prism – apex over weak rectus muscle

Moving the image in the opposite direction of the eye

42

## Therapeutic Prism



Prescribed prism – base over weak rectus muscle

Moving the image in the direction of the eye

43

## Vison 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

44

## 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

45

**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

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

46

**Diplopia**

stereopsis

walking

balance

reading

visual field loss
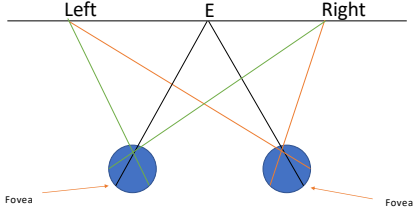
Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

47

**Normal Binocular Vision**

Left        E        Right

Fovea                    Fovea

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

48

## Slide 49

### 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)

49

## Slide 50

### Prism Therapy

**Divergence** - bilateral Base In (B.I.)
· Advantage - promotes bifocal stimulation
· Disadvantage - reduces (P.F.R.) prism fusional vergence amplitude

50

## Slide 51

### 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.)

51

### 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

52

### BVD Anisometropia

Power difference of $\geq$ +/- 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

53

### 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

54

### Verify by Flat Transposition

OD: -1.00 +2.50 x 165
OS: -1.75 +1.50 x 015

55

### Anisometropia in Multifocal

OD: +1.50 -0.50 x 180

OS: -1.00 -0.75 x 180

Add: +2.75

PD: 32/34

+1.00          -1.75

+1.50   —|—        -1.00   —|—

OD               OS

56

### Discovery

OD: -2.25 -1.50 x 135

OS: -1.00 - 2.00 x 090

Add: +2.75

PD: 35/34

57

### Slab-off | Bicentric Grinding
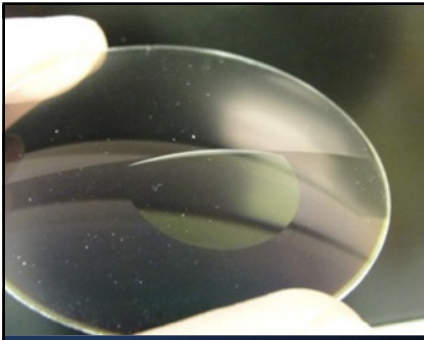
Slab-off - the use of prism in the reading portion of a lens to balance unequal prism in the $090^{th}$ meridian between the OD and OS lenses.

**Slab-off Methods:**

- Traditional Slab-off
- Reverse Slab-off

58

Slab Off

59

### Traditional Slab-off

| | |
|---|---|
| Imbalance = | > 1.50 D x $090^{th}$ Meridian |
| Lens Selection = | Weakest Plus Power |
| Lens Selection = | Stronger Minus Power |
| Ground (Surfaced) = | Base Up Prism x $090^{th}$ Meridian |

60

## Reverse Slab-off

| | |
|---|---|
| Imbalance = | > 1.50 D x 090th Meridian |
| Lens Selection = | Strongest Plus Power |
| Lens Selection = | Weaker Minus Power |
| Ground (Surfaced) = | Base Down Prism x 090th Meridian |

61

## Solution

How much slab-off should you prescribe?

OD: -2.25 -1.50 x 135

OS: -1.00 - 2.00 x 090  Add:  +2.50  OU

Ft. 28

PD: 35/34

62

## Slab-off Made Easy

Calculate the dioptric power in the 090th meridian of each lens

$D_e = S + [ C (sine\ a)2 ]$

Calculate the amount of prism 10 mm (reading level - FT 28) or 8 mm (reading level - FT 35) below the distance optical center per lens

$P = (1\ cm) (D_e)$

The dioptric difference between each lens is the amount of prism required

63

## Calculate Slab-off Ft. 28

- Calculate the dioptric power in the 090th meridian of each lens
- Calculate the amount of prism use 1 cm (10 mm)
- The dioptric difference between each lens is the amount of prism required

OD: -2.25 -1.50 x 135
OS: -1.00 - 2.00 x 090
Add: +2.50, Ft. 28

OD: -3.00 | OS: -1.00

(3) (1.0) | (1) (1.0)

OD: 3D | OS: 1D

3 - 1 = 2

**OD = 2 Diopters, BU**

64

## Calculate Slab-off Ft. 35

- Calculate the dioptric power in the 090th meridian of each lens
- Calculate the amount of prism use .8 cm (8 mm)
- The dioptric difference between each lens is the amount of prism required

OD: -2.25 -1.50 x 135
OS: -1.00 - 2.00 x 090
Add: +2.50, Ft. 35

OD: -3.00 | OS: -1.00

(3) (.8) | (1) (.8)

OD: 2.40 D | OS: 0.80 D

2.40 − 0.80 = 1.60

**OD = 1.60 Diopters, BU**

65

## Slab-off Verification

Slab-off verification using a a lens clock.

- Measure the base curve in the 090th meridian (distance portion only)
- Measure the base curve with the center pin on the slab-off line, one pin on the distance portion and one pin on the near portion
- The difference is equal to the Base Up prism

66

## Verification of Bi-Centric Grinding



Slab-off

First Measurement

Second Measurement

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

67

## Slab-off Verification

| 1 | 2 | 3 |
|---|---|---|
| Base Curve 090th meridian (distance portion) = +6.25 D. | Base Curve 090th meridian (dual curve) = +8.25 D. | Net Result 2.00  B. U. |

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

68

## What is Aniseikonia?

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

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

69

## Refractive vs. Axial Aniseikonia

**Refractive** - result of refractive anisometropia

**Axial -** result of axial anisometropia

70

## Solutions

- Keratometry or Topography
  - Delta K difference indicates refractive anisometropia
  - Solution = Contact lenses

- Biometry ("A Scan")
  - Significant delta between OD & OS axial length
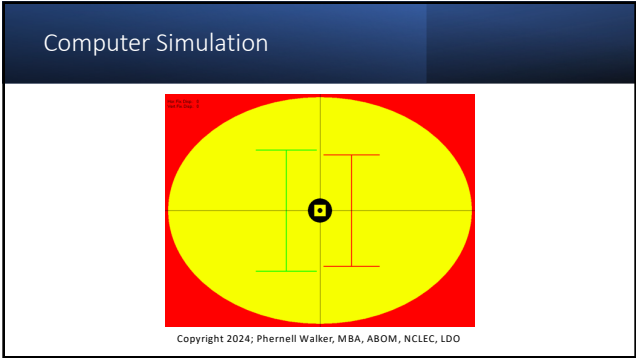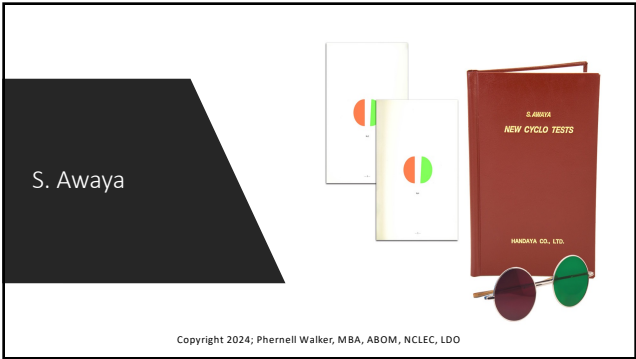  - Solution = Iseikonic spectacles vs. contact lenses

71

## Subjective Tests

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

72

## Computer Simulation

73

S. Awaya

74

Synoptophore
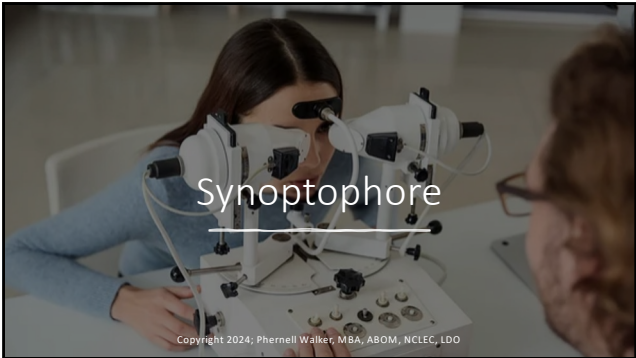
75

Types of Aniseikonia

**Physiological Aniseikonia**

**Anomalous Aniseikonia**

76

---

Physiological Aniseikonia

Normal function of visual system

Helps determine object position and stereopsis

77

---

Anomalous Aniseikonia

**Occurs when the object is seen straight ahead**

**Retinal images that are difficult to fuse or in a distorted space perception**

78

---

## Dynamic Aniseikonia

Subcategory of Anomalous Aniseikonia

Two perceived retinal images are of a different size

Although images are the same, eye rotation to foveate to a different part of the image anisometropic lenses might induce anisophoria, causing an apparent aniseikonia.

79

## Aniseikonia Candidates

Individual tolerance for magnification differential threshold

Anisometropia prescriptions can significantly cause aniseikonic symptoms

80

## Common Symptoms

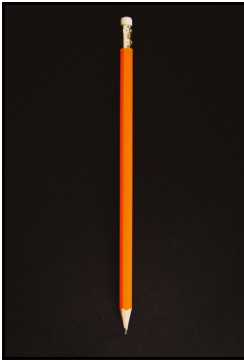| | | | |
|---|---|---|---|
| Headaches 67% | Asthenopia (fatigue, burning, tearing, pain, pulling) 67% | Photophobia 27% | Reading difficulty 23% |
| Nausea15% | Motility (diplopia) 11% | Nervousness11% | Vertigo and dizziness 7% |
| General fatigue 7% | Distorted space perception 6% | Binocular Vision Dysfunction (driving issues) 40% | |

81

## 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)

82
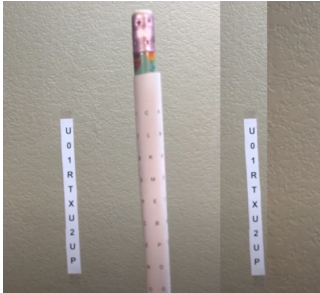
## Convergence Insufficiency Pencil Push-Up Treatment

83

Pencil Push-Up Treatment

84

## Pencil Push-Up Treatment
### Practice Makes Perfect

85

## Stereopsis

- Depth perception
- Dependent on the ability to use both eyes together
- Deficiencies results in reduced 3D vision, headaches and eye strain during 3D movies

86

## Take Aways

1. Though 20% of Binocular Vision Dysfunction (BVD) is diagnosed, an estimated 56% of people suffer from BVD

2. Consider adding vision therapy and, or lens designs that address BVD issues to your ophthalmic lens portfolio

3. Consider prism lenses even for small amounts of strabismus to provide the best vision for your patients.

87

Questions

Copyright 2024; Phernell Walker, MBA, ABOM, NCLEC, LDO

88