Scleral Lens Troubleshooting and Complications

Possible Scleral Lens Indications

Irregular Astigmatism
- Keratoconus
- Pellucid Marginal Degeneration
- Post Corneal Trauma
- Post keratoplasty
- Post K-Pro
- Post Refractive Surgery
  - RK, PRK and LASIK
- Post HSV and HZV
- Athletes
- GP stability (rocking) issues

Some eyes can not be optimally fitted with corneal lenses
Pathologic Ocular Surface Disease

- Chemical Burns
- Ocular Pemphigoid
- Stevens-Johnson Syndrome
- Symblepharon formation
- Graft vs Host Disease
- Persistent Epithelial Defect
- Exposure Keratitis
- Neurotrophic Keratopathy
- Severe Dry Eye
  - Sjogren’s Syndrome,
  - Filamentary Keratitis
  - Limbal Stem Cell Deficiency

Traditional Corneal / Scleral Shape

Scleral Shape
New Understandings

Scleral Lens Fitting Objectives

1. Central Vault Zone (250 to 400 microns)
2. Peripheral Lift Zone
3. Limbal Lift Zone
4. Scleral Landing Zone

Anatomy of a Scleral Lens
Scleral Lens Fitting by Sagittal Height

Zone #1, Central Vault Zone

What is the Appropriate Central Corneal Clearance???

Central Clearance Zone

250 to 400 microns of Apical Clearance

Apical Clearance at Dispensing

250 microns

Apical Clearance Post 8 Hours

150 microns
Scleral Lens Settling

11 subjects, 22 eyes
At lens application and 8 hours post lens wear
• Average apical clearance on application: 393um
• Average apical clearance after 8 hours: 265um
• Average drop in sag between insertion and 8 hours (22 eyes): 127um

Zone #2, Peripheral Corneal Zone (PCZ)

Peripheral Cornea and Limbal Clearance

Adequate Clearance

Appropriate Limbal Clearance

Inadequate Limbal Clearance

Inadequate Peripheral Corneal Clearance
Changing the PCZ
Peripheral Corneal Zone

Plus changes (+) =
more depth

Minus changes (-) =
less depth

1 degree steps = 25
microns sag

Zone #3, Limbal Lift Zone (LLZ)

Limbal Lift Zone
Standard Limbal Lift Zone

+5 Degree In the Limbal Lift Zone

Changing the LLZ Limbal Lift Zone

Plus changes (+) = more depth

Minus changes (-) = less depth

1 degree steps = 25 microns sag

Zone #4, Scleral Landing Zone (SLZ)

Scleral Landing Zone Evaluation
Ocular Surface Disease...

Pre-Scleral

2 Months Post Scleral

SJS 20/400
6 months Post Scleral Lens 20/25

The Re-Birth of Scleral Lenses
High DK (100 DK+)
GP lens materials
Computer assisted manufacturing techniques
Advanced in our understanding of scleral shape
Increasing knowledge related to the management of unique scleral lens complications

Surface Lubrication
Initial Presentation
After 4.5 hours scleral lens wear

Graft versus Host Disease
Right Eye Pre-Lens
Left Eye Pre-Lens
Right Eye After 6 Hours
Left Eye After 6 Hours
Why do these lenses work so well in managing ocular surface disease?

When Things Go Wrong With Scleral Lenses

Is there tear exchange beneath well fitted scleral lenses?

Tear Exchange Study #1
1. A scleral lens was placed on the right eye of 3 subjects, using fluorescein dissolved into PF saline as the application solution.
2. Subjects wore the lens for 8 hours and photography was performed at 30 min, 1, 2, 4, 6, and 8 hrs.
3. Anterior segment OCT was performed at each time point to monitor lens settling.

Subject SM

Right Eye
Baseline
30 mts.
1 hr.
2 hr.
4 hr.
6 hr.
8 hr.
Left Eye
What is the best scleral lens application solution PF Unisol saline, PF inhalation saline or PF artificial tear...other?

LacriPure from Menicon
ScleraFil from Bausch + Lomb

What are the mechanisms for “Epithelial Bogging” and should we be concerned about it?

Are there any new thoughts related to the etiology and management of post lens tear “fogging”?
The Human Tear Film

Mucous Layer
- Mucopolysaccharide
- Glycoproteins
- N-Ac-glycosaminoglycans
- Sialic acid
- Fucose
- N-acetylgalactosamine
- Mannose
- Galactose

Aqueous Layer
- Water 98%
- Solids 2%
- Inorganics
- Cations
- Anions
- Organics
- Glucose
- Urea

Proteins*
- Lysozyme
- Lipocalin
- IgA
- Lactoferrin

Lipid Layer
- Wax esters
- Cholesterol esters
- Fatty acids
- Free cholesterol
- Triglycerides (TAG)
- OAHFA

*Tear Reservoir Proteins

Tear Reservoir Lipids: Cholesterol

Oil-Red-O Lipid Stain
In a Non-“Cloudy” Patient

Oil-Red-O Lipid Stain
In a “Cloudy” Patient

Maria Walker MS OD
Sheila Morrison
Tear Reservoir Lipids: Cholesterol

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<thead>
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<th>CLEAR</th>
<th>Fogged</th>
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<tr>
<td>50.0 ug/ml</td>
<td>211.2</td>
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<tr>
<td>58.8 ug/ml</td>
<td>197.4</td>
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<tr>
<td>47.4 ug/ml</td>
<td>335.6</td>
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Right Eye Post 8 Hours
“Limbal CLEARANCE” Design

Traditional Scleral Lens Design

440 um Apical Clearance
- Right Eye AM
- Left Eye AM

490 um Apical Clearance
- Right Eye AM
- Left Eye AM

Post 8 Hours of Lens Wear

Peripheral Corneal/Limbal Landing Design

“Limbal Alignment” Design

430 um Apical Clearance
- Right Eye AM
- Left Eye AM

420 um Apical Clearance
- Right Eye AM
- Left Eye AM

Post 8 Hours of Lens Wear

Managing “Fogging”
Why do we see so much initial non-wetting of these lenses and how do we best manage it?

How do we best manage surface debris and deposits?

Should scleral lenses be Plasma Treated and “wet shipped”?

When is it appropriate to place the patient on the “Progent” lens cleaning regime?

Surface Deposits Non-Wetting
Anything new related to the condition called conjunctival prolapse?
Conjunctival Prolapse

Transient Conjunctival Prolapse

Axial Display
Elevation Display

Is it OK???
Is the oxygen permeability of our current GP lens materials adequate for today's scleral lens designs?

Pacific University
Scleral Lens Corneal Swelling Project
Contamac Comfort DK 65
Contamac Extra DK 100
Contamac Extreme DK 125

12 Subjects Overnight Corneal Swelling
No Contact Lens Wear

12 Subjects Overnight Corneal Swelling
No Contact Lens Wear

Normal Non-Lens-Wear Corneal Swelling = 2.80%
Contamac Comfort DK 65 N = 16
Average Swelling in Percentage: 2.27%
Contamac Extra DK 100 N = 16
Average Swelling in Percentage: 1.54%
Contamac Extreme DK 125 N = 16
Average Swelling in Percentage: 1.39%

AC PMMA Scleral Lens OS
Alex
Baseline Corneal Thickness 513 um
Corneal Thickness after 8 Hours 606 um
8 Hour Corneal Swelling 93 um
Percent Swelling 18%

High DK Scleral Materials
• B + L, Boston XO2 DK = 141
• Contamac, Optimum Extreme DK = 125
• B + L, Boston XO DK = 100
• Paragon HDS 100 DK = 100
• Contamac, Optimum Extra DK = 100
• Lagado, Tyro -97 DK = 97
Corneal Edema PKP

Clear PKP with Endothelial Dysfunction

Cell count less than 500 cells per square mm.

BE PREPARED

Overnight Scleral Lens Wear: Pilot 1 Results

SM

- 9 hours overnight scleral lens wear
- Contamac Extreme Dk 125
- OD wore scleral lens only
- Pre & Post measurements taken:
  - Habitual corrected visual acuity
  - OCT global pachymetry
  - OCT apical clearance
  - Medmont topography
  - Slit lamp exam w NaFl

SM Apical Clearance

Pre & Post 9 hours of overnight scleral lens “settling”.

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<thead>
<tr>
<th>Clearance</th>
<th>OD</th>
<th>OS</th>
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<tr>
<td>INITIAL</td>
<td>400um</td>
<td>n/a</td>
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<tr>
<td>FINAL</td>
<td>280um</td>
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Lens Settling Overnight OD: 120um

SM Habitual Corrected Visual Acuity

Pre & Post 9 hours of overnight scleral lens wear OD; no lens OS: Snellen

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<tr>
<th>ACUITY</th>
<th>OD</th>
<th>OS</th>
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<tbody>
<tr>
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<tr>
<td>FINAL</td>
<td>20/25-</td>
<td>20/20</td>
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Reduction by ~1 line Snellen Acuity
SM Corneal Thickness - OD
Pre & Post 9 hours of overnight scleral lens wear: Pachymetry (OCT).

PRE 592um
POST 670um
13.2% Corneal Swelling

SM Corneal Thickness - OS
Pre & Post 9 hours of NO scleral lens overnight: Pachymetry (OCT)

PRE 596um
POST 621um
4.2% Corneal Swelling OS

12 Subjects Overnight Corneal Swelling
No Contact Lens Wear

Average Corneal Swelling: 2.8%

SM Topography Change - OD
• Pre & Post 9 hours of overnight scleral lens wear: Maps (Medmont)
Pre K's (D) Steep: 43.81 Flat: 42.72
Post K's (D) Steep: 43.93 Flat: 42.88
No significant topographical change

SM Cobalt Blue Photo - OD
Post 9 hours of overnight scleral lens wear: Anterior Segment Camera
Mild Epithelial Bogging and trace SPK noted

Scleral Lenses on an Overnight / Extended Wear Basis???
Primary reasons:
• to provide protection for persistent corneal erosions
• to promote more rapid wound healing.

Is there adequate oxygen permeability through scleral lenses in the closed eye environment ???
Do Scleral Lenses Provide Adequate Oxygen Permeability for Overnight Lens Wear?

Paul Nefedov, Sheila Morrison OD, MS, Patrick Caroline, Randy Kojima and Beth Kinoshita OD

• Ten normal eye subjects participated in this two part study.

• In **Phase 1** baseline overnight corneal swelling for each subject with no CL wear.

• In **Phase 2**, only the right eye of each subject was fitted with a 0.45 mm thick, plano-scleral lens manufactured in the Boson XO material (Dk 141). The lens was worn overnight on the right eye for 8 hours.

• Corneal thickness was measured immediately upon awakening, and the percent of corneal swelling was calculated.

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**SJS with PED**

- **Day 1**
- **Day 4**
- **Day 7**
- **Day 11**

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**Stevens Johnson Syndrome at age three**

- **Right Eye**
- **Left Eye**

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**Patient at Age Three**
Right Eye Scleral Lens

Left Eye Pre Scleral Lens

Left Eye Scleral Lens

What is the best technique for managing pinguecula?
Patient BH

43 yo female, Keratoconus OU
Wearing scleral lenses for 5 years
Due for follow-up November
May cc: “staple broke my contact lens”

Patient BH

CC: “I was fixing my desktop stapler and a staple flew out of the staple and broke my right contact lens”
- Incident had occurred 2 weeks prior
- Pain at incidence reported as 2/10, immediately removed lens from right eye
- Reports redness/irritation for 3-4 days post-incident
- Had resumed lens wear with back-up 1 week prior to appointment

Patient BH

20/20
Additional Unknown Complications

Epithelial and Endothelial long-term Health

Long term effects of Conjunctival Compression

Long term Limbal Health Implications

??

Take home points

• Major Research Indicated

• Scleral Lenses have Transformed Modern Specialty Lens Care

Scleral Lens Comfort

High DK Scleral Materials

• Menicon Z DK = 163
• B + L, Boston XO2 DK = 141
• Contamac, Optimum Extreme DK = 125
• B + L, Boston XO DK = 100
• Paragon HDS 100 DK = 100
• Contamac, Optimum Extra DK = 100
• Lagado, Tyro -97 DK = 97

Average 8.5

Number of Subjects

Traditional GP Scores

Traditional SCL Score
Traditional Corneal / Scleral Shape

Scleral Shape
New Understandings