Fitting the irregular cornea: making the most of today's technology

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Disclosures

- Consultant for CooperVision Specialty Eyecare
- Ad board member for Bausch and Lomb
- As an educator, we receive free fitting sets and lenses for our students from almost every manufacturer.
- I have no financial interest in these products.

Topographic evaluation of the ocular surface

Options

Topography

- Primarily curvature data
- Central 6-9 beyond is calculated
- Extrapolated elevation data

Tomography

- Elevation and thickness data
- Up to about 12 mm beyond is calculated
- Diagnosis and progression of ectasia and corneal disease

Profilometry

- Elevations very accurate
- Up to 22mm
- May be more invasive due to drops
- Many CL fitting applications

Tomography

GOLD STANDARD FOR ECTASIA

Tomography (although often still referred to as topography)

Elevation based assessment

More accurate

Looks at both surfaces: anterior and posterior

Can calculate corneal thicknesses based on the surfaces

- Global maps of thickness to see changes across the ocular surface

Gives a little wider evaluation of the cornea and can extrapolate out to about 12mm

Eg. Pentacam

Map displays

AXIAL/SAGITTAL

TANGENTIAL/INSTANTANEOUS

POSTERIOR ELEVATION/FLOAT

ANTERIOR ELEVATION/FLOAT

CURVATURE/POWER

PACHYMETRY

Maps

Refractive or power

- Visual outcome
- Helpful with multifocals

Tangential or instantaneous

- True shape
- Change over time
- More detailed

Axial

- Assumes centered apex
- Based on perfect sphere
- Best optical scenario
- Good for baseline

Elevation

- Simulates fluorescein pattern
- Shows height above or below a best fit sphere
- Gives RBF for help with fitting

Indices

I-S- compares upper and lower	• Inferior steepening if + • >1.2 suggests KC
CIM	• Height vs. normal cornea • >1 suggests irregular
Q-value- assesses shape	• + oblate • - prolate
E	• Eccentricity • >.6 likely KC

Belin evaluation and grading for keratoconus: the new standard

A. Anterior curvature

B. Posterior curvature

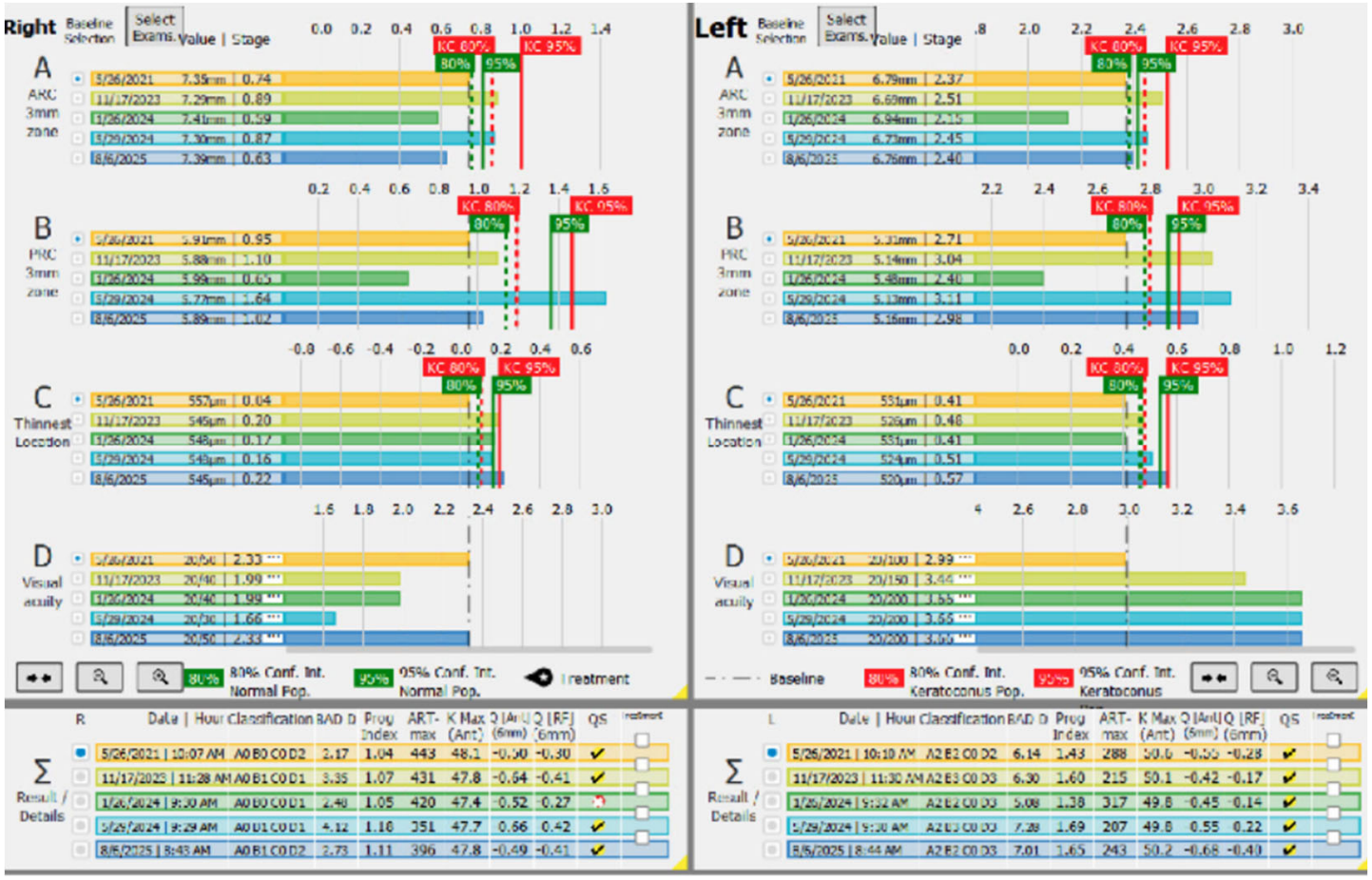
C. Pachymetry

D. Distance vision (usually with glasses)

+ scarring – no scarring

Centered on the thinnest location of the cornea

Belin ABCD Progression Display



How I approach a scan

Q – is it prolate or oblate
- Some fit sets are actually labeled as oblate or prolate

BFS or RBF – what is the closest curvature to the shape of this eye
- When fitting corneal GPs this really helps me find where to start

What is the highest elevation vs the lowest elevation?
- Big differences are hard to span with a GP
- If very high differences, hard to get even clearance without a highly customized lens

Where are these locations based on axial?
- Significantly off-center high spots impact lens centration

KC severity and progression

Profilometry

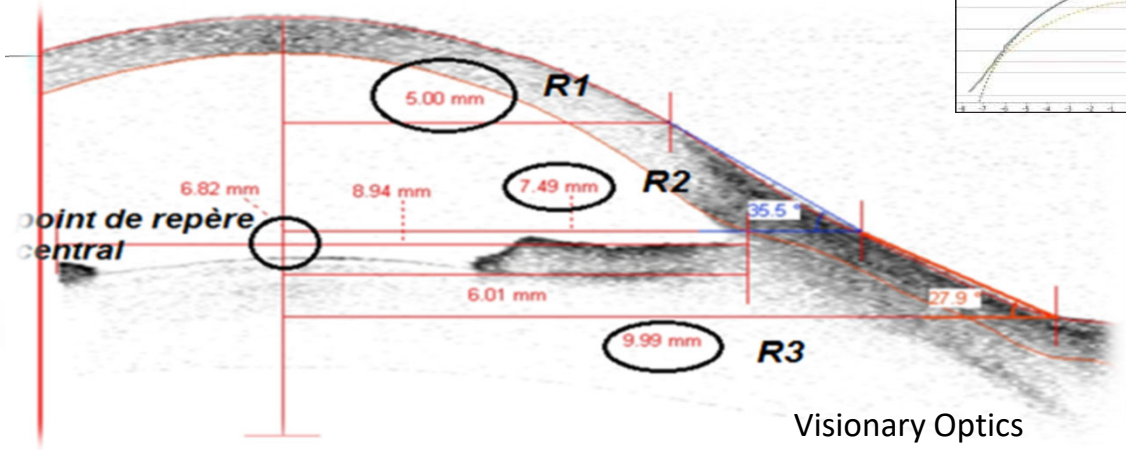
SMAP

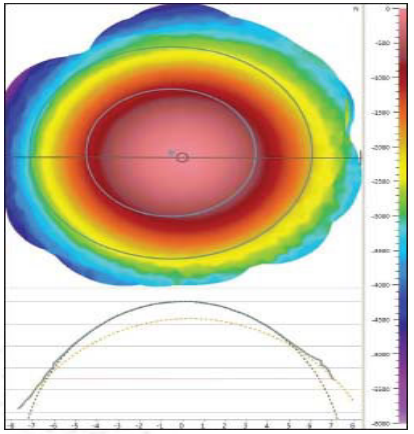
EAGLET

PENTACAM CSP

Sagittal Mapping

Eaglett Eye





Visionary Optics

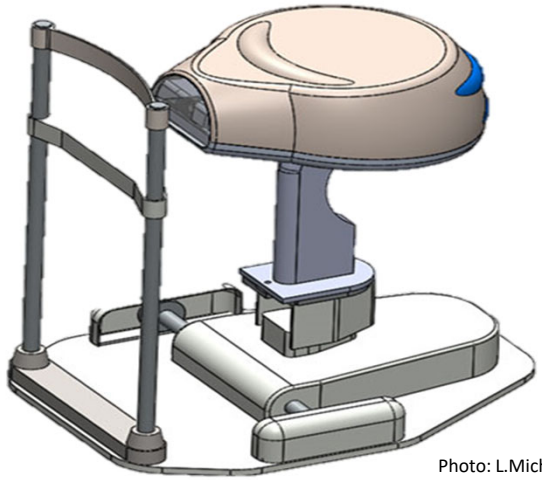


Photo: L.Michaud OD

Scleral | Scleral Lens Education Society

Lid Retraction

The lids must be held WIDE open

Options

- Swab
- Practitioner upper lid and patient lower lid
- Band aids or tape to hold lids open
- Speculum not recommended

Pentacam CSP

No fluorescein

Wide open

5 Pentacam scans

Stitches together

CSP vs CSP Pro

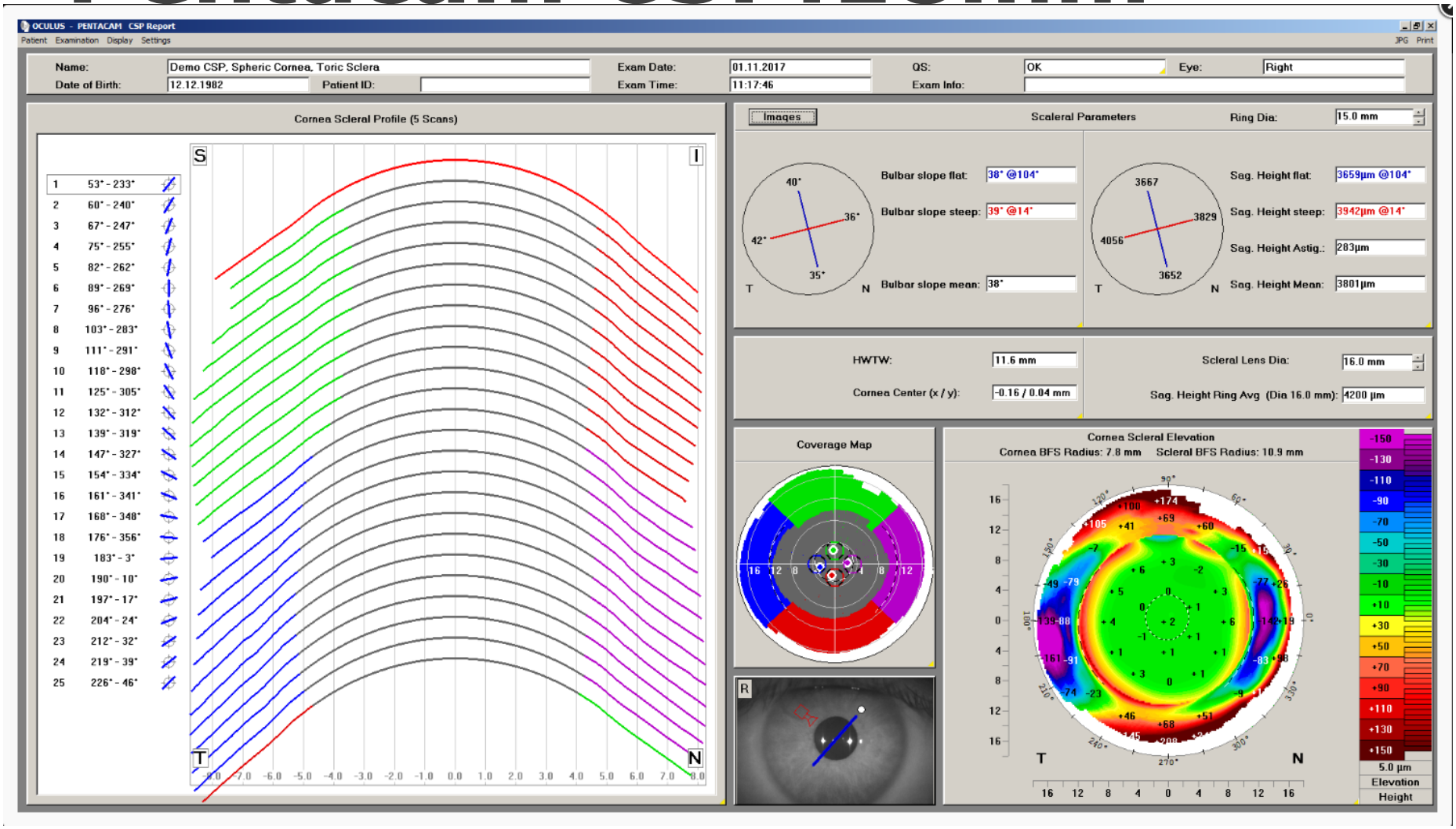
CSP

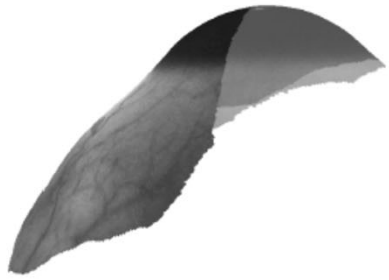
- 5 images in 5 fields of gaze
- Stitched together

CSP Pro

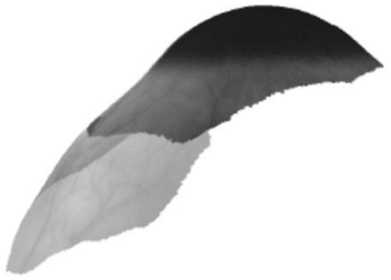
- Single image
- Requires lid retraction to at least 15mm

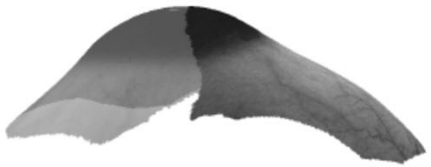
Pentacam CSP:18mm





Straight to
Up Gaze





Straight to
Down Gaze

Smap allows us to visualize the asymmetry and toricity of the sclera

- This eye has 4.5D of scleral toricity at 16mm
- 3 images uses fluorescein
- Images are stitched together

Eaglet

Single Capture

Uses fluorescein

Take multiple images to insure a good image

Requires good lid retraction

Align

- Focusing spheres
  - Directly above each other
- Red cross centered
- Center the small circles with the corneal reflexes

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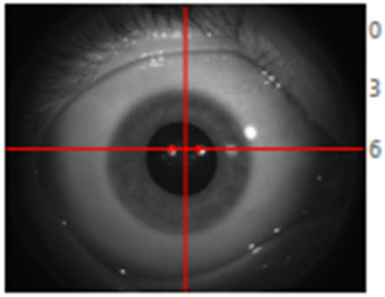
OD

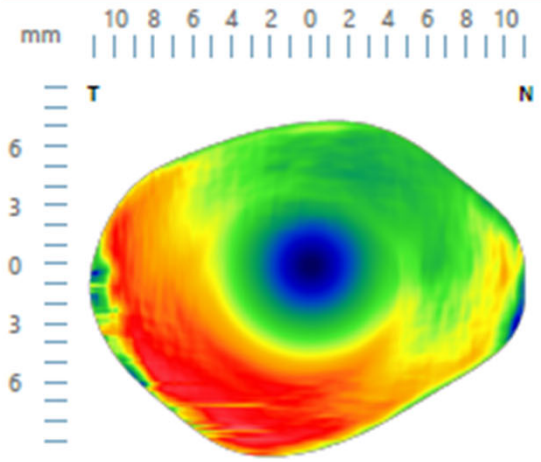
HVID	11.53mm
Limbus	12.00mm
Astigmatism	1.9D 19°
SimKs	8.03mm
SimKf	8.41mm
εs, εf	0.31 0.60
KPI	26%

	SAG	T - N	Angle T	Angle N
10	1.58	0.09	34°	29°
12	2.15	0.32	38°	24°
14	2.75	0.68	40°	26°
16	3.44	1.02	41°	29°

Source



Tangent angles



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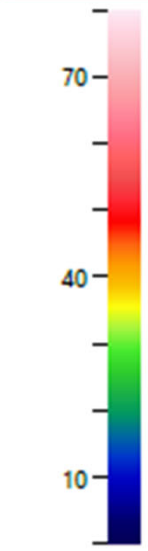
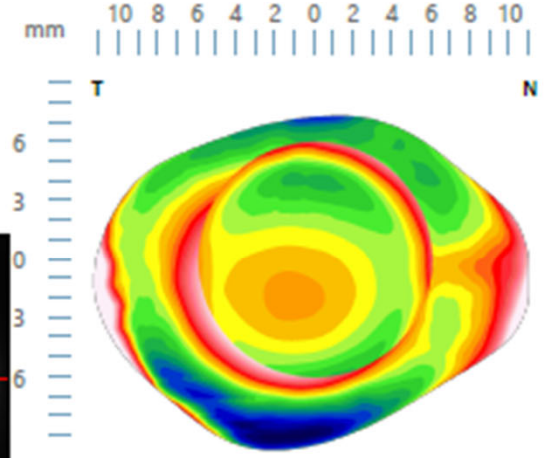
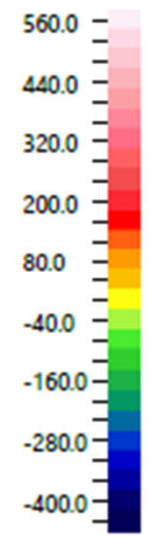


Bisphere elevation



µm



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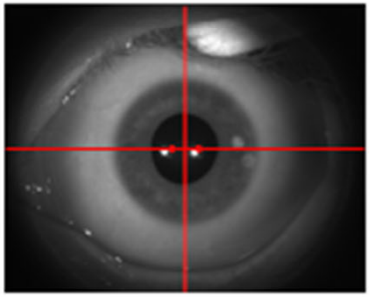
OS

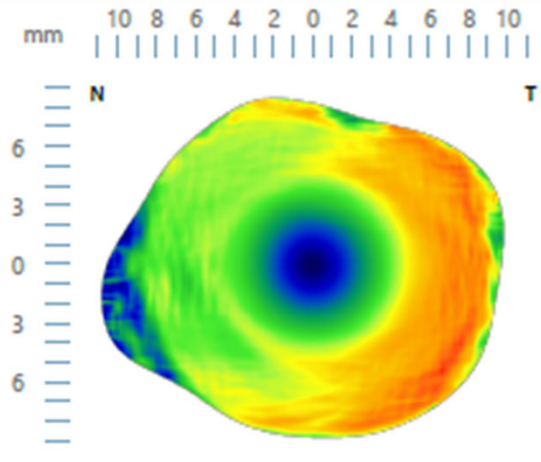
HVID	11.48mm
Limbus	12.00mm
Astigmatism	0.8D 151°
SimKs	7.77mm
SimKf	7.92mm
εs, εf	0.27 0.63
KPI	26%

	SAG	T - N	Angle T	Angle N
10	1.67	0.05	36°	30°
12	2.34	0.23	39°	30°
14	2.98	0.56	42°	28°
16	3.67	0.93	42°	28°

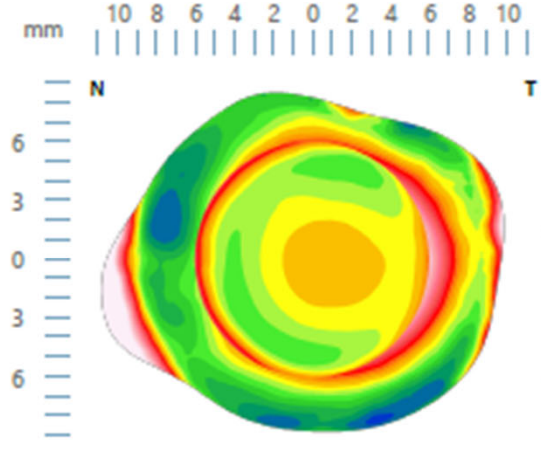
Source



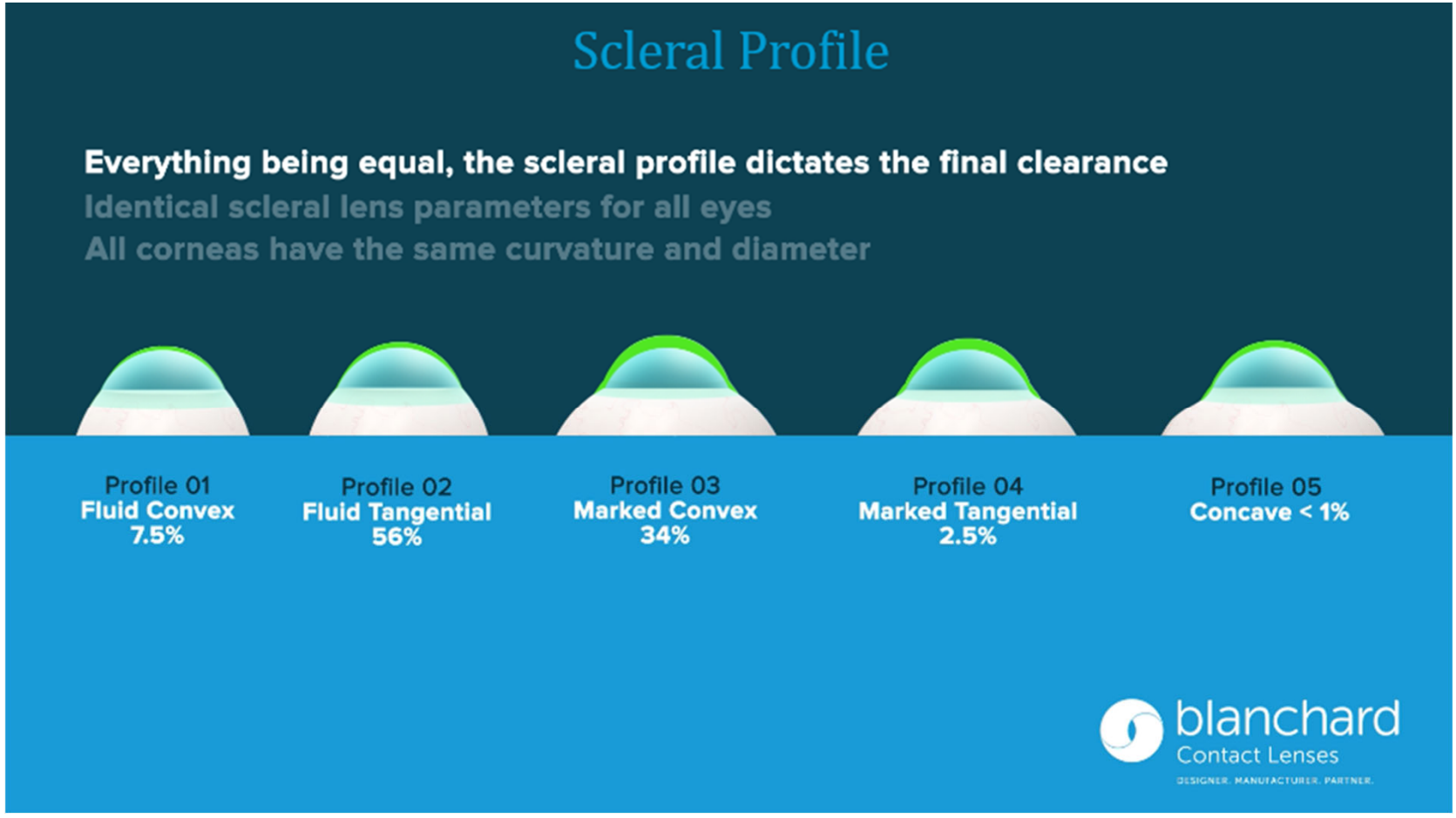
Tangent angles



Bisphere elevation



Scleral shape



Helps address obstructions

Visualize elevations and obstructions so you can choose a design that has

- Notch
- Sector adjustments
- Microvaults

Profilometry: Scleral toricity

Toricity increases further away from limbus[1]

Nasal angle is flatter than infero-temporal[2]

Normal WTR scleras: average of 170-190 microns elevation difference[3]

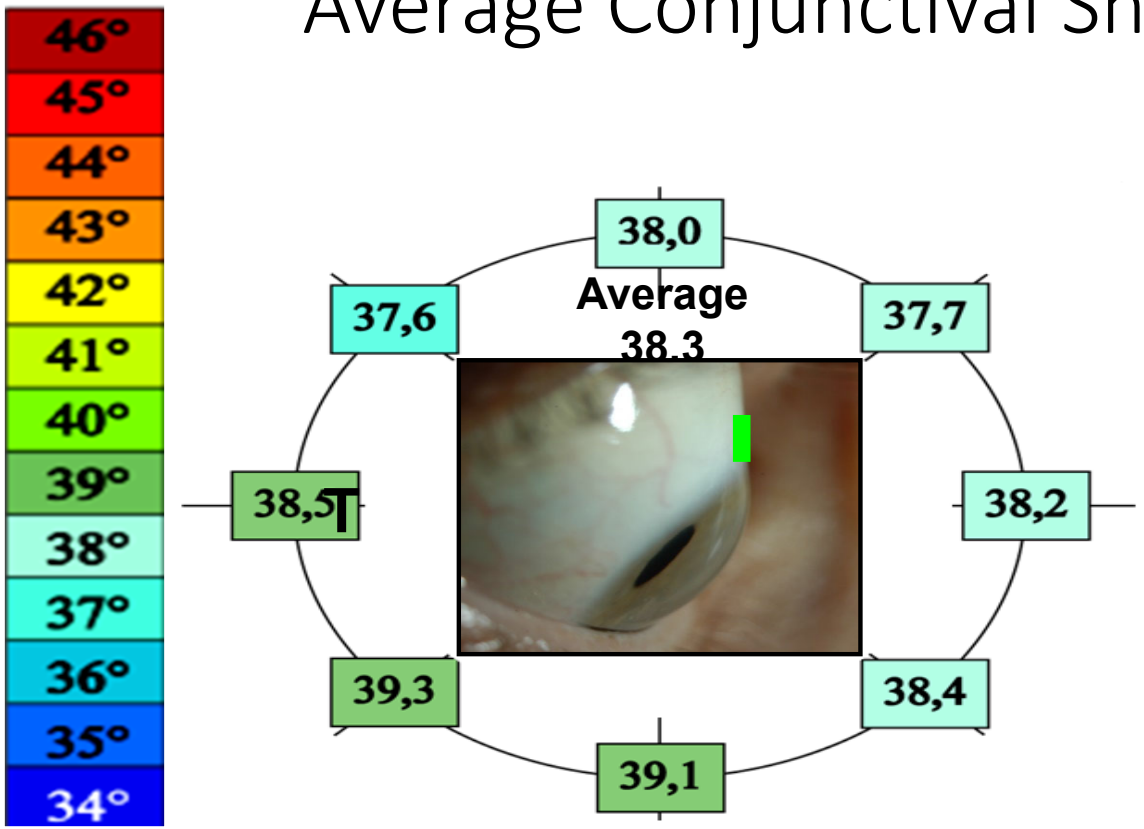
Keratoconic corneas show up to 500 microns elevation difference[3]

Left eyes were different from right[1]

1.Badlitz, Baumer, Conrad, Wolffsohn. Scleral topography analyzed by optical coherence tomography. CLAE 2017: 40(4): 242-7.
2. Van der Worp, E. (2010). *A guide to scleral lens fitting*. College of Optometry, Pacific University.
3. Ritzman, Caroline Borret, Korszen. An analysis of anterior scleral shape and its role in the design and fitting of scleral contact lenses. CLAE. 2018; 41(2): 205-13.

Tangent angles- not curves

Average Conjunctival Shape at 15mm



Toricity: 2D

Photo: M. Lipson OD

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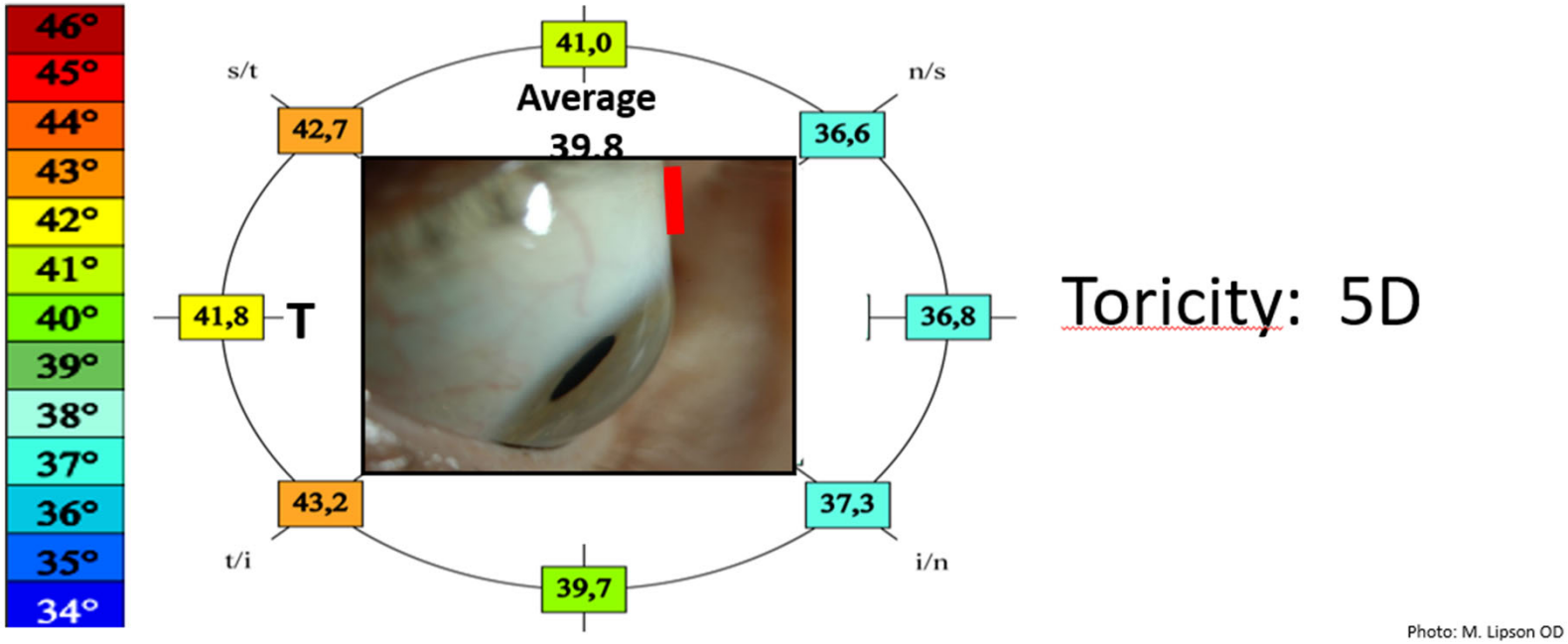
Average Conjunctival Angles at 20mm



Toricity: 5D

Photo: M. Lipson OD

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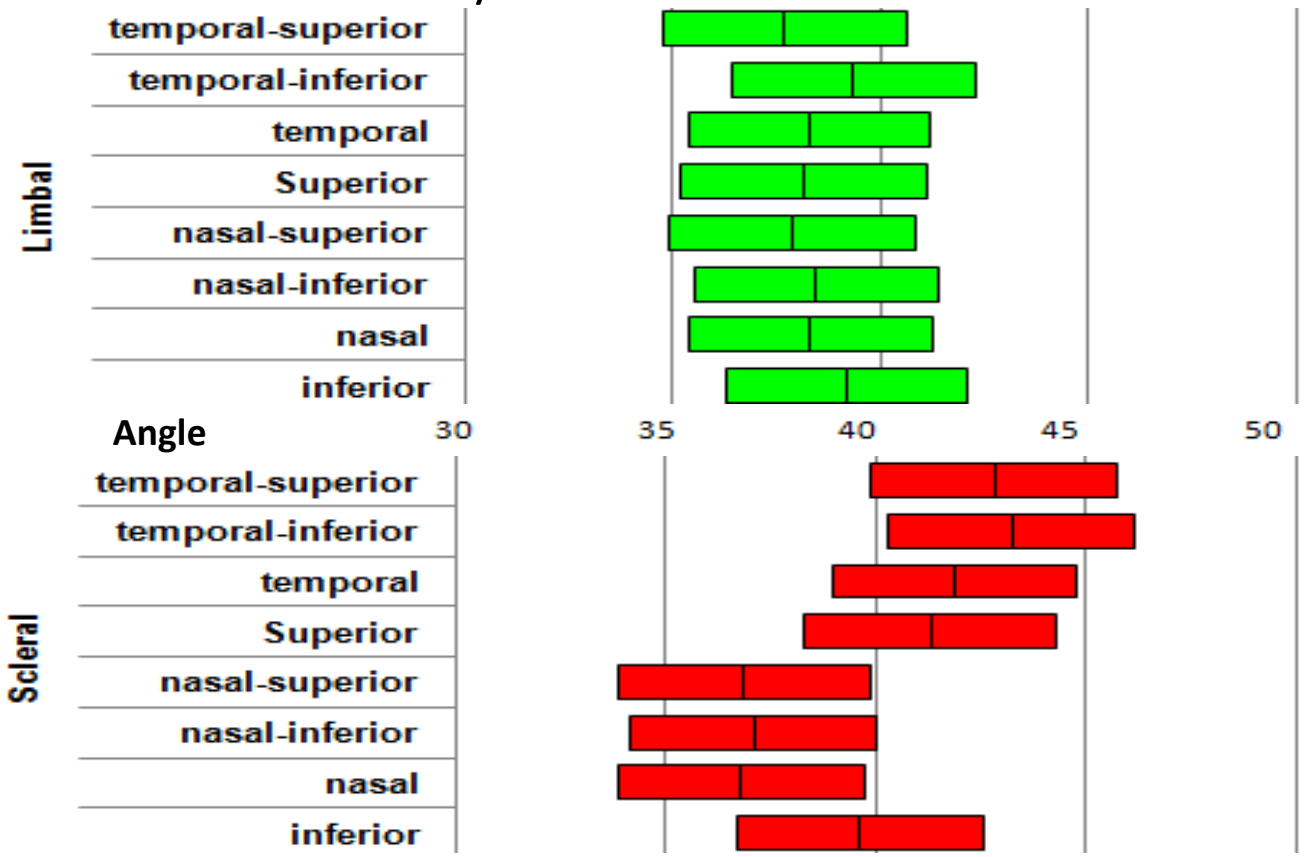
Limbal Angle
10.0 - 15.0 mm

Scleral Angle
15.0 - 20.0 mm

Almost symmetrical near limbus



Highly asymmetric further away from limbus

Tina Graff, Patrick Caroline, Eef van der Worp, Randy Kojima

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Ritzmann et al

- The closer to the limbus the more symmetrical the sclera
- Toricity is more critical in larger diameter
- Lenses land first at the highest point which often results in infero-temporal decentration

Visser et al

- Toric sclerals increased comfort and wearing time
- Torics provide a more aligned fit and more centered optics

Contact Lens and Anterior Eye 42 (2019) 63–69

Contents lists available at ScienceDirect

Contact Lens and Anterior Eye

journal homepage: www.elsevier.com/locate/clae

The influence of centre thickness on miniscleral lens flexure

Stephen J. Vincent*, Louise P. Kowalski, David Alonso-Caneiro, Henry Kricancic, Michael J. Collins

Contact Lens and Visual Optics Laboratory, School of Optometry and Vision Science, Queensland University of Technology, Australia

Flexure most notable if scleral toricity was 200 microns or higher.

In highly toric scleras, thinner lenses also flexed slightly more.

However in all instances toricity was 0.50D or less.

Eyeprint

For severely irregular corneas and perhaps the shortest chair time consider a mold with a 3D designed lens.

Lens selection

The regular cornea

Lenses are generally fit with a diagnostic lens set

Lenses range from 14.0 to roughly 16.0 in these patients, depending on HVID

Lenses offer an excellent alternative for patients with corneal astigmatism note that the size of these lenses is comparable to that of soft lens and us your choice of design should be very similar to your thought process when you choose a given soft lens

Scleral lenses on regular corneas

Lens choice is impacted by corneal size

Adjustments to sagittal depth easier to calculate

Provide excellent comfort and vision

Are an excellent option and for those who have failed with soft lenses

Offer an alternative for new wearers with significant refractive error

Provide tear reservoir for dry eye sufferers

Many multifocals now available

Irregular corneas

Size is often based on how much irregularity there is and how delicate the cornea is.

The larger the lens the more fluid will bathe the cornea and help rehabilitate the ocular surface.

However with lenses that have extreme peaks and valleys very large lenses can lead to bubbles

Still need to meet the +3mm minimum

Lids

If you have a tiny fissure, you'll have to go smaller

This is very critical with patients with cicatricial diseases like Steven-Johnson Syndrome and Scleroderma when the fissure may be narrowed and the skin tough, tight, and/or scarred

Must select a lens that can be appropriately inserted between the lids

If the opening is very large as in Grave's you may need larger still.

First step= Size

HVID + 3 (min)

That way you will have at least a 1.5 mm overlap (similar to a soft lens)

So, if you have a patient with a larger cornea, you may select a fitting set with a larger diameter or at least one that can be designed larger

Diameter

HVID or WTW

- Pd ruler with magnification, topographer, Volk Eye check
- Minimum 3mm
  - Egs.
    - HVID=12 add 3=15. Select a lens of at least 15m
    - HVID=11.4 add 3=14.4 Select a lens of at least 14.4

SAG

BC vs Sagitta

Fitting sets come either way

However, the fitting relationship is all about the sagittal depth/height

So, you have to keep in mind the height of the cornea

General techniques for selecting lens (product dependent)

Topography/Ks

OCT chord measurements

Corneal profile
- Overall shape of eye
- Often there is a recommendation for a particular type of irregularity

Middle or designated lens

Instrument driven-3D designs
- Profilometry systems predict first lens

First lens predictions

sMap
- Visionary products
  - Latitude customized
  - Europa
- Choose closest lens and OR

Eaglet and Pentacam
- Multiple lens companies
- Pentacam export data
  - Predicted lenses
  - Scanfit lenses
- Eaglet
  - First lens recommendations
  - Export data for scanfit and BostonSight
- Give K readings so in theory can calculate Rx

3D designed lenses

Smap and Eaglet now scan the surface and can be loaded with the nomogram for various lens designs allowing the individualization of specialty lenses.

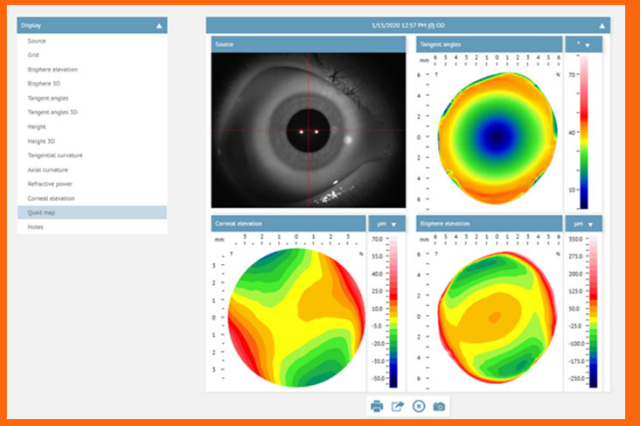
- sMap
  - Latitude and Aurora
- Eaglet
  - Zen, Onefit, Synergeyes VS, BostonSight, AVT, acculens

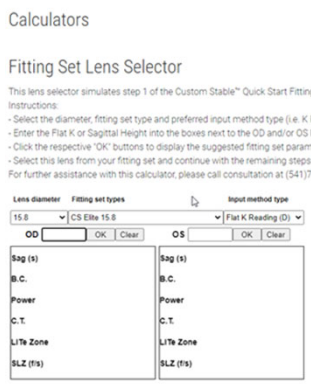
Scanfit

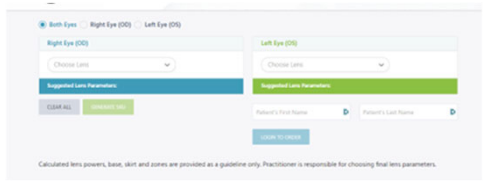
Export the files and send to the lab and they will custom design for the patient

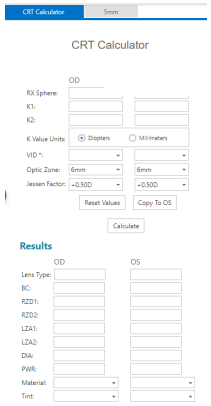
Can use either Pentacam CSP or Eaglet

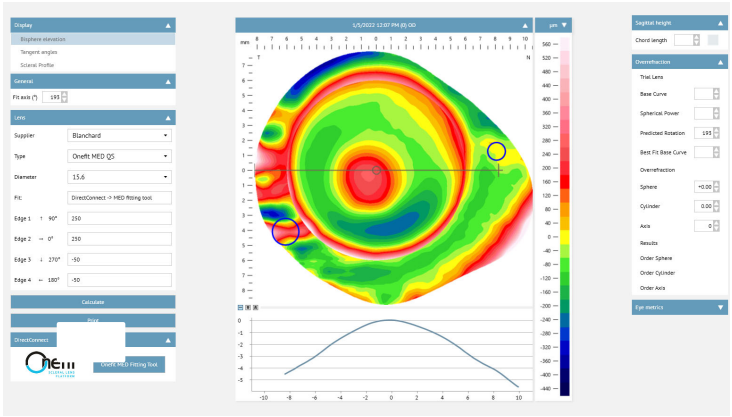
Empirical options











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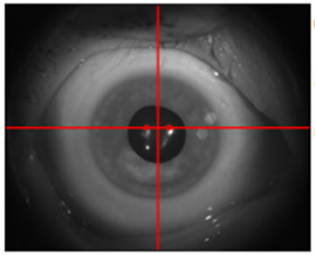
OD

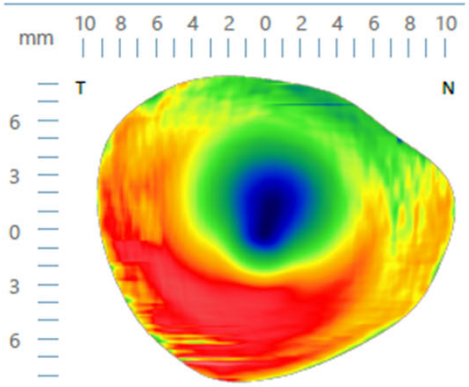
HVID	11.64mm
Limbus	12.00mm
Astigmatism	7.5D 6°
SimKs	4.75mm
SimKf	5.30mm
εs, εf	0.54 1.13
KPI	227%

	SAG	T - N	Angle T	Angle N
10	1.98	0.57	41°	35°
12	2.79	0.73	40°	39°
14	3.54	0.88	45°	31°
16	4.31	1.29	45°	32°

Source



Tangent angles



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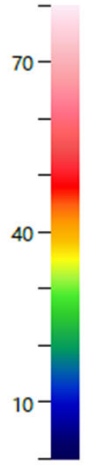
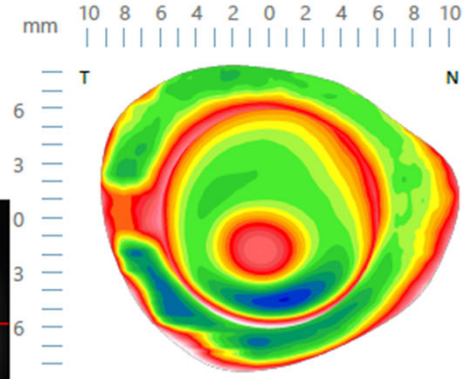
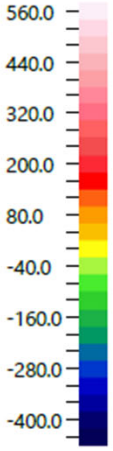


Bisphere elevation



µm



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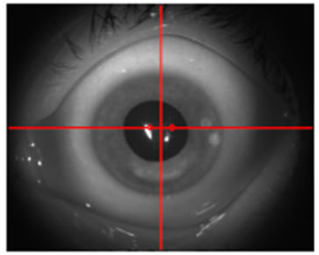
OS

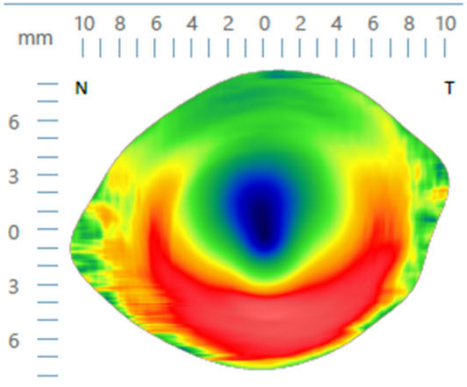
HVID	12.07mm
Limbus	12.00mm
Astigmatism	3.8D 121°
SimKs	5.29mm
SimKf	5.62mm
εs, εf	1.20 1.50
KPI	214%

	SAG	T - N	Angle T	Angle N
10	2.00	0.23	38°	36°
12	2.91	0.18	45°	47°
14	3.85	0.27	44°	36°
16	4.61	0.49	36°	33°

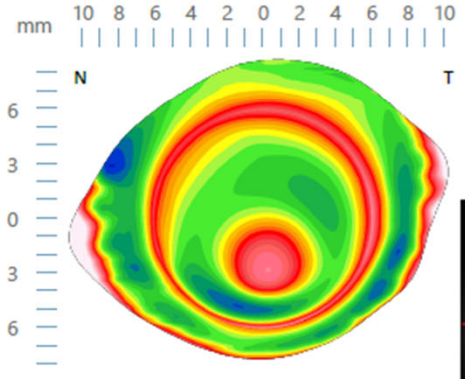
Source



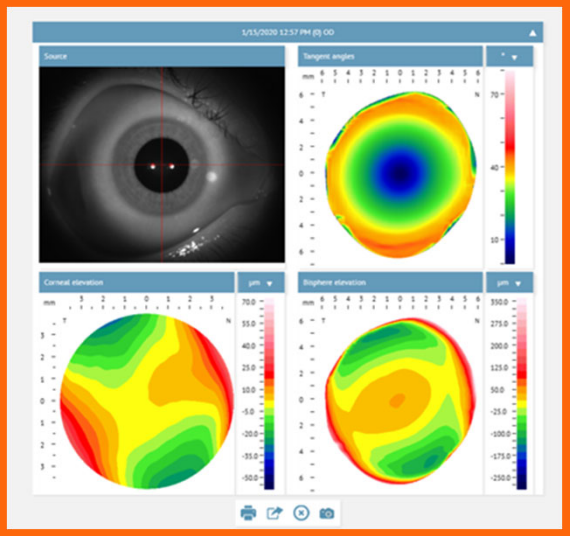
Tangent angles

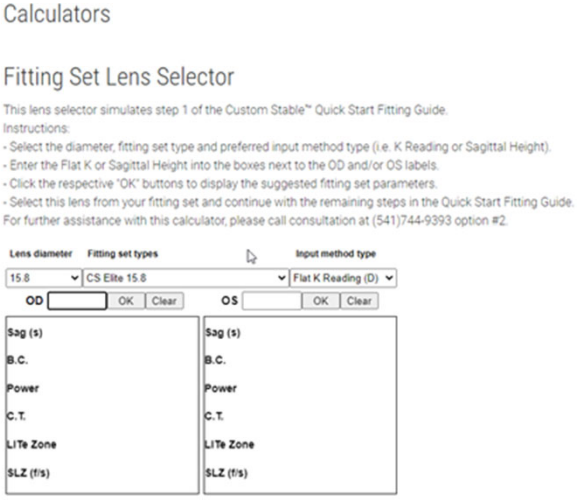


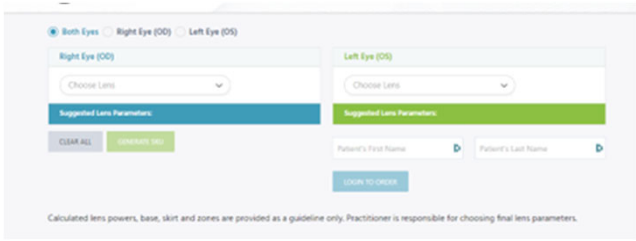
Bisphere elevation

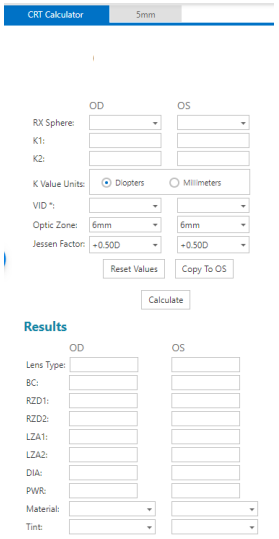


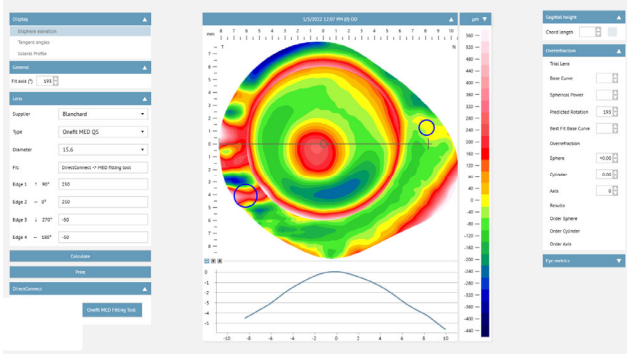
Custom Designing











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Evaluating the lenses

SLIT LAMP VS OCT

Lens settling

Lenses settle on average a total of about 100 microns
- Mini-scleral
  - 100-150
- Full scleral
  - 80-100

You lose about 50 in the first 30 minutes

The rest (another 50)usually over the next couple of hours.

Varies with the "softness" of the conjunctiva

Therefore, if time allows wait 30 minutes to scan.

Importance of follow-up visits with lenses on for 2-4 hours minimum

Central cornea

Overall fluorescein

- Low mag, diffuse cobalt light with wratten filter
- If bowl was filled with fluorescein during fit the pupil should be slightly obscured
- There should be green everywhere
  - It takes ~60 microns or NaFL to fluoresce
- Helpful to determine relative clearance in comparison to limbus
  - IE. should be greener centrally vs. peripherally

Evaluation of clearance

Clearance

- Generally, we overestimate with slit lamp vs OCT
- Some studies say experience improves some studies say no difference.

Technology improving

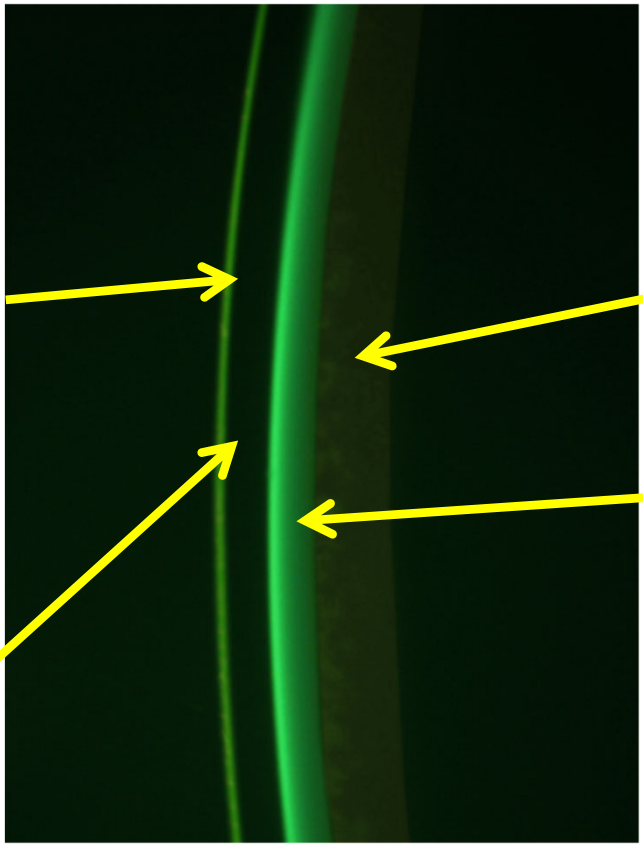
- New pentacam which also has anterior seg OCT
- Numerous multi use OCTs that allow clearance evaluation

Optic section over apex

- White light, 16-25X
- Comparison
- Measure based on the known thickness of the lens
- Depending on the fitting sets your goal
  - Roughly 150 microns settled for normal corneas
  - For diseased corneas, usually 200-250

- DO scan the entire lens looking for any relative areas of insufficient or excessive clearance. This is critical for the irregular eye.

White Light – High Mag (16x)
30-40 degeree angle



Tear Layer on front surface of lens

Lens CT =.35mm
350 microns

OK if large scleral

You can order final lens thinner

Corneal Thickness

Central Clearance
Apical Clearance (AC)
Approximately equal to lens CT
AC=350
1:1 ratio

Scleral | Scleral Lens Education Society

Ideal Corneal Vault

Literature:

- Low = 50-100 microns (mc)
- Moderate = 100-250 mc
- High= 250-400 mc

Manufacturers:

- Design dependent

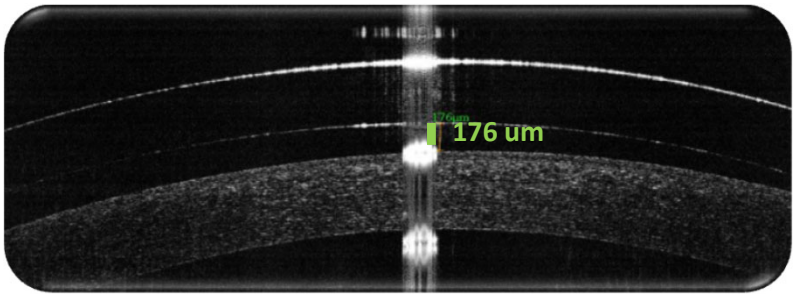


Photo: Karen Lee OD

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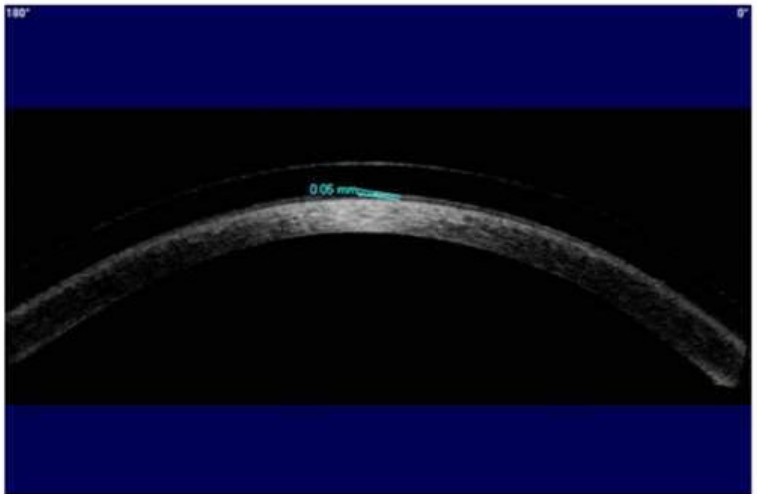
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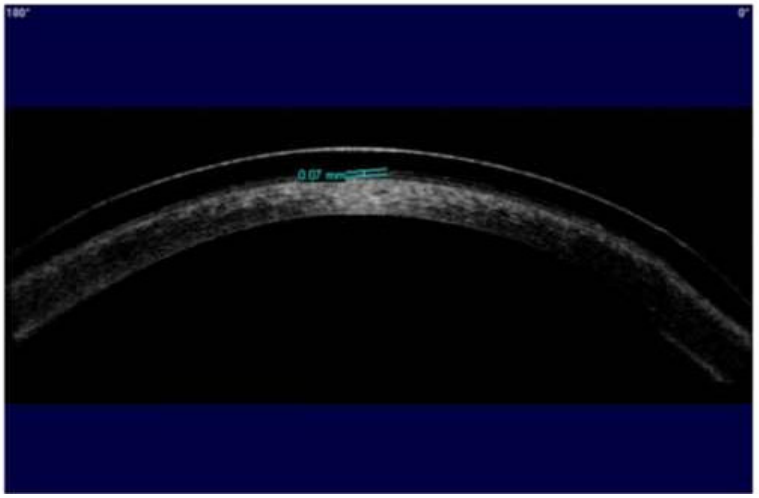
0°
0.05 mm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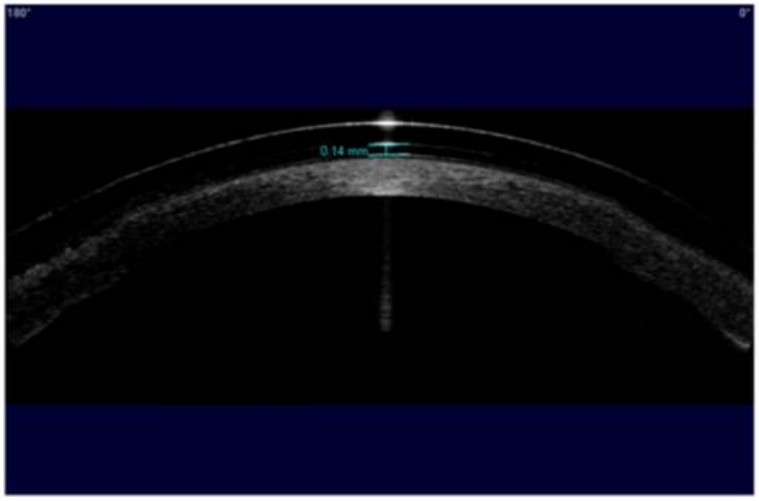
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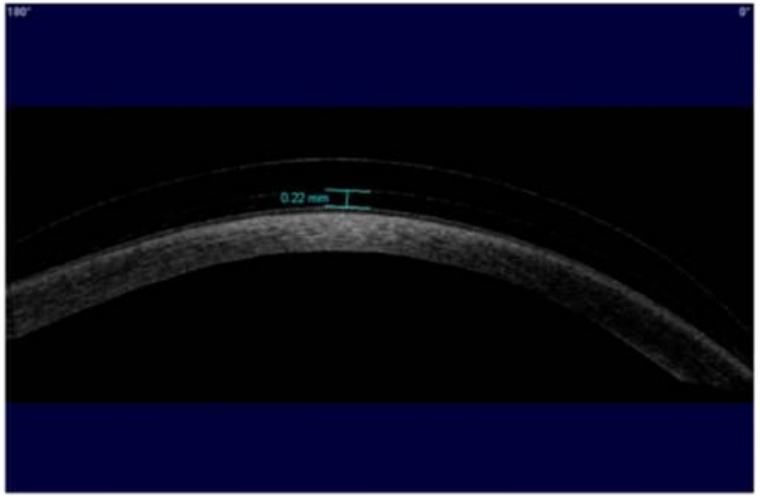
0°
0.14 mm


180°
0°
0.22 mm

limbus

The limbus must be cleared

Compression at the limbus could damage delicate stem cells

View with optic section, white light, and fluorescein

- Optic
  - Should be able to perceive clearance (60-70 microns)
- Overall
  - When no parallax/shadow should see green

Conjunctiva: should look like a well fit soft lens

Vessels
- No drag or blanch
- High mag should see bloodflow in the conjunctival vessels

Indirect view of edge
- Assess for shadows that may indicate lift off (often uncomfortable at that point)

No impingement
- Meaning the lens should not compress or dig into the conjunctiva
- This is easily seen with the OCT on raw image

It is preferable that the conjunctiva is not pulled up under the lens

Edges

Look for impingement

- Compression of vessels
- Blanching
- Impression of lens on conj upon removal

Look for leakage

- Add fluorescein to the front of the lens and look to see where it is leaking in
- Lift/leakage contributes to flexure and to fogging

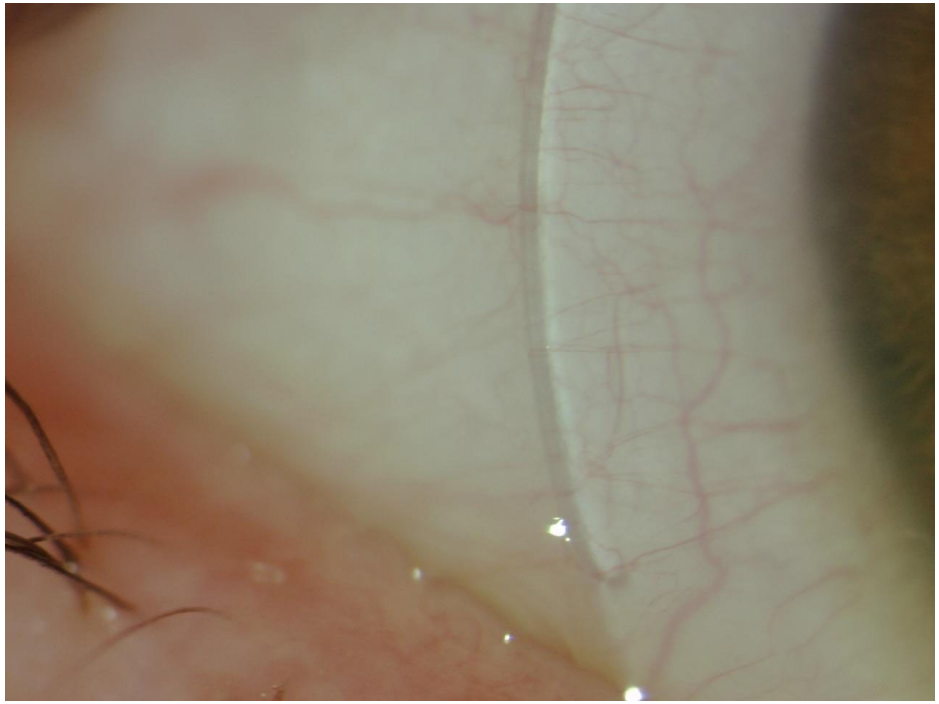
Helping with lens designs

Need to align periphery for centration

Need to align periphery to reduce posterior tear lens fogging

Need to align periphery to minimize flexure

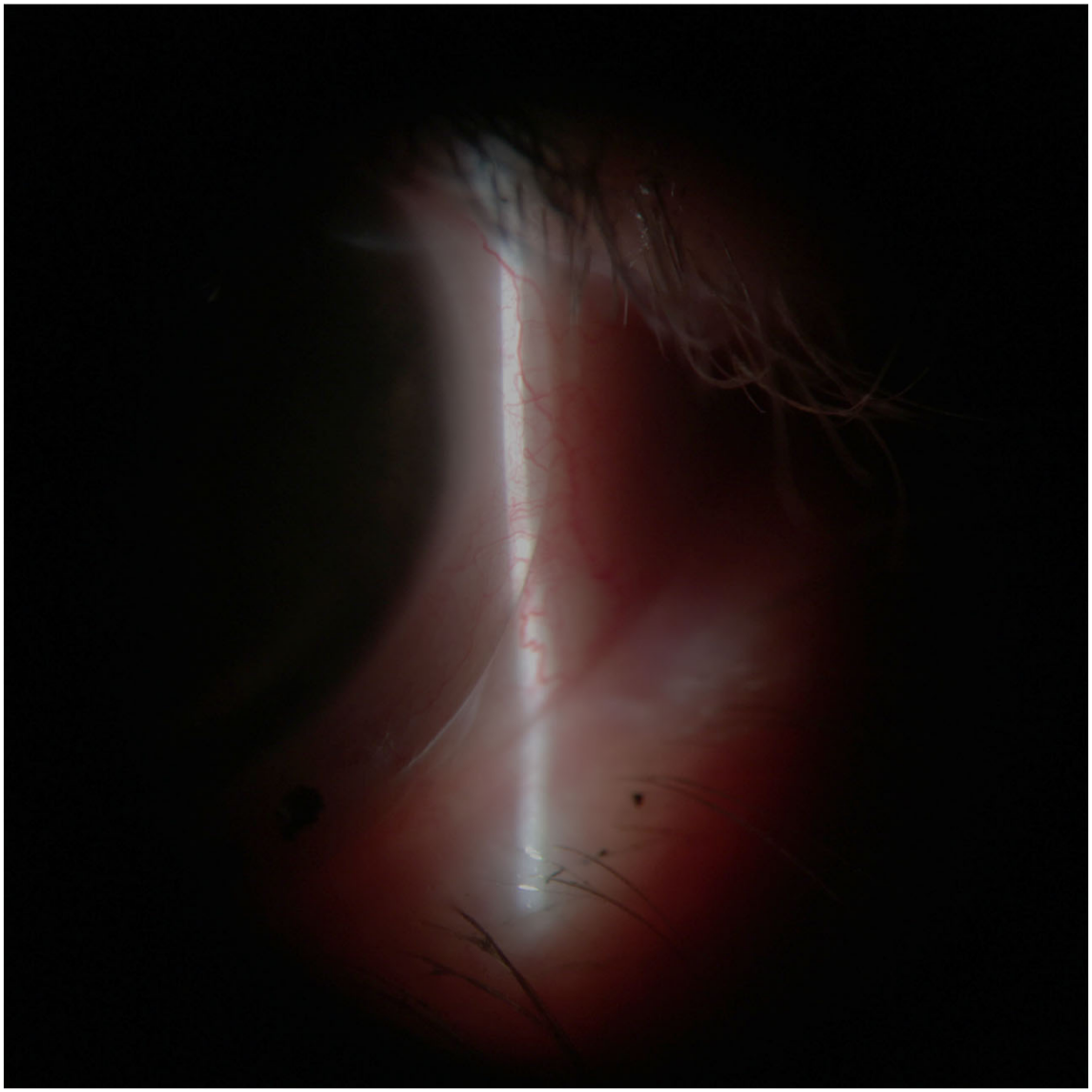
You should be able to appreciate the edge of the lens.



The lens is not in focus at the same time as the edge.

Indicating lift off

Sometimes you will actually see a significant shadow



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Remember

Goal (upon insertion) should be around 250-400 microns depending on design when you immediately view the lens. In general, this is approximately a one-to-one relationship between the thickness of the lens and the thickness of the tear layer behind the lens.

You must clear the limbus but not pool at the limbus

You should be able to rotate the lens freely

There should not be any blanching

Utilize tools and consultants

“Box” options

Several companies offer HIPAA compliant file shares

Can load pictures, drawings, topography/profilometry, OCTs

Make sure you include the lens details and OR

You may be able to call, videocall or email back and forth with the consultant to achieve the desired fit.

If no OCT, consider photography

If you don't have a slit lamp camera, consider purchasing an adaptor

- Some go over the eyepiece
- Some replace the eyepiece
  - Need to know the slit lamp eye piece diameter

Pictures to include

- Diffuse white light low mag so you can see the lens centration and markings.
- A diffuse picture with fluorescein using cobalt light and wratten fliter when possible
- An Optic Section over the apex- white light with fluorescein and fairly high mag

Adaptor

Once aligned can do videos and may be able to get actual slit photos and not just diffuse

Photos often require external light supplementation

- Blue for fluorescein
- White for others

Will need space between the eyepiece and the adaptor ~1-2cm

Tips

If additional mag beyond your phone itself. Here are some tips.

Moderate diffuse illumination

Low mag

Check view through one ocular

Hold phone over the eyepiece with one had

Adjust/tilt until have distinct circle

Use opposite hand to adjust joystick if needed to keep focus

HOAs, Multifocals, Front torics

Get a good fit first

Once you have designed your lens and are happy with the fit, you can do even more

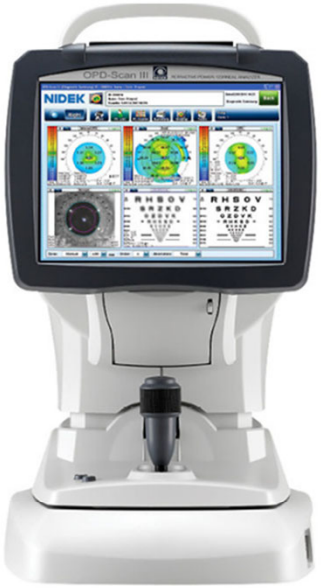
- Multifocals optics can be decentered based on the lens fit to keep the optics over the visual axis
- Front torics can be added when residual astigmatism is present
- HOA
  - New devices do Hartman Shack aberrometry and send the pattern to the lab to be able to improve quality of vision

HOA

Once have a good fit

Bring them back with the lens fully settled

1. Cycloplege them and put the lens back on and scan
2. Leave the lens on but let them dark adapt in a fully darkened room



Fitting codes

Defining medical necessity

You should define for your practice so any carrier can see that you clearly apply the same standards

This is the form you used in lab and is available at the specialty clinic's nursing station in both hard copy and e-format.

We also have sections that review prices and explain that we will work with their insurance but if deemed not covered that they will be responsible. Patients are asked to sign.

We explain this may be different than how their insurance defines MNCL.

Medically Necessary Contact Lens Determination

Contact lenses are deemed medically necessary at the KYCO clinic under the following circumstances: Your attending has indicated below your qualification(s).

1. Albinism with severe photophobia
2. Anisometropia > 2.50
3. Aphakia
4. Corneal Ectasia
5. High Refractive Error:

> = 3.50 astigmatism

> -10.00 nearsighted (Myopia)

> + 6.00 farsighted (Hyperopia)

6. Keratoconus
7. S/P transplant
8. Vision not correctable with eyeglasses to at least 20/30
9. Severe ocular surface disease

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CL fitting codes 9231X

ALL include the following preamble

"The prescription of contact lenses includes specification of optical and physical characteristics (such as power, size, curvature, flexibility, gas-permeability). It is NOT a part of the general ophthalmological services.

The fitting of a contact lens **includes instruction and training** of the wearer and **incidental revision** of the lens during the training period.

Follow-Up of successfully fitted extended wear lenses is reported as part of a general ophthalmological service. (92012 et seq)

The supply of contact lenses may be reported as part of the fitting. It may also be reported separately by using the appropriate supply code"

9231x

Note: There is no time frame in the codes themselves.

- Consensus: successful I&R, dispense and a follow-up or two with minor revision
  - Eg. Power change, base curve change. Ie. nothing major.

❖**These CL codes are the only codes that include any follow up**

❖**Unless required by your VBM contract, many of which require 90 days**

92313

"Prescription of Optical and Physical Characteristics of and Fitting of Contact Lens, With Medical Supervision of Adaptation; Corneoscleral Lens"

Fitting corneoscleral

Again not considered a covered service for medical insurance and usually not for vision plans.

Must review your contracts and their plan/eligibility.

DO NOT USE FOR PATIENTS WITH KERATOCONUS OR ECTASIA

92311 and 92312

"Prescription of Optical and Physical Characteristics of and Fitting of Contact Lens, With Medical Supervision of Adaptation; Corneal Lens for APHAKIA"

- One eye 92311
- Two eyes 92312

If your patient is aphakic, you will use this code regardless of lens design.

It includes the same adaptation and minor revision subtext. So it does include some follow up care.

Aphakia diagnosis codes

Aphakia

- H27.01 right eye
- H27.02 left eye
- H27.03 both eyes

92311 one eye diagnoses

92312 diagnosis

92072

"Fitting of Contact Lens for Management of Keratoconus, Initial Fitting"

"For Subsequent Fittings(visits), Report Using Evaluation and Management Services or General Ophthalmological Services"

92072

Only code to be used for patients with KC regardless of lens design

Only for the day of the fitting

Follow up visits use E/M or Ophthalmology codes

- Charge every visit

Exception vision care plans that have coverage for this code generally do not allow you to bill again within 90 days. So your fees for these contracts will need to be higher. This is based on your contract NOT the rules of the codes.

Diagnosis codes for 92072

Keratoconus

- Unspecified H18.601-3
- Stable H18.611-13
- Unstable H18.620-623

Corneal ectasia

- H18.711-3

Remember

9231X fitting, adaptation and minor revision

- 92311/12 are for aphakia and are usually covered by medical

9207X day of fit only

- 92071 material if purchased is separate
- 92072 is the only code for a patient with KC

For all of these you need to use the appropriate HCPCS

Coding for lenses HCPCS

Vcodes for materials

- Medicare DME: durable medical equipment
  - Aphakes
  - Prostheses
- Seldom with medical carriers
- Coverage is contract and plan dependent with vision care plans

- NOTE: only aphakic contact lenses and fittings are covered by medicare.

VCodes

V2510—Contact Lens, GP, Spherical, Per Lens

V2511—Contact Lens, GP, Toric, rPe Lens

V2513—Contact Lens, GP, Extended Wear, Per Lens
- Eg. Pediatric aphake in EW

V2520—Contact Lens, Hydrophilic, Spherical, Per Lens

V2521—Contact Lens, Hydrophilic, Toric, Per Lens

V2523—Contact Lens, Hydrophilic, Extended Wear, Per Lens
- Pediatric silsoft

V2531—Contact Lens, GP, Scleral, Per Lens

V2599—Contact Lens, Other Type
- Hybrids

The importance of a CC

When fitting patients with medically necessary contact lenses, the most important thing is the medical condition.

Thus, your chief complaint must be medical in nature.

You are evaluating their condition in the presence of the lens.

A CC that starts with vision cannot be billed to their medical insurance and at audit could result in repaying the insurance company and in penalties. If done with regularity could result in criminal charges if done with governmental insurers or with civil suits if other third parties.

Appropriate CC examples

Physician directed follow up for KC. Patient denies any redness, pain, discharge or light sensitivity. However, does note haloes around lights. Seems better with MN CLs. Patient denies any itching and reports they do not rub their eyes.

Ocular health exam for KC. Patient concerned about possible progression of KC. Feels vision is not as clear as it used to be with SRx or MN CLRx. Patient reports eyes have been itching lately and has been struggling not to rub. Patient denies any redness, pain, discharge or light sensitivity.

Ocular health exam for KC. Patients reports occasional redness especially at end of day with MNCL. However, denies any discharge, pain or light sensitivity. Patient is using tears TID which seem to be help with redness

Coding Summary

Assessment should match the CC and medical condition

The plan should address the medical aspect of the case as well as the vision rehabilitaiton of the MNCL as well as risks and appropriate rtc and urgent instructions.

Fees

Make sure you charge for your time.

Do not leave $ on the table.

Evaluate your fees to make sure you are covering the average chair time it takes to do a fitting and if you are billing a code that includes follow-up care that includes enough to cover the average number of visits in your clinic.

Mark up your materials to cover any add-ons,shipping, warranties and to still allow for the occasional lens you might end up “eating”

Agreements

Make sure they sign

- When the warranty is up
- How many visits or how much time if any is covered with the fit
- Lenses must be returned to receive a credit/cancellation
- Fit fees are non-refundable

Don’t forget to give a copy of the prescription once you are done.

CASES

Telehealth can help

Allows you to do a follow up in their own environment

Take screenshots of lens placement

Consider fluorescein strips and blue lights

See what they are using the lenses for

SECO link for distance acuity

Conclusions

New technology improves the starting point for both GP and scleral lenses

Minimizes chair time

Reduces lens cleaning

Reduces remakes even on very complex eyes

Improved match in periphery of sclerals results in better centration, less fogging, reduced redness and improved vision

Please contact me with
any questions:

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