

CONTACT LENS OPTIONS AND FITTING STRATEGIES FOR THE MANAGEMENT OF THE IRREGULAR CORNEA

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Consultant/Advisor/Speaker

- ▶ Accufocus
- ▶ Alcon
- ▶ AMO
- ▶ Annidis
- ▶ Bausch + Lomb
- ▶ Bruder Healthcare
- ▶ EyeBrain
- ▶ Optovue
- ▶ Revision Optics

Shire
Tear Lab
Tear Science
TLC Vision

Irregular Cornea Contact Lens Options

- ▶ **Standard Soft Lenses**
- ▶ **Custom Keratoconic Soft Lenses**
- ▶ **Corneal Gas Permeable Lenses**
- ▶ **Intra-Limbal Gas Permeable Lenses**
- ▶ **Piggyback and Recess Systems**
- ▶ **Scleral Gas Permeable Lenses**
- ▶ **Hybrid Lenses**



Types of Irregular Corneas

- ▶ **DEGENERATIONS**
 - Keratoconus
 - Keratoglobus
 - Pellucid marginal degeneration
 - Terrien's marginal degeneration
 - Salzmann's nodular degeneration
 - Ehlers-Danlos syndrome
- ▶ **AFTER SURGERY**
 - Cornea transplant (PK, PKP)
 - Radial keratotomy (RK)
 - Photorefractive keratectomy (PRK)
 - Phototherapeutic keratectomy (PTK)
 - Epikeratophakia
 - LASIK
- ▶ **DYSTROPHIES**
 - Cogan's dystrophy
 - Bowman's dystrophy
 - Granular corneal dystrophy
 - Lattice corneal dystrophy
 - Meesmann's corneal dystrophy
- ▶ **CORNEAL SCARRING**
 - After infection
 - After trauma

CL Options: Soft Lenses

- **Advantages:**
 - Comfort
 - Centration (draping)
 - Corneal Protection
- **Limitations:**
 - Vision (due to draping effect)
 - Dehydration
 - Hypoxia /microbial contamination



CL Options: Custom Soft KC Lenses

- ▶ **HydroKone** (Visionary Optics)
- ▶ **NovaKone** (Alden)
- ▶ **Kerasoft** (dist. By B&L)
- ▶ **Soft K** (Acculens & Advanced Vision, & SLIC Labs)
- ▶ **Continental Kone** (Continental)
- ▶ **Keratoconus lens** (Gellflex)
- ▶ **Solltex** (Marietta)
- ▶ **Ocu-Flex K** (Ocu-Ease, Optech)
- ▶ **UCL -55** (United)
- ▶ **Flexlens Keratoconus** (X-Cell)
- ▶ +++ Others

CL Options: Corneal GP Fitting Goals

- ▶ **"Avoid Apical Bearing!"**
- ▶ **Match the periphery of the cornea** (if normal)
- ▶ **"Size Matters":**
larger more decentered areas of irregularity require larger lenses & OZ
- ▶ **Address Vision Needs:**
irregularity, astigmatism, presbyopia

Tandem/Piggyback Contact Lens Fitting In Irregular Corneas



CL Options: Tandem/Piggyback CL

- **Soft lens component contributes about 20% of its power in air to the system**
 - Typically low power (+/- 0.50) – has negligible influence on GP fit or net system power
 - Use of +power to somewhat mask corneal irregularity and possibly improve GP centration – i.e. use of apx. +6 (≈ +1.2D Net effect)
 - High DK material
 - Can combine with any GP design



CL Options: New Hybrid CLs

- ▶ **Combination GP center & Soft periphery**
- ▶ **Advantages:**
 - ▶ Vision of GP / Comfort of SCL
 - ▶ One lens to handle
 - ▶ High Oxygen Transmissibility
 - ▶ Design Options
(reg cornea, MFL, KCN, Rev. Geom)

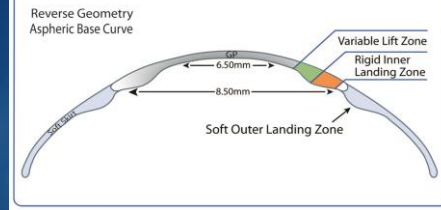


CL Options: New Hybrid CLs

- ▶ **Historical Disadvantages:**
 - ▶ Lens tightening over time*
 - ▶ Secondary inflammatory response*
 - ▶ More difficult with larger and more decentered cones/Irreg. C's
 - ▶ Design limitations (fit & vision)



UltraHealth Lens Design



Intro To Scleral Lenses

Scleral Classifications: New Nomenclature

Lens Type	Description	Definition of Bearing Area
Corneal		Lens Rests Entirely On Cornea
Corneo-Scleral		Lens Rests Partly on Cornea & Partly on Sclera
Scleral	Mini-Scleral Up to 6mm > HVID	Lens Rests Entirely on Sclera
	Large Scleral More than 6 mm > HVID	

Adapted from Nomenclature introduced by Scleral Lens Education Society (June 2013).



Predicting estimates of oxygen transmissibility for scleral lenses
Langis Michalodakis, Ruf van der Weep, Daniel Breeney, Richard Wadell, Claude J. Glanville
http://www.sclerallenseducation.com/CLAE/CLAE.htm

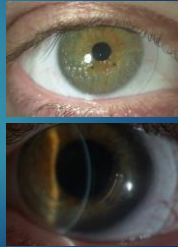
Clearance	100 µm	125 µm	150 µm	200 µm	250 µm	300 µm	350 µm	400 µm
100	291	280	272	197	104	42	-20	-80
125	364	325	286	208	130	52	-23	-100
150	437	391	345	250	156	62	-30	-120
170	495	449	389	293	177	59	-35	-136
200	583	521	456	333	218	83	-40	-160
250	729	651	575	437	260	104	-50	-200
300	875	781	687	500	312	125	-60	-240

Recommendations on Expected Clearance?

Intro To Scleral Lenses

Risk and Benefit Ratio

- Fitting complexity increases despite subjective comfort
 - I/R skills
 - Dk/t
 - Lens flexure
 - Conjunctival tissue modulus
 - Scleral Toricity
 - Scleral Obstacles
 - Wetting angle
 - Debris entrapment
 - Tear exchange
 - Limbal clearance



Intro Scleral Lenses

Potential Indications: A Growing List

Ocular Surface Protection & Therapeutic	<ul style="list-style-type: none"> OSD (Sjogren's KCS, Dry eyes, SJS, OCP, GvHD, Chemical/thermal burns, Stem Cell failure, Neurotrophic keratitis, Delayed Epithelial healing, Trichiasis, Entropion/Ectropion, Scleral-/Mucosa-Patch Grafts...) Pterygium/Pinguecula ?Off label - Drug delivery/retention?
Optical Rehabilitation	<ul style="list-style-type: none"> KC/Ectasia PMD/Keratoglobus PKP and other post-surgical corneas (ie, RK) Scarring (ie, Post-trauma, corneal anesthesia) Corneal dystrophies Presbyopia*/Aphakia*/High Ammetropia*
Cosmesis	<ul style="list-style-type: none"> Scleral Prosthesis ?Painted Iris? Lid Ptosis Crutch?

Scleral Lenses

- Becoming extremely popular for all irregular corneal conditions
 - Great comfort
 - Remarkable acuity
 - Becoming easier to fit



Scleral market estimates: Bausch & Lomb data and internal estimates

Scleral Indications

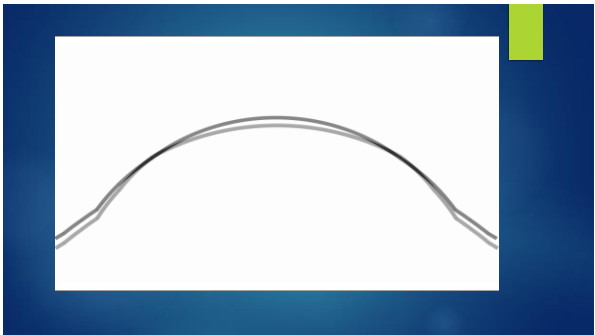
- Steep KC corneas
- Flat, post refractive surgery corneas
- The wide array of post graft cornea shapes
- Small corneas and large corneas



Prolate versus Oblate

This example shows the difference in base curve and shape of Zenlens **prolate** and **oblate** designs. Note both lenses have the same sag.

Oblate shape will have from 250 to 400 um of additional mid-peripheral clearance compared to prolate shape.



Design Attribute #3

- ▶ Lens adjustments will not affect the rest of the lens fit
- ▶ If fitter wants something changed, they just ask for the change and everything else remains consistent, e.g.:
 - ▶ Can change SAG without having to change base curve
 - ▶ Can increase limbal clearance without having to change the SAG
 - ▶ Can modify the shape of the lens without altering the SAG.

Attribute #3: The Smart Curve

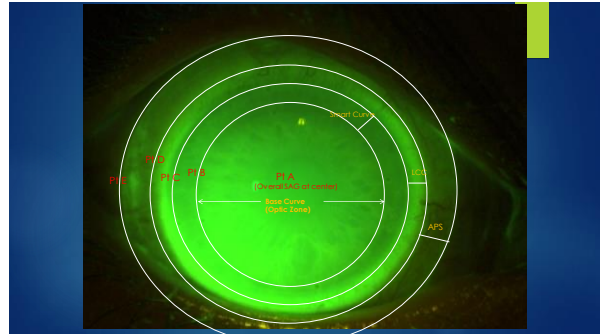
Moving the fit points:

Design Attribute #4

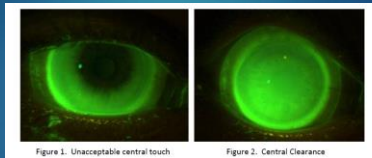
- ▶ Generous scleral landing area

Design Attribute #5

- ▶ Toric PCs are available to order
 - ▶ Scleral landing curves are available in 30 micron steps--flatter or steeper
 - ▶ You can mix and match them to create the toricity you desire
- ▶ Front toric optics can be added to the anterior OZ
 - ▶ With back surface scleral zone toricity or with front surface dual elliptical stabilization for rotational stability



Evaluate the Corneal Clearance



Evaluate the Corneal Clearance

Once central clearance is observed, use SLE cross section view to determine the amount of clearance, as below:

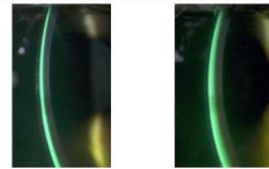
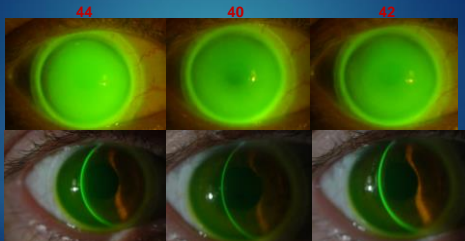


Figure 3. 4.600 SAG lens with roughly 200 microns of vault

Figure 4. 4.900 SAG lens with roughly 500 microns of vault

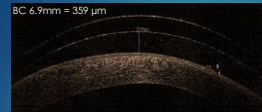
If you want somewhere in between, just specify the sag you want.

Intro To Scleral Lenses If All Starts in the Center: VRM



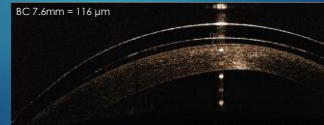
Intro To Scleral Lenses If All Starts in the Center: VRM

BC 6.9mm = 359 μ m



Can estimate in lens design:
1) Central clearance, &
2) BC-related SAG changes

BC 7.6mm = 116 μ m



Evaluate the Limbal Clearance

Figure 5. Unacceptable limbal bearing

Figure 6. Clearance extends beyond limbus with larger diameter lens

Evaluate the Limbal Clearance

2) **Limbal Clearance:** The lens should also exhibit clearance beyond the limbus. If a lens does not demonstrate full limbal clearance, either move to a larger diameter or ask for an increased limbal clearance as a custom parameter when ordering.

Evaluate the Limbal Clearance

Insufficient Limbal Clearance:

Request additional microns of clearance added to standard:

- +50 microns if limbal touch is within one quadrant
- +100 microns if touch/bearing is in two quadrants
- +150 if it's in three quadrants

If 360 degrees of touch, try larger diameter

Additional microns can be requested in any amount. Displayed values are suggestions.

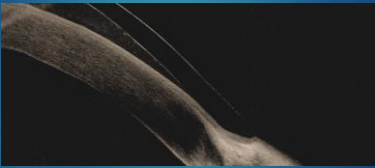
Evaluate the Scleral Landing Zone

Scleral impingement

Blanching at 3 & 9 o'clock:
Ordered toric APS Flat 2 / Stp 1

Toric APS

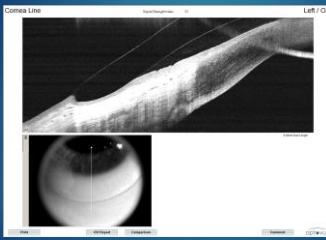
Keratoconus Challenge CL Options: Scleral Haptic Evaluation



Edge too steep: compression


Courtesy:
Blackford Labs
& Lergis Michael O.D., M.Sc. F.A.O.

Keratoconus Challenge CL Options: Scleral Haptic Evaluation



Edge too steep: compression

Keratoconus Challenge CL Options: Scleral Haptic Evaluation



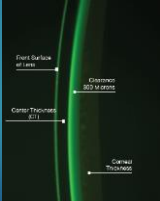
Optimal landing

Courtesy:
Blackford Labs
& Lergis Michael O.D., M.Sc. F.A.O.

Intro To Scleral Lenses It All Starts in the Center!

- ▶ SAG estimation after "proper" settling (\pm NaFL)
 - ▶ Optic Section (~45°)
 - ▶ OCT
 - ▶ Design variables
 - ▶ Patient variables

Time	Average Setting
20 Min	25.58%
1 hour	59.48%
2 hours	70.85%
4 hours	87.20%
8 hours	98.50%



Bauer A, Linnichy J. Let's Settle This Once and For All: A Comparison of Scleral Lens Settling. ONLS Poster. Jan 2015.

Joni Linnichy, PhD, Contact Lens, Opt. Group, W. Virginia Polytech. (Contact Research Institute, Virginia College of Optometry)

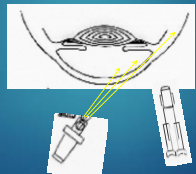
Fitting the Zenlens

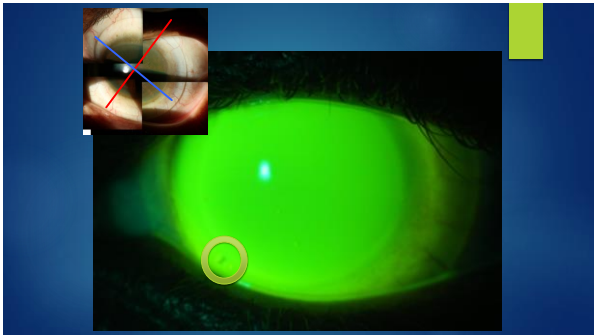
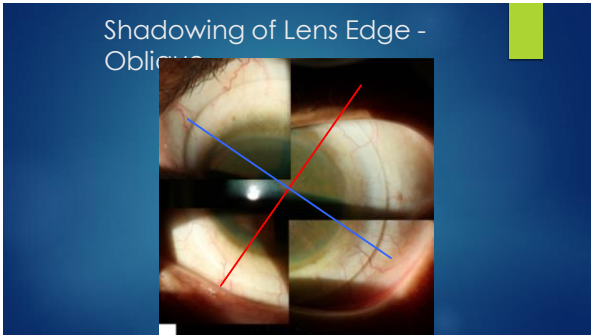
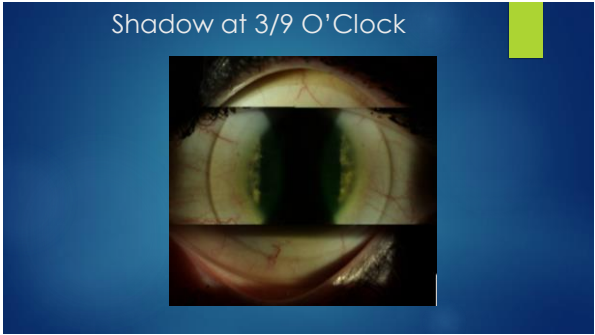
Over-Refract to determine final lens power

- Adjust over-refraction for vertex distance
- Factor in **-2.00** power of the **Dx lens**
- If modifying SAG value from the Dx lens, Base Curve can remain constant, so no need to adjust lens power for SAG
- If cylinder is present in over-refraction, use topography or keratometry to check for lens flexure
 - Refer to cylinder correction chart

Shadowing of the Lens Edge

- ▶ Easy way to assess the edges for excessive lift
- ▶ Position slit beam across lens and view the far lens edge





Fitting the Zenlens

Troubleshooting	
PROBLEM	POSSIBLE SOLUTIONS
Bubbles under lens	<ul style="list-style-type: none"> • Restruct on proper application • Check for edge lift in one or more quadrants; may require toric or steeper PC • Reduce vault, if possible
Blanching/Redness	<ul style="list-style-type: none"> • May need to flatten PC • If occurring in opposing meridians, consider toric PCs
Limbal bearing	<ul style="list-style-type: none"> • Order with increased limbal clearance • Go to larger lens diameter
Debris/Clouding under lens	<ul style="list-style-type: none"> • Typically occurs with flat edge in the superior quadrant: steepen PC or go to toric PC • Check for excessive corneal or limbal clearance
Poor wetting	<ul style="list-style-type: none"> • Try rubbing GP conditioner on lens for 30 seconds, then rinse off and apply saline • Address lid hygiene issues
Poor vision	<ul style="list-style-type: none"> • Ensure proper Rx and lens surface is clean • If cylinder is present in the over-refraction, refer to the Cylinder Control Options section on the inside of this card

- Patient AG
- ▶ AG: 45 year old Hispanic male
 - ▶ History of keratoconus
 - ▶ Had Corneal transplant 2015 in OS
 - ▶ Advanced keratoconus in OD- contact lens failure
 - ▶ Having corneal transplant in OD next month

Patient AG

	Sphere	Cylinder	Axis	VA
od	-17.50	-4.00	92	20/70
os	-8.75	-1.00	90	20/25

Four Step Lens Evaluation Process

Evaluate Central Clearance

- ▶ Adjust clearance in microns
- ▶ Each lens in diagnostic set is 100 μ m different

Evaluate Mid-Peripheral Clearance

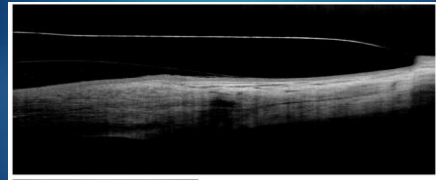
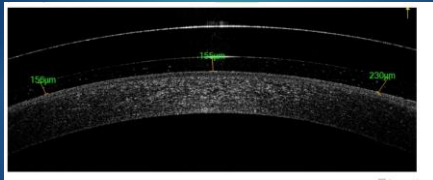
- ▶ If central clearance is ideal, base curve adjustments can increase narrow mid-peripheral clearance and decrease excessive mid-peripheral clearance

Evaluate Limbal Clearance

- ▶ Adjust clearance in microns
- ▶ Lower clearances (without touching) aid in centration

Evaluate Advanced Peripheral System landing on conjunctiva

- ▶ Flatten or steepen APS in 30 μ m steps
- ▶ Toric peripheries are available



Final Result

- ▶ Visual acuity OS: 20/25 +2
- ▶ Able to wear lens full day with good comfort
- ▶ Anxious to have transplant on OD

Patient MP

- ▶ 64 year old WF
- ▶ History of Fuchs dystrophy
- ▶ Had PKP OD; 2006, OS 2014
- ▶ Wearing RGP's for past 10 years
- ▶ Comfort has decreased and vision not stable
- ▶ Wearing time has decreased to 9 hours per day

Exam Findings

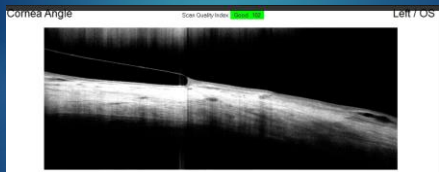
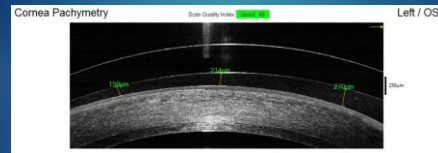
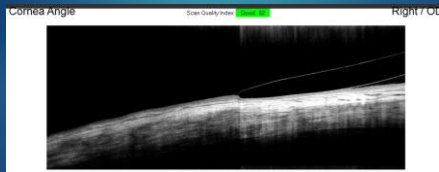
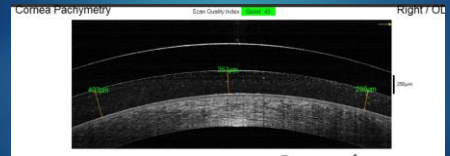
	Sphere	Cylinder	Axis	Add	VA
oo	0.00	-3.50	76	+1.75	20/40
os	+1.00	-1.50	118	+1.75	20/50

Contact lens fit:

Zen Lens

OD: 7.7 Base curve / 4650 sag / 16.0mm dia / Flat 3 edge / Plano

OS: 7.1 Base curve / 52.00 sag / 16.0 mm dia / Flat 3 edge / +0.50



MP Final evaluation

Visual acuity with Scleral Contacts

OD: 20/20

OS: 20/20 -2

Wearing time 14 hours per day

Very comfortable

Patient comments on how clear her vision is

Patient OV

- ▶ 26 year old Hispanic male
- ▶ Referred to our office due to drastic vision change
- ▶ Seen by two other eye doctors who could not determine the problem with his eyes and could not provide glasses which worked
- ▶ Pentacam confirms diagnosis of keratoconus

Patient OV

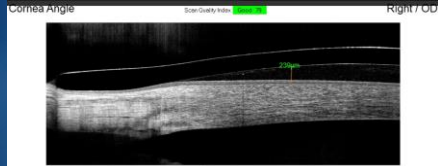
	Sphere	Cylinder	Axis	VA
oo	-3.25	-1.00	106	20/40, -3
os	+0.75	-4.25	106	20/25, -2

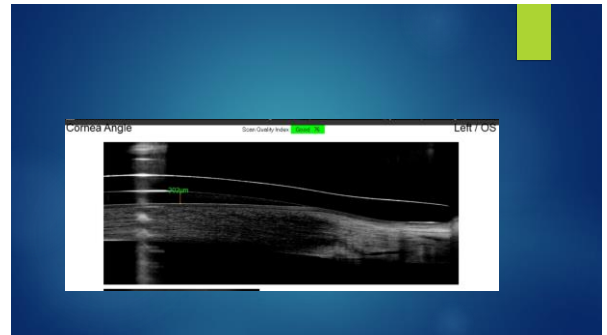
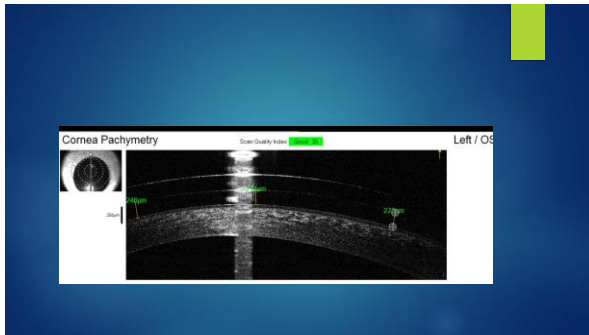
Patient OV

- ▶ Slit Lamp shows mild thinning inferiorly OU
- ▶ Topography shows more aberration in visual axis OD
- ▶ Pentacam shows inferior posterior distortion
- ▶ Went over options for visual correction: Glasses, soft lenses, RGP's, Hybrids, Sclerals

Patient OV

- ▶ Patient decides to go with Scleral contacts
- ▶ Dispense Blanchard One Fit 2.0, a good design for early cones
- ▶ Final lenses:
One Fit 2.0: OD: 8.0 BC / 14.9 dia / -3.75 / std edge
OS: 8.0 BC / 14.9 / -2.25 / Steep 1





Patient OV

- ▶ Visual acuity with contacts: OD 20/20, OS 20/15
- ▶ Wearing time 12-14 hrs per day
- ▶ Patient very happy with crispness of vision as well as comfort