GP Single Vision and Toric Lens Fitting

Michael Gzik FCLSA, ABO/NCLE, COT


NCLE Review
ABO/NCLE National
Opticians Conference
Friday November 2nd 2012
Washington DC

Prescription Analysis for Contact Lenses

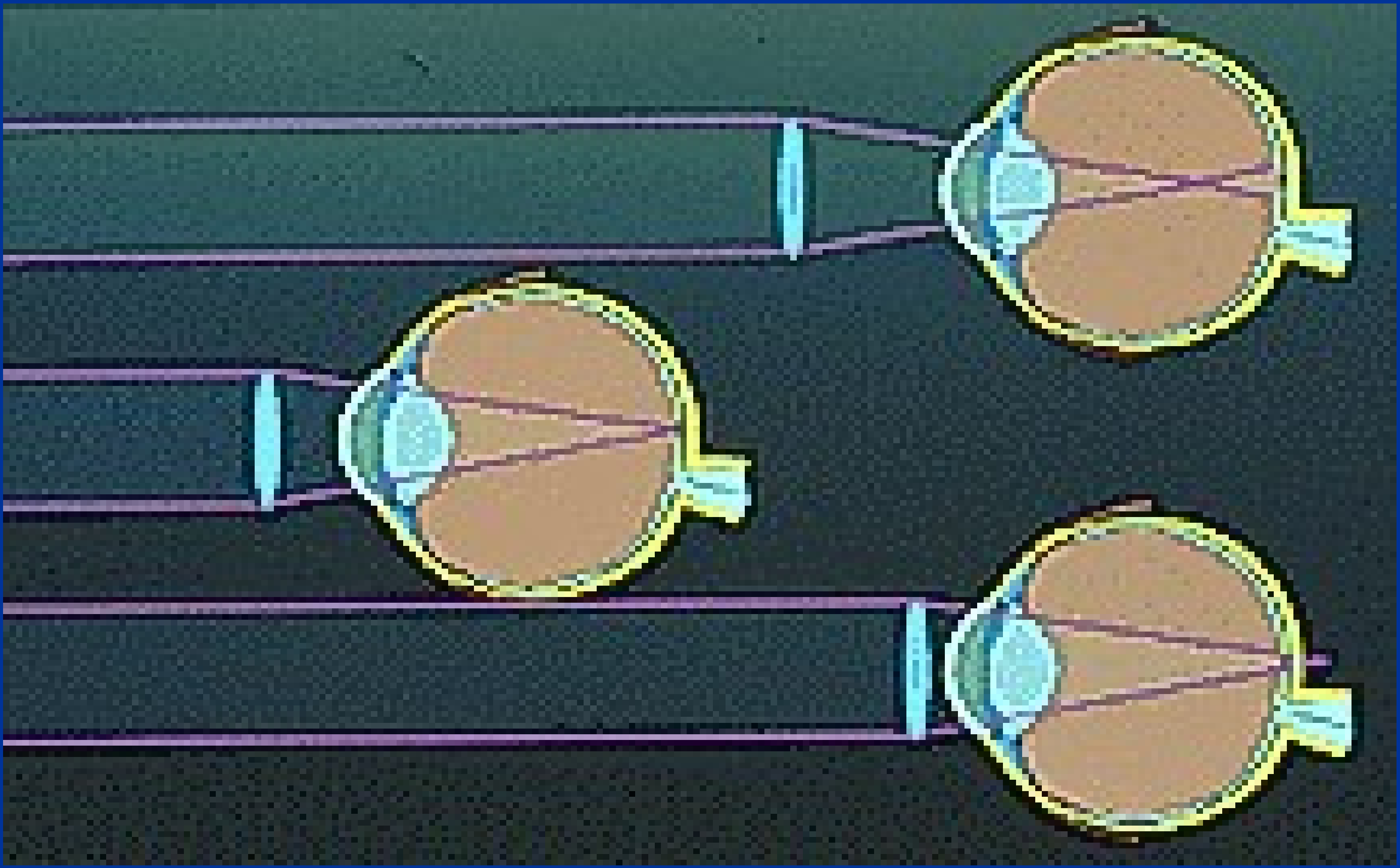
- All prescriptions in minus cylinder form (transpose from + to -)

- Vertex distance compensation for anything over +/- 4.00 diopters

- Start with the spherical power for all prescriptions

Vertex Distance

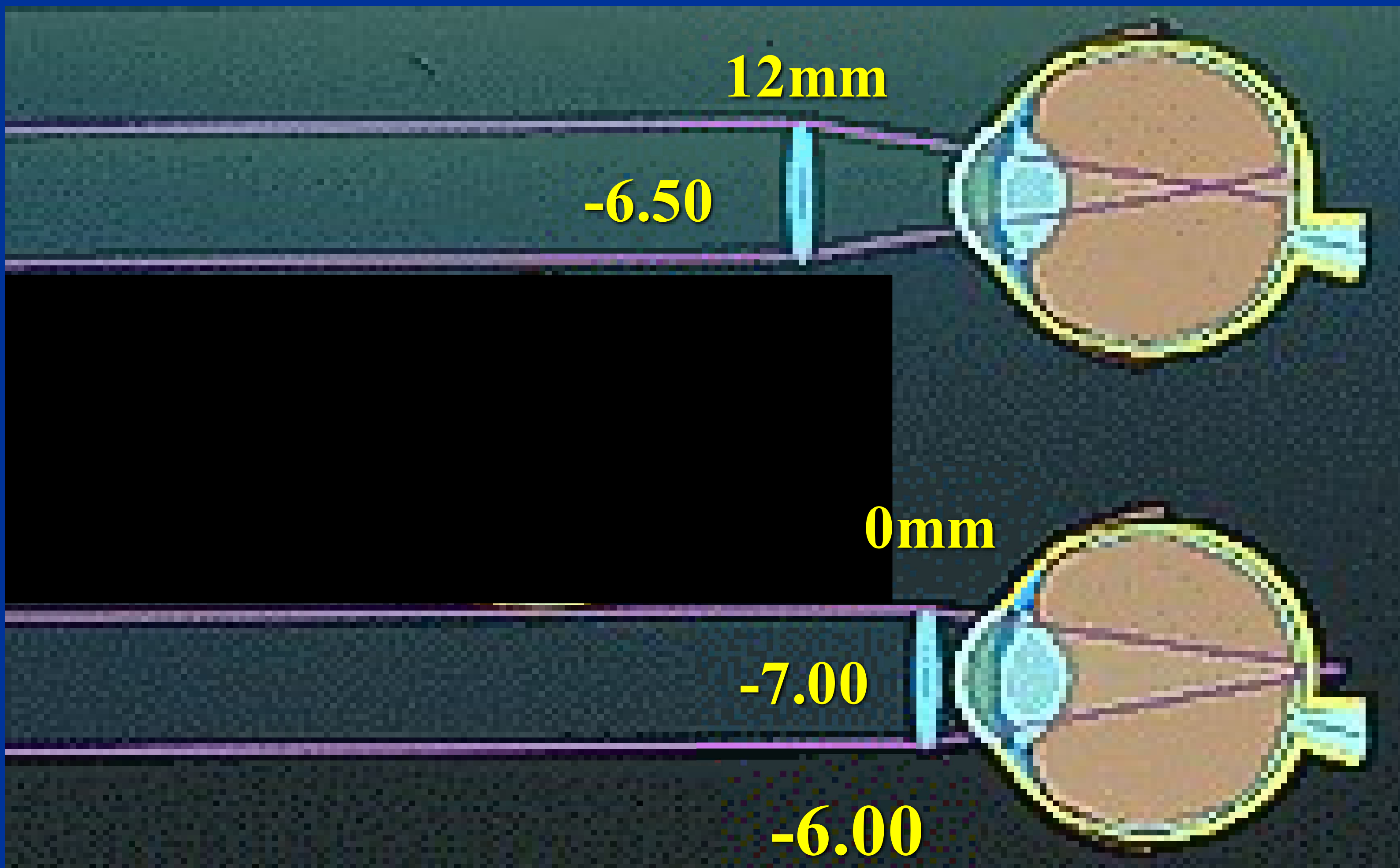
Moving any spectacle lens closer to the eye makes it more minus



To compensate, always add plus power when "vertexing" contact lenses

Vertex Distance

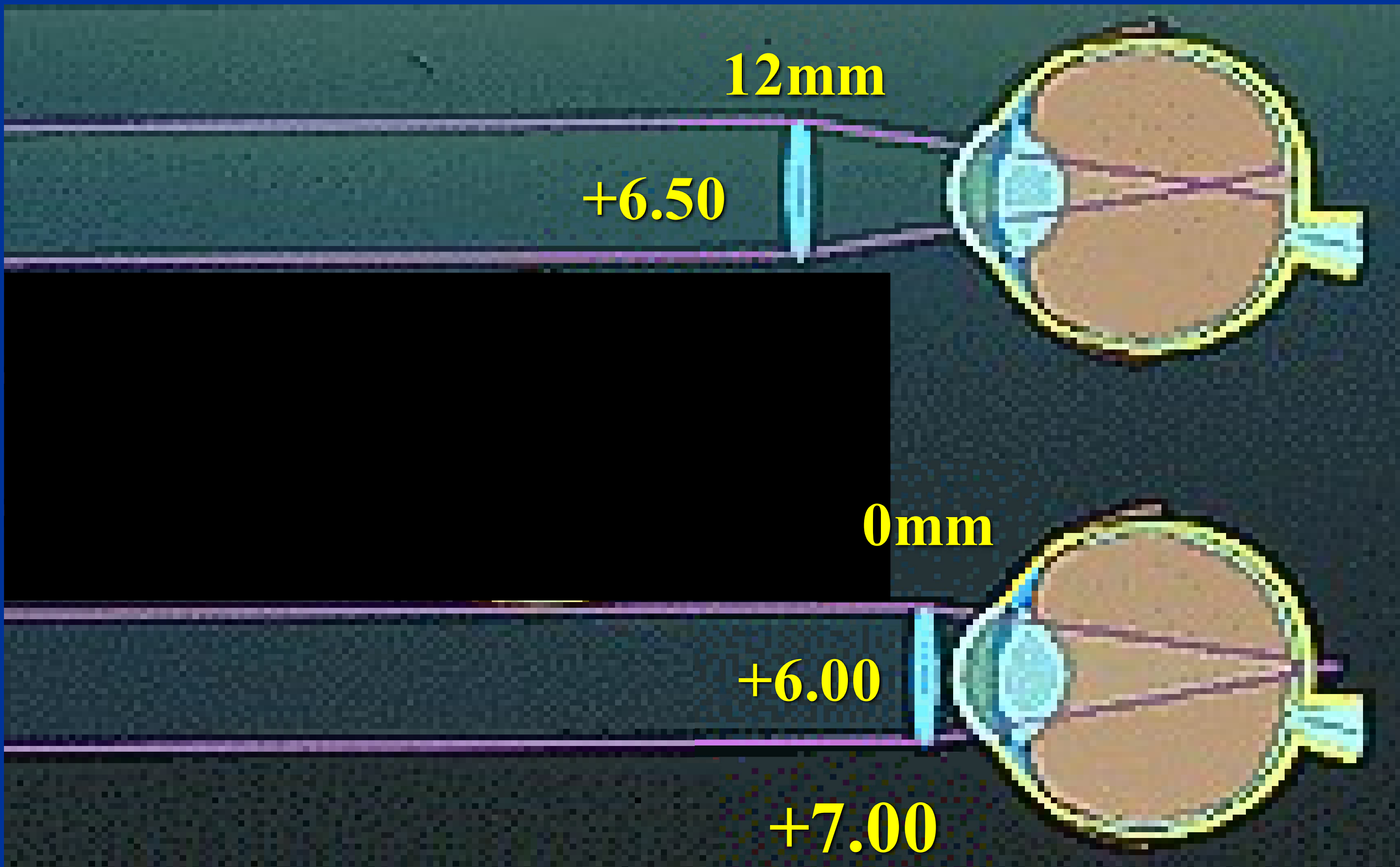
Moving any spectacle lens closer to the eye makes it more minus



To compensate, always add plus power when "vertexing" contact lenses

Vertex Distance

Moving any spectacle lens closer to the eye makes it more minus



To compensate, always add plus power when “vertexing” contact lenses

Determining The Rx

Vertex any amount over +/- 4.00D

Example: - 5.25 - 1.25 x 180

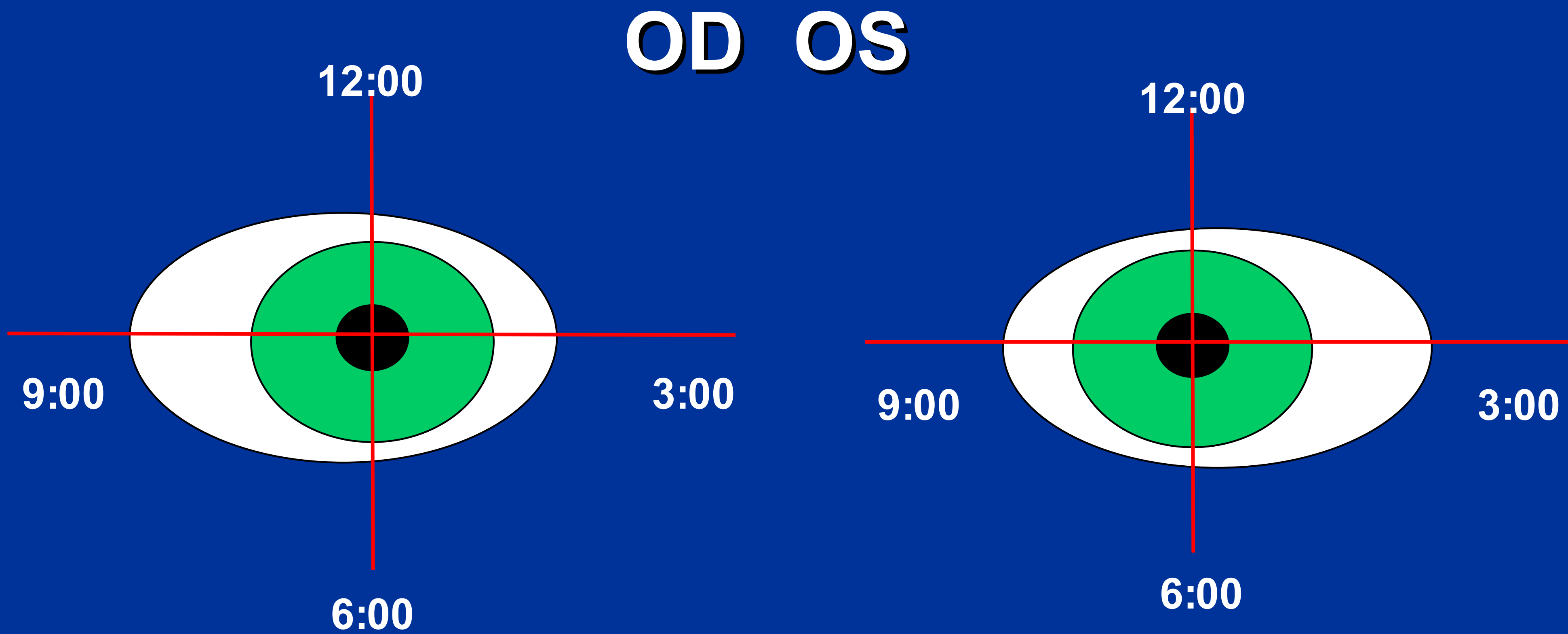
Becomes: - 5.00 - 1.00 x 180

Example: + 5.25 - 1.25 x 180

Becomes: + 5.50 - 1.50 x 180

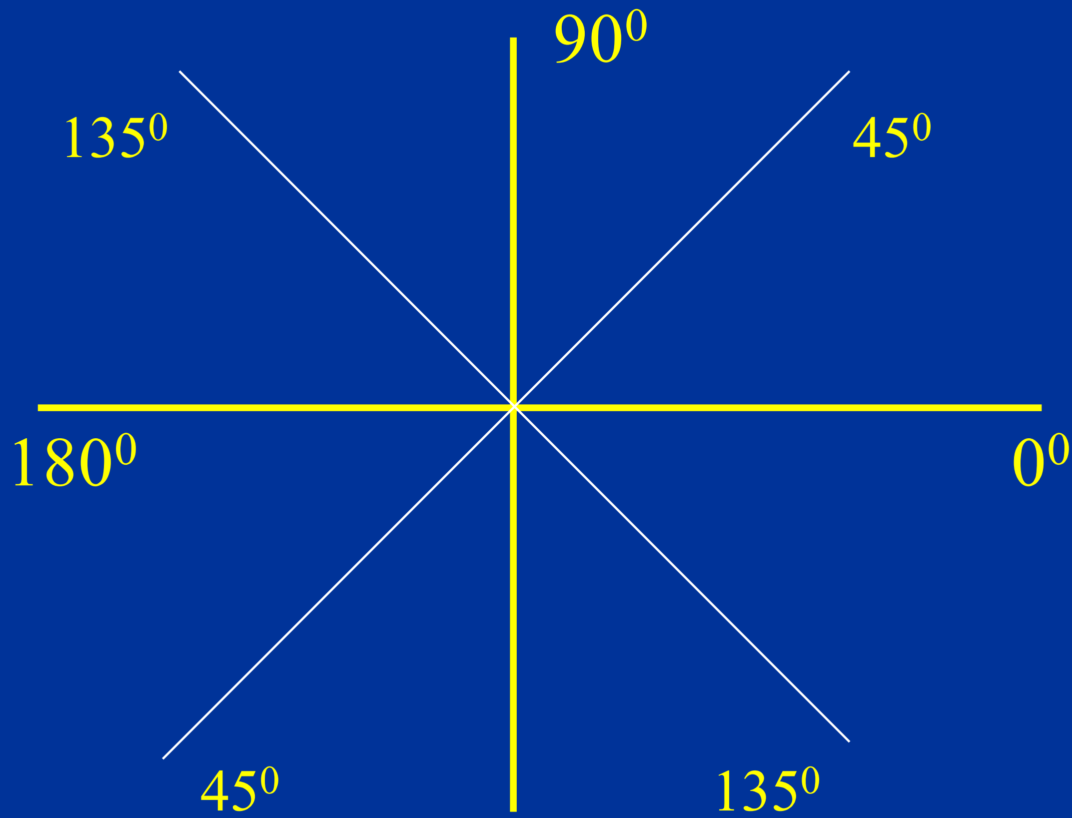
Practitioner's Perspective:

"Clock landmarks"



Every hour represents 30 degrees
Every minute represents 5-6 degrees

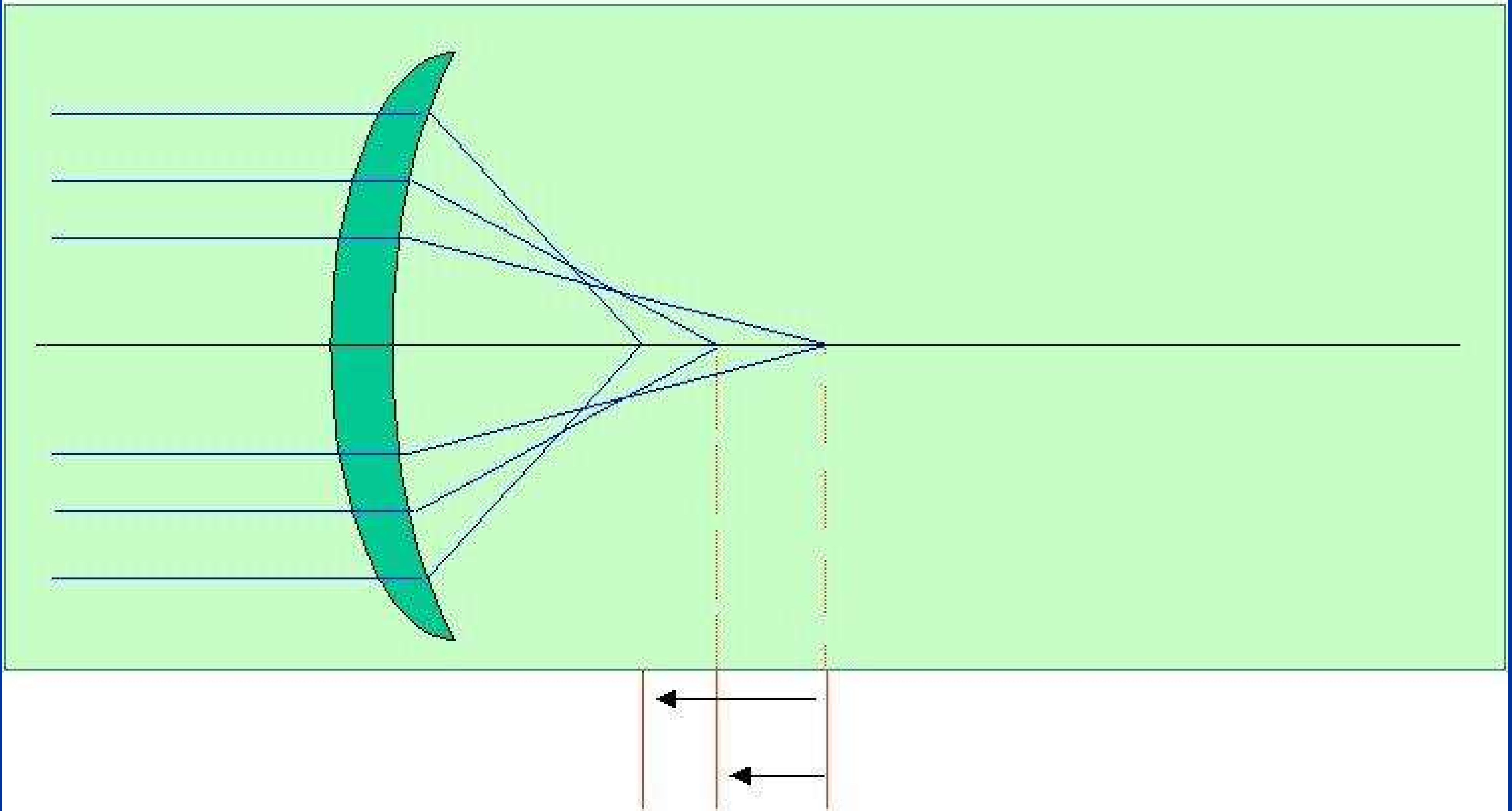
Optical Cross Axis



Spherical Equivalent

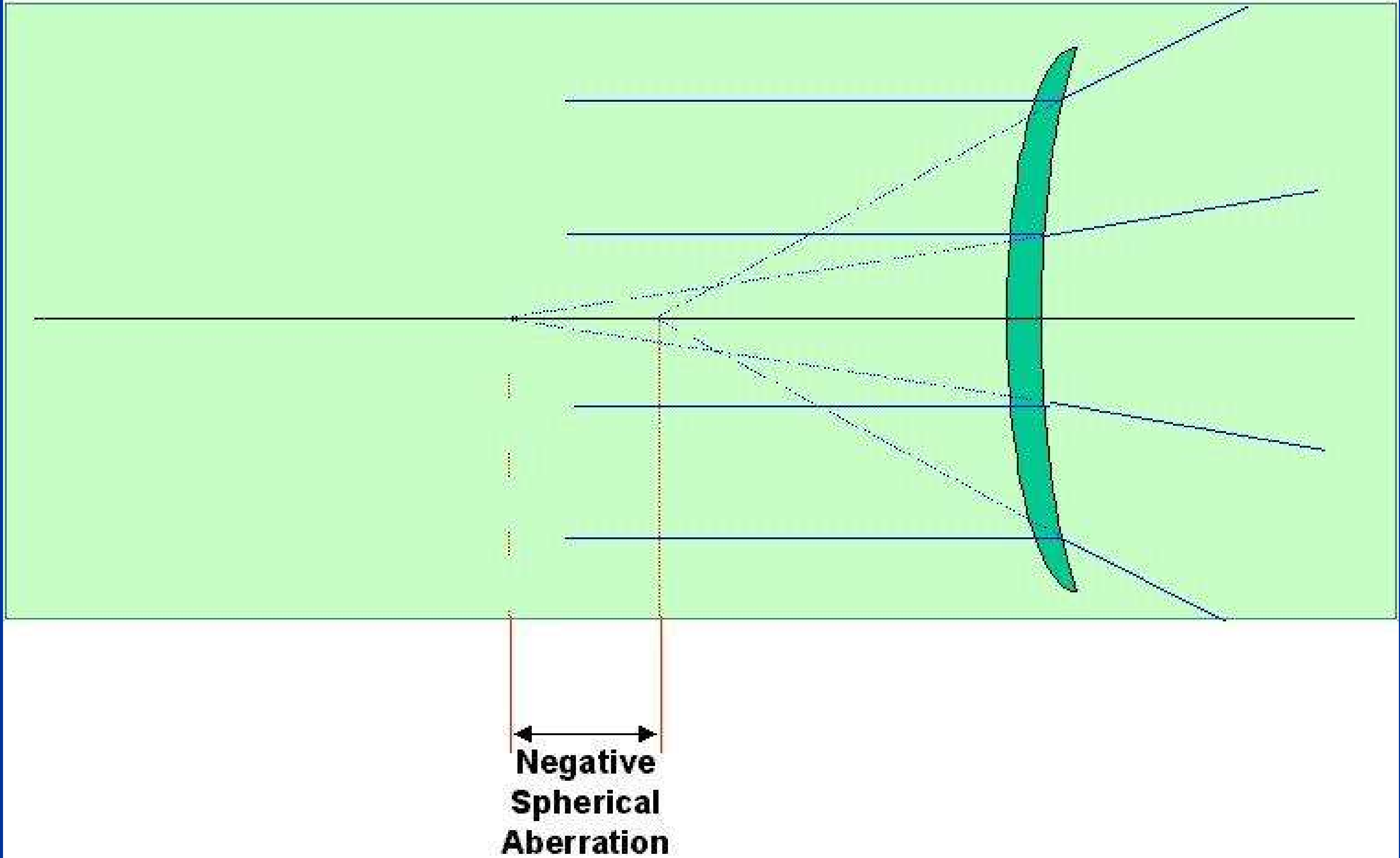
- Example
  - Sphere + 1/2 of astigmatic component
  - Spectacle Prescription:
    - -2.00 - 1.00 x 180
  - Spherical Equivalent:
    - -2.00 + (-0.50) = -2.50D

Plus Power Lens with Spherical Aberration



As light passes through more and more peripheral parts of the lens, the imaged produced is a focal point closer and closer to the lens

Minus Power Lens with Spherical Aberration



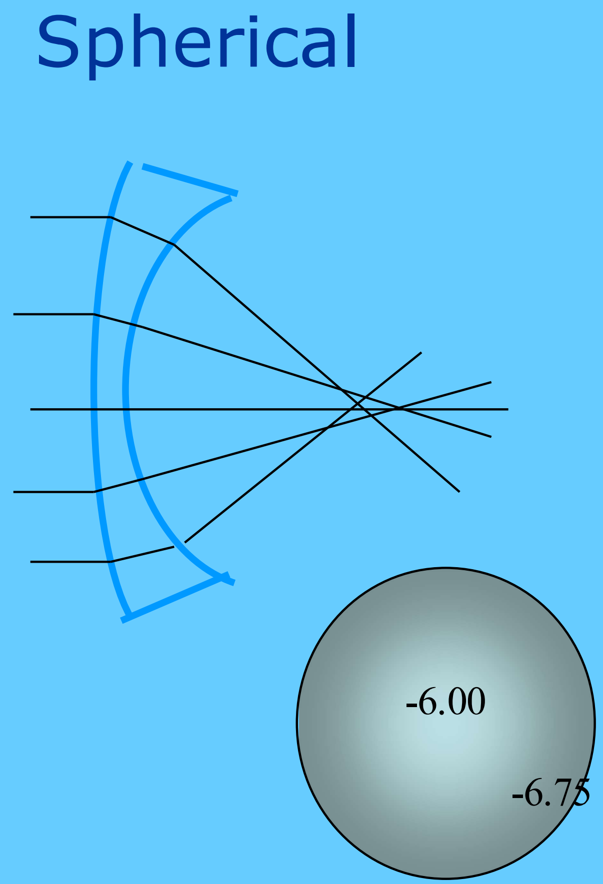
In a minus lens the light rays passing through the periphery of the lens are also focused closer to the lens

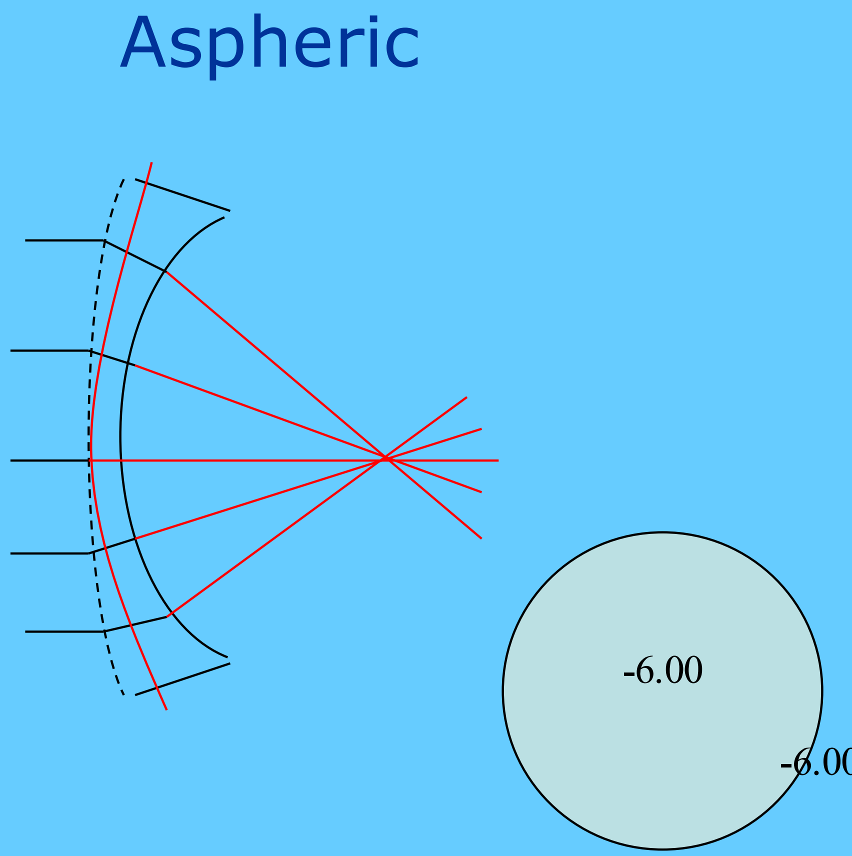
Correction of Spherical Aberration

- To reduce spherical aberration in a plus lens decrease the curve on the front surface (aspheric)

- To reduce spherical aberration in a minus lens increase the curve on the front surface (aspheric)

Aspheric optics correct the aberrations of spherical lenses





With the Rule Astigmatism

- Horizontal meridian is least curved
- Vertical meridian is most curved

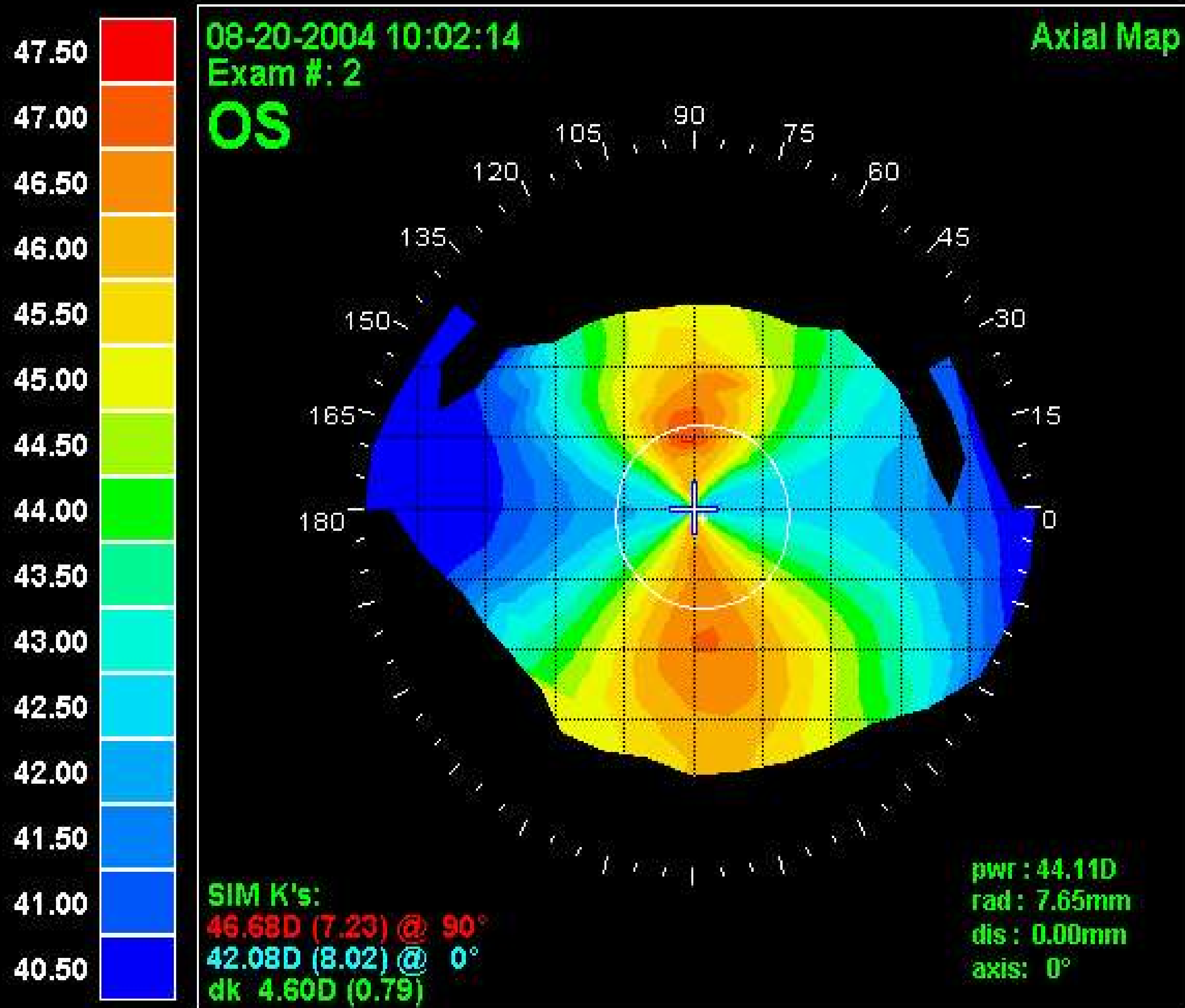
K's 42.00@180 / 43.00@90

Rx -3.00 -1.00 x 180

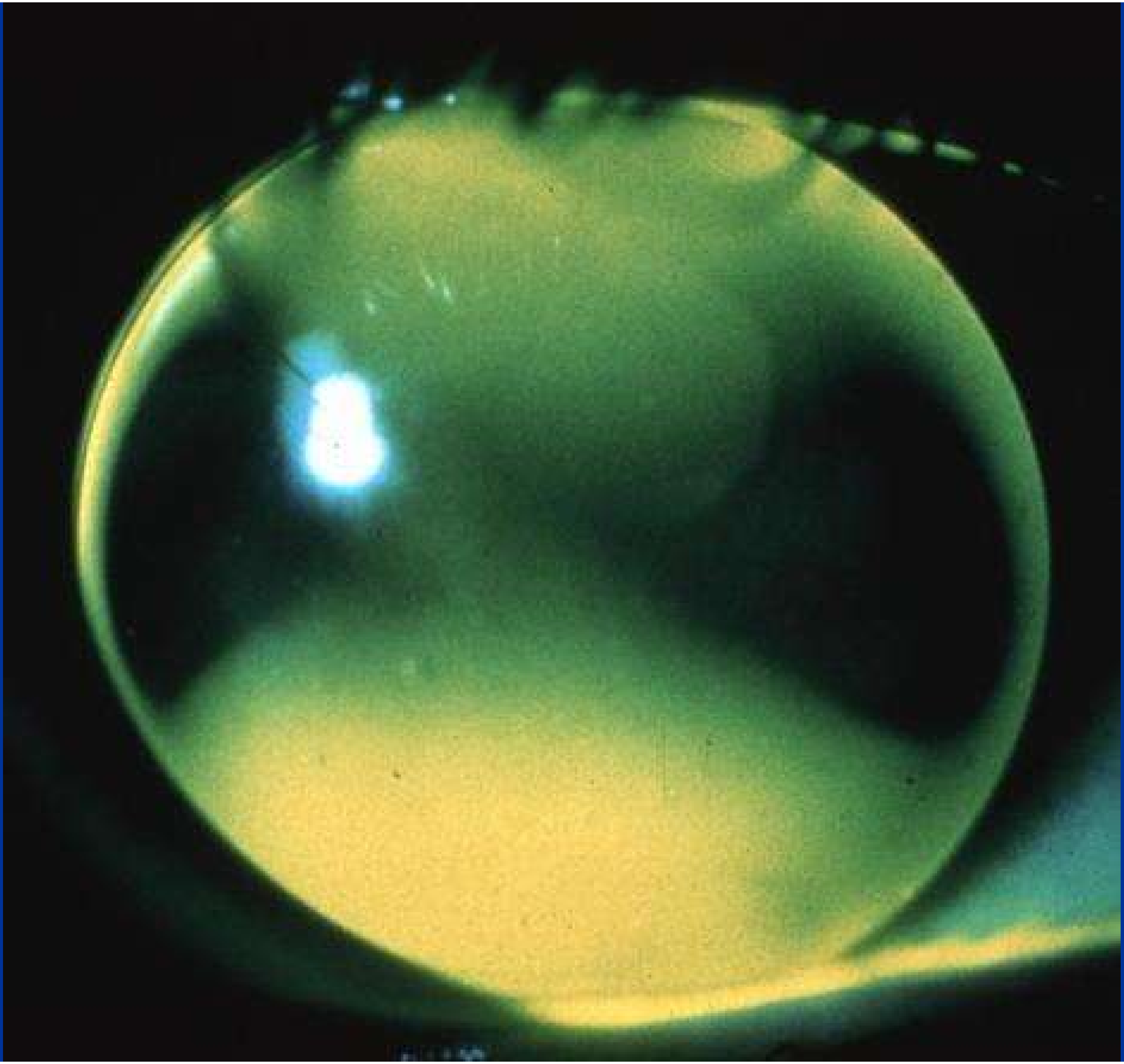
[redacted]
Patient ID: 0009

EyeSys

New York Optometric
Merriam



Hyperopic Astigmatism Man Rx + 8.75 -4.00 x 005

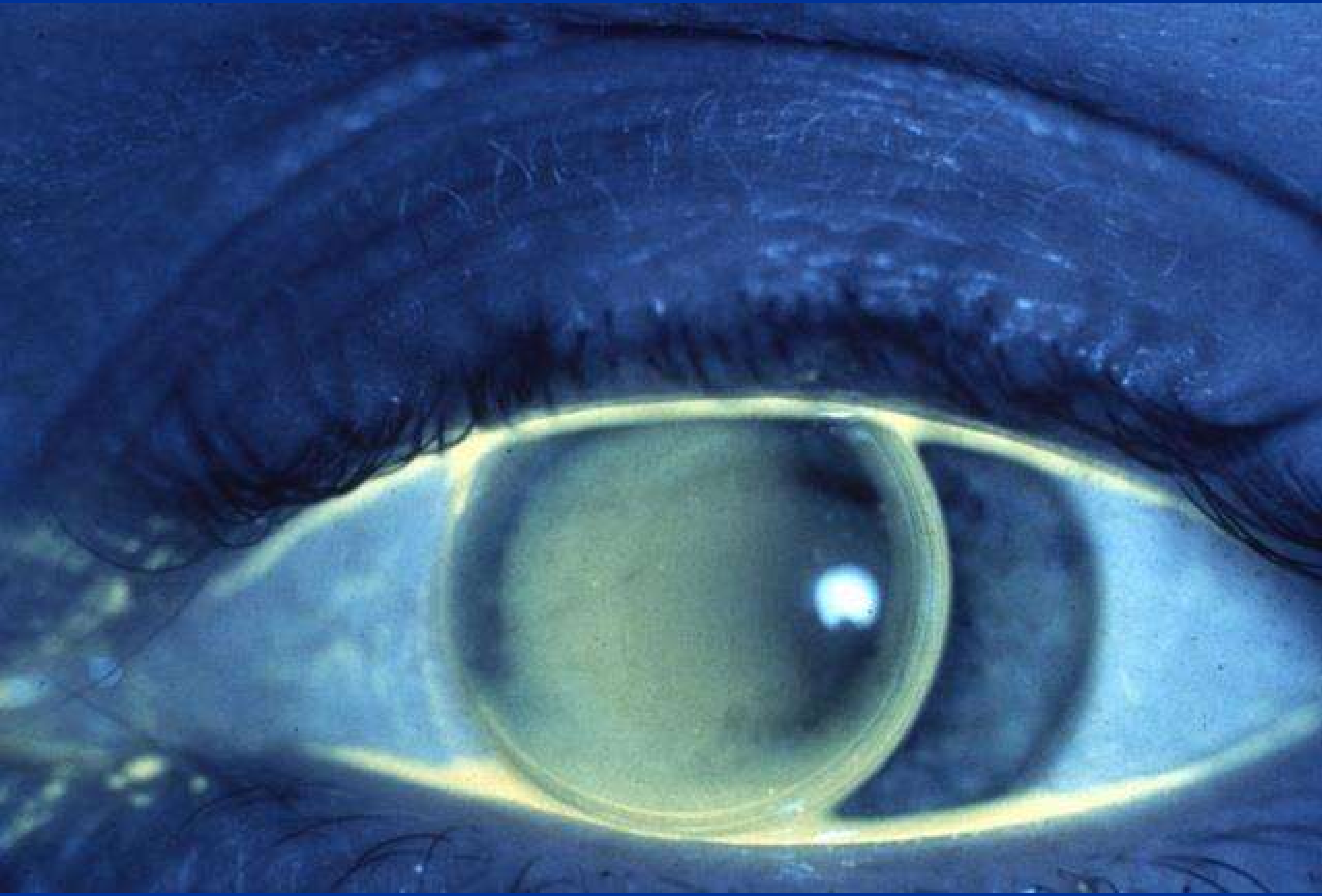


Against the Rule Astigmatism

- Horizontal meridian is most curved
- Vertical meridian is least curve

K's 44.00@180 / 42.00@90

Rx -3.00-2.00X90



Irregular Astigmatism

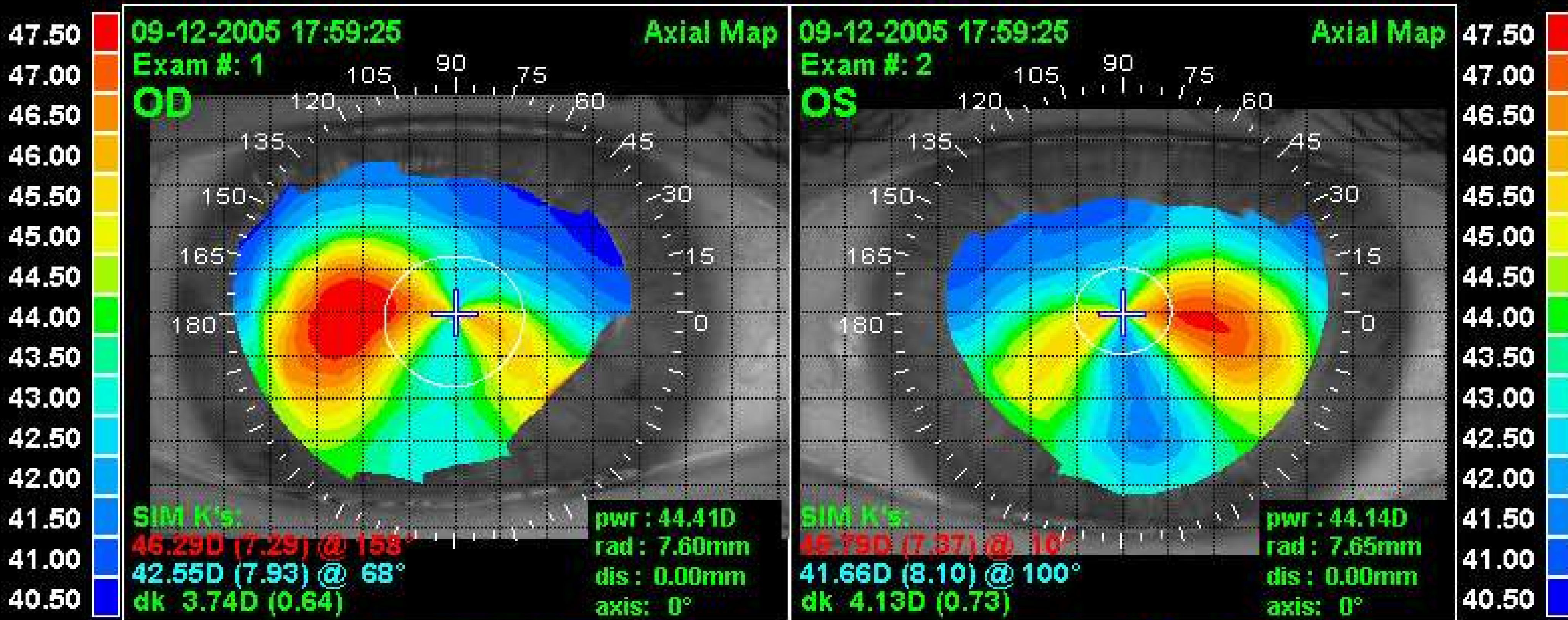
- Principle meridians are not perpendicular
- In certain cases they are distorted
- E.g. keratoconus, trauma, post surgical

- K’s 42.00@10 / 44.00@70
  2+ Distortion
  Rx -3.00-3.50x15 20/30

New York Optometric

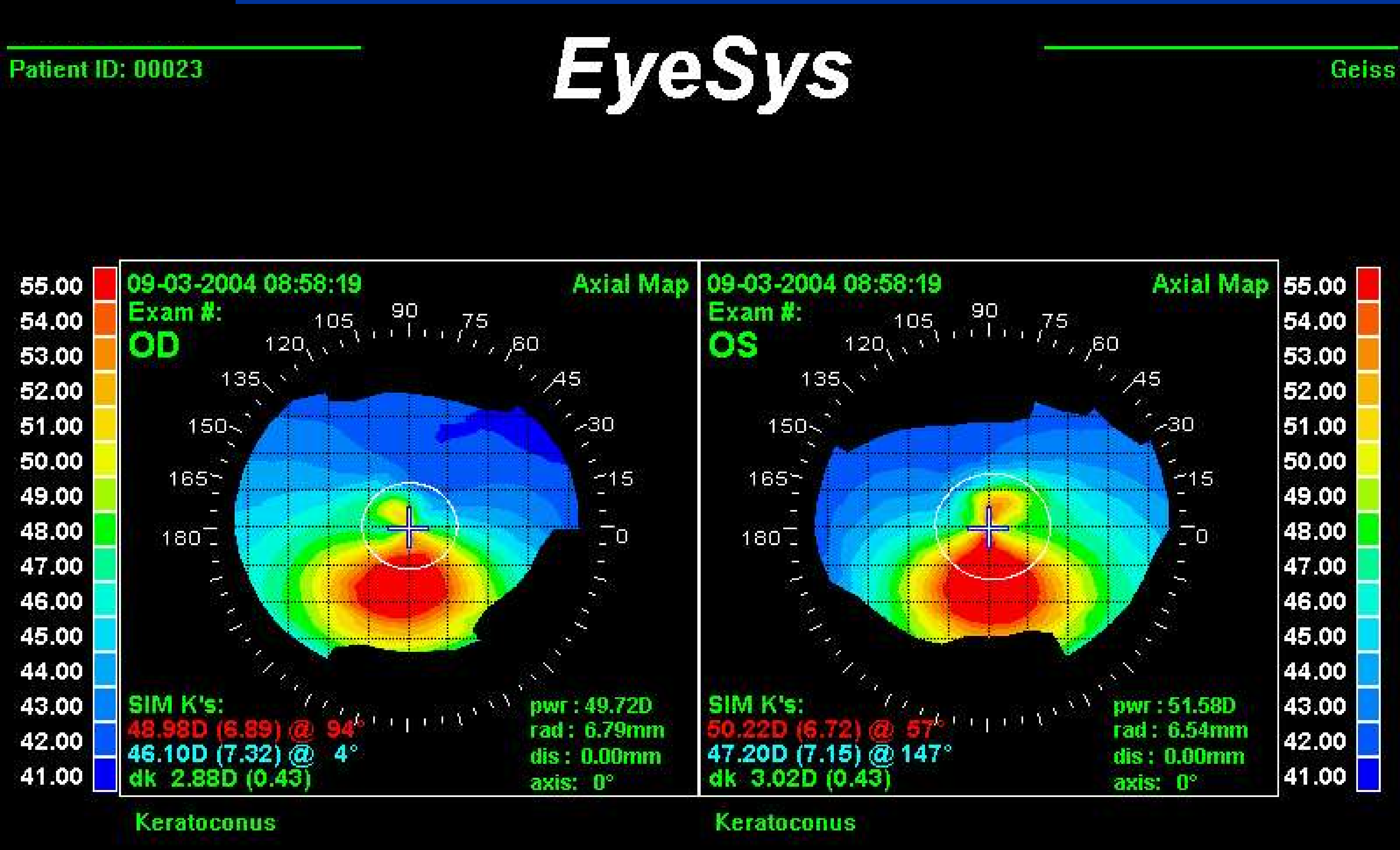
Janovsky

EyeSys



Keratoconus Man Rx -2.00 -3.50 x 075

Keratoconus Man Rx -1.50 -2.75 x 110

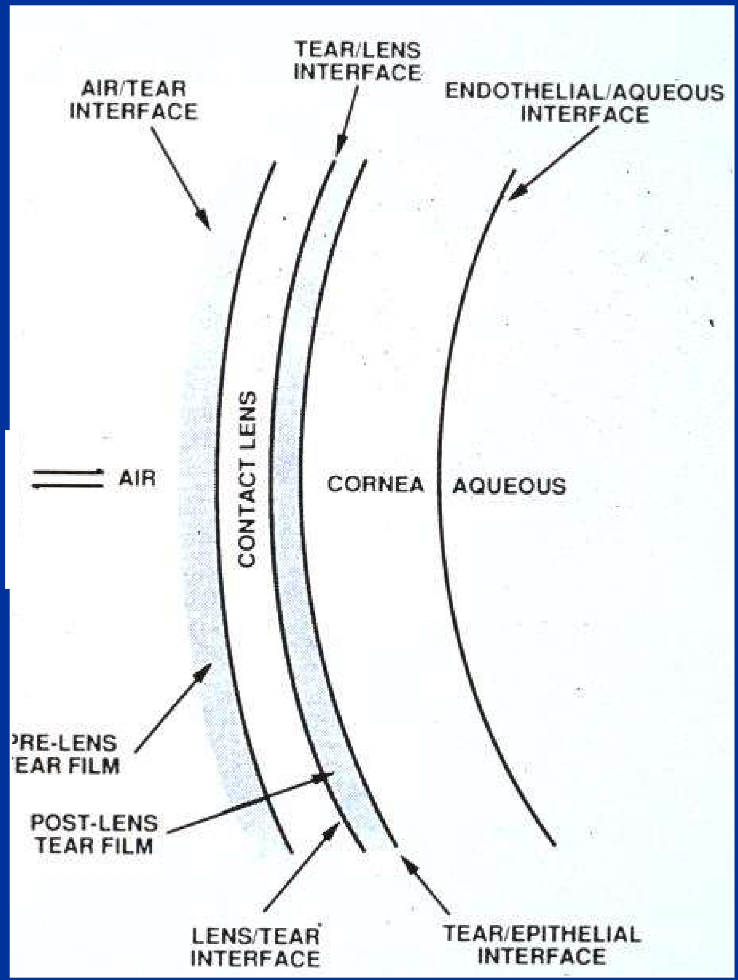


Patient ID: 00023
EyeSys
Geiss
09-03-2004 08:58:19
Axial Map
Exam #:
OD
SIM K's:
48.98D (6.89) @ 94°
46.10D (7.32) @ 4°
dk 2.88D (0.43)
pwr : 49.72D
rad : 6.79mm
dis : 0.00mm
axis: 0°
Keratoconus
09-03-2004 08:58:19
Axial Map
Exam #:
OS
SIM K's:
50.22D (6.72) @ 57°
47.20D (7.15) @ 147°
dk 3.02D (0.43)
pwr : 51.58D
rad : 6.54mm
dis : 0.00mm
axis: 0°
Keratoconus
55.00
54.00
53.00
52.00
51.00
50.00
49.00
48.00
47.00
46.00
45.00
44.00
43.00
42.00
41.00

GP Lens Power Rules

1) Put the Rx in minus cylinder
2) Vertex any power greater than +/- 4.00D
3) If the amount of refractive cylinder is similar to the amount of corneal cylinder, the rigidity of the lens will correct the astigmatism
4) Determine the tear lens created between the corneal surface and the base curve of the lens

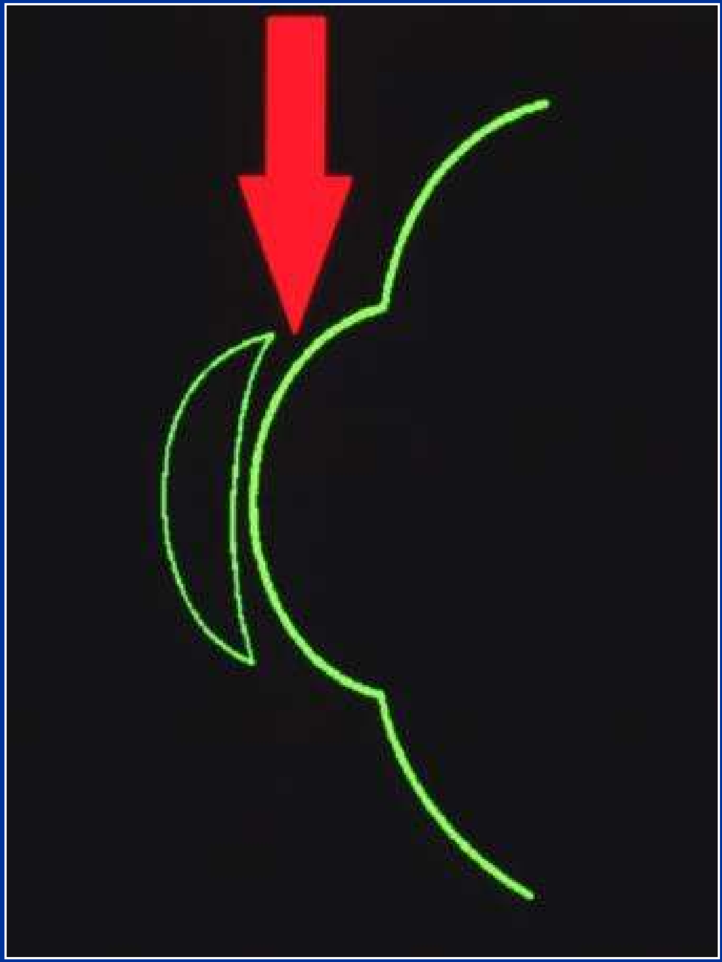
GP Lens Power



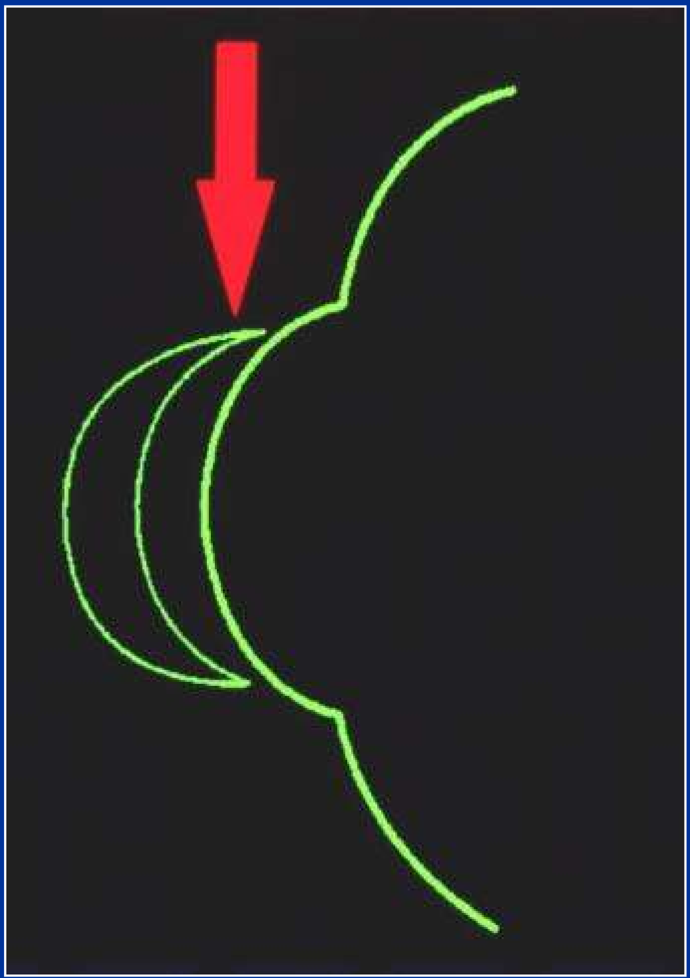
A tear lens that is formed between the lens and the cornea will have no power if the base curve parallels the flattest meridian

GP Lens Power

A minus tear lens is created when the base curve of the contact lens is fit flatter than the flattest "K" reading



GP Lens Power



A plus tear lens is created when the base curve of the contact lens is fit steeper than the flattest “K” reading

GP Lens Power

"SAM"

When a rigid lens is fit *steep*, add the same amount of *minus* to compensate for the plus tear lens

"FAP"

When a rigid lens is fit *flat*, add the same amount of *plus* to compensate for the minus tear lens

"SAM"
Steep Add Minus

EXAMPLE:

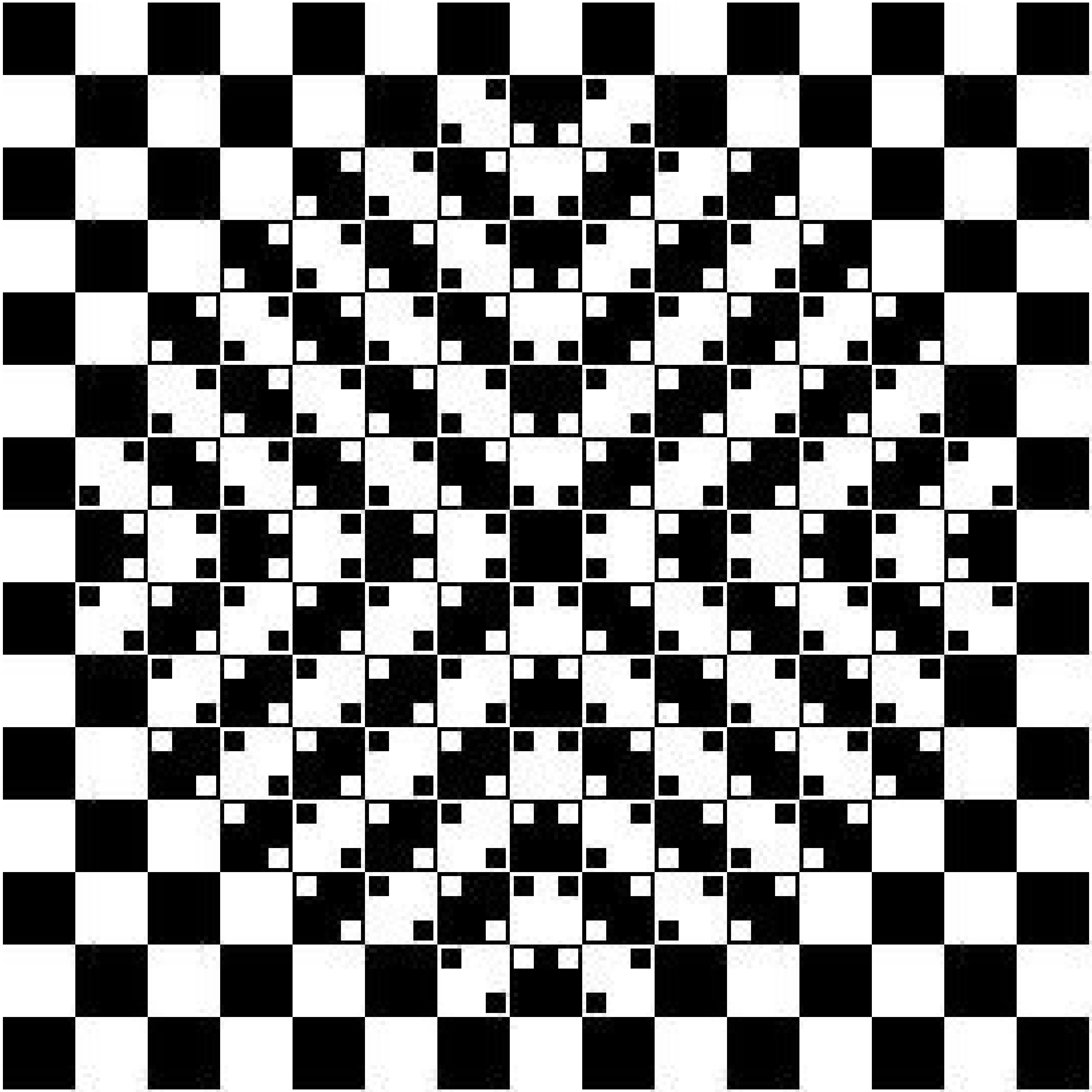
Flat "K"	43.00 D
Base Curve	43.25 D
Tear Lens Created	+0.25 D
Patient Rx	-4.50 -1.00 cx 180
Add to Compensate	-0.25 D
Final Lens Power	-4.75 D

"FAP"
Flat Add Plus

EXAMPLE:

Flat "K"	43.00 D
Base Curve	42.50 D
Tear Lens Created	-0.50 D
Patient Rx	-4.50 -1.00 cx 180
Add to Compensate	+0.50 D
Final Lens Power	-4.00 D

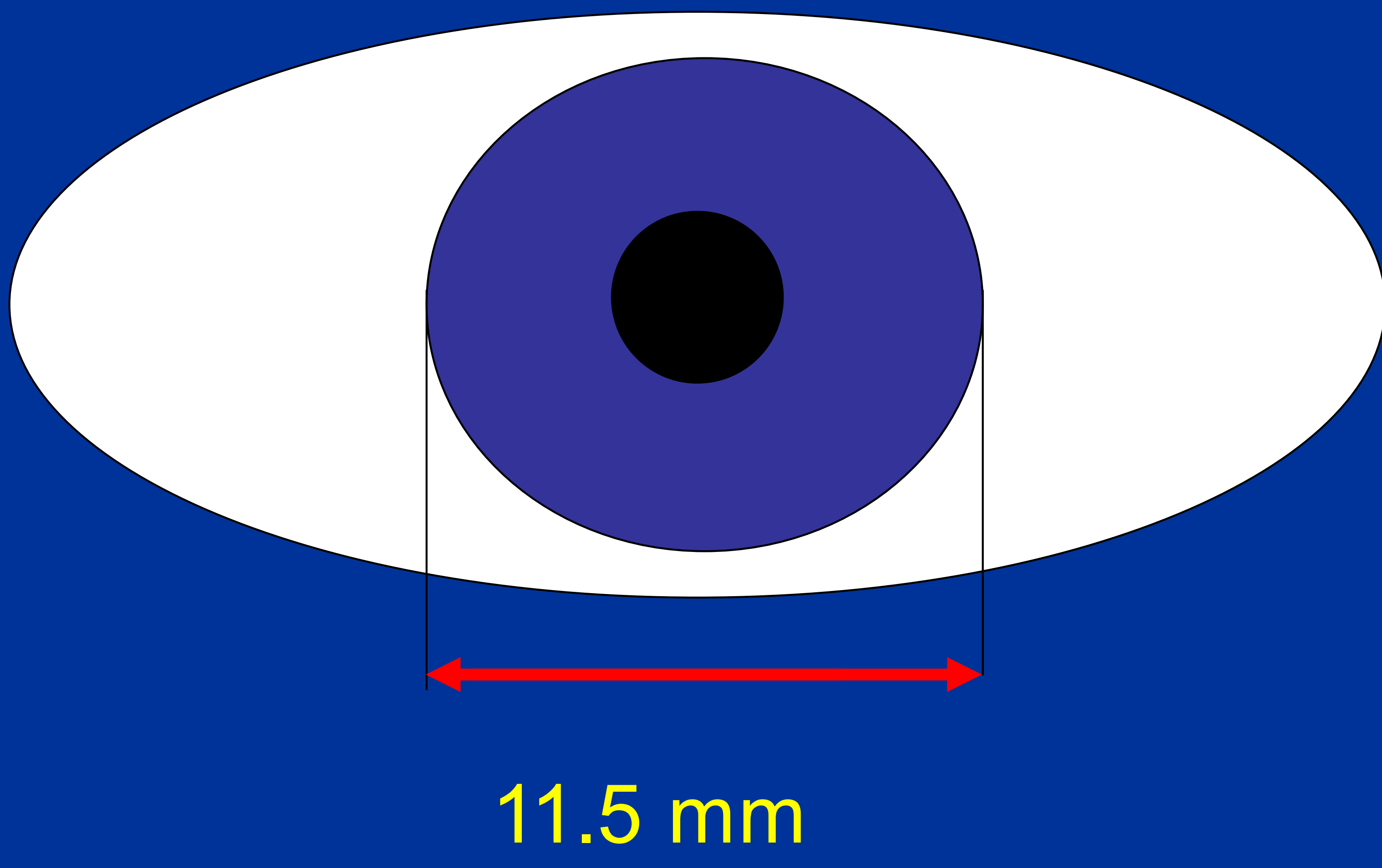
"A bulge"



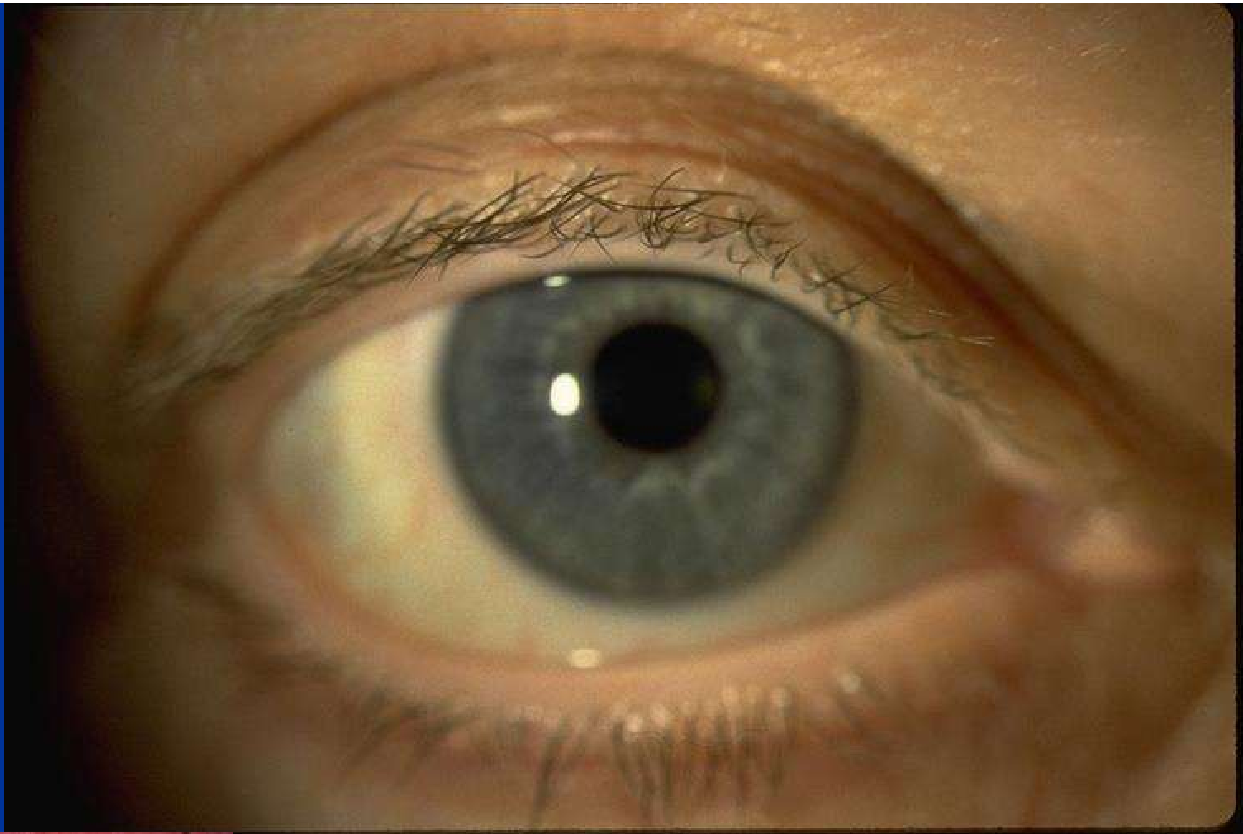
Corneal Curvature

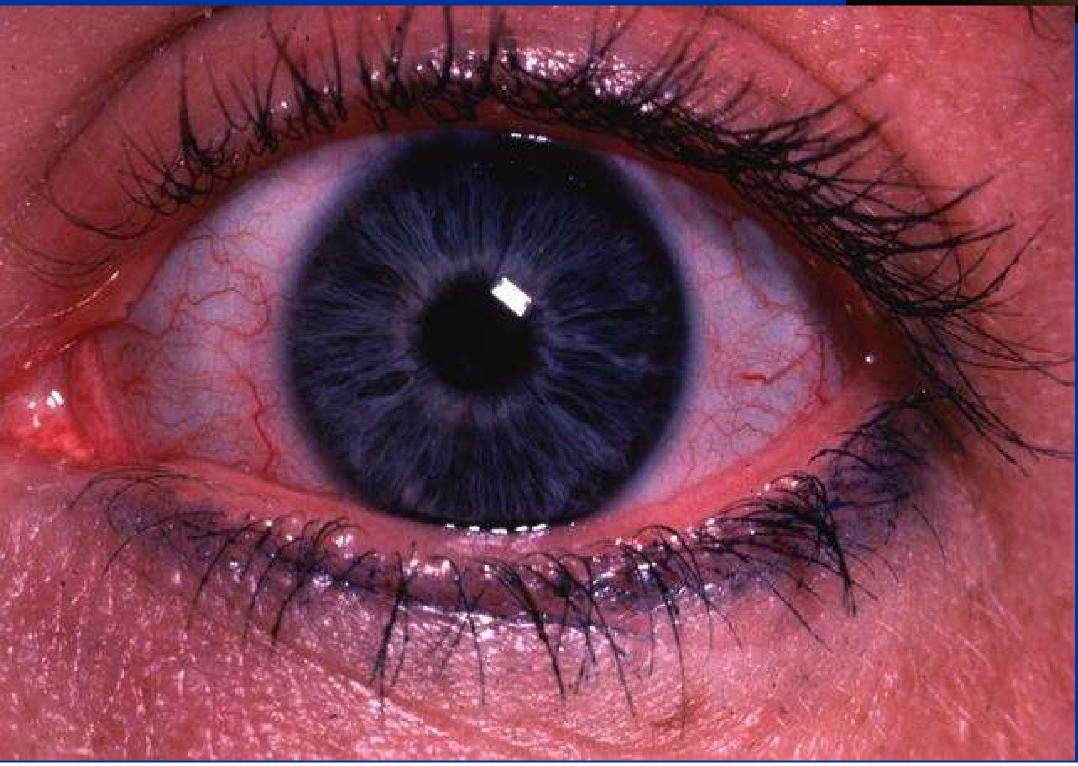
- Keratometry reading “K’s”
- Corneal mapping systems
- Practitioners use diopters 44.00/45.00
- Manufacturers use metric radius of curvature 7.67 / 7.50 “base curve”

HVID
Horizontal Visible Iris Diameter



Eye Lid Anatomy

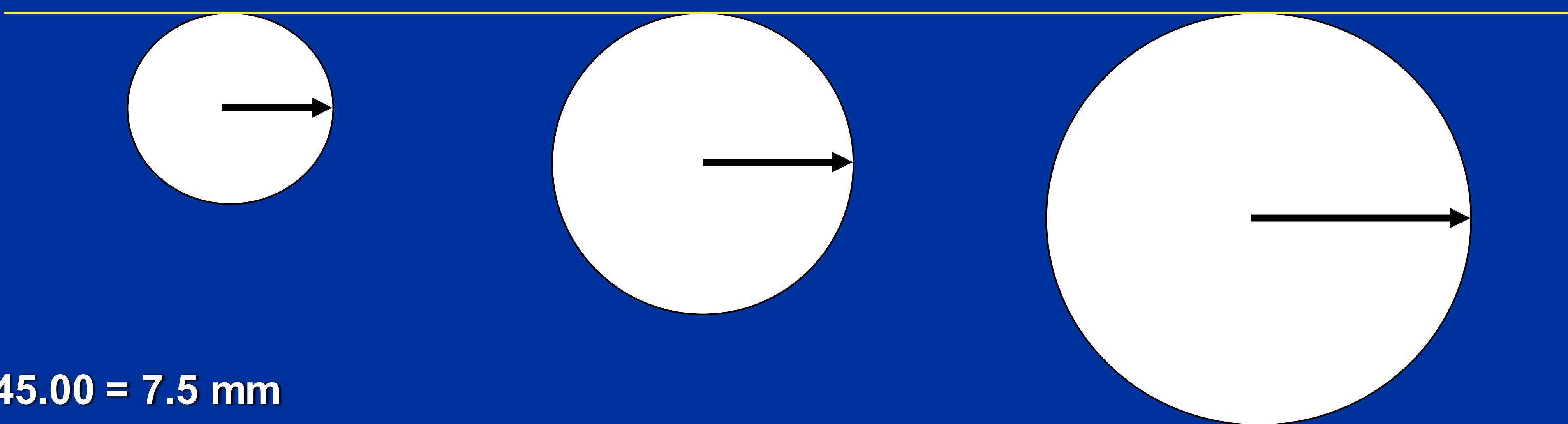




GP DESIGN OPTIONS

- SPHERICAL
- ASPHERIC
- FRONT SURFACE TORIC
- BACK / BITORIC TORIC
- BIFOCALS/MULTIFOCALS
- REVERSE GEOMETRY
- SCLERAL

Radius of Curvature



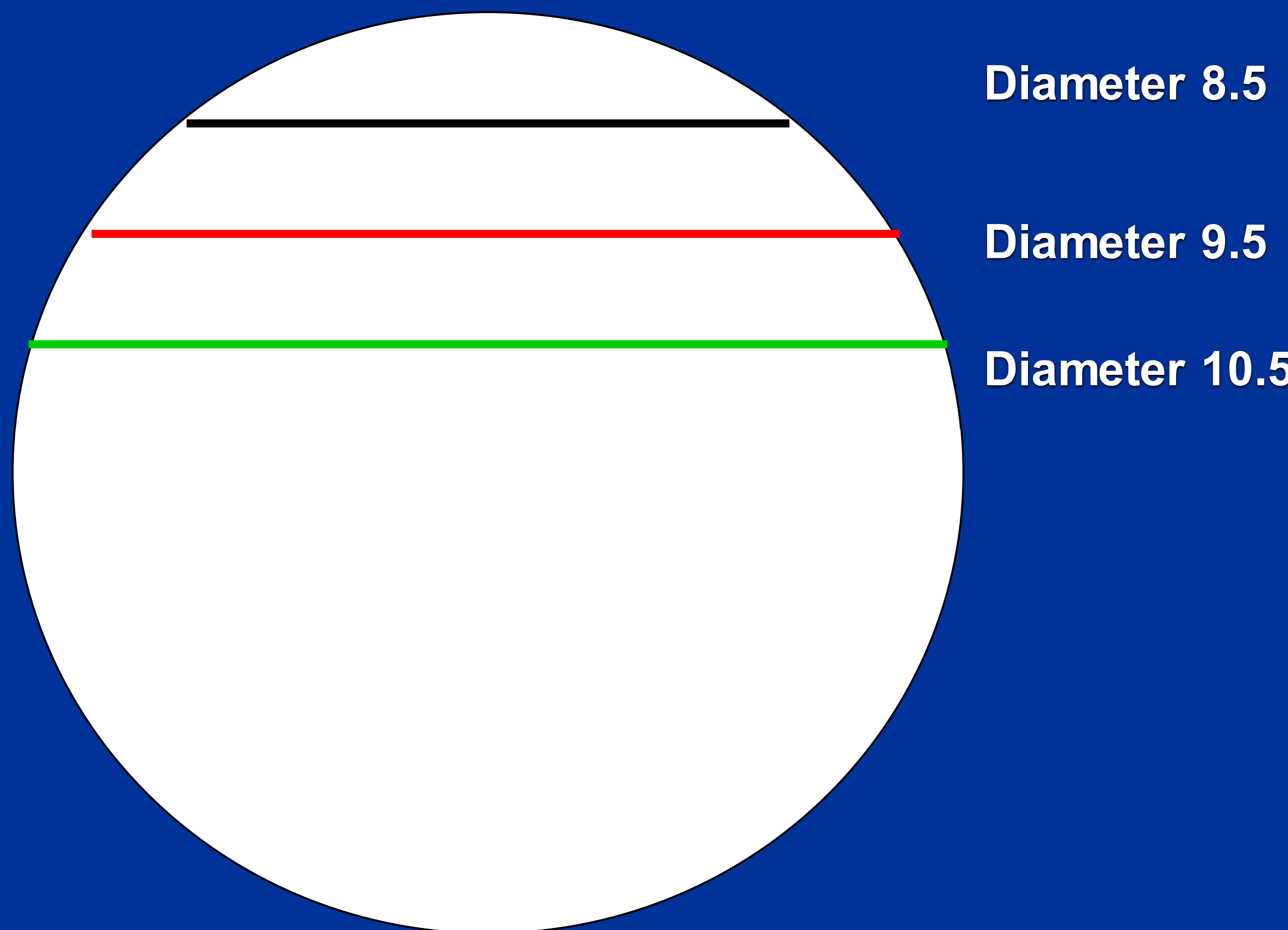
45.00 = 7.5 mm

43.00 = 7.85 mm

39.25 = 8.6 mm

Diopter to millimeter

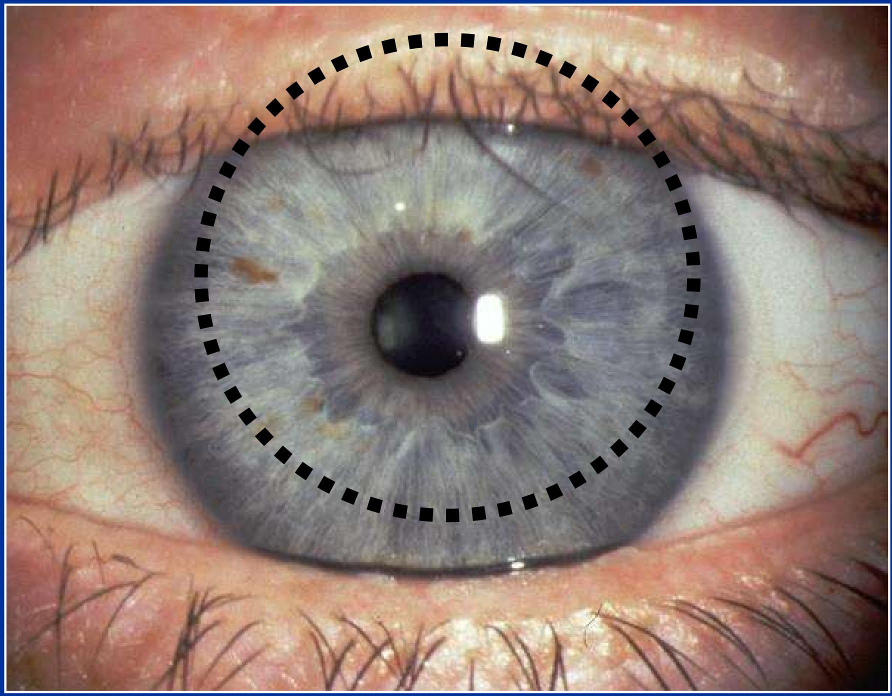
Lens Diameter



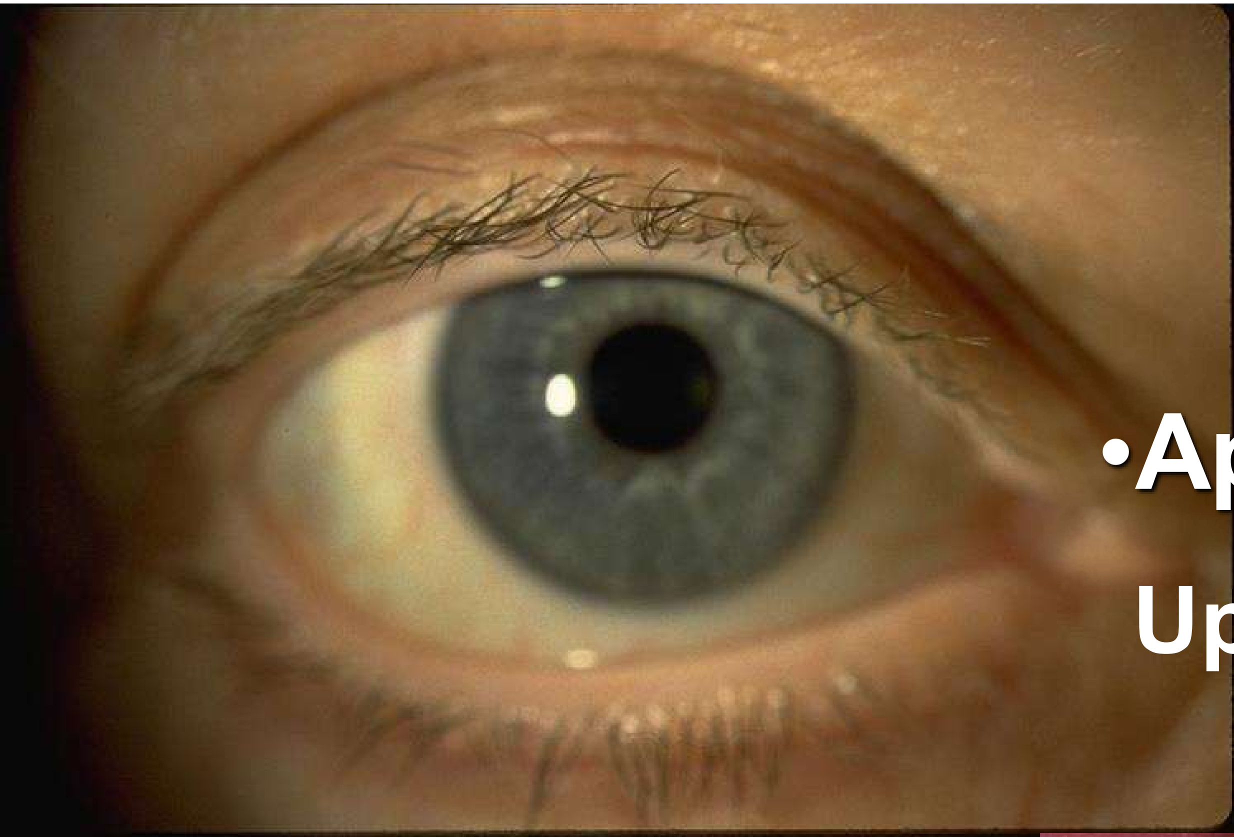
Base Curve = 7.80 / 43.50

Lid Position

If the upper lid positions on the superior cornea, fit the lens with the apical alignment philosophy



Eye Lid Anatomy

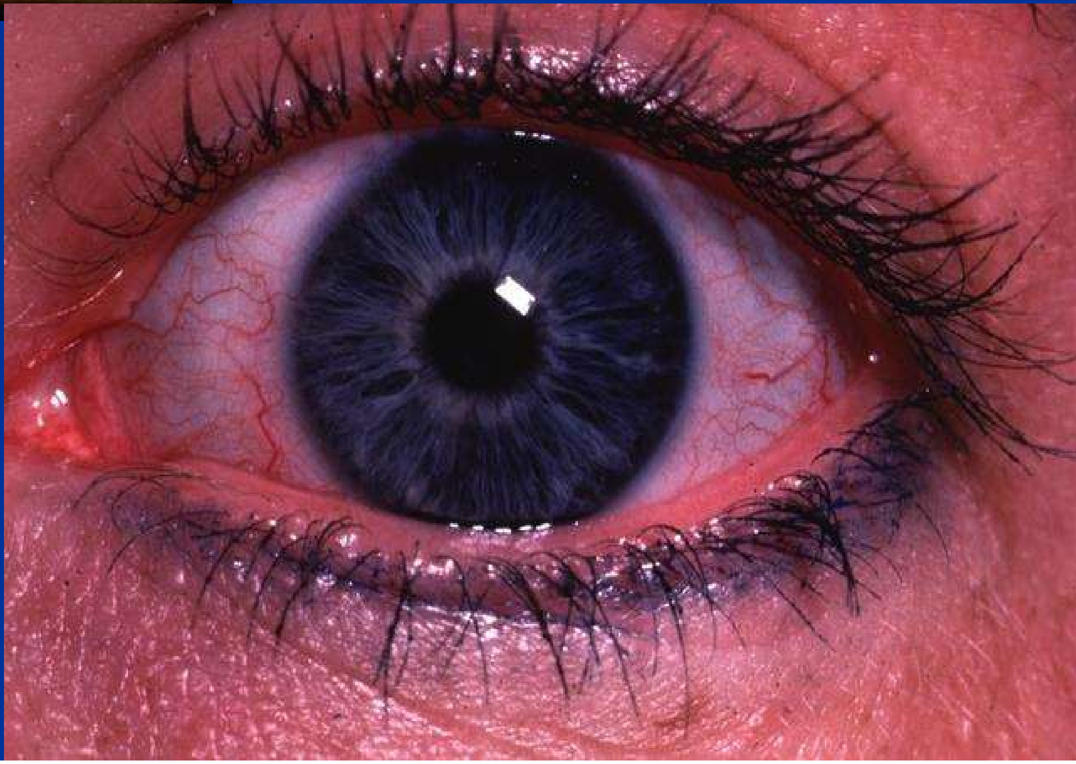


- Apical alignment

  Upper lid attachment

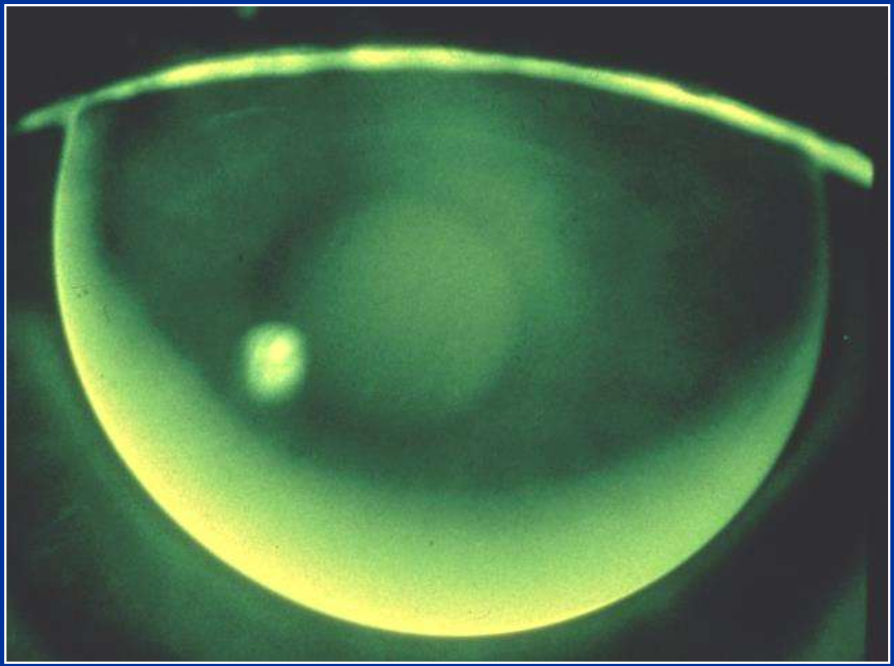
- Apical clearance

  Intrapalpebral



Apical Alignment Fitting
Base Curve Radius

To achieve alignment with the cornea, the base curve chosen must be flatter than the flattest corneal reading



Apical Alignment Fitting

Base Curve Radius

Same base curve…

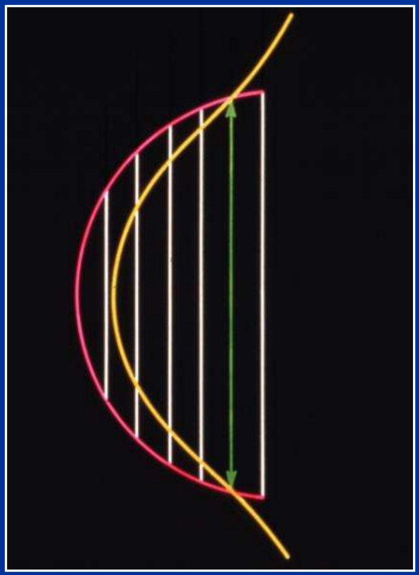
…results in areas of touch

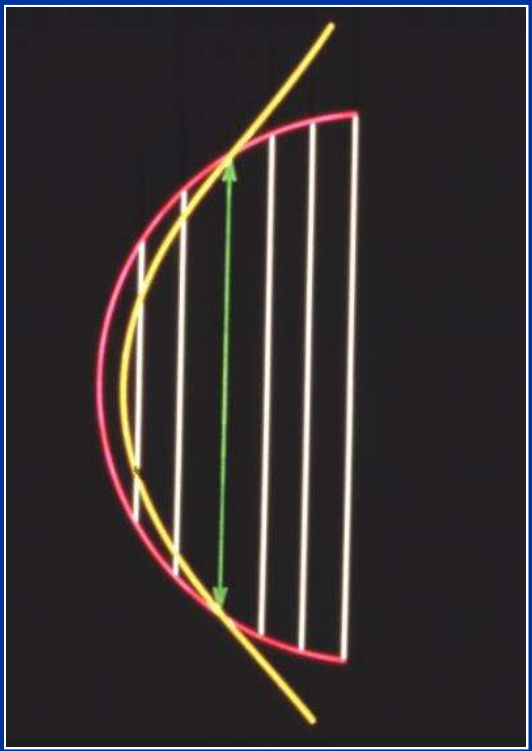
A flatter base curve…

…results in alignment

Apical Alignment Fitting

Optic Zone Diameter





Reducing the optic zone diameter flattens the lens to cornea relationship

The optic zone diameter will impact the alignment of the base curve to the cornea

Apical Alignment Fitting

Optic Zone Diameter

One method of determining the optic zone diameter is to choose one that is equal to the radius of curvature of the base curve in millimeters

Example:

Base curve radius 45.00 D = 7.5 mm

Optic zone diameter = 7.5 mm

Apical Alignment Fitting

Secondary Curve Radius

Choose a secondary curve radius 1.0 mm flatter than the optic zone radius of curvature

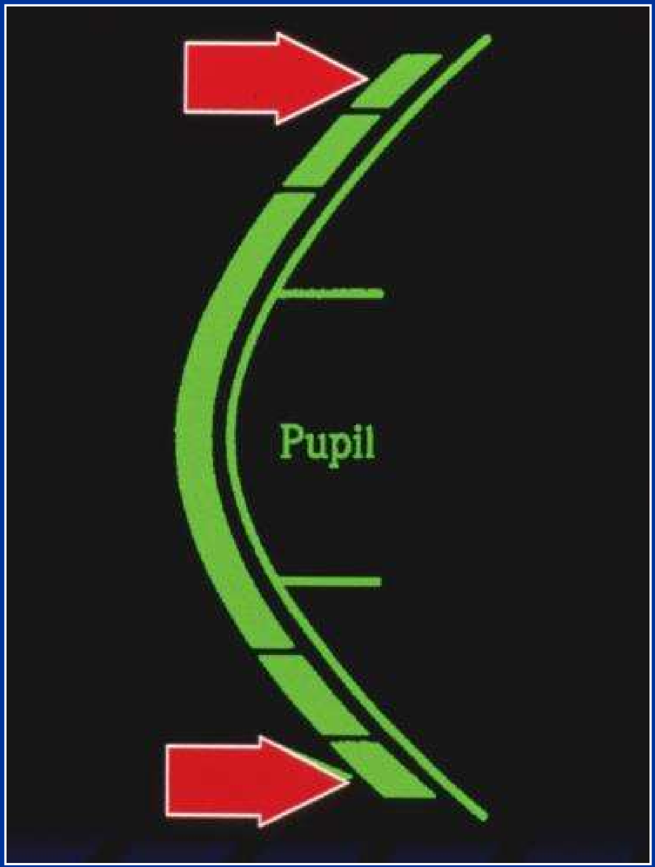
Example:

Base curve radius = 7.5 mm

Secondary curve radius = 8.5 mm

Apical Alignment Fitting
Peripheral Curve Radius

Consider a standard peripheral curve radius of 12.25 mm at 0.4 mm width



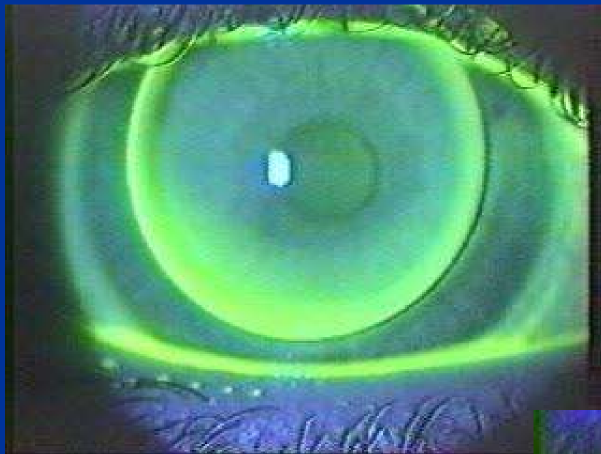
Apical Alignment Fitting
Overall Diameter

Consider an overall diameter 2.3 mm smaller than the HVID

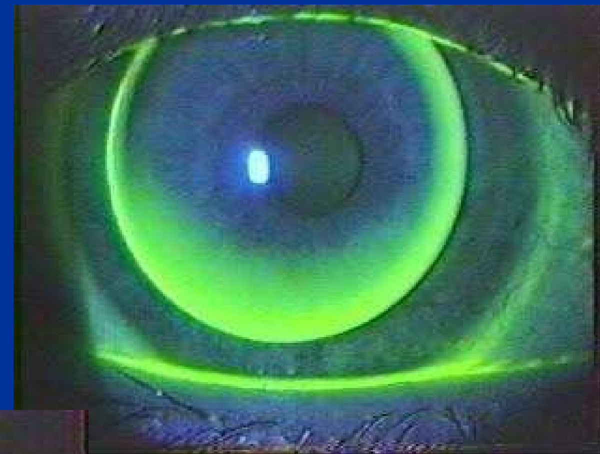
Example:

HVID = 11.5 mm

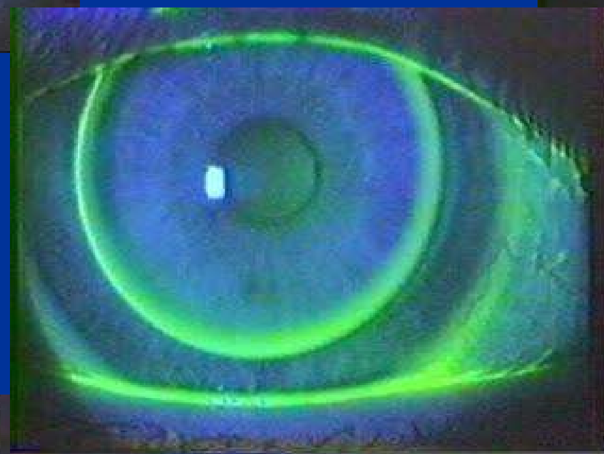
Overall diameter (11.5 mm – 2.3 mm) = 9.2 mm



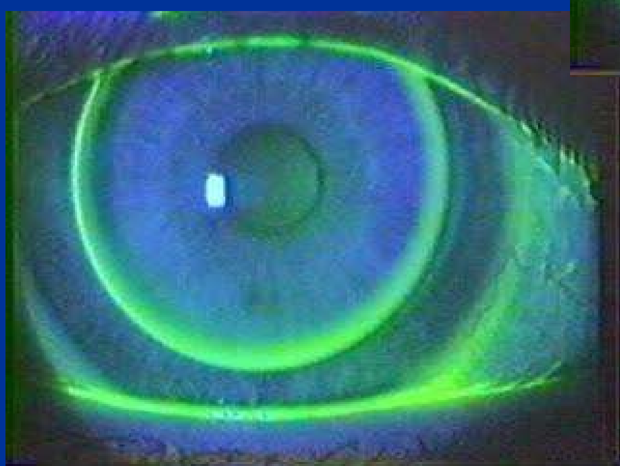
1.50D Flat



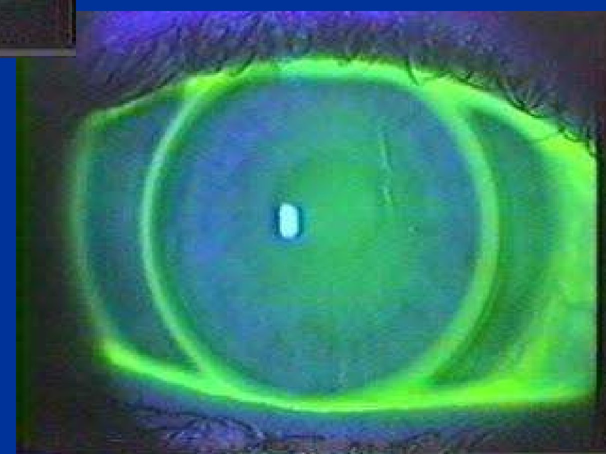
1.00D Flat



.50D Flat

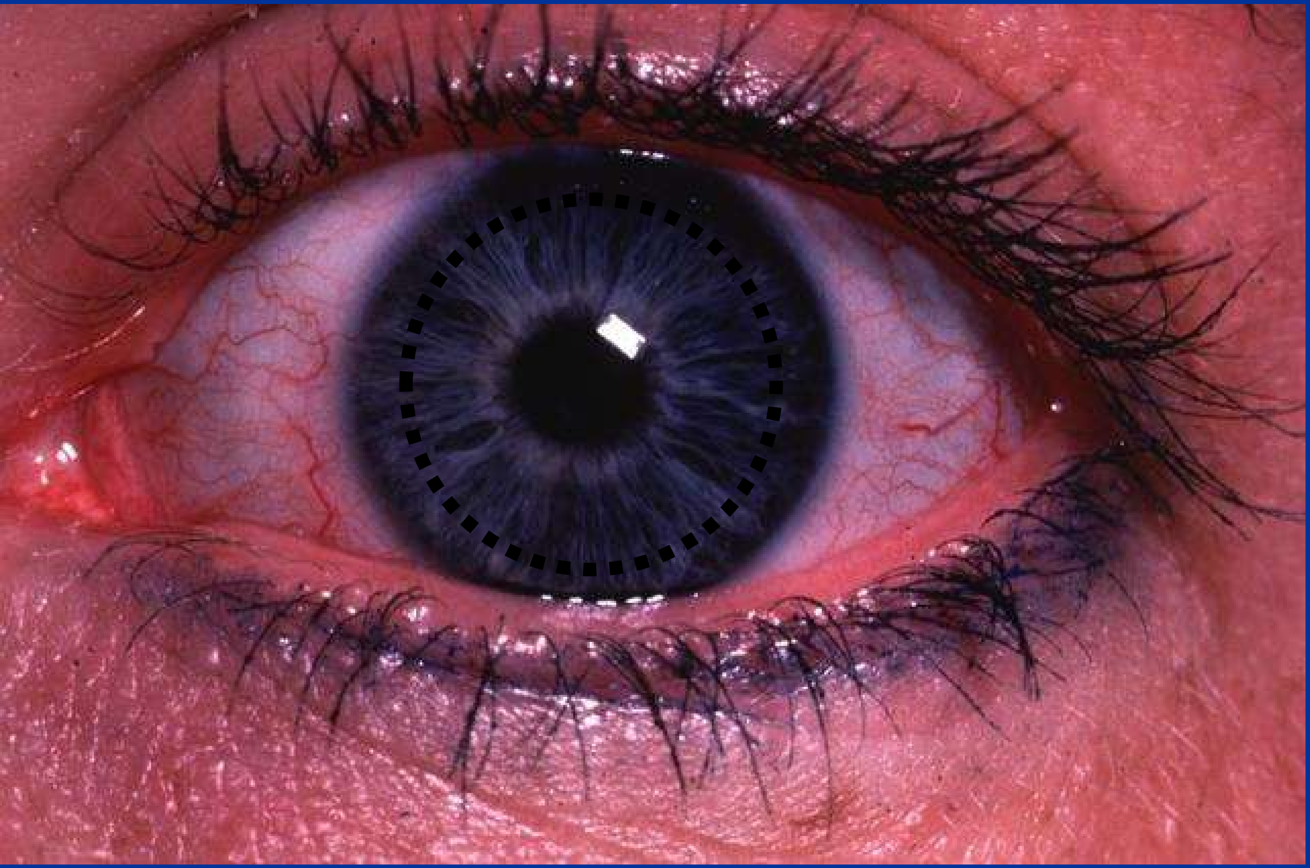


On K



1.00D Steep

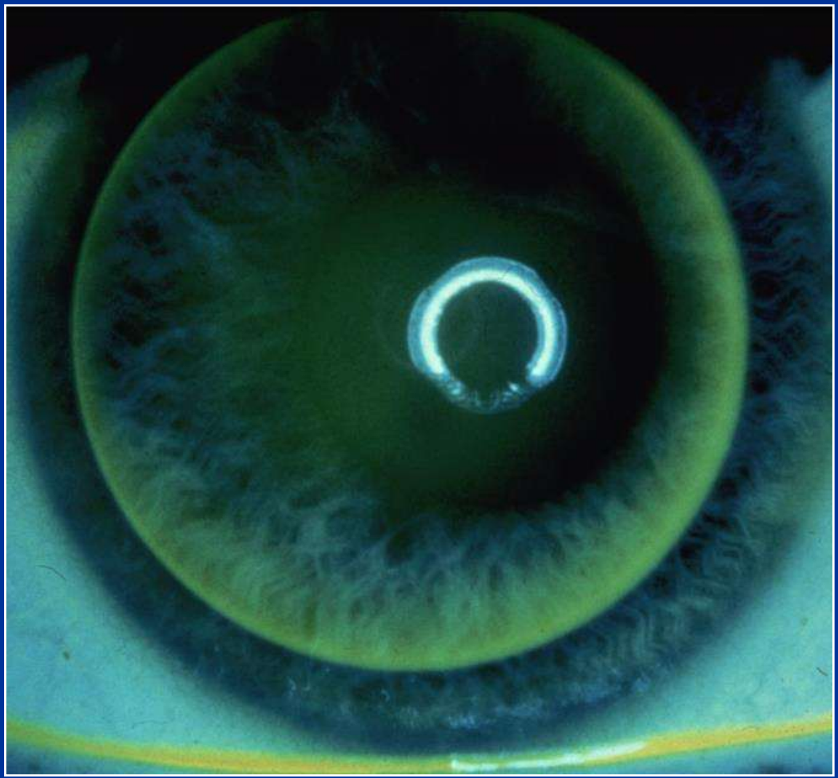
Lid Position



If the upper lid positions above the superior limbus, fit the lens with the apical clearance philosophy

Apical Clearance Fitting
Base Curve Radius

To position the lens between the lids, the base curve chosen must be steeper than the flattest corneal reading



Apical Clearance Fitting

Base Curve Radius

The amount of corneal cylinder determines the base curve radius

Corneal Cylinder	Base Curve Radius
0.00 to 0.75 D	0.25 D steeper than “K”
0.87 to 1.50 D	0.50 D steeper than “K”
1.62 to 2.50 D	0.75 D steeper than “K”
2.62 to 3.50 D	1.00 D steeper than “K”

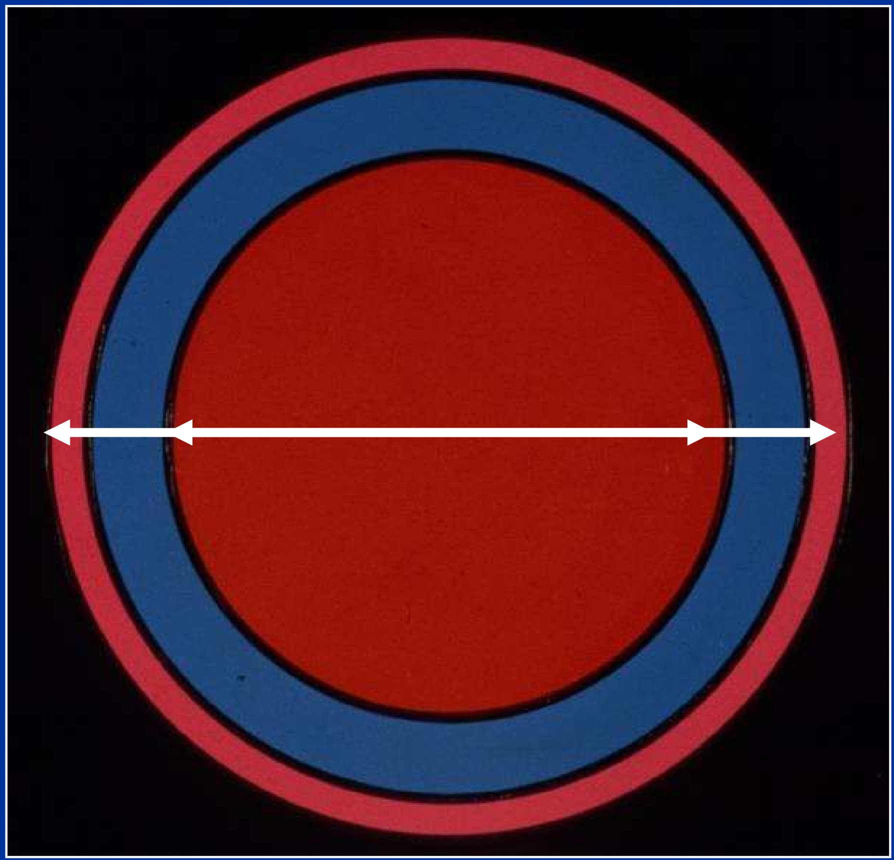
Apical Clearance Fitting

Overall Diameter

Corneal Diameter	Overall Lens Diameter
12 mm or larger	9.0 mm
11.0 to 11.5 mm	8.5 mm
10.5 or smaller	8.0 mm

Apical Clearance Fitting
Optic Zone Diameter

The optic zone diameter will be 1.2 mm smaller than the overall diameter



Toric Designs

- Front surface
- Back surface
- Back surface toric
- Toric peripheral

Front Surface Toric Designs

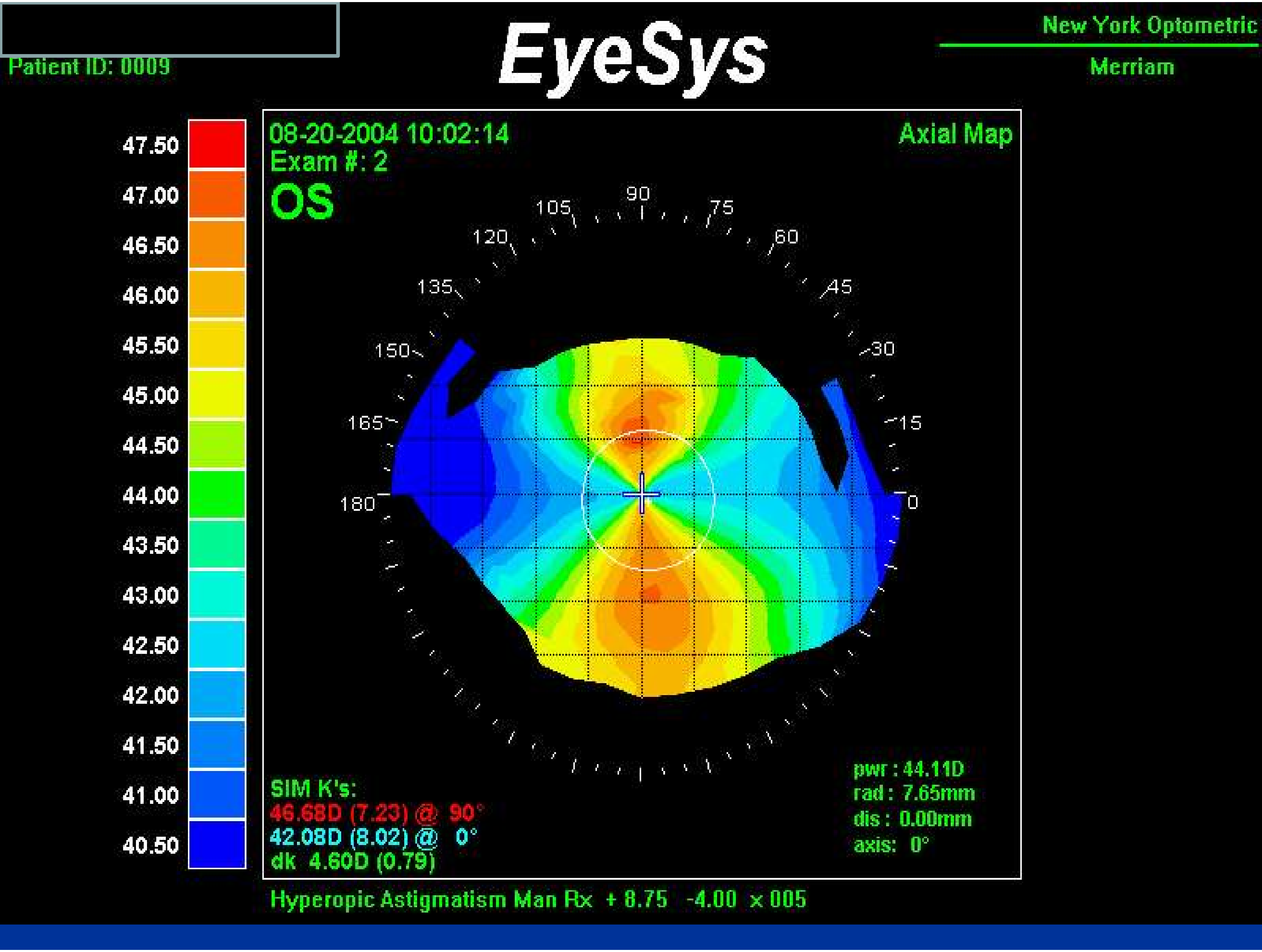
- Prism
- Truncation
- Thinzones “slab off “
- Peri-ballast

Back Surface Cylinder

- Toric back surface/spherical front
- Refractive astigmatism is 40% greater than corneal
- K’ 42.000@180 / 45.00@90
- Rx -2.00-4.25 x 180

Bi-Toric Designs

- Toric curves on both surfaces
- 40% more cylinder is induced
- Extra cylinder is neutralized by toric front surface
- K’s 42.00@180 / 46.00@90
- Rx -1.00-4.00 x 180


[redacted]
Patient ID: 0009
EyeSys
New York Optometric
Merriam
08-20-2004 10:02:14
Exam #: 2
OS
Axial Map
47.50
47.00
46.50
46.00
45.50
45.00
44.50
44.00
43.50
43.00
42.50
42.00
41.50
41.00
40.50
90
105
75
120
60
135
45
150
30
165
15
180
0
SIM K's:
46.68D (7.23) @ 90°
42.08D (8.02) @ 0°
dk 4.60D (0.79)
pwr : 44.11D
rad : 7.65mm
dis : 0.00mm
axis: 0°
Hyperopic Astigmatism Man Rx + 8.75 -4.00 x 005

Bi-Toric Saddle Fit

- Less than 2.50 corneal cylinder
- Fit on K, diameter 8.2-8.8mm
- Rx – 2.00 – 3.00 X 180

  K’s 45.00@180 / 47.50@90
- BC 45.00/47.50 (7.50 / 7.10)

  CL Rx. -2.00 / -4.75   8.8

Low Toric Simulation

- Fit on flat K horizontal meridian
- Fit .50-1.25 flatter than steep vertical meridian
- Greater corneal toricty = flatter vertical curve
- Rx -2.00 - 4.25 x 180

  K's 42.00@180 / 46.00 @90

  BC 42.00 / 45.25

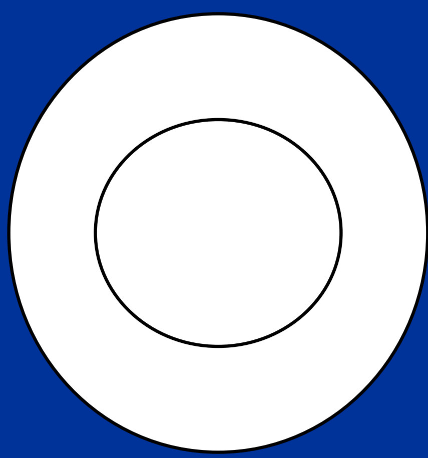
  Rx -2.00 / -5.75

Back Surface Cylinder

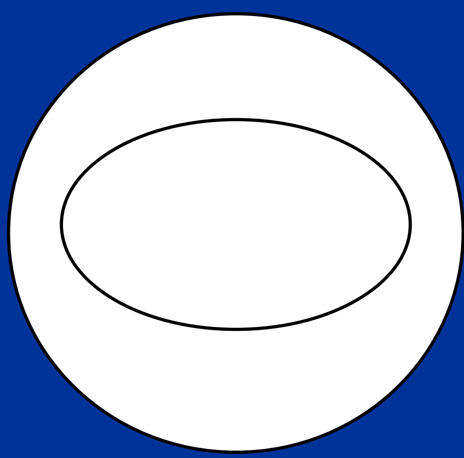
- Toric back surface / spherical front
- Refractive astigmatism is 40% greater than corneal
- K’ 42.000@180 / 45.00@90
- Rx -2.00-4.25 x 180

Toric Peripheral Curves

- Produce .circular OZ



Spherical PC's produce Oval O Z



References :

Taddeo AndrewA
“Toric RGP lens Design”
Rakow Phyllis L.
Toric Soft Lnses Advanced
Contact Lens Manual
Volume II Contact Lens
society of America

Bi-Toric

- K's 42.00@180 / 46.00@90
- Rx -1.00-4.00 x 180
- Design

Peripheral Curves

- Spherical less than 3.00 cylinder
- Toric greater than 3.00 cylinder

Spherical Power Effect Bitorics (SPE)

- Described by Saver 1963
- Toric back curve plus cylinder front
- Plus cyl. same amount and axis as induced back cyl.
- 45.00/47.00 = 7.50/7.18 Pl/-2.00
- 45.00/48.00 = 7.50/7.03 PL/-3.00

Diagnostic Fitting SPE

- BC 42.50 / 45.50 (7.94/7.42)
- DRx PL / -3.00 MOR -4.50
- Lens Rx -4.50 /-7.50 (drum reading)

Cylindrical Power Effect Bitorics (CPE)

- BC 42.50/45.50 (7.94/7.42)
- DRx PL/-3.00 MOR -1.25-2.25 x 180
- Add -1.25@180 and -3.50 @90
- Lens Rx -1.25/-6.50