ASB OPTICIANRY EDUCATION SERVICES

Establishing a Solid Foundation: RGP Designs and Fitting

NCLE Level II - 2 hours

Andrew S. Bruce, LDO, ABOM, NCLEM, FCLSA
Contact: asbopticianry@gmail.com
Website: www.asbopticianry.com

1

On behalf of Vision Expo, we sincerely thank you for being with us this year.

Vision Expo Has Gone Green!

We have eliminated all paper session evaluation forms. Please be sure to complete your electronic session evaluations online when you login to request your CE Letter for each course you attended! Your feedback is important to us as our Education Planning Committee considers content and speakers for future meetings to provide you with the best education possible.

VISION EXPO

2

Financial Disclosure Statement

Andrew Bruce provides consulting services for . . .

- VSP Optics/UUniversity
- Mitsui Chemicals

- All relevant relationships have been mitigated
- He has NO financial interest in any product presented in this course.

3

Learning Objectives

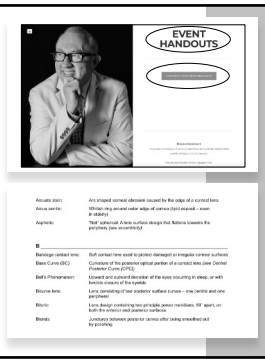
- Introduce the fundamentals of rigid contact lenses, and explore associated parameters and material characteristics
- Compare rigid fitting philosophies, and discuss the role of the keratometer and corneal topographer
- Discuss interpretation of K's for lens design selection
- Provide an overview of slit lamp biomicroscopy
- Present lens verification procedures
- Examine fluorescein patterns and present ways to improve the lens-cornea fitting relationship.

4

www.asbopticianry.com

Event Handouts

"Contact Lens Terminology"



5

Scleral vs. Corneal Designs

- 1st gen. scleral lenses: 18-20mm in diameter
- Corneal designs smaller than corneal diameter
- 9.2mm widely recognized as diameter of choice
- Which is better?

6

Benefits of a Scleral Design

- Mask corneal irregularities/injuries spread out over a large surface area of the cornea
- Mask corneal astigmatism
- Provide relief for patients with dry eye issues
- Excellent wearer comfort and easy adaptation.

7

Benefits of a Corneal Design

- Mask centrally located corneal irregularities
- Mask corneal astigmatism
- Facilitate a healthy corneal metabolism
- Easy handling.

8

Lens Materials

9

PMMA

Advantages
Excellent optical quality and wettability
Good deposit resistance
Good stability and durability
Relatively easy to manufacture
Can be cleaned, disinfected, modified

Disadvantages
Impermeable to oxygen and other gases (Dk = 0).

10

Rigid Gas Permeable Lens Materials (GP)

- GP materials are permeable to oxygen and other gases
- GPs reduce the potential corneal health risks associated with PMMA
- Currently, many GP materials available, some with very high permeability.

11

Cellulose Acetate Butyrate

- Late 70's: first GP material
- Good wettability
- Good protein deposit resistance
- Affinity for lipid deposition
- Poor durability
- Low Dk (4 - 8).

12

Silicone Acrylate

- Addition facilitated increased oxygen permeability by process of *diffusion*
- Provided higher Dk's than CAB
- Good dimensional stability with limited flexure
- Decreased optical quality over CAB and PMMA
- Inherently hydrophobic / poor wettability properties
- Prone to deposit accumulation.

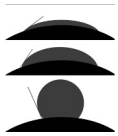
13

Fluorosilicone Acrylate

- FSA gold standard of GP materials
- Addition of Fluorine to minimize protein deposition, aid in oxygen transmission by *solubility*
- Facilitated very high Dk's
- Proper monomer combination improves stability, wettability, and deposit resistance
- Wettability issues still a daily struggle.

14

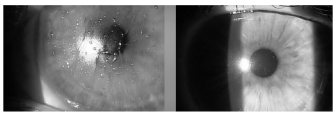
Surface Wettability



- Indicates how well tears spread across lens
- Determined by a material's wetting angle
- With contacts, low wetting angle preferred
- Dry eye patients, especially, benefit from materials with good wettability properties.

15

Surface Treatments



- Plasma treatment / Tangible Hydra-PEG
- Optimize wettability, minimize deposit accumulation
- Enhance acuities and wearer comfort.

16

Optical Fundamentals of Rigid Lenses

17

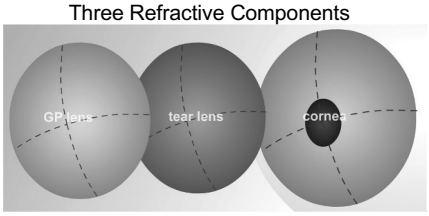
Why Fit a Rigid Lens and Not a Soft?

- Excellent optics
- Totally customizable to facilitate great precision
- Rigid properties mask corneal irregularities, provide a new primary refractive surface
- Allow more precise management of an astigmatic cornea, neutralize corneal toricity
- GP refractive properties are combined with those provided by the lacrimal/tear lens, and the cornea.

18

"GP-Tear Lens-Cornea" Combination

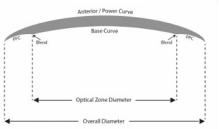
Three Refractive Components



19

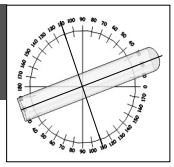
Rigid Lens Parameters and Material Considerations

Base Curve (CPC)	Dk or Dk/t
Anterior / Power Curve	Color
Peripheral Curve (PPC)	Center Thickness
Overall Diameter (OAD/DIA)	Edge Design
Optical Zone Diameter (OZD)	Deposit Resistance
Material	Wetting Angle / Wettability



20

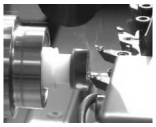
Sources of Astigmatism



- Lenticular
- Corneal: regular *or* irregular
  - Regular . . .
    - **WTR:** 001˚ to 030˚ & 150˚ to 180˚
    - **ATR:** 060˚ to 120˚
    - **Oblique:** 030˚ to 060˚ & 120˚ to 150˚.

21

Rigid Lens Designs



Rigid Design	Calculated Residual Astigmatism	Corneal Toricity
Spherical	< 0.75	< 2.50
Front Surface Toric	> 1.00	< 1.00
Back Surface Toric	> 0.75 @ axis of k-toricity	> 1.50
SPE Bitoric	< 0.75	> 1.50
CPE Bitoric	> 0.75	> 1.50

22

Corneal Curvature Conversion

Surface Power Formula

D = n-1 / r

D = Corneal curvature in diopters
n = Refractive index of the tear film (1.3375)
r = Radius of curvature of cornea in mm
1= Refractive index of air

Ex: Convert K's of 44.50D to radius of curvature, in mm

Rearranging, r = n-1 / D

r = (1.3375–1) / 44.50

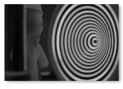
r = 0.00758 meters = 7.58mm

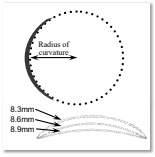
To Simplify

- Radius of curvature in mm = 337.5 / curvature in diopters
- Curvature in diopters = 337.5 / Radius of curvature in mm.

23

Base Curve





- Posterior central radius of curvature
- Based on corneal K's in diopters
- Fitting protocol: on K, FTK or STK
- Fitting philosophy influences BC selection.

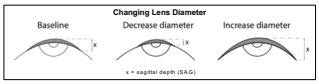
24

Lens Overall Diameter (OAD / DIA)

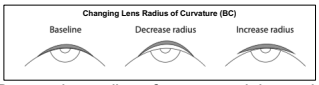
- Determined by HVID, lens type and design, and fitting philosophy
- Influences centration, stability, and overall fit.

25

Effects of Changing OAD/BC



- Influences sagittal depth (SAG)
- Decreasing diameter loosens the fit
- Increasing diameter tightens the fit



- Decreasing radius of curvature tightens the fit
- Increasing radius of curvature loosens the fit.

26

BC-OAD Relationships

Every 0.5mm diameter change requires 0.25D (0.05mm) change in base curve to maintain lens-cornea relationship

Corneal Cylinder	DIA: 8.5mm	DIA: 9.0mm	DIA: 9.5mm
PL to 0.50D	0.25D STK	On K	0.25D FTK
0.75 to 1.25D	0.50D STK	0.25D STK	On K
1.50 to 2.00D	0.75D STK	0.50D STK	0.25D STK
2.25 to 2.75D	1.00D STK	0.75D STK	0.50D STK
3.00 to 3.50D	1.25D STK	1.00D STK	0.75D STK

27

GP Fitting

28

Rigid Lens Fitting Approaches

- **Empirical:** Data based
  - Keratometry
  - Topography
- **Diagnostic:** Based on diagnostic lenses.

29

Rigid Lens Fitting Philosophies

Apical clearance

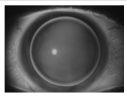
- Designed to center on cornea, interpalpebral position
- Steep BC can result in flexure, unstable vision

Corneal alignment / Upper Lid Attachment

- Preferred approach
- Lens positions over superior cornea, influenced by upper lid
- Provides stable vision, minimal flare, easy adaptation, low lid awareness, natural blink rate, and less peripheral desiccation (drying).

30

Apical Clearance



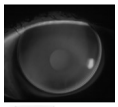
Base curve: Steeper than flat K
Diameter: 8-9mm
Lens thickness: Thinnest possible without flexure.

Corneal Cylinder	Base Curve
PL to 0.75D	0.25D STK
0.87 to 1.50D	0.50D STK
1.62 to 2.50D	0.75D STK
2.62 to 3.50D	1.00D STK
> 3.50D	Consider Toric BC

HVID	Lens Diameter
< 10.5mm	8.0mm
11.0mm – 11.5mm	8.5mm
> 12.0mm	9.0mm

31

Corneal Alignment or Lid Attachment



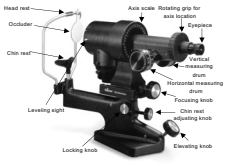
Base curve: 0.50D to 1.50D flatter than FTK
Diameter: 9.2 - 9.6mm (avg. 9.5mm)
Lens thickness: minimum allowable for material.

Corneal Cylinder	Base Curve
PL to 0.75D	1.00D FTK
0.87 to 1.25D	0.75D FTK
1.37 to 1.75D	0.50D FTK
1.87 to 2.75D	0.25D FTK
2.37 to 2.75D	On K
2.87 to 3.50D	0.25 STK
> 3.50D	Consider Toric BC

HVID	Lens Diameter
< 10.5mm	9.2mm
11.0mm – 11.5mm	9.4mm
> 12.0mm	9.6mm

32

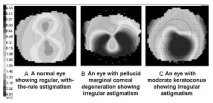
Keratometer



- Used to measure corneal curvature, central 3-4mm
- Range: 36.00D to 52.00D *(extendable)*
- Provides keratometry values (K's)
- Also used to evaluate tear film and soft lens fit.

33

Corneal Topographer



- Used to provide corneal "mapping"
- Broader coverage than a standard keratometer
- Provides detailed analysis of the overall corneal shape
- Very important when working with irregular corneas
- Vital for procedures such as ortho-k/refractive surgery.

34

Interpreting K's

Standard Notation
45.00 @ FTK / 46.00 @ STK
45.00 / 46.00 @ STK
(assumes axes 90 degrees apart)

- K's indicate corneal curvature in primary meridians
- Determines source of astigmatism: corneal/lenticular
- **Example Rx/K's:** -2.00 -2.50 x 090 44.00/46.50 @ 180
  - Refractive astigmatism = 2.50D
  - From K's, corneal astigmatism = 2.50D
  - What's the source?
  - Cornea is responsible for ALL the refractive astigmatism.

35

Base Curve and Diameter Selection

Base Curve Selection

- K's indicate power meridians and source of astigmatism – corneal and/or lenticular
- K's determine best suited lens type/design
- Fitting philosophy determines recommended BC range

Diameter Selection

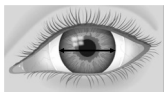
- Influenced by HVID, lens type/design, fitting philosophy
- General starting point = HVID - 2.5mm.

36

Horizontal Visible Iris Diameter (HVID)

Classification:

Small = ≤ 11mm
Medium = 11.5mm
Large = ≥ 12mm

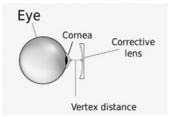


To measure: PD ruler
Graticule scale on slit lamp
Corneal topographer, AND ???
Soft lens of known diameter.

37

Compensating For Changes in Vertex Distance

Why necessary?



- Due to changes in "effective power"
- Increase VD = increase effective plus
- Decrease VD = decrease effective plus
- Compensation necessary over +/- 4D for contacts.

38

Effective Power Calculation Example

Effective Power Formula = $\frac{\text{Original Power}}{1 + (\text{change in VD (m)} \times \text{Original Power})}$

Q: *Calculate contact lens power for +5.00DS refracted at a VD of 12mm*

USING FORMULA

Effective power at a corneal plane = +5.00 / 1 + (+0.012 x +5) = **+4.71D**

(CONFIRM: Lens moved closer so effective power should be less "plus")

What CL Power should be used? **+5.25D**

IMPORTANT

If VD increases, change is negative "-" If VD decreases, change is positive "+".

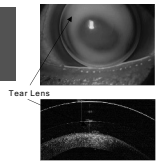
39

Determining Rigid Lens Powers

- Transpose to minus cylinder *(if necessary)*
- Compensate for changes in vertex power
- Determine astigmatism and its source
- Select design, based on magnitude/source of astigmatism
- Determine flattest meridian from K's
- Decide on initial BC selection, based on K's/philosophy
- Compensate for tear lens (SAM and FAP).

40

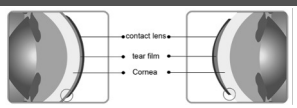
The Tear Lens



- A rigid contact lens "vaults" the corneal surface
- Creates a space filled with tears - the "tear lens"
- Combination of tear lens and rigid lens provide a crisp, clear refracting surface.

41

FAP: Flatter Add Plus SAM: Steeper Add Minus



- Steeper BC = more central space / more tear lens *(more plus)*
- Flatter BC = less central space / less tear lens *(less plus)*
- Tear lens influences total refractive properties
- FAP/SAM used to compensate for changes.

42

Calculation Example

K readings: 44.00 / 45.00 @180
HVID: 11.5mm
Rx: -3.00 -1.00 x 090

- Type of astigmatism?
- Source(s) of refractive astigmatism?

PLAN . . .

For an *apical clearance fit* with 1.00D of corneal astigmatism:

- Fit lens 0.50D STK
- Going steeper adds minus (SAM)

Lens BC and power? 44.50D **(7.58mm) / -3.50D**

Appropriate diameter: 8.5mm *or* 9.5mm? **8.5mm**

43

Verification Procedures

44

Lensometry

INDUSTRY STANDARD: BACK VERTEX POWER (CONVEX SIDE UP)

Lens Design	Lensometer Readings	Notation
Spherical	Spherical	Power Drum Reading
Back Surface Toric	2 Different Power Readings 90° apart No Prism	Drum Readings in Both Meridians No Axis
Front Surface Toric	2 Different Power Readings 90° apart Prism Present	Sphere Cylinder Axis (Same as Glasses)
Bitoric	2 Different Power Readings 90° apart No Prism	Drum Readings in Both Meridians No Axis

45

Radiuscope Interpretation

The Drysdale Principle
Measures the distance between lens surface and its center of curvature

- Single BC with no prism from lensometry = **Spherical**
- Single BC with prism from lensometry = **Front Surface Toric**
- If NO prism and 2 different meridians, convert BC readings to diopters and compare to lensometry:
  - If BC toricity x 1.5 = Refractive Cylinder: **Back Surface Toric**
  - If BC toricity = Refractive Cylinder: **SPE Bitoric**
  - If neither apply: **CPE Bitoric.**

46

Back Surface Toric Example Calculation

- From lensometry: -4.00 / -5.50, no prism
- From radiuscope = 7.67mm / 7.50mm *(convert to diopters)*
- Using D = 337.5/r: BC = 44.00D / 45.00D

FINDINGS

- Refractive toricity = **1.5D** Surface toricity = **1D**

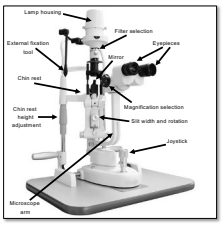
Surface toricity ≠ refractive toricity, so NOT a SPE bitoric
Surface toricity x 1.5 = 1.5D = refractive toricity
Therefore, lens is a back surface toric.

47

Fitting Evaluation and Follow Up Care

48

Slit Lamp Biomicroscopy



- Permits magnified eye health examination, using various kinds of illumination
- Three main parts:
  - Illumination system (illumination arm)
  - Observation system (viewing arm)
  - Mechanical system (base).

49

Viewing and Illumination Techniques

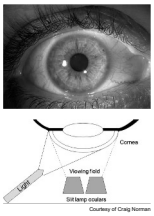
Direct: Viewing structures within the focused light
Indirect: Viewing structures not within the focused light

Illumination types vary with . . .

- Positioning
- Beam size, width, and shape
- Point of focus.

50

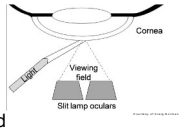
Diffuse



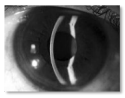
- Broad uniform view
- Recommended 45˚angle between oculars and beam
- Slit width: wide open
- Low magnification
- Low beam intensity.

51

Direct Focal

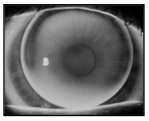


- Oculars viewing where beam focused
- Type varies with beam size:
  - **Optic section:** small, thin beam
  - **Parallelepiped:** larger/thicker, most common with contacts
- Magnification: med to high
- Beam intensity: med to high.



52

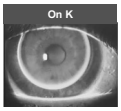
Fluorescein Evaluation

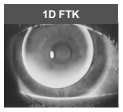


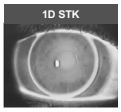
- Cobalt blue filter "excites" fluorescein in tears *(enhance with Wratten #12 yellow)*
- Becomes brilliant fluorescent green where tears are present
- Variations in intensity of "green" indicate how much space is between the cornea and contact lens . . .
  - More-green = More space *(more tears)*
  - Less-green = Less space *(fewer tears)*
- *NOTE: Even when green glow is absent, pre-corneal tears are still present.*

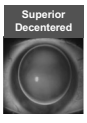
53

Fluorescein Patterns









54

Lens Centration and Movement

RULE OF THUMB
Lens will center over steepest curve, especially with irregular corneas

Apical Clearance Fit

- Should stabilize, centrally
- Remain relatively central during 4-6 sec blink
- Lens excursions approx. 1.5mm with blink

Corneal Alignment/Lid Attachment Fit

- Lens moves only with blink, lifts, and re-centers
- No drag or excessive "floating" around.

55

Correcting For Lens Decentration

General Lateral Decentration

- Steepen BC
- Increase OAD or OZD
- Steepen peripheral curves
- Consider ATR astigmatism

Apical Clearance Fit

- *Superior decentration:* reduce OAD, steepen BC, change SG or RI
- *Inferior lens drop:* increase OAD, steepen or flatten BC based on fluorescein pattern, change SG or RI.

56

Correcting For Lens Decentration (cont.)

Corneal Alignment/Lid Attachment Fit

- *Superior decentration:* steepen BC, decrease OAD or OZD, flatten peripheral curves, change SG or RI
- *Inferior lens drop:* increase OAD or OZD, steepen or flatten BC based on fluorescein pattern, change SG or RI
- Relies on interaction between upper lid and lens, consider . . .
  - Hyperflange lenticular or CN bevel with high minus
  - Myoflange lenticular with high plus.

57

Prepare Patient For Success

Provide Detailed Care & Maintenance Instructions

- Brand name solutions for cleaning, disinfection, & rinsing
- Routine case replacement
- The "Dos and Don'ts" of contact lens wear

Recommended Follow-Up Protocol

- 1-3 months after finalized
- 6-12 month intervals after successful.

58

To Take Away . . .

- Despite the popularity of soft lenses, don't forget the many benefits of GPs
- Try not to be intimidated by the fitting and follow-up process
- Embrace every chance you get to work with GPs as an opportunity to expand your skill set and provide your patients with great vision

Resources

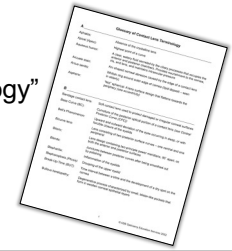
GP Lens Institute: www.gpli.info
Valley Contax: www.valleycontax.com

59

Event Handouts

www.asbopticianry.com

"Contact Lens Terminology"



60

Thank You!

Speaker Contact Information
Andrew S. Bruce, LDO, ABOM, NLCEM, FCLSA

www.asbopticianry.com
Email: asbopticianry@gmail.com
Instagram: @asbopticianry

61