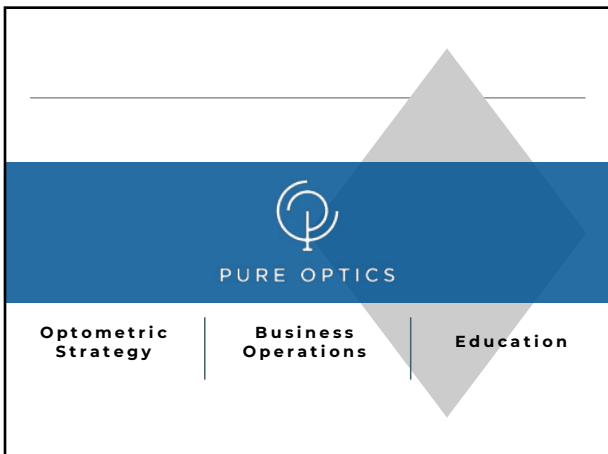





1



2



3



Phernell Walker, MBA, ABOM, LDO

w: pure-optics.com

e: phernell@pure-optics.com

Copyright 2021-2024, Phernell Walker, MBA, ABOM, LDO

4

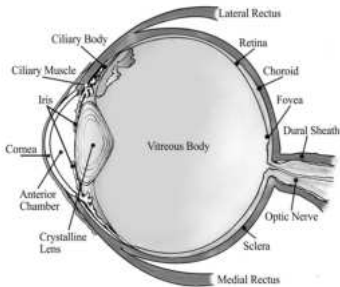
Refraction - We Bend Light

1. Refraction the process of bending light.
2. The process of measuring the refractive state of the eye.

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

5

Human Eye



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

6

Refractive State

No Refractive Error:

- Emmetropia

Ametropia (Refractive Errors):

- Myopia
- Hyperopia
- Astigmatism

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

7

Gullstrand's Model Eye

- Allvar Gullstrand (Sweden)
- 1862 - 1930
- Cornea: +43.00 D (ct = .5 mm)
- Crystalline Lens = +19.00 D
- Index of Refraction:
 - Cornea: 1.376n
 - Crystalline lens: 1.416n
 - Aqueous/ Vitreous: 1.336n
 - Abbe Value: 45
- Axial length: 24 mm



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

8

Emmetropia

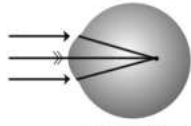
- No refractive error present
- Cornea and lens shaped correctly
- Distance between fovea and lens is correct
- Axial Length
- Light from 20ft. Is focused on the retina
- The eye can accommodate for near objects
- Emmetropia eye needs no corrective lenses

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

9

Myopia

- Nearsighted
- Eyeball is too long
- Distance lens and fovea is too great
- Light comes to a focus in the vitreous humor
- Sometimes the crystalline lens does not need to accommodate for near vision
- A minus (diverging) lens is use to correct



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

10

Myopic VA Approximation

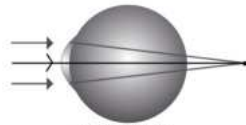
Myopia	Distance Acuity
-1.00D	20/80
-2.00D	20/200
-3.00D	20/400
-4.00D	less than 20/400

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

11

Hyperopia

- Farsightedness
- Eyeball's axial length is too short
- Light from distance may or may not focus on the retina
- Light from closer source focuses behind the retina
- A plus (converging) lens is used to correct Farsightedness



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO



12

Objective Refraction

Determine the refractive state of the eye without patient input

Examples:

- Auto-Refractor
- Retinoscope



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO


13

Retinoscopy

Process of shining a light into your patients eye and observing the "fundus reflex".

Look for the Motion of the Reflex:

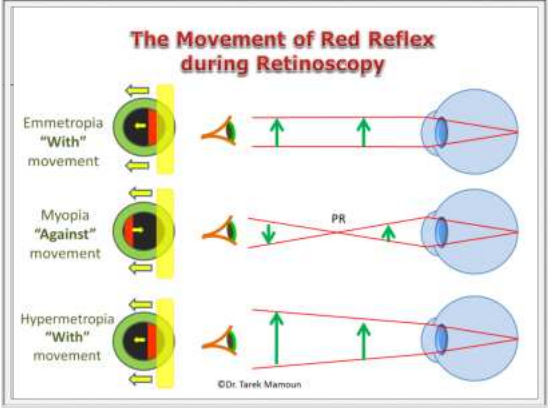
- With Motion
- Against Motion



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

14

The Movement of Red Reflex during Retinoscopy



Emmetropia "With" movement

Myopia "Against" movement

Hypermetropia "With" movement

©Dr. Tarek Mamoun

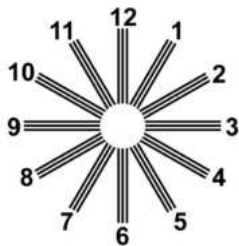
15



16

Astigmatism

Refractive condition whereby light does not focus on the retina. Instead two line foci are created 090 degrees apart.



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

17

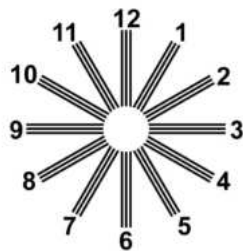
Clock Dial Method

1. Fog Patient (Plus Power) to ~ 20/40
2. Which lines are clearest?
3. Equally in Focus = 0 Astigmatism
4. Not equally in focus = Astigmatism
5. Multiply the lower number x 30 to determine the axis

Example:

If 3 & 9 are clear: $3 \times 30 = 090$

Answer: Axis = 090



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

18

Jackson Cross Cylinder (JCC)

- Jackson Cross Cylinder is a combination of two cylinders (minus & plus power) 090 degrees apart
- JCC Power = +/- 0.25 or +/-0.50
- Red Dots = Minus Power
- White Dots = Plus Power



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

19

Presbyopia

- This is a condition, not a refractive error
- Crystalline lens loses natural ability to focus
- Ciliary loses its elasticity, ability to accommodate
- Accommodation lessens with age
- Multifocal's such as Bifocals, trifocals, progressive, SV near are used to correct

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

20

Astigmatism

- The most common refractive error of all
- The cornea is aspherical in the in the central zone
- Light has different focal points in different meridians creating a *line focus*
- Meridians are usually 90 degrees apart
- Almost 2/3 of the population has astigmatism
- Spherocylindrical lenses are used correct

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

21

Myopia & Near Point

The eye has no need to accommodate, and does not converge...

This is not necessarily a good thing!

The myope has a tendency to under accommodate and under converge.

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

22

Uncorrected Myopia

- Force eyes to converge at near
- Alternate vision
- Eyes turn outward
- Don't use one eye

Myopes typically lean towards exophoria

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

23

Hyperopic Children

The young hyperopic child can accommodate at near.

In fact, they over accommodate, and over converge and typically have esophoria.

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

24

Uncorrected Hyperope

- Ignore one image, develop lazy eye
- Diplopia
- Asthenopia
- Alternate vision
- Eyes can become crossed-eyed
- Typically have esophoria

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

25

Refraction Methods

- Habitual Rx (WRx)
- Auto-Refractor (AR)
- Manifest Rx (MRx)
- Cycloplegic (CRx) (aka Wet)
- Final Rx (Rx)

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

26

Subjective Refraction

Subjective refraction is used after the initial objective refraction (used to determine a starting point or for non-communicative patients).

Basic Order:

1. Find Spherical Power
2. Determine Cylinder Axis & Power
3. Refine the Sphere
4. Binocular Balancing (Dissociated Prism or Duochrome)

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

27

Lighting Conditions

Indirect lighting should be used when performing a refraction.

Total darkness, nor bright light should be used. Light with a dimmer switch works best.



Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

28

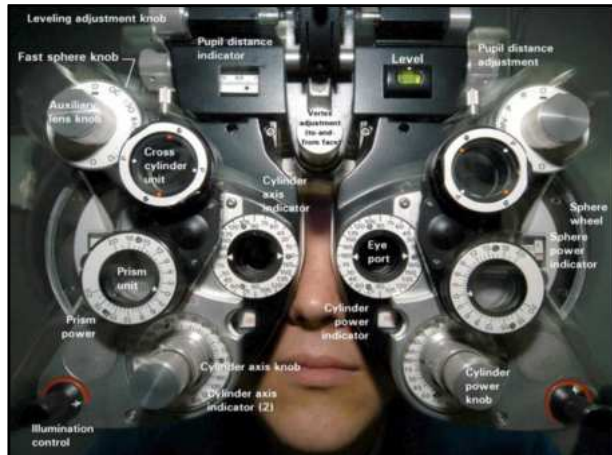
Phoropter

The phoropter is an instrument used to: determine the refractive state of the eye, measures amount of deviation of the eyes with the use of prisms needed to neutralize the imbalance.

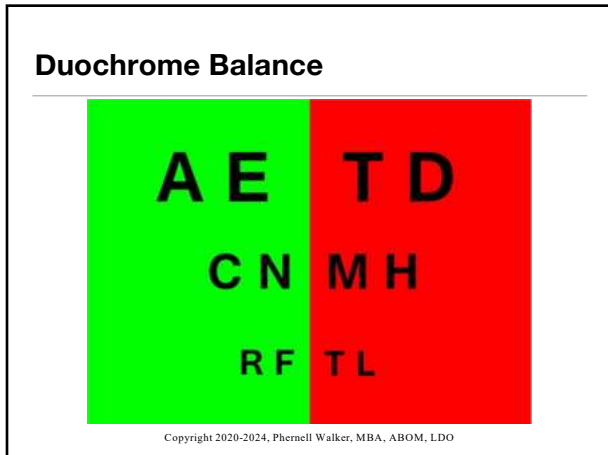
It contains many plus, minus, cylindrical and prism lenses secured in a "lens bank".

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

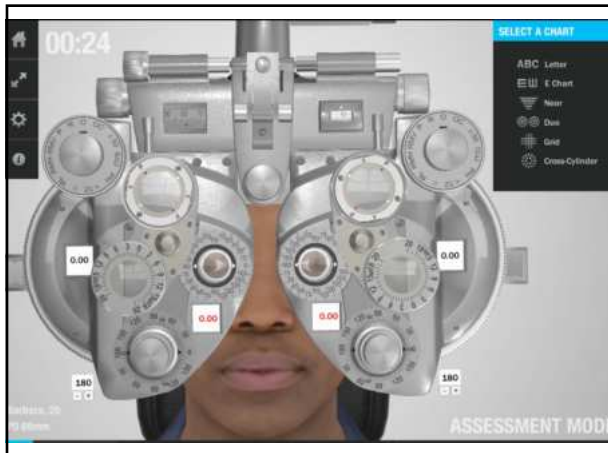
29



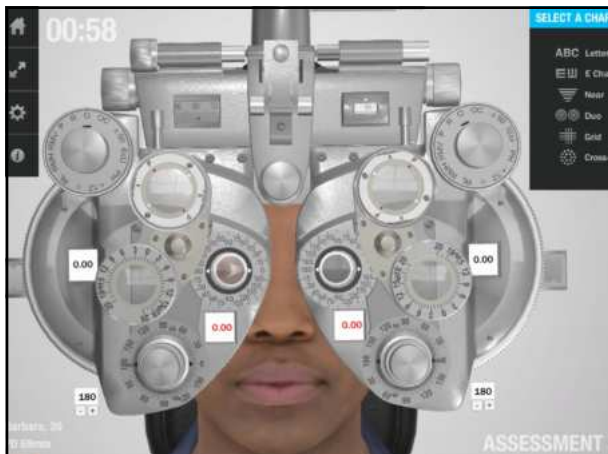
30



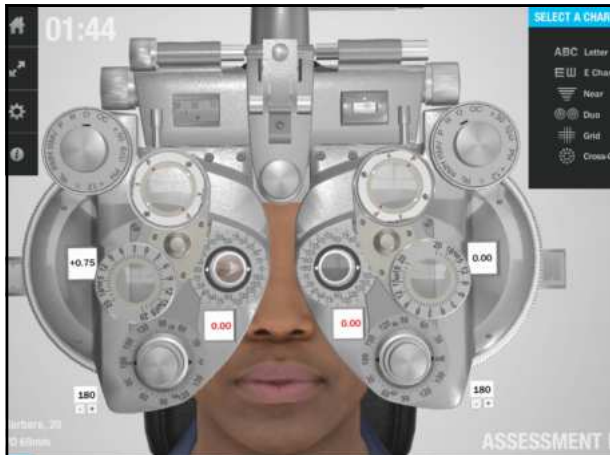
34



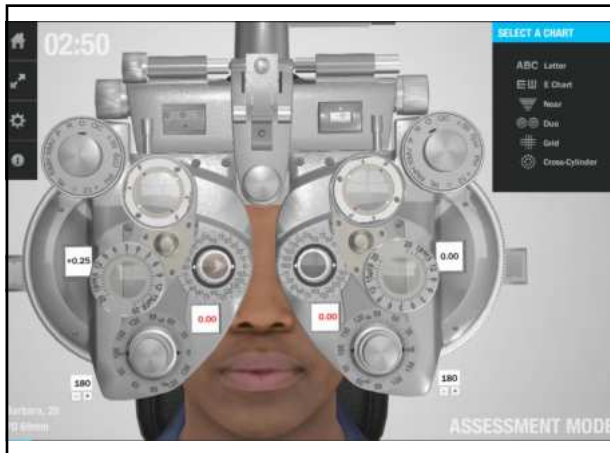
35



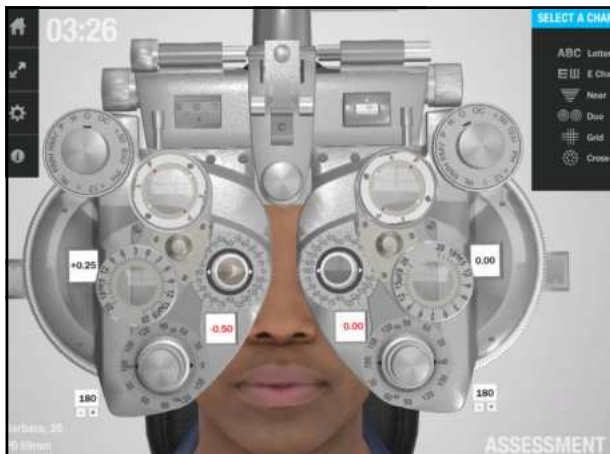
36



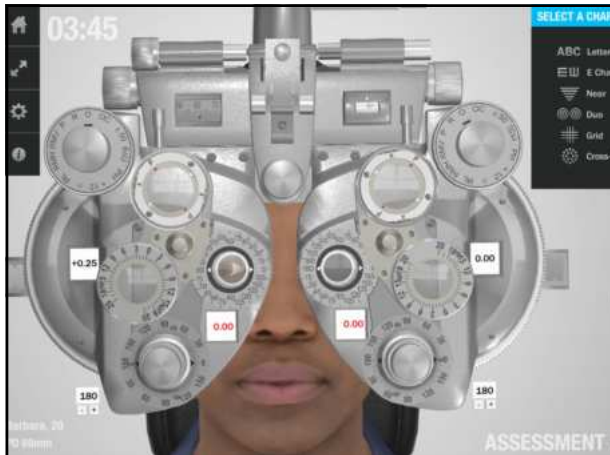
37



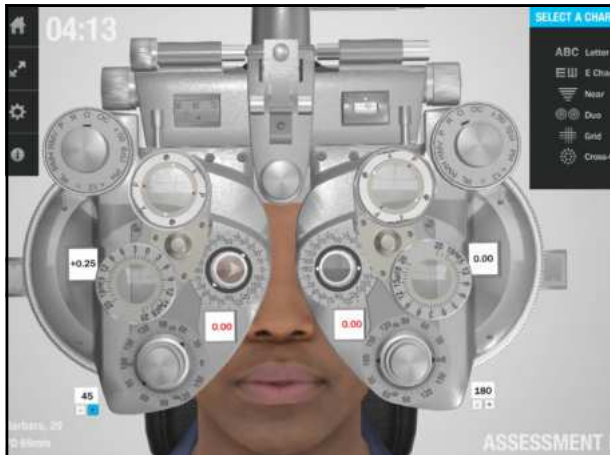
38



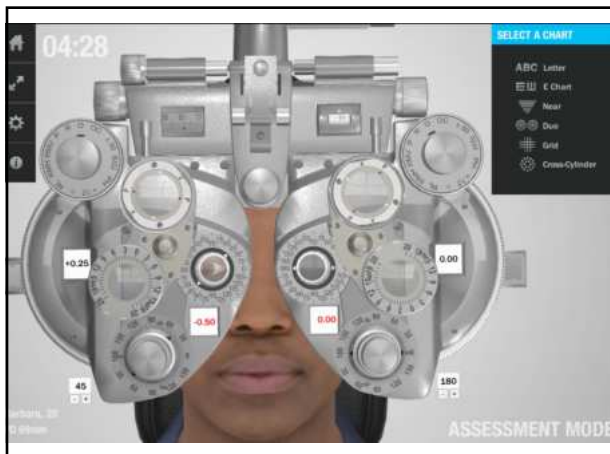
39



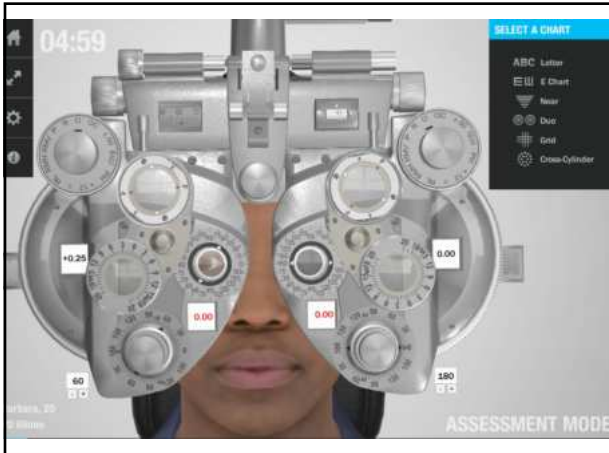
40



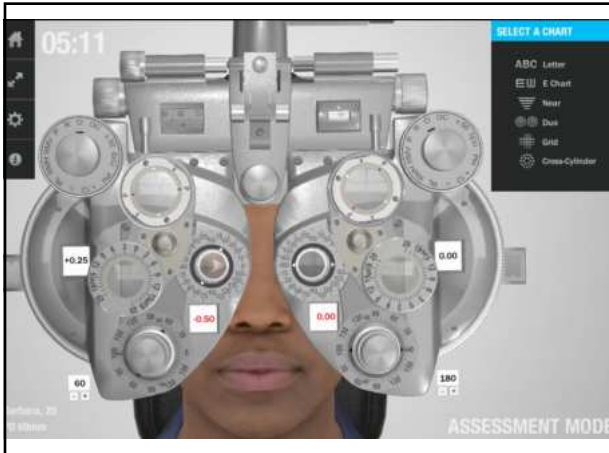
41



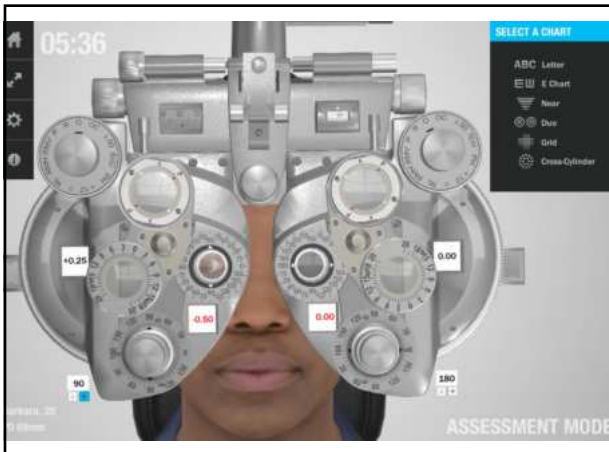
42



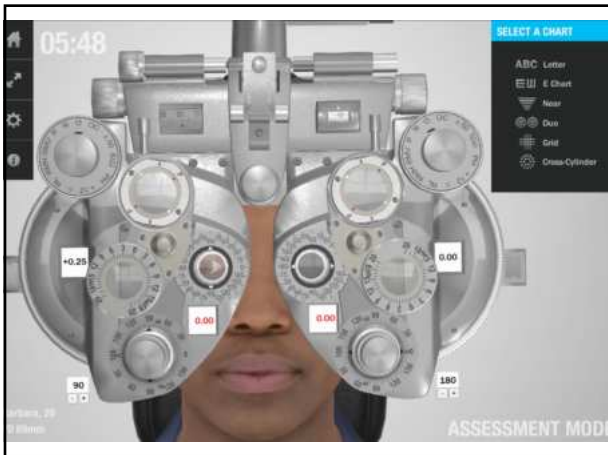
43



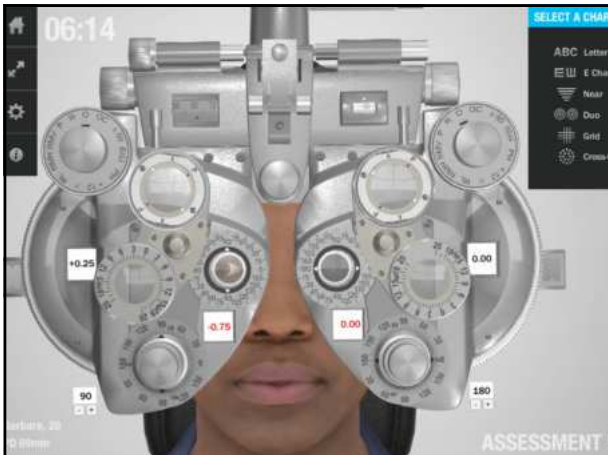
44



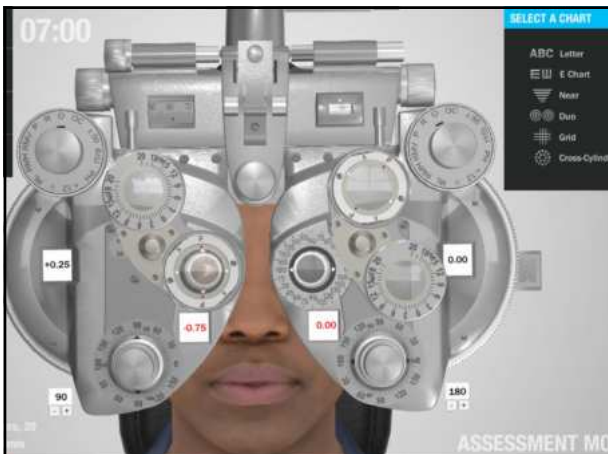
45



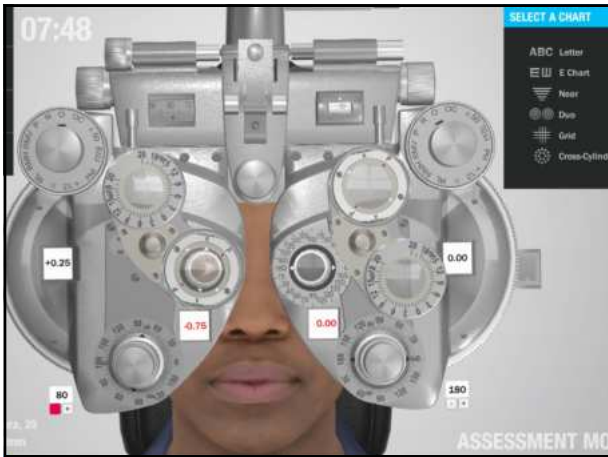
46



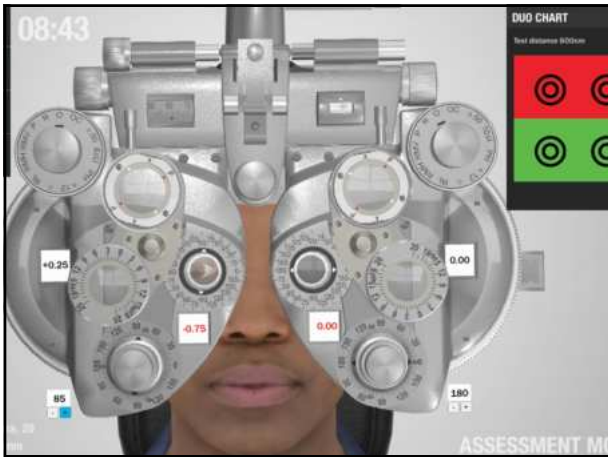
47



48



49



50

Beware

Pseudomyopia:
Condition of on-going spasm of accommodation. A hyperope or emmetrope becomes falsely myopic.

Correction:
Requires plus lenses
Prism Base In – to relieve convergence from the work of overcoming excessive exophoria & relieve acc/ conv.
Function
Visual Training

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

51

Add Power

- An add or additional plus power is typically prescribed for presbyopes.
- This can be measured with a reading rod or estimated by age.

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

52

Average Add Power

Age	Myopia	Emmetrope	Hyperope	(low- high)
34-38	X	X	X	+0.75
39-40	X	+1.00	+0.75	+1.25
44-48	+1.00	+1.25	+1.25	+1.75
49-55	+1.50	+1.75	+1.75	+2.25
56-62	+1.75	+2.00	+2.25	+2.50
63	+2.25	+2.50	+2.50	+2.50

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

53

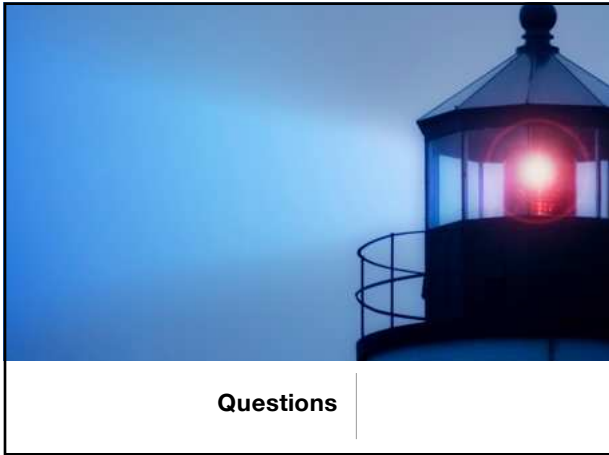
Refraction Goal

The goal of a refraction is to provide the patient with the clearest perceived vision as possible!

Prescribe the most plus power possible for hyperopes and the least minus power to myopes.

Copyright 2020-2024, Phernell Walker, MBA, ABOM, LDO

54



55



56
