1 **Scleral Lenses 101**
**-the basics and beyond**

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2 **Overview**

- Clinical Indications
- Advantages and Challenges
- Terminology
- Anterior eye anatomy
- Basic Design Features
- Instrumentation
- Fitting basics – lens selection, fitting, evaluation, follow-up
- Tips and Troubleshooting

3 **Clinical Indications**

- Vision Improvement
  - *Correcting the irregular cornea*
    - *Corneal Ectasia*
      - *Primary – Keratoconus, Keratoglobus, Pellucid marginal degeneration (INTACS, CXL)*
      - *Secondary – post-refractive surgery, corneal trauma*
    - *Corneal Transplant*
    - *Corneal Degenerations*
  - *Normal Cornea*
    - *Presbyopia, moderate to high corneal astigmatism*
    -
-

4 **Clinical Indications**

- Ocular Surface Protection
  - *Dry Eye*
  - *Incomplete lid closure*
  - *Sjorgen's Syndrome*
  - *Stevens-Johnson Syndrome*
  - *RCE / corneal abrasions*
  - *Graft host disease*
  - *Infiltrative keratitis*
  -
    -
-

5 **Persistent corneal epithelial defects**

- Epithelium-off CXL (16 year old male)

- Constant epithelial defect for 2 months
  - Neomycin/dexamethasone, Zirgan, Oflaxacin, doxycycline, acyclovir, AT, BCL
- Applied a scleral contact (15.6 diameter)
  - Wore extended wear for 6 days
  - Cont Maxitrol and oflaxacin drops
- Lens removed after 6 days of wear
  - epithelial defect healed
  - overlying corneal haze

6 **Corneal Abrasion**

- Healing response attributed:
  - Oxygenation
  - Moisture
    - Constant tear film
  - Protection of the corneal epithelium
    - Minimal abrasion
- *Allows epithelium to migrate, adhere, and proliferate over the persistent epithelial defect.*
  -

7 **Clinical Indications**

- *Cosmetic/Sports*
  - *Hand-painted scleral lenses*
  - *Ptosis*
  - *Water sports*
  -
- *Lens failure in other designs*
  -
-

8

**Advantages of Scleral GPs vs Corneal GP**

- Centration
  - *Fitting a "regular" part of the eye*
- Lens Retention
  - *Minimal chance of inferior standoff*
- Comfort
  - *Reduced lid interaction; no corneal interaction*
- Vision
  - *Masking severe corneal irregularity*

9 **Challenges associated with scleral lenses**

- Handling
  - *Difficult I and R (initially)*
  - *Apprehensive patients*
- Fitting

- *Subtle fit indications*
- *Increased chair time*

- Physiology
  - *Dk/L – Oxygen must diffuse over great distance*
  - *Long-term effects of scleral lens wear are unknown*

10 **Terminology**

- Classification
-
  - Corneo-scleral 12.9mm to 13.5mm
  - Semi-Scleral 13.6 mm to 14.9mm
  - Mini-Scleral 15.0mm to 18.00mm
  - Full-Scleral 18.1mm to 24+

11 **Terminology**

12 **Anatomy and Shape of the Anterior Ocular Surface**

- Maximum scleral lens size for normal eye: 24mm
- Scleral Shape Study
-

13 **Anatomy and Shape of the Anterior Ocular Surface**

- Corneal Toricity does not typically extend to sclera
-
- The ocular surface beyond the cornea is nonrotationally symmetrical
  - Asymmetrical
  - The entire nasal portion typically flatter compared to the rest
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14 **Anatomy and Shape of the Anterior Ocular Surface**

- Clinical Consequences
  - Temporal-Inferior decentration of scleral lenses
    - Inferior decentration
      - Weight/gravity
      - Eyelid pressure
    - Temporal
      - Flatter nasal elevation
- Conjunctival Prolapse

15 **Basic Design Features**

- Spherical Design
  - Concentric symmetrical (spherical) scleral lens
  - Non-toric back surface
  - Optic Zone
    - Centermost zone

- Optics/Lens power
  - –Anterior surface
- Back surface
  - –Ideally mimics corneal shape
- Completely vaults cornea

16 **Basic Design Features**

- Spherical Design
  - Concentric symmetrical (spherical) scleral lens
  - Non-toric back surface
  -
  - – Transition Zone
    - Mid-periphery or limbal zone
    - Creates the sagittal height
    - Can be reserve geometry
    - Completely vaults limbus

17 **Basic Design Features**

- Spherical Design
  - Concentric symmetrical (spherical) scleral lens
  - Non-toric back surface
  -
  - – Landing Zone
    - Area of the lens that rests on anterior ocular surface
    - Scleral zone or haptic
    - Alignment to provide even pressure distribution is key

18 **Basic Design Features**

19 **Basic Design Features**

- Toric Lens Designs
  - – Front Surface Toric -
    - Anterior surface front toric optics to improve vision
    - Located on the front surface of the central optical zone
    - Indicated when residual cylinder over-refraction is found
    - Needs stabilization
      - –Dynamic stabilization zones or prism ballast
      - –LARS

20 **Basic Design Features**

- Toric Lens Designs
  - – Back Toric Haptics
    - Landing zone is made toric to improve lens fit

- Does not interfere with central zone of scleral lens
- Better ocular health
  - –Fewer areas of localized pressure
  - –Decreased bubble formation
  - –Longer wearing time and better patient comfort
- More frequently needed in larger diameter sclerals

21 **Basic Design Features**

- Toric Lens Designs
  - – Bitoric both anterior optics and back toric haptics
    - Front surface toric optical power
    - Back surface toric periphery
    - No need for lens stabilization

22

23 **Basic Design Features**

- Multifocal Scleral lens design
-
  - – Simultaneous Multifocal Lens Design
    - Aspheric or concentric
    - Center Near and Center Distance Designs
      - –Can adjust near powers
      - –Can adjust zone size
    - Not all scleral lens designs have a MF option

24 **Basic Design Features**

- Multifocal Scleral lens design
-

25 **Basic Design Features**

- Lens Material
  - – High(est) Dk lens material; plasma or hydra-PEG
    - Considerably thicker when compared to corneal GP
      - –250 microns to 500 microns
    - Optimum Extreme, Menicon Z
- Increasing Oxygen transmissibility
  - – 1. high Dk material (Dk > 125)
  - – 2. minimal tear clearance behind the lens (<200)
  - – 3. Reduced center thickness of the lens (<.250)

26 **Fitting Basics**

- Hydra-PEG
  - – *Polyethylene glycol (PEG) – base polymer*
    - *Covalently bonded to the lens surface*
    - *Creates a wetting ocular surface, increases surface wettability, increases lubricity,*

*decreases protein and lipid deposits, improves TBUT.*

27 **Fitting Basics**

- Completely vault the *cornea* and *limbus* while aligning to the *bulbar conjunctiva*

28 **Fitting Basics**

29 **Fitting Basics**

- 1. Diameter
- 2. Clearance
- 3. Landing Zone Fit
- 4. Lens Edge
- 5. Asymmetrical Back Surface Design
  - Some trial sets are toric back surface
- 6. Lens Power

30 **Fitting Basics**

- 1. Diameter
  - Choose a Fitting Set
    - Direct vs Indirect control
  - Laboratory warranty/exchange policy
  - Overall Diameter
    - Larger – more clearance needed, ectasias
    - Smaller – easier to handle, less clearance

31 **Fitting Basics**

- 1. Diameter
  - HVID
    - <12mm
      - Start with a 16.0 mm or smaller lens
    - >12mm
      - Start with a 16.0 mm or larger lens
  - Diameter of the optical zone and the transition zone chosen roughly 0.2mm larger than the corneal diameter

32 **Fitting Basics**

- 2. Clearance
  - Minimum of ~100 microns
  - Typically aim for 200-300 microns after settling
  - Maximum of 600 (if desired)
  -
  - Base Curve Determination
    - Select an initial base curve that is flatter than the flat k value
    - Use 14 mm chord OCT, measure sagittal depth

33 **Fitting Basics**

- Evaluate overall corneal chamber appearance
  - Diffuse beam, low mag, medium illumination
  - Observe centration, areas of bearing, tear lens appearance, look for bubbles

34 **Fitting Basics**

35 **Fitting Basics**

- Evaluate central clearance

36 **Fitting Basics**

37 **Fitting Basics**

38 **Fitting Basics**

39 **Fitting Basics**

- Change lens base curve/sagittal depth until desired central clearance is reached
  - Considerations:
    - All scleral lenses will settle over a period of hours
    - Expect ~ 90 to 150 microns settling
    - Aim for 150 to 300 microns *after* settling
    - Build-in settling time into fitting session ~30 min

40 **Fitting Basics**

- UMSL Study:
  - No significant settling after 4 hours of wear
  - Most settling within the 1st hour
  - Large Diameter Scleral settle ~90 microns, slower
  - Mini Scleral ~130 microns, faster
  -
-

41 **Fitting Basics**

- Evaluate remaining corneal chamber
  - Optic Section
  - Sweep limbus to limbus noting tear lens thickness
  - Looking for tears in optic section beyond the limbus and should increase in thickness toward the central cornea

  *** Adequate limbal clearance is critical for an acceptable fit and good tear exchange***

42 **Fitting Basics**

- Anterior Segment OCT

43 **Fitting Basics**

- Anterior
  Segment OCT

44 **Anterior Seg OCT**

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45 **Fitting Basics**

- 3/4. Landing Zone Fit/Edge
  - Bulbar conjunctival vessels
  - Look for blanching
    - *Inappropriate scleral curve alignment*
    - *Typically indicates PC is too tight*
    - *Or new toric back surface haptics*
  - Confirm no lens movement
  - Perform all peripheral lens evaluations in Primary Gaze.

- Ideal alignment when vessels course unobstructed under the scleral curves

46 **Fitting Basics**

47 **Fitting Basics**

48 **Fitting Basics**

- Anterior Segment OCT

49 **Fitting Basics**

- 5. Asymmetrical Back Surface Design
  - Allows for more equal pressure distribution
  - Can help center a inferiorly decentered lens
  - Flat and steep meridian
    - Can adjust either independently
    - Flat meridian is typically marked
    - Will lock into place

50 **Fitting Basics**

- 6. Lens Power/Over-Refraction
  - Expect close to spherical OR
  - If OR yields significant cylinder check - flexure
    - Do over-keratometry or over-topography
  - Residual Cylinder

- Front surface toric
- Usually has a great visual outcome

51 **Fitting Basics**

- Design and Order
  - Often lens modifications will need to be made from the best trial lens fit
  - Lab Consultants are helpful
    - Some warranties require consultation when re-ordering
  -

52 **Fitting Basics**
**Scleral Lens Handling**

- Insertion
  - Prepare Lens
    - Large DMV
    - Clean lens, rinse
  - Fill with non-preserved sol
    - 0.9% NaCl inhalation sol
    - Off label: Addipak, Modudose
    - Lacripure, ScleralFil (buffered)
    - Refresh Optive single vials
    - Celluvisc

53 **Is buffered better??**

54 **Fitting Basics**
**Scleral Lens Handling**

55 **Fitting Basics**
**Lens Insertion**

- Place paper towels on patient's lap
- Have patient tuck chin to chest and look straight down
- Have patient hold lower lid
- Clinician hold upper lid
- Insert lens straight onto cornea

56 **Fitting Basics**
**Scleral Lens Handling**

57 **Fitting Basics**
**Lens Application**

58 **Fitting Basics**
**Scleral Lens Handling**

- Removal
  - Loosen Lens – gently nudge lens

- Medium DMV
  - placed on inferior portion of lens
- Hold both lids

59 **Fitting Basics**
**Lens Removal**

60 **Fitting Basics**
**Scleral Lens Handling**

61 **Fitting Basics**
**Scleral Lens Handling**

- Educate patient about proper lens orientation upon insertion
  - Dots at 6 o'clock

62 **Parameter Considerations**

- Common Parameter Changes:
  - Sagittal Height
  - Overall diameter (OAD)
  - Optic Zone Diameter (OZD)
  - Base Curve (BC)
  - PC width
  - PC radius of curvature
  - Center Thickness

63 **Parameter Considerations**

- Common Parameter Changes:
  - Sagittal Height
    - Adjustment to the transition zone
    - Allows clinician to increase or decrease central lens clearance without adjusting base curve or peripheral lens curves
    - Indicate to lab the amount of clearance you want to gain or lose
    -

64 **Patient GH**

- Fit in 2013
- OD: 7.50 / -7.00 / 14.5 20/50
- OS: 7.5 / -7.50 / 14.5 20/40
- SLE: central touch in both eyes
  - Increase diameter; increase sagittal height; steepen lens

65 **Patient GH**

- New Scleral Lens
  - OD: 7.5 / 14.8 / -7.50 -1.25 x 013 20/30
    - 1.5 steep limbal zone
  - OS: 7.18 / 14.8 / -8.25 -0.75 x 162 20/40+

- –1 step flat limbal zone; 1 step flat scleral zone

66 **Parameter Considerations**

- Common Parameter Changes:
  - – Overall diameter (OAD) / Optic Zone Diameter (OZD)
    - Can increase or decrease
      - –More likely to increase
    - If you need additional central clearance
      - –Can increase OZD which will increase OAD
    - If you need more clearance at limbus
      - –Can increase OZD which will increase OAD

67 **Parameter Considerations**

- OZD changes: often done to improve fit
  - – OZD increase *<u>without</u>* BC compensation

68 **Parameter Considerations**

- Increase OZD *<u>with</u>* BC compensation

69 **Parameter Considerations**

- Common Parameter Changes:
  - – Base Curve (BC)
    - Typically adjusted during initial fit
    - Flatter base curve to address peripheral lens tightness or excessive central clearance
    - Steeper base curve to increase central clearance or loose periphery
  - – If you need to adjust the central clearance, but you are happy with peripheral alignment
    - Adjust sagittal height NOT base curve

70 **Parameter Considerations**

- Common Parameter Changes:
  - – PC width / PC radius of curvature
    - Make wider or smaller
    - Steeper or flatter
    - Toric Haptics
  - – Center Thickness
    - Can increase or decrease
      - –Considerations: flexure and edema
    -

71 **Parameter Considerations**

- Scleral Curve Changes

72 **Tips for Fitting**

- 1. Go flatter than flat K value for initial lens selection

- 2. Use Fluorescein for initial lens selection
  - Use BLUE Light – GET THE BIG PICTURE
  - Use WHITE Light – to evaluate everything else

- 3. Analyze Superior and Inferior lens edges in Primary Gaze
- 4. Try not to make parameter changes at dispensing
- 5. Toric Haptics – spin lens and watch for quick return

73 **Tips for Follow-up**

- 1. Ask patient: "How do you take care of your lenses"
- 
- 2. Follow-up should be at least 2 hours after lens insertion
- 
- 3. Paint the front of the lens to look for fluid exchange
- 
- 4. Remove lens and evaluate cornea

74 **Troubleshooting**

- Problem: <u>Decreased vision after insertion</u>
  - Often caused by mucin build-up in tear lens
  - Begins ~30min to 4 hrs after insertion

- Possible Solutions
  - Reinsert lens with fresh solution/ use solution mixture
  - Rx lid hygiene
  - Rinse eye prior to insertion
  - Refit with decreased central clearance/better peripheral alignment
  - Change lens material or Lens coating – Hydra-PEG

75 **Troubleshooting**

- Decreased Vision after Insertion

76 **Troubleshooting**

- Conjunctival Prolapse

77 **Troubleshooting**

<u>Conjunctival Prolapse</u>

  - Caused by negative pressure under the lens

  - More prominent in patients with loose conjunctival tissue or elderly patients
- Check for neovascularization
- Solution

- 1. Fit a asymmetrical back surface scleral lens to help alleviate the problem
- 2. Decrease limbal clearance

78 **Troubleshooting**

Conjunctival Prolapse

- Prolapse with tight PC
  - Flatten the PC

79 **Troubleshooting**

Conjunctival Prolapse

- Prolapse with peripheral alignment
  - Decrease the limbal clearance
  - 2 ways:
    - Flatten the BC
    - Decrease the reverse curve

80 **Troubleshooting**

- Problem: Diffuse Corneal Staining on follow-up
  - Due to fill media, care systems, AT's or meds
  - Can be difficult to isolate cause
  - Can be more significant if tear exchange is low

- Possible solutions:
  - Switch Care systems
  - Rx 0.9%NaCl inhalation solution
  - Completely rinse MPS off lens
  - Confirm compliance with prescribed care

81 **A severe case of stain**

- 27 yo patient with Keratoconus OU
  - Wearing scleral lens OU – 2014
  - Hx of Corneal Crosslinking OU ('09)
  -
- Presents 7/2017
  - Cc: blurred vision OS> OD
  - using clear care to clean lenses
  - sometimes sleeps in lenses
  - uses Boston Advance to fill lenses prior to insertion

82 **A severe case of stain**

- 27 yo patient with Keratoconus OU

- VA 20/30– OD 20/125 OS
- SLE: Punctate staining OU, mild corneal edema OS
- 150 microns clearance OU
- Adequate limbal clearance
- No peripheral blanching or impingement

- Plan: educated patient about proper lens care;
  RTC 1 week fitting

83 **Troubleshooting**

- Problem: Poor surface wetting
  - MGD can contribute / cause problem
  - Multipurpose Solution (MPS) may cause problems
  - Lens Material
  -
- Possible Solutions:
  - Evaluate lid margins/ tear film
  - Prescribe lid hygiene if necessary
  - Change MPS / Lens material
  - Lens Coating – hydra-PEG

84 **Troubleshooting**

- Problem: Poor surface wetting (old lens)
  - Lens Coating break-down
  - Lens Material break-down
  -
- Possible Solutions:
  - Order new lenses (with HydraPEG)
  - Clean with laboratory cleaner
  - Prescribe Progent

85 **Troubleshooting**

- Problem: Corneal edema at follow-up
  - Can arise after weeks / months => f/u is important!
  - More common in post PK corneas
  - Higher risk in corneas with low endothelial cell count
  - Consider Dk/L as Dk is likely not the issue

- Possible Solutions:
  - Prevention: do endothelial cell count before fitting (1000 +?)
  - Scrutinize grafts at *every* visit!
  - Educate graft patients on symptoms of rejection: pain, light sensitivity, redness, blurred vision

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86

87 **Troubleshooting**

- Keratoconus and Fuchs!  Oh My!
- 64 you Female with Keratoconus
  - Presents with blurry vision in scleral lenses and irritation OU
    - Lenses are uncomfortable and dry
    - Redness OU
  - Interested in Eyeprint PRO
  - 20/40- OD  20/30- OS  HVID 12mm
  - OD: +0.75 -4.00 x 175  20/40-  OS: +1.50 -3.50 x 180  20/30-
  - Pingecula Temporal and Nasal OU
  - 
- P

88 **Case TS: KCN and Fuchs**

- Initial FITTING
- *HVID 12mm; Pingecula T/N OU*
  - 8.4 base curve  4.6 sagittal height  17.0 diameter
  - OR: +3.75 -0.75 x 180  20/25--  +4.00 -0.75 x 180  20/30
  - 
- Options to Troubleshoot Pingecula:
  - Microvault
  - Toric PC
- 

89 **Case TS: KCN and Fuchs**

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90 **Case TS: KCN and Fuchs**

- Keratoconus and Fuchs!  Oh My!
  - At one year follow-up

91 **Case TS: KCN and Fuchs**

- Toric Haptics/Peripheral Curves
  - Steepen the Vertical meridian to relieve pressure in the horizontal
  - Flatten the hortizonal meridian
  - Always evaluate the location of the flat meridian markings
  - 
  - 

- MicroVault
  - Confirm lens design can incorporate microvaults
  - Measure location and size
-

92 **Troubleshooting**

- Problem: Discomfort immediately after insertion
  - *Ask patient where discomfort is located*
  - Poor peripheral fit – too flat
  - Base curve too flat- central bearing or touch
  - Mucus adhered to back surface of lens
  -
- Possible solutions:
  - Adjust peripheral systems for proper alignment
  - Select steeper base curve
  - Clean inside of bowl daily; prescribe Progent (Menicon) to remove mucus
    -

93 **Troubleshooting**

- Problem: Discomfort after several hours of wear
  - Follow-up patient questions
  -
  - Does your eye become red while wearing the lens?
  - Does your eye become red after lens removal?
  - Where is the irritation located?
  - Do you notice any changes in your vision?
  - What solution(s) are you using for lens application?

94 **Troubleshooting**

- Problem: Discomfort after several hours of wear
  - Poor peripheral fit (too steep)
  - Lens is too small to support its weight
  - Corneal chamber too small
  -
- Possible solutions:
  - Adjust peripheral systems for proper alignment
  - Increase surface area of scleral curves
  - Increase OAD or corneal chamber size if appropriate

95 **Troubleshooting**

- Problem: Lens hurts upon removal with subsequent difficulty wearing it the next day
  - Poor peripheral fit – scleral compression
    - Causing rebound hyperemia and inflammation
    -

- Possible solutions:
  - Changing Diameter
  - Changing peripheral curves
-

96 **Troubleshooting**

- Problem: Bubbles under the lens
- Too much sagittal height/Too flat peripheral curves
  - Improper insertion
  - Fenestration hole
  -
- Possible Solutions:
  - Fill bowl completely with solution prior to insertion
  - Remove fenestration hole
  - Central bubble: Adjust lens parameters to decrease sagittal height
  - Peripheral bubbles: steepen peripheral curves or increase lens diameter

97 **Patient AB**

- History: KCN OU; crosslinking OU
- Lens history: soft toric lenses
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98 **Patient AB**

- Examination findings
  - MR:
    - OD +0.75 -3.50 x 060 20/70+
    - OS -0.25 -0.75 x 142 20/100+
  - Lens options
    - Specialty Corneal lens
      - Patient attempted to wear and could not adapt
    - Intralimbal design
      - Patient attempted to wear and could not adapt
    - Scleral Lens
-

99 **Patient AB**

100 **Patient AB**

101 **Final Thoughts**

- Consider mini-scleral / scleral for appropriate patients
  - Select one lab, one design
- First couple fits are the most challenging
- Scleral lenses are not going away
- Consultants are a great resource
- Huge practice building opportunity

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