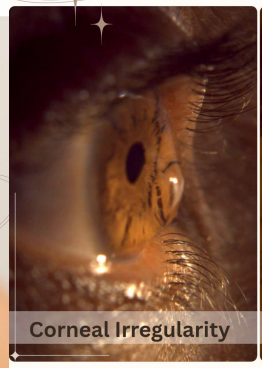
Presented By :
Ariel Cerenzie, OD, FAAO, FSLS

Candidates Fitting Process Troubleshooting

The Scleral Lens Toolkit:

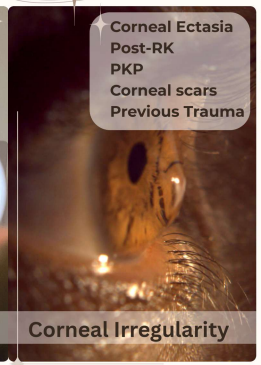
Designs, Diseases, and Day-to-Day Tips



Corneal Irregularity

Ocular Surface Disease

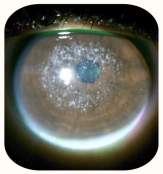
High Refractive Error



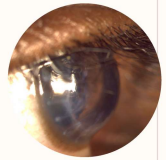
Corneal Irregularity

Corneal Ectasia
Post-RK
PKP
Corneal scars
Previous Trauma

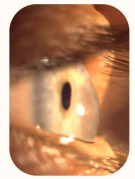
Trauma



Corneal Degenerations



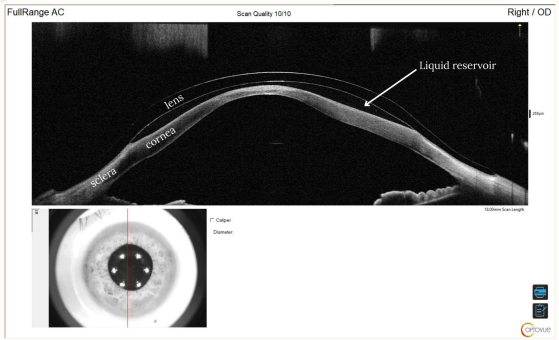
PKP



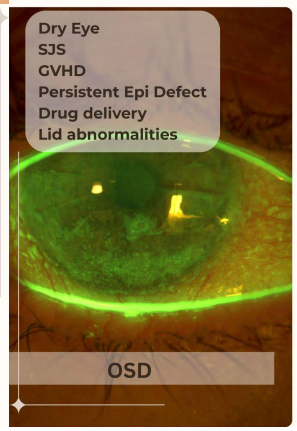
KTC

Scarring

Post RK

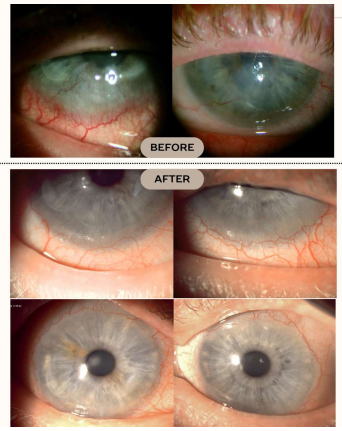


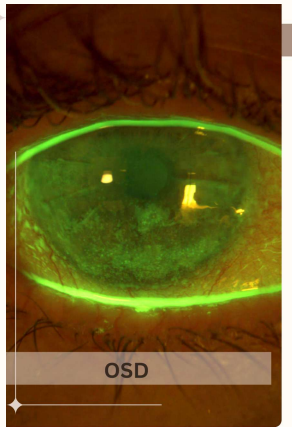
Corneal Irregularity



Dry Eye
SJS
GVHD
Persistent Epi Defect
Drug delivery
Lid abnormalities

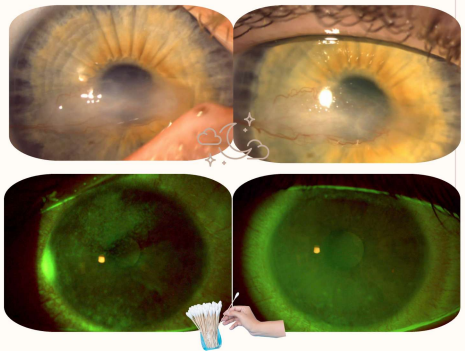
OSD



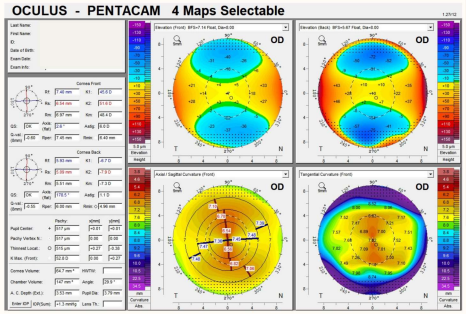


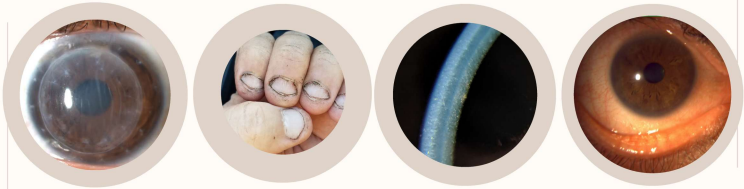
OSD

Candidates Fitting Process Troubleshooting

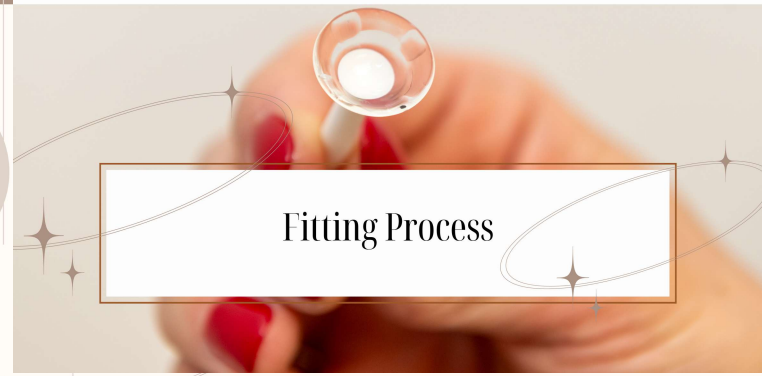


High Refractive Error

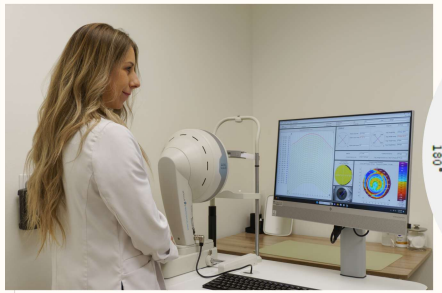


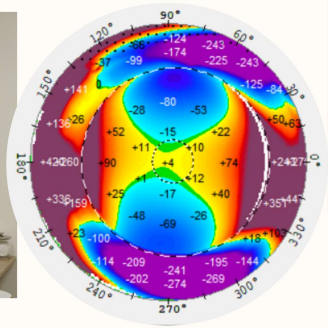


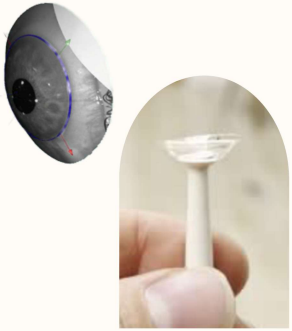
Contraindications

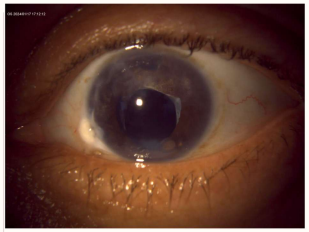


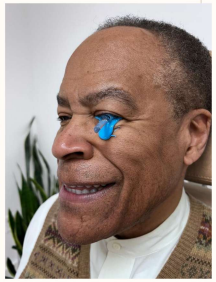
Fitting Process



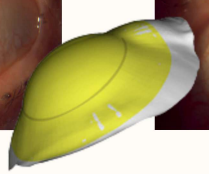


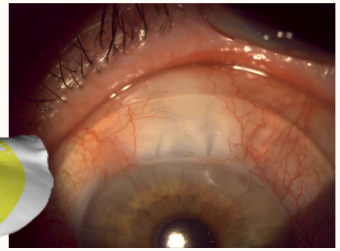






Candidates **Fitting Process** Troubleshooting





Candidates **Fitting Process** Troubleshooting

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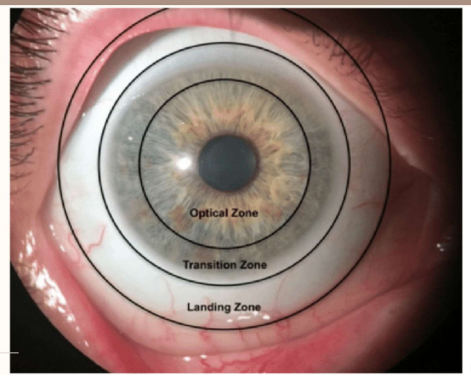


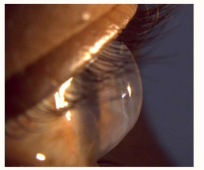
Photo courtesy of Dr. Daddi Fadel

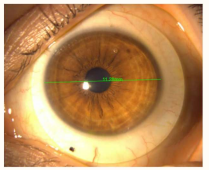
Candidates **Fitting Process** Troubleshooting

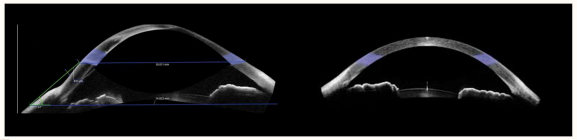
Candidates **Fitting Process** Troubleshooting

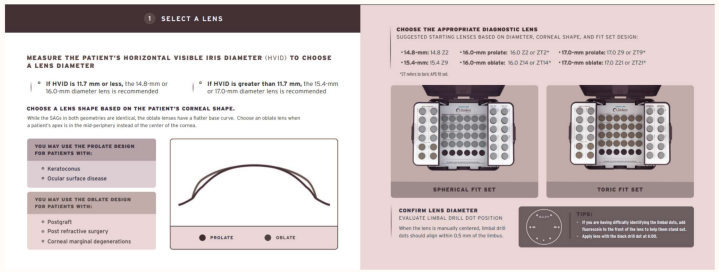
Diameter Considerations

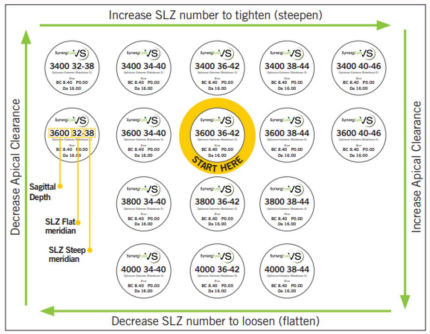
- “Proud” Grafts
- Advanced Ectasia
- Ocular Surface Disease
- HVID











Instructions

Photos A, B & C Credit: Ferris State University

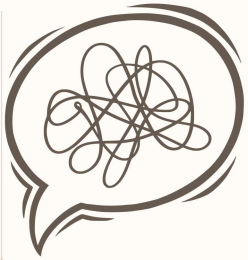
1. **Obtain K Reading to Determine Starting Lens***
   - 36 to 46 = Oblate – Multiply flat k by 100 to determine starting lens sagittal depth. example: 40.50 × 100 = 4050 µm*
   - >46 = Prolate – Multiply flat k by 100 and subtract 250 to determine starting lens sagittal depth. example: (48.50 × 100) – 250 = 4600 µm*

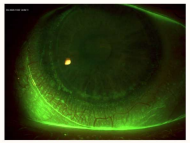
* Calculations above are based on the use of a 15.8 diameter trial lens. When using other diameter fitting sets, use the calculated sagittal depth found using the method above and consult the following conversion chart.

Diameter	to Calculate Sag
14.8	Subtract 400 µm
16.8	Add 350 µm
17.8	Add 650 µm

2. **Prepare & Apply the Lens**
   - Watch the Custom Stable Application & Removal video at valleycontax.com/videos-and-webinars?goto=3
3. **Central Clearance: Evaluate Pre-Settling**
   - 200 to 500 µm = Proceed to step 4.
   - < 200 µm = Select the next steeper lens. Return to step 2.
   - > 500 µm = Select the next flatter lens. Return to step 2.
4. **Wait 20 Minutes for Lens to Settle**
5. **Central Clearance: Evaluate & Tune**
   - 150 to 250 µm post-settling is ideal. (photo A)
   - Perform CCZ adjustments to reach goal.
6. **Limbal Clearance: Evaluate & Tune**
   - 50 to 100 µm post-settling is ideal. (photo B)
   - Perform LITe adjustments to reach goal.
7. **Scleral Landing Zone: Evaluate & Tune**
   - Avoid blanching, impingement & lift. (photo C)
   - Perform SLZ adjustments for each meridian to achieve proper landing zone angle and toricity. "∞" mark indicates flat meridian.
8. **Perform Final Diagnostics**
   - Notate the location of flat SLZ using 0/180 (horizontal) as reference. (photo D)
   - Over-Refract
9. **Place Your Order**
   - Call 800-547-8815 to speak with a friendly and experienced consultant.
   - Visit valleycontax.com to place your order online.

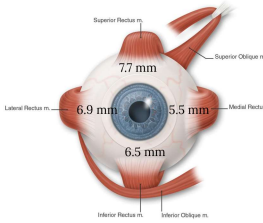
Aligning Limbus

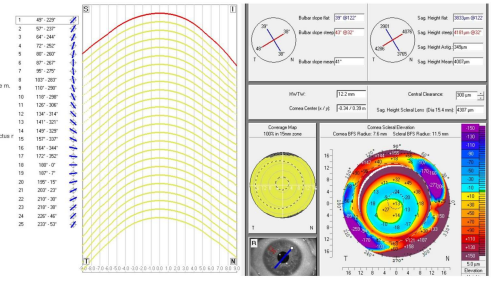




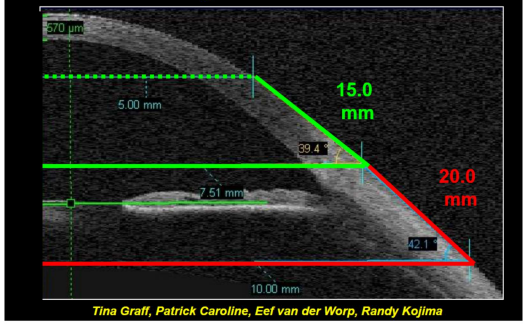
Aligning Edges

SCLERAL TORICITY

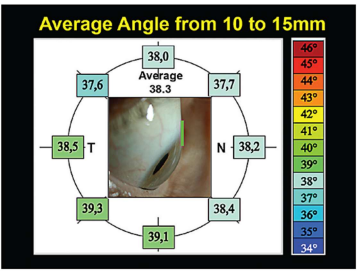


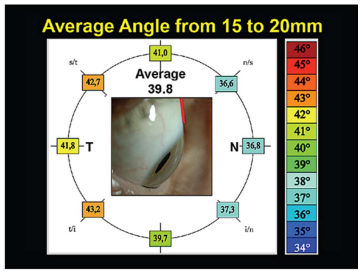


Scleral Angle at 15.0 & 20.0 mm



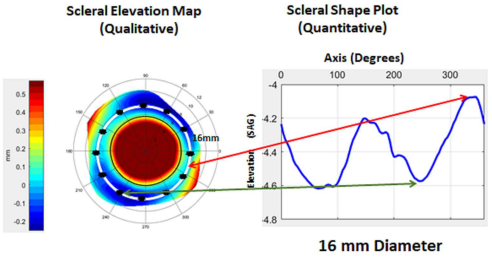
Tina Graff, Patrick Caroline, Eef van der Worp, Randy Kojima





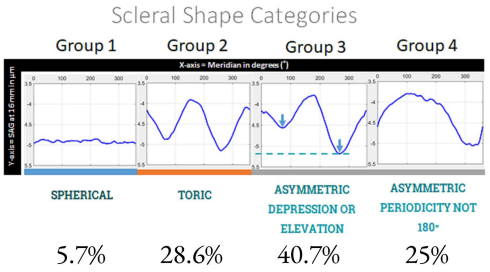
Beyond the Limbus: Scleral Peripheral Curves and Their Modifications
Contact Lens Spectrum, Volume: 31, Issue: February 2016, page(s): 30-33

Candidates **Fitting Process** Troubleshooting



DeNaeyer, Gregory, et al. "Correlation of corneal and scleral topography in cases with ectasias and normal corneas." Journal of Contact lens Research and Science 3.1 (2019): e10-e20.

Candidates **Fitting Process** Troubleshooting



DeNaeyer, Gregory, et al. "Correlation of corneal and scleral topography in cases with ectasias and normal corneas." Journal of Contact lens Research and Science 3.1 (2019): e10-e20.

Candidates **Fitting Process** Troubleshooting

5.7% spherical ⟶ spherical landing zone

28.6% toric-regular ⟶ toric landing zone

40.7% asymmetric

25% periodicity different from 180º

⟶ 65.7% with a quadrant-specific/custom design.

DeNaeyer, Gregory, et al. "Correlation of corneal and scleral topography in cases with ectasias and normal corneas." Journal of Contact lens Research and Science 3.1 (2019): e10-e20.

Scleral shape and its correlations with corneal astigmatism

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[2] Department of Biomedical Engineering, Wroclaw University of Science and Technology, Wroclaw, Poland
[3] Department of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium

ABSTRACT

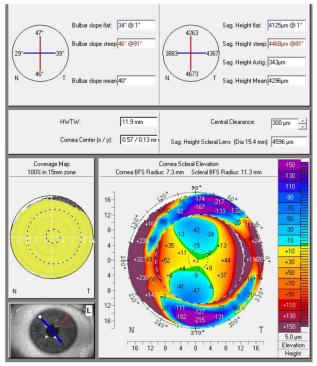
Purpose: To assess the correlation between scleral shape and corneal astigmatism.

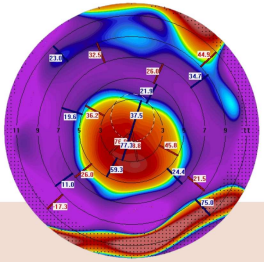
Methods: Twenty-two participants (11 non-astigmatic and 11 astigmatic) aged from 19 to 36 years and with no previous ocular surgeries were included in this study. Three-dimensional (3D) corneo-scleral maps from both eyes (44 eyes) were acquired using a corneo-scleral topographer (Eye Surface Profiler). Each 3D map was split up in 13 concentric annuli, each 0.5 mm-wide, staring at 1.0 mm radius from the corneal apex to the scleral periphery at 7.5 mm from the apex. Each ring was fitted to a quadratic function of the radial distance to the apex, to calculate the elevation difference between the raw data and the fitting surface ring. For each ring the resulting elevation difference between original and fit data profile was fit to a sum of sines function. Decentration and astigmatic terms obtained from the sinusoidal fit were analyzed and compared between non-astigmatic and astigmatic groups.

Results: In astigmatic eyes corneal and scleral asymmetry are highly correlated, while both appear independent from each other in non-astigmatic eyes. No significant difference between astigmatic and non-astigmatic eyes was found for decentration term ($p > 0.05/[N$ (Bonferroni)), while for the astigmatic component the differences were statistically significant ($p < 0.05/N$ (Bonferroni)).

Conclusion: Corneal and scleral shape are correlated in astigmatic eyes, suggesting that astigmatism is not restricted to the cornea, but should rather be considered a property of the entire eye globe.

Candidates **Fitting Process** Troubleshooting



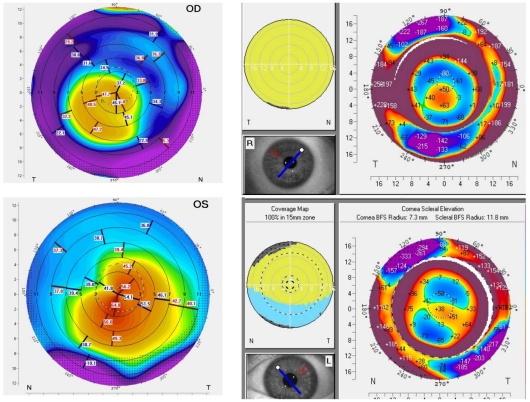


"When considering lens design, eyes that exhibit central ectasia have scleral shapes that are similar to normal eyes and would, on average, be best fitted with a scleral lens that has a **toric landing zone.**

Eyes that have peripheral ectasia would, on average, require a scleral lens with a more customized landing zone design, such as a **quadrant-specific or a free-form design.**"

"This difference is higher if the apex of the ectasia is ≥ 1.25 mm from the corneal center"

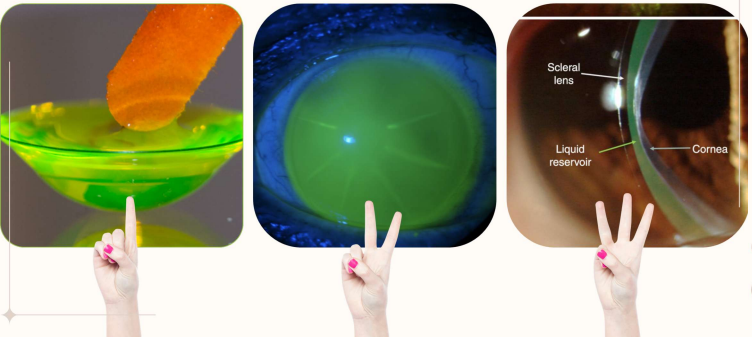
DeNaeyer, Gregory, et al. "Correlation of corneal and scleral topography in cases with ectasias and normal corneas." Journal of Contact lens Research and Science 3.1 (2019): e10-e20.



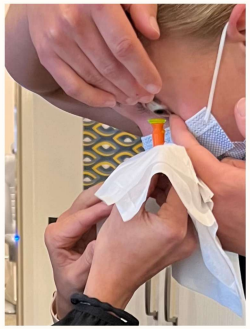
A few rules of

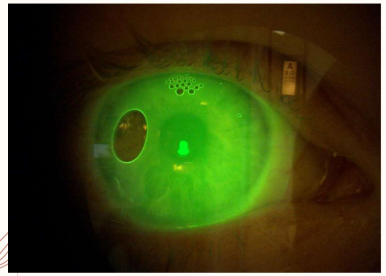
More likely to need toric peripheral curves if

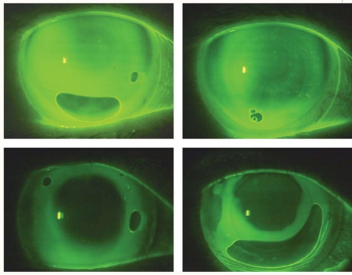
- > 15 mm scleral lens
- Corneal astigmatism

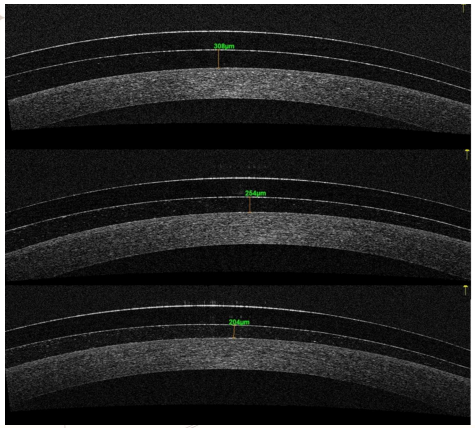


FLOWER INSERTION METHOD





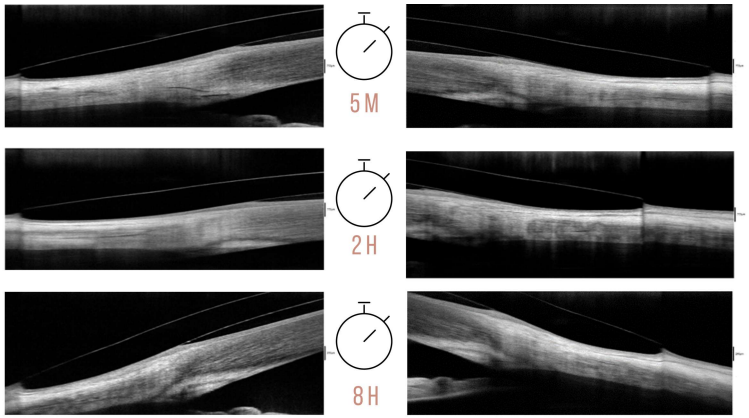




5 MINUTES

2 HOURS

8 HOURS



Settling

Smaller Diameter,[1-2]
More clearance,[3-6]

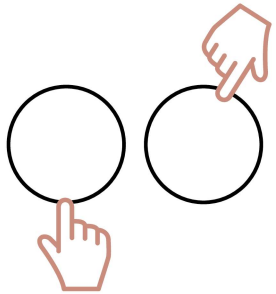
1. Orchere, H, et al. Effect of Time on Scleral Les Settlig ad Change in Corneal Clearance (2017)
2. Esen, f, et al. Influence of Apical Clearance on Mini-scleral Lens Settling (2017).
3. Esen, f, et al. Influence of Apical Clearance on Mini-scleral Lens Settling (2017). Caroline, et al. Scleral Lens Settling (2016)
4. Kauffman, et al. A Comparison of the Short-Term Settling of Three Scleral Lens Designs. (2014).
5. Tan, et al. Effects of Scleral Lens Tear Clearance on Corneal Edema and Post-Lens Tear Dynamics (2018), Bray, et al. Change in Over-Refraction after Scleral Lens
6. Settling on Average Corneas (2017), Courey, et al. Variation of Clearance Considering Viscosity of the Solution Used.. (2017)

Technology General Anatomy Fitting Process Troubleshooting

GOALS

- Centration
- Central clearance ~250 um
- Limbal clearance ~50 um
- Smooth landing of edges

Step 1: Ask About **Lens Awareness**



Step 2: Diffuse clearance **throughout lens**

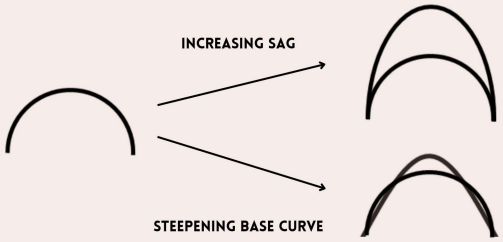
SLIT LAMP

Diffuse beam
Blue Light
Wratten Filter
Low Mag

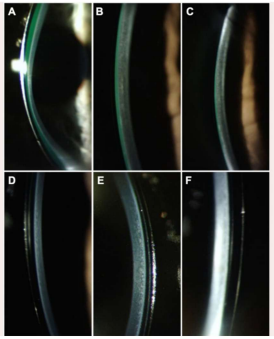
LOOKING FOR

Any areas of bearing?
Centration?

Step 3: Appropriate **Central Clearance?**



Step 3: Appropriate **Central Clearance?**



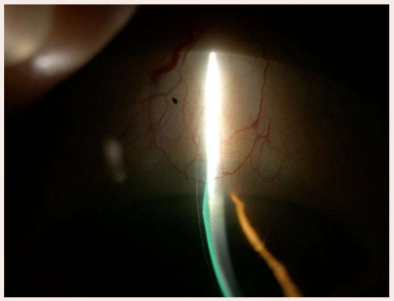
SLIT LAMP

Optic section
White Light
High Mag

LOOKING FOR

Clearance

Step 4: Appropriate **Limbal Clearance?**



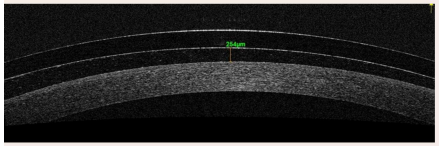
SLIT LAMP

Optic section
White Light
High Mag

LOOKING FOR

Areas of touch?
Areas of excess clearance?
Centration?

Step 3: Appropriate **Central Clearance?**



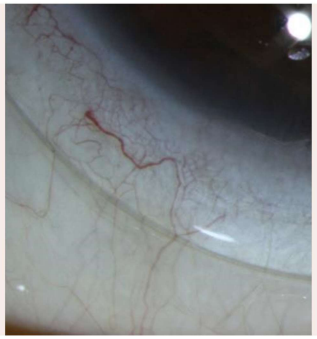
SLIT LAMP

Optic section
White Light
High Mag

LOOKING FOR

Clearance

Step 5: Aligned **Edges?**



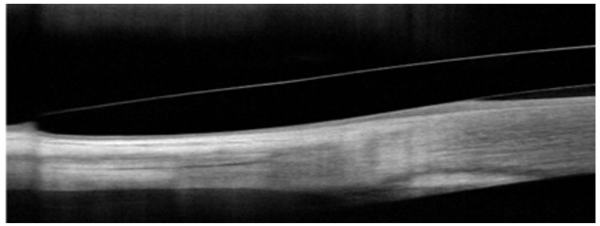
SLIT LAMP

Diffuse Beam
White Light
Low Mag

LOOKING FOR

Blanching?
Impingement?
Healing?
Lift?

Step 4: Aligned **Edges?**



Steep Edges

If SLZ is too tight (too steep) → decrease the SLZ number (flatten)

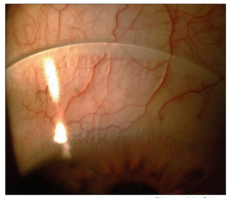


Photo: H. Otten

Lens edge too steep.
Lens too tight.
Decrease SLZ by 2.

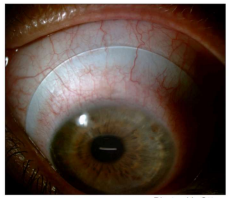


Photo: H. Otten

Blanching.
Lens too tight.
Decrease SLZ by 4.

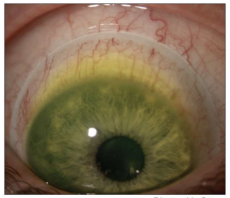


Photo: H. Otten

Extreme edge tightening
around entire lens. Decrease
SLZ by 6 in both meridians.

Flat Edges

If SLZ is too loose (too flat) → increase the SLZ number (steepen)

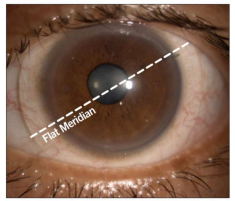


Photo: H. Otten

Excessive edge lift
in flat meridian.
Increase SLZ by 2 in flat meridian.

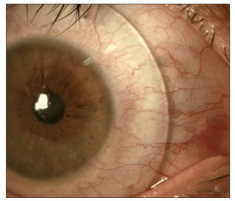
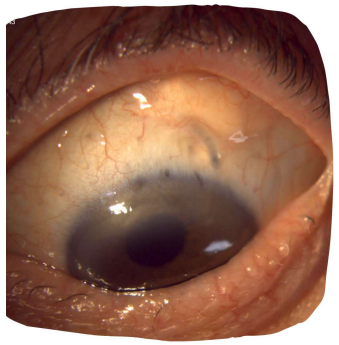


Photo: H. Otten

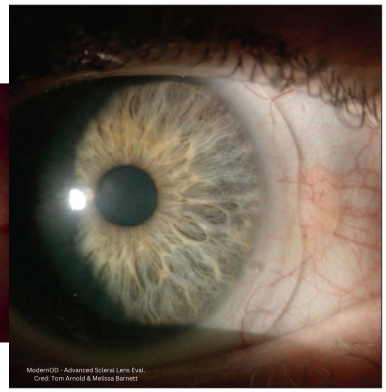
Excessive edge lift
in both meridians.
Increase SLZ In both meridians.

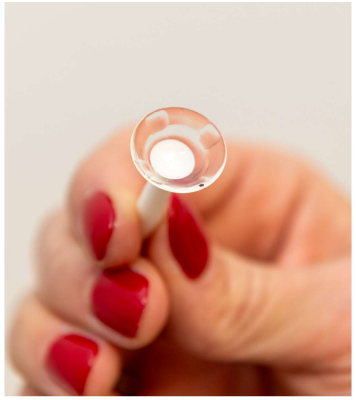
OBSTACLES ON THE SCLERA

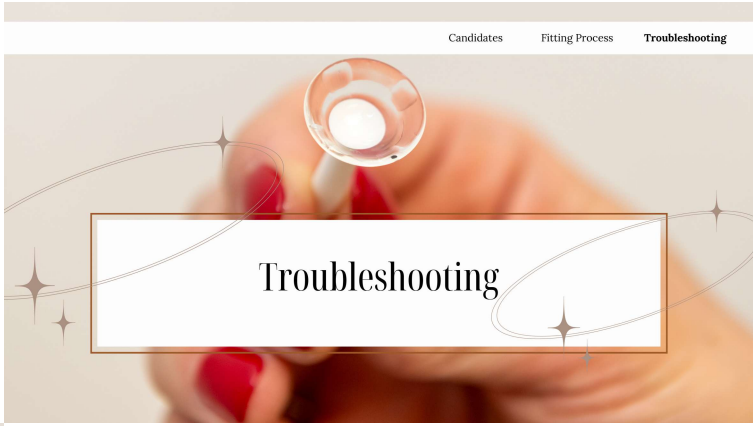


THE FIX

Microvault
Notching
Custom-mold
Scleral Topography Based







Questions at follow-up:

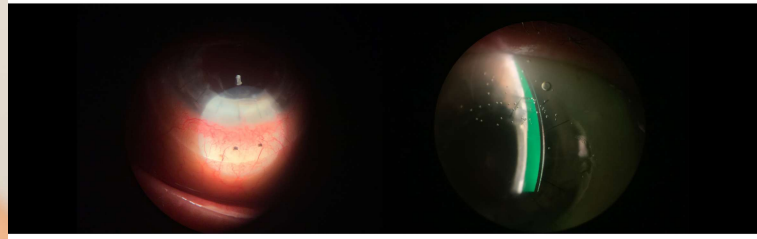
- WTT/AWT (Wear Time Today/Average Wear Time):
- Solutions:
- Comfort?
- Ease of insertion/removal?
- Redness?
- Vision throughout day?

Candidates Fitting Process **Troubleshooting**

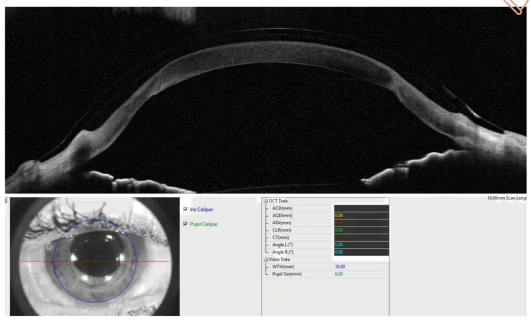
Difficulty with removal...follow-up questions:

- Is it difficult to remove regardless of how long it's been on?
- Do drops help?
- Where is the plunger being applied?
- *Watch them take it out*

"MY LENSES ARE DIFFICULT TO REMOVE"



"MY LENSES ARE DIFFICULT TO REMOVE"



Candidates | Fitting Process | **Troubleshooting**

Difficulty with removal solutions

- Ensure alignment of edge, limbus, saggital height
- Adjust diameter/edge design
- Add fenestrations/smart channels

"MY VISION IS BLURRY"

WHEN?

IMMEDIATELY — LATER IN DAY

IMMEDIATE

Over-Refraction
Sphere
Cyl
[Lenticular cyl]
[Decentered lens]
[Lens flexure]

HOAs

Insertion Bubble

Optic Zone Size

Existing Pathology
Scarring
Back-surface irregularities

Non-Wetting Lens

Perform auto-refractor (AR) over scleral lens

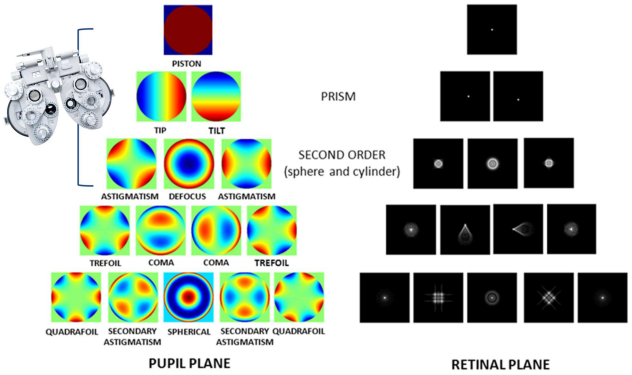
-1.00-1.75x090

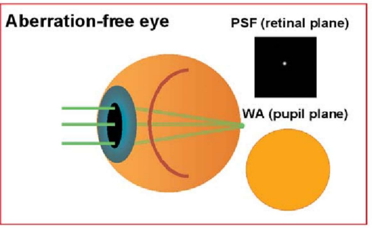
Auto-Ks 49.00/49.00@180
↓
Check for centration & rotational stability
↓
Add -1.00-1.75x180 over-refraction

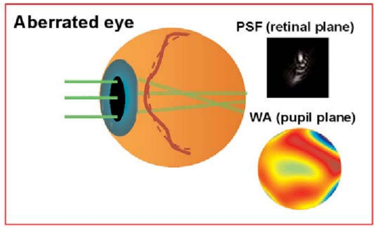
Not stable? Add spherical-equivalent

Auto-Ks 49.00/50.75@90
↓
Check for Flexure:
- Aligned Edges?
- Thin lens?

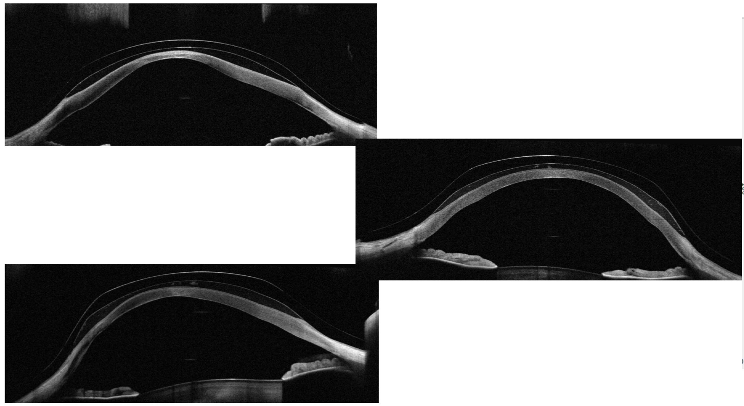
↓
Refine fit

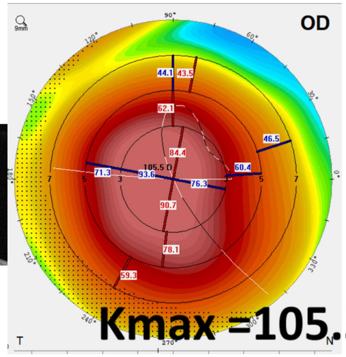


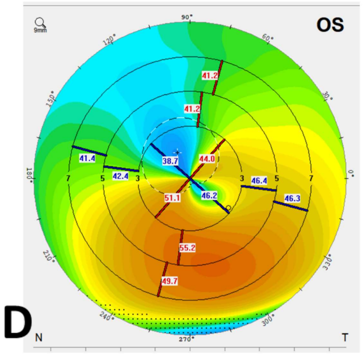


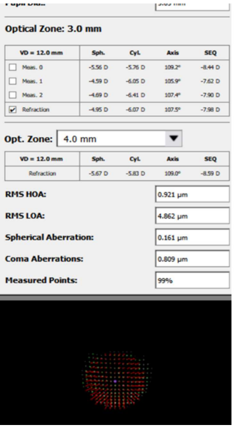


Glare/haloes/Starbursts
Shadowing/smearing
Monocular diplopia
Ghost images
Reduction in CS
Distorted night vision









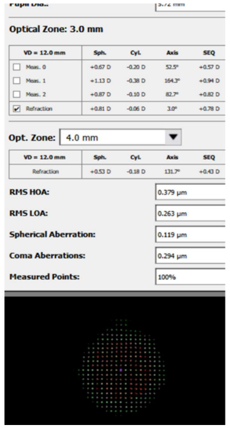
Optical Zone: 3.0 mm

VD = 12.0 mm	Sph.	Cyl.	Axis	SEQ
☐ Meas. 0	-5.56 D	-5.76 D	109.2°	-8.44 D
☐ Meas. 1	-4.59 D	-6.05 D	105.9°	-7.62 D
☐ Meas. 2	-4.69 D	-6.41 D	107.4°	-7.90 D
☑ Refraction	-4.95 D	-6.07 D	107.5°	-7.98 D

Opt. Zone: 4.0 mm

VD = 12.0 mm	Sph.	Cyl.	Axis	SEQ
Refraction	-5.67 D	-5.83 D	109.0°	-8.59 D

RMS HOA: 0.921 µm
RMS LOA: 4.862 µm
Spherical Aberration: 0.161 µm
Coma Aberrations: 0.809 µm
Measured Points: 99%



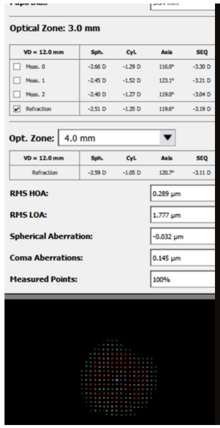
Optical Zone: 3.0 mm

VD = 12.0 mm	Sph.	Cyl.	Axis	SEQ
☐ Meas. 0	+0.67 D	-0.20 D	52.5°	+0.57 D
☐ Meas. 1	+1.13 D	-0.38 D	164.3°	+0.94 D
☐ Meas. 2	+0.87 D	-0.10 D	82.7°	+0.82 D
☑ Refraction	+0.81 D	-0.06 D	3.0°	+0.78 D

Opt. Zone: 4.0 mm

VD = 12.0 mm	Sph.	Cyl.	Axis	SEQ
Refraction	+0.53 D	-0.18 D	131.7°	+0.43 D

RMS HOA: 0.379 µm
RMS LOA: 0.263 µm
Spherical Aberration: 0.119 µm
Coma Aberrations: 0.294 µm
Measured Points: 100%



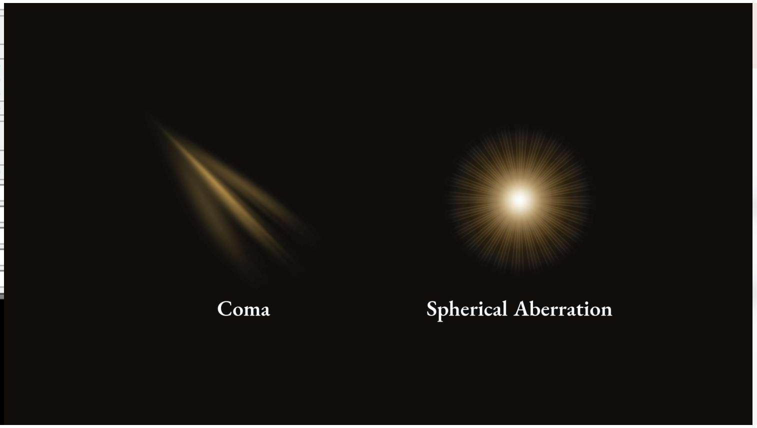
Optical Zone: 3.0 mm

VD = 12.0 mm	Sph.	Cyl.	Axis	SEQ
☐ Meas. 0	-2.66 D	-1.29 D	116.0°	-3.30 D
☐ Meas. 1	-2.45 D	-1.52 D	123.1°	-3.21 D
☐ Meas. 2	-2.40 D	-1.27 D	119.0°	-3.04 D
☑ Refraction	-2.51 D	-1.35 D	119.6°	-3.19 D

Opt. Zone: 4.0 mm

VD = 12.0 mm	Sph.	Cyl.	Axis	SEQ
Refraction	-2.59 D	-1.05 D	120.7°	-3.11 D

RMS HOA: 0.289 µm
RMS LOA: 1.777 µm
Spherical Aberration: -0.032 µm
Coma Aberrations: 0.145 µm
Measured Points: 100%



IMMEDIATE

Over-Refraction
Sphere
Cyl
[Lenticular cyl]
[Decentered lens]
[Lens flexure]

HOAs

Insertion Bubble

Non-Wetting Lens

Optic Zone Size

Existing Pathology
Scarring
Back-surface irregularities

MID-DAY

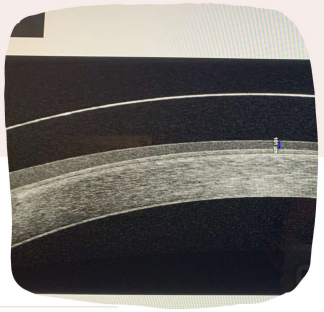
Corneal Edema

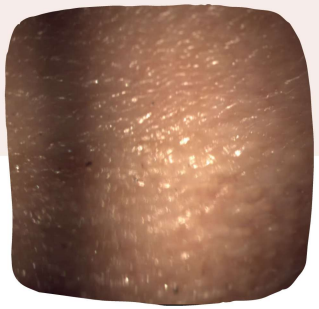
Fogging

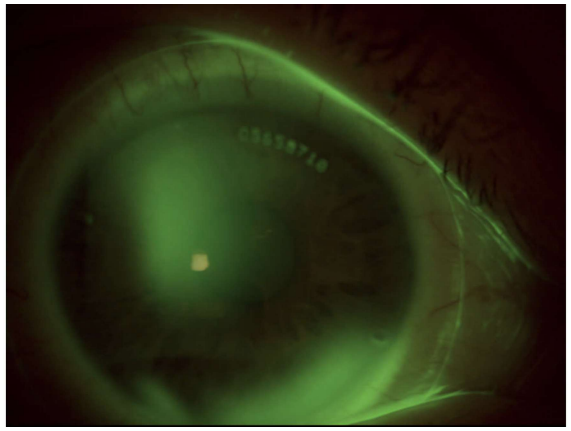
Non-Wetting Lens

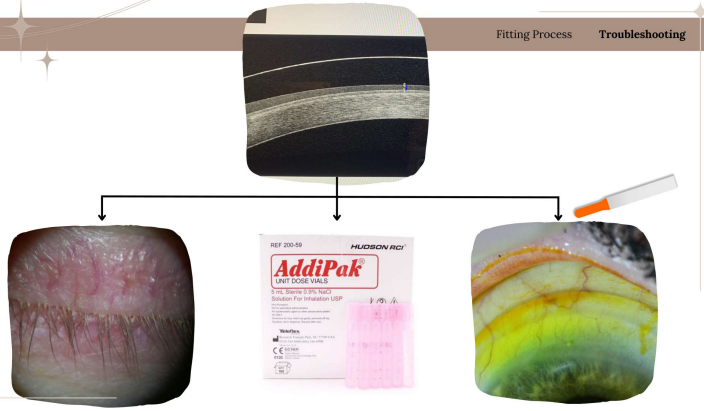
Deposits

"Fogging"



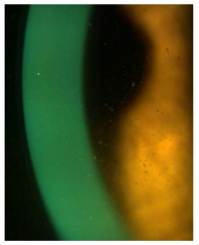






MID-DAY FOGGING

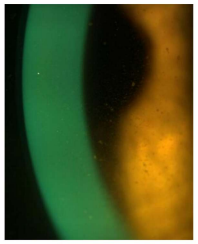
- Epithelial Sloughing: Higher MMP -> More fogging
- Those with fogging had an average **central clearance** ~ 50 microns greater than the average clearance for those without fogging. Hypoxia caused by increased central clearance could cause inflammation that in turn causes midday fogging.
- The study found that 80% of the participants with fogging had **tightly fitting lenses**, compared to 40% of the wearers without interrupted wear. Interestingly, the tear exchange rate measured by fluorophotometry was the same in the two groups



Fogt, Jennifer Swingle. "Midday Fogging of Scleral Contact Lenses: Current Perspectives." Clinical Optometry (2021): 209-219.

MID-DAY FOGGING

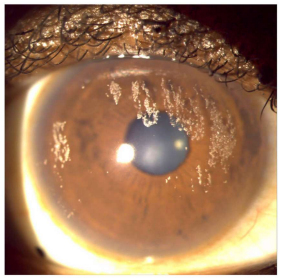
1. Align Edges
2. Treat OSD
3. Ensure proper insertion
4. Ensure proper filling solution
5. Minimize central clearance
6. Add viscous PFAT (Celluvisc, Optase Intense, etc)

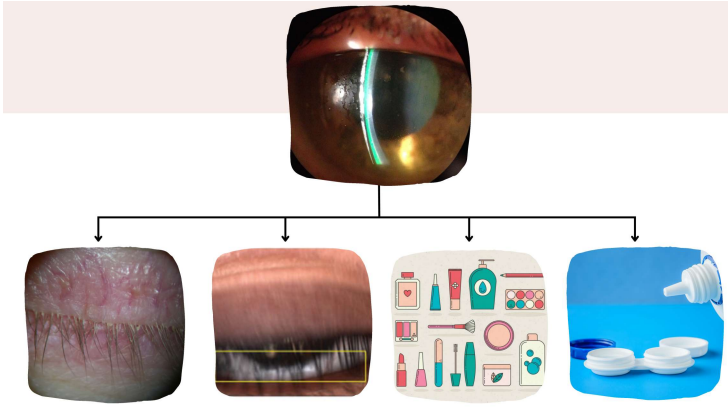


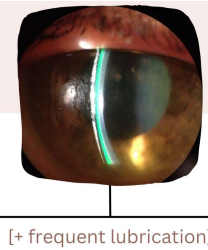
Fogt, Jennifer Swingle. "Midday Fogging of Scleral Contact Lenses: Current Perspectives." Clinical Optometry (2021): 209-219.

DEPOSITS

1. Abrasive nightly cleaners
2. Mechanical rubbing
3. Protein remover
4. Progent treatment
5. Frequent lubrication throughout day





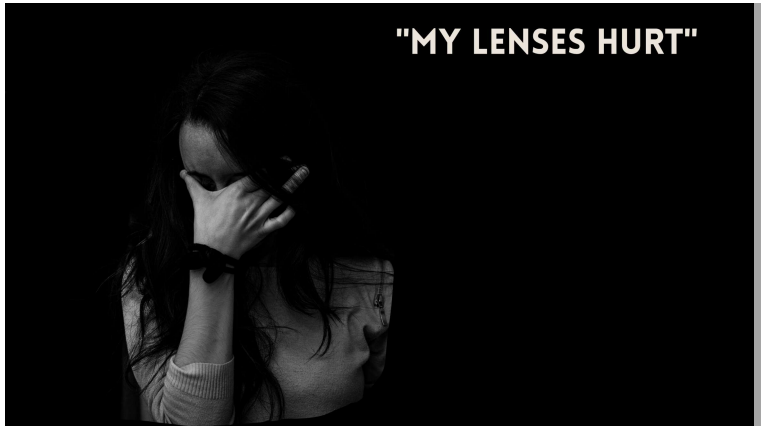


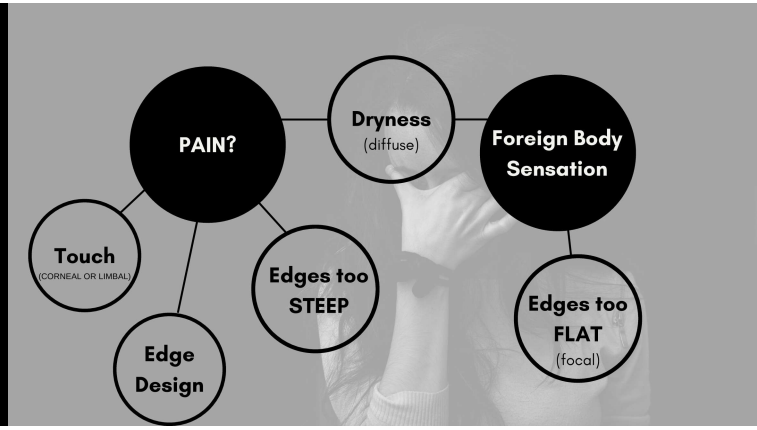
[+ frequent lubrication]

Plasma ttx lens
Surfactant cleaner
Conditioner

HydraPEG ttx lens
MPS Cleaner/Conditioner

Reverse piggyback?

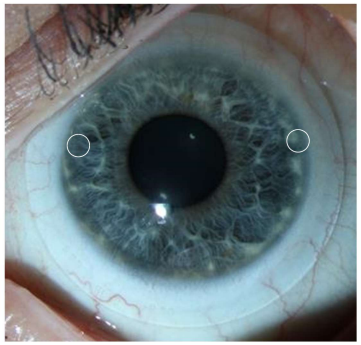




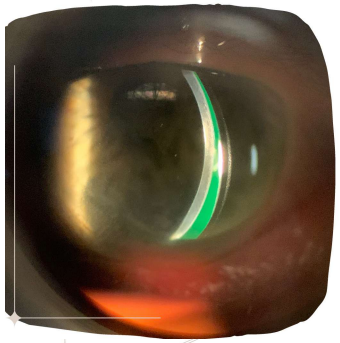
"MY EYES ARE RED AFTER I TAKE OFF MY LENSES"

When?

Upon Insertion	End-of-Day
Tight Edges	Tight Edges
Limbal Touch	Limbal Touch
Bubbles	Bubbles
Improper filling sol'n	Scleral Obstacle
Improper insertion	OSD



Decentration

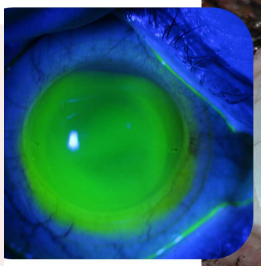


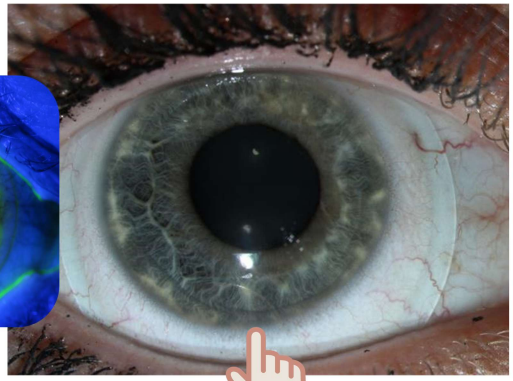
THE CONSEQUENCES

Cylindrical OR
Superior/superior temporal touch
Inferior compression/impingement

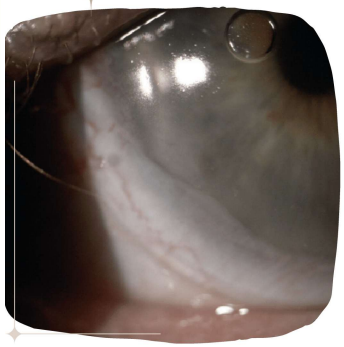
THE FIX

Add toricity/quad-specific PC
Decrease saggital height
Decrease diameter





Conjunctival Prolapse

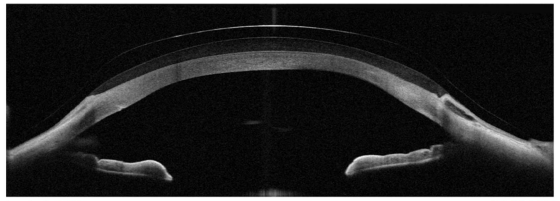


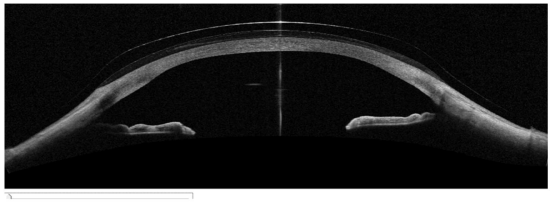
THE CAUSE

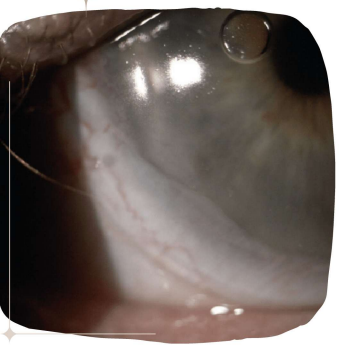
Excessive limbal clearance
Excessive central clearance
Large chamber diameter
Conjunctivochalasis
Forceful lens application

THE FIX

Decrease central/limbal clearance
Decrease chamber size
Conjunctival resection (if necessary)
Add channels/fenestrations

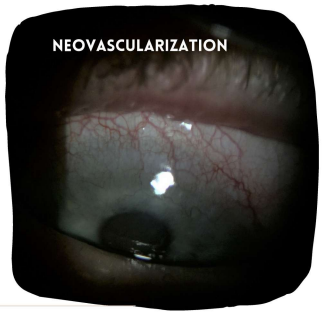






THE RISK

- Localized vascularization,
- Conjunctivalization (fibrovascular pannus)
- Impaired stem cell function.



THE CAUSE

Excessive limbal clearance
Decreased oxygen transmission
Bearing on limbus
Chronic conjunctival prolapse

THE FIX

Decrease limbal clearance
Improve scleral lens alignment

Fitting Philosophies While some practitioners strive for maximum lens material oxygen permeability and minimum reservoir and lens thickness to minimize corneal hypoxia, is this always necessary? Recent laboratory-based studies of young, healthy eyes have provided further insights into the effect of manipulating these variables on corneal edema (Figure 3). Dhallu and colleagues[22] demonstrated that increasing the lens oxygen permeability beyond a Dk of 100 provided no further reduction in corneal edema, and Fisher and coworkers[23] highlighted that minimizing the fluid reservoir thickness (Dk of ~80) provided a greater reduction (~two times greater) in corneal edema than similar modifications for lens thickness values (Dk of 141).

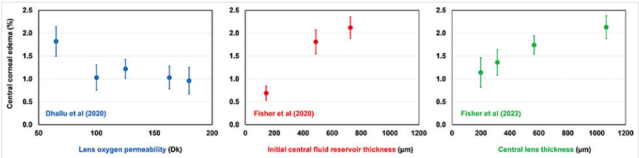
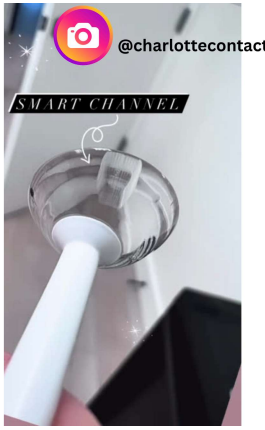


Figure 3. Mean (± standard error) scleral lens-induced central corneal edema as a function of lens oxygen permeability (blue), initial central fluid reservoir thickness (red), and central scleral lens thickness (green). For other lens and fitting parameters refer to Dhallu et al (2020), Fisher et al (2020), and Fisher et al (2022).

VINCENT, STEPHEN J., PHD OD, and JANPG BERGMANSON. "NO FEE CE: CURRENT CONTROVERSIES IN SCLERAL LENS PRESCRIBING."



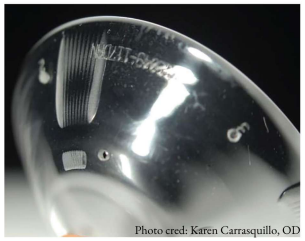


Photo cred: Karen Carrasquillo, OD

Candidates Fitting Process **Troubleshooting**

CORNEAL EDEMA

Candidates Fitting Process **Troubleshooting**

THE CAUSE

Overwear
Sleeping in lenses
Compromised cornea
Excessive central clearance
CL too thick
Low dK

Scleral
Scleral Lens Education Society

GPLI

Contact Lens SPECTRUM

FITTING GUIDE

Questions?

drc@charlottecontactlens.com

Dr. Ariel Cerenzie

Hot Topics in Myopia Management

What's the best?

Monthly (center D)

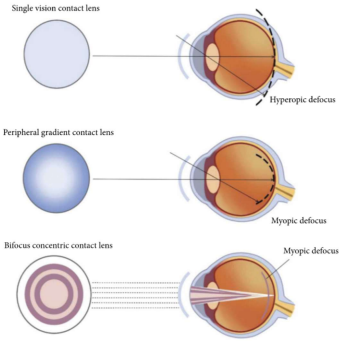
Biofinity MF SiHy:
Sphere: Up to -10.00 D
Cyl: Up to -5.75

Proclear MF Hydrogel:
Sphere: Up to -20.00 D
Cyl: Up to -5.75

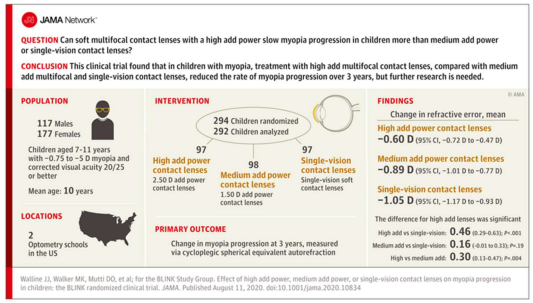
Daily (center D)

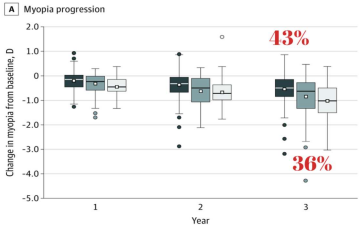
MiSight:
+2.00 Concentric Rings
Sphere: Up to -7.00 D
Cyl: Up to -0.75

Aspheric
Sphere: Up to -12.25 D



Russo, Andrea, et al. "Myopia: Mechanisms and Strategies to Slow Down Its Progression." Journal of Ophthalmology (2022).





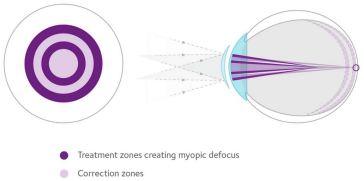
Walline JJ, Walker MK, Mutti DO, et al; for the BLINK Study Group. Effect of high add power, medium add power, or single-vision contact lenses on myopia progression in children: the BLINK randomized clinical trial. JAMA. Published August 11, 2020. doi:10.1001/jama.2020.10834

Multifocals Orthok Atropine

FDA APPROVAL RANGES

Age
8-12 yo

Refraction
-0.75 D to -4.00 D SE
≤ 0.75 DC

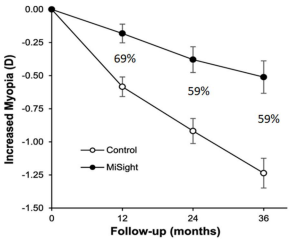


Multifocals Orthok Atropine

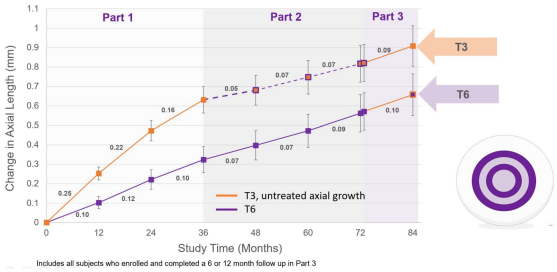
Design:
109 children (8-12 years old)
-0.75 to -4.00D of myopia and < 1.00D of astigmatism

Fit with either
MiSight 1-Day
Proclear 1-Day

Results (3 years):
-0.73 D (59%) reduction in myopia progression
0.32 mm (52%) reduction in axial elongation
No cases of serious ocular adverse events reported.



Multifocals Orthok Atropine



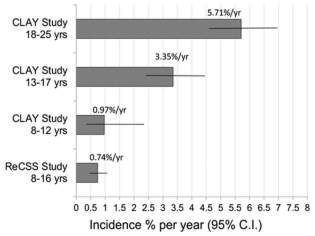
Chamberlain P et al. Myopia Progression in Children on Cessation of Dual-Focus Contact Lens Wear: MiSight 1-day 7-year findings AAO November 2021

Multifocals Orthok Atropine

> Across the 6-years, there were no contact lens related serious adverse events and biomicroscopy showed no significant changes. Results suggest that children this age can successfully wear daily-disposable hydrogel contact lenses with minimal impact on ocular physiology.

Woods, Jill, et al. "Ocular health of children wearing daily disposable contact lenses over a 6-year period." Contact Lens and Anterior Eye 44.4 (2021): 101591.

Multifocals Orthok Atropine

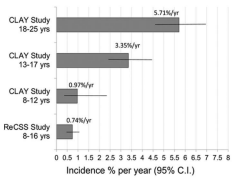


ReCSS Study

Retrospective Cohort Study of the Safety of Pediatric Soft Contact Lens Wear

- Studied children prescribed lenses <13 yo
- 1,000 children over 2,713 years of wear
- Annual incidence of inflammatory events: <1%
  - Conjunctivitis
  - FB abrasions
  - No vision loss

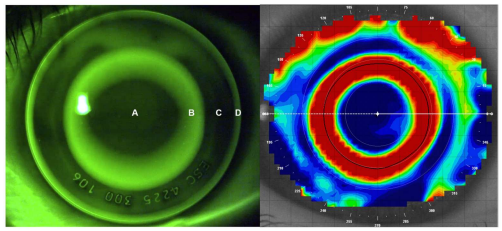
Chalmers, et al. Ophthalmic Physiol Opt. 2020.; Bullimore, et al. Ophthalmic Physiol Opt. 2020.



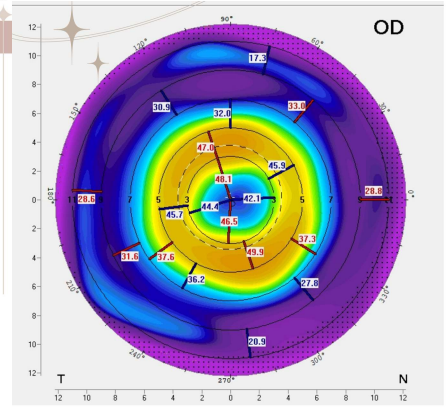
> A daily disposable modality should be preferred ....solutions and storage cases are two major risk factors for infectious and inflammatory events

Chalmers, et al. Ophthalmic Physiol Opt. 2020.; Bullimore, et al. Ophthalmic Physiol Opt. 2020.

Multifocals Orthok Atropine



Vincent, Stephen J., et al. "RCLA CLEAR-Orthokeratology." Contact Lens and Anterior Eye 44.2 (2021): 249-269.



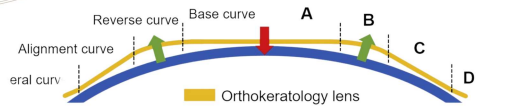
Guo, Biyue, et al. "Variation of Orthokeratology Lens Treatment Zone (VOLTZ) Study: A 2-year randomised clinical trial." Ophthalmic and Physiological Optics 43.6 (2023): 1449-1461.

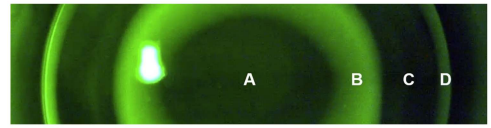
Refractive Error

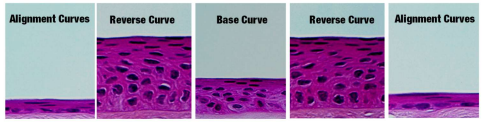
- Sphere: Up to -6.00D*
- Cyl: Up to -1.75D*

5 mm vs. 6 mm BOZD
- 0.20 mm less AL

Multifocals Orthok Atropine







AXIAL ELONGATION

~50% Ranging from 41-45% in most meta-analyses.

Weiss RS, Park S. Recent updates on myopia control: preventing progression 1 diopter at a time. Curr Opin Ophthalmol 2019
Lipson MJ, Brooks MM, Koffler BH. The Role of Orthokeratology in Myopia Control: A Review. Eye Contact Lens 2018;44:224-30
Cheung SW, Boost MV, Cho P. Pre-treatment observation of axial elongation for evidence-based selection of children in Hong Kong for myopia control. Cont Lens Anterior Eye 2018
Hiraoka T, Kakita T, Okamoto F, Takahashi H, Oshika T. Long-term effect of overnight orthokeratology on axial length elongation in childhood myopia: a 5-year follow-up study. Invest Ophthalmol Vis Sci 2012;53:3913-9
Swarbrick HA, Alharbi A, Watt K, Lum E, Kang P. Myopia control during orthokeratology lens wear in children using a novel study design. Ophthalmology 2015;122:620-30

> There is sufficient evidence to suggest that OrthoK is a safe option for myopia correction and retardation. Long-term success of OrthoK treatment requires a combination of proper lens fitting, rigorous compliance to lens care regimen, good adherence to routine follow-ups, and timely treatment of complications.

Liu, Yue M., and Peiying Xie. "The safety of orthokeratology—a systematic review." Eye & contact lens 42.1 (2016): 35.

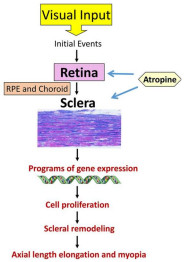
Non-selective antagonist of muscarinic acetylcholine receptors

Muscarinic ACh Receptors are found in the:

Retina: The layer involved in transferring the signaling cascade toward the choroid and/or the sclera. Atropine boosts dopamine release from cellular stores, which then controls eye growth.

Choroid: Atropine results in rapid and transient choroidal thickening and inhibited eye growth. Suggested that the choroidal thickening and eye growth may be linked. Atropine was found to inhibit choroidal thinning induced by hyperopic defocus.

Sclera: Blocks the proliferation of scleral fibroblasts and consequent axial elongation



Refractive Error

- No Limit!

	ATOM 2			LAMP		
Atropine Dosage	0.5%	0.1%	0.01%	0.05%	0.025%	0.01%
Refractive Efficiency	75%	68%	59%	66%	43%	27%
Axial Efficiency	29%	25%	-8%	51%	29%	12%

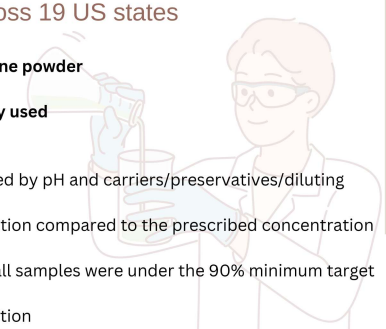
0.05% atropine remained the optimal concentration over 3 years

The difference in rebound effects were clinically small across all three studied atropine concentrations.

Stopping treatment at an older age was associated with a smaller rebound.

What's in a Bottle

A Survey of 26 pharmacies across 19 US states



- **Diluted from 1% atropine gtts or atropine powder**
- **Preservatives may vary: BAK commonly used**
- **Atropine is an unstable compound**
  - Susceptible to hydrolysis - influenced by pH and carriers/preservatives/diluting agents
  - Analysis found the actual concentration compared to the prescribed concentration was:
    - As low as 70% and a quarter of all samples were under the 90% minimum target concentration.
    - More neutral pH = more degradation

Richdale K, Tomiyama ES, Novack GD, Bullimore MA. Compounding of Low-Concentration Atropine for Myopia Control. Eye Contact Lens 2022;48:489–92.

	0.05% Atropine	0.025% Atropine	0.01% Atropine	Placebo
Photopic pupil size (+mm)	1.03	0.76	0.80	0.13
Photophobia, 2 weeks	31.2%	18.5%	5.5%	12.6%
Photophobia, 1 year	7.8%	6.6%	2.1%	4.3%
Photochromic Lenses	30.3%	34.3%	30%	39.6%
Accommodative Amp (D), 4 mo	-2.38	-1.34	-0.50	-0.35
Accommodative Amp (D), 1 yr	-1.98	-1.61	-0.26	-0.32
PALS	0.96%	0%	1.8%	0.9%

Randomized Controlled Trial > Optom Vis Sci. 2023 Aug 1;100(8):550-556.
doi: 10.1097/OPX.0000000000002031. Epub 2023 Jun 6.

Effect of Low-dose Atropine on Binocular Vision and Accommodation in Children Aged 6 to 17 Years

Rachel Emily Breliant, Yi Pang, Alaina Bandstra, Valerie Kattouf

"Pupil size was significantly enlarged by **0.01%, 0.03%, and 0.05%** atropine in both dim and bright illumination with more effect at 60 minutes after application. However, low dose atropine eye drops **have no effect on binocular vision measurements**.

Thus, in respect to binocular vision, it is relatively safe to use low-dose atropine to treat myopia progression in children aged 6 to 17 years."

Which one is better?

Consider

- **Kid's/Parent's preference**
  - Previous CL experience
  - FDA approval
  - Wary of "drugs"
- **Hygiene**
- **Maturity**
- **Concerns of compliance**
- **Extracurricular activity involvement**
- **BV issues?**

Which one is better?

- **Esophoria and accommodative lag**: Likely to be **improved** in **orthokeratology** wear. 1,2
- Multifocal contact lenses can potentially cause small exophoric shift and/or increase in accommodative lag.3,4
- The **MiSight**/dual focus concentric contact lens design **does not appear to alter accommodation or phoria**.5,6

1.Gifford K, Gifford P, Hendicott PL, Schmid KL. Near binocular visual function in young adult orthokeratology versus soft contact lens wearers. Cont Lens Anterior Eye. 2017 Jun;40(3):184-189.
2.Gifford KL, Gifford P, Hendicott PL, Schmid KL. Zone of Clear Single Binocular Vision in Myopic Orthokeratology. Eye Contact Lens. 2020 Mar;46(2):82-90.
3.Gong CR, Troilo D, Richdale K. Accommodation and Phoria in Children Wearing Multifocal Contact Lenses. Optom Vis Sci 2017;94:353-360.
4.Schmid KL, Gifford KL, Chan P, Christie B, Crouther S, Nahuysen O, Sechenova K, Sevil L, Youssef M, Atchison DA. The effects of aspheric and concentric multifocal soft contact lenses on visual quality, vergence and accommodation function in young adult myopes. Invest. Ophthalmol. Vis. Sci. 2019;60(9):3893.
5.Gifford KL, Schmid KL, Collins J, Maher C, Makan R, Nguyen TKP, et al. Accommodative responses of young adult myopes wearing multifocal contact lenses. Invest Ophthalmol Vis Sci. 2019;60(9):6376.
6.Ruiz-Pomeda A, Pérez-Sánchez B, Cañadas P, Prieto-Garrido FL, Gutiérrez-Ortega R, Villa-Collar C. Binocular and accommodative function in the controlled randomized clinical trial MiSight® Assessment Study Spain (MASS). Graefes Arch Clin Exp Ophthalmol. 2019 Jan;257(1):207-215.

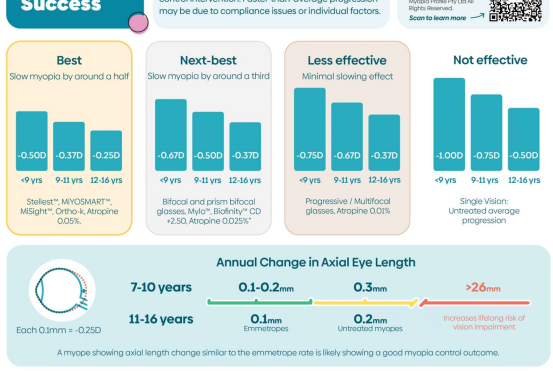
IS IT WORKING?

4. Gauging Success

The charts below show average refractive progression per year, based on child's age and current myopia control intervention. Faster-than-average progression may be due to compliance issues or individual factors.

MyopiaProfile

Scan to learn more



Atropine + Orthok Atropine + Soft CLs RLRL

Combination Therapy

The Latest on Combination Therapy
Orthokeratology + 0.01% Atropine

2-years RCT: - combination ttx significantly slowed axial elongation compared to ortho-k alone - 0.17 mm vs. 0.34 mm
- Additive effect was particularly **pronounced in the first six months** of treatment, suggesting that the combination is most effective in the early stages.[1]

2-years retrospective study: Combination ttx reduced axial elongation by 36% compared to ortho-k alone - 0.28 mm vs. 0.44 mm.[2]
- Additive effect was more pronounced in younger children, indicating that **early intervention may provide greater long-term benefits.**

1. Tan Q, Ng ALK, Cheng GPM, Woo VCP, Cho P. Combined 0.05% atropine with orthokeratology in childhood myopia control (AOK) study: A 2-year randomized clinical trial. Cont Lens Anterior Eye. 2023;46:101723.
2. Du L, Chen J, Ding L, Wang J, Yang J, Xie H, et al. Add-On Effect of 0.05% Atropine in Orthokeratology Wearers for Myopia Control in Children: A 2-Year Retrospective Study. Ophthalmol Ther. 2023;12:2557–68.

The Latest on Combination Therapy
Biofinity + 0.01% Atropine

3-year RCT - Myopia progression was -0.52 D in the combination group, -0.55 D in the SMCL group, and -1.09 D in the SV group, indicating no significant added benefit of atropine when combined with SMCL. Axial elongation was also similar between the combination and SMCL groups (0.31 mm vs. 0.39 mm).

Conclusion: adding 0.01% atropine to SMCL does not provide a meaningful additional benefit.

Jones JH, Mutti DO, Jones-Jordan LA, Walline JJ. Effect of Combining 0.05% Atropine with Soft Multifocal Contact Lenses on Myopia Progression in Children. Optom Vis Sci. 2022 May 1;99(5):434–442.

The Latest on Combination Therapy
Orthokeratology + 0.05% Atropine

1 year retrospective study - Children using ortho-k combined with 0.05% atropine experienced significantly less axial elongation over a year compared to those using ortho-k alone (0.14 mm vs. 0.27 mm).
- Effect appeared to diminish slightly in the second half of the year, suggesting a potential adaptation period.[1]

Some studies suggest that the effectiveness of atropine in combination therapy may plateau after 1.5 years.[2]

1.
1. Wen L, Liu H, Xu Q, Pan W, Lin Z, Xiao Z, et al. Add-on effect of using 0.05% atropine in fast progressors of orthokeratology: A preliminary retrospective study. Cont Lens Anterior Eye. 2025;48:102282.
2. Du L, Chen J, Ding L, Wang J, Yang J, Xie H, et al. Add-On Effect of 0.05% Atropine in Orthokeratology Wearers for Myopia Control in Children: A 2-Year Retrospective Study. Ophthalmol Ther. 2023;12:2557–68.

The Latest on Combination Therapy
RLRL + Orthok

Repeated low-level red-light therapy (RLRL)
- 12 month RCT
- 8-13 yo fast progressors
- RLRL + Orthok: -0.02 mm
- Orthok only: 0.27 mm

"These results suggest that RLRL therapy significantly enhances the myopia control effect of orthokeratologyin children with fast axial elongation. The treatment was well tolerated, with no serious adverse events reported" 14

Jones JH, Mutti DO, Jones-Jordan LA, Walline JJ. Effect of Combining 0.05% Atropine with Soft Multifocal Contact Lenses on Myopia Progression in Children. Optom Vis Sci. 2022 May 1;99(5):434–442.

The Latest on Combination Therapy
MiSight + 0.01% Atropine

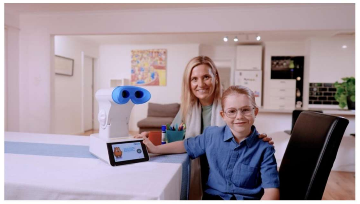
3- year retrospective study - myopia progression in children using 0.01% atropine alone, 0.01% atropine plus MiSight 1 Day, and a control group wearing single-vision spectacles. Children treated with 0.01% atropine alone showed significantly less myopia progression than the single vision group, with 0.44 D in year 1 and 0.51 D in year 2. The combined MiSight + 0.01% atropine group exhibited the lowest myopia progression, with 0.35 D in year 1 and 0.44 D in year 2.

Conclusion: No clear additive effect was observed in one study of MiSight 1 Day and 0.01% atropine, but study limitations prevent a definitive conclusion.

Erdinest N, London N, Lavy I, Landau D, Ben Ephraim Noyman D, Levinger N, Morad Y. Low-Concentration Atropine Monotherapy vs. Combined with MiSight 1 Day Contact Lenses for Myopia Management. Vision (Basel). 2022 Dec 12;6(4):73

Presented By :
Ariel Cerenzie, OD, FAAO, FSLS

Red Light Therapy



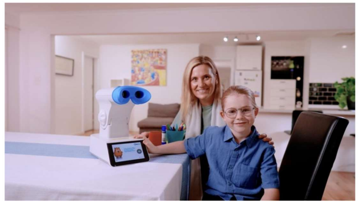
Myopia structural changes: Choroidal thinning and reduced blood flow --> hypoxia.

Unpublished reports indicate potential benefits:

- Increased choroidal thickness
- Improved blood flow
- Stabilization of axial elongation.

Potentially could reduce scleral hypoxia and reduce risk of development/progression of myopia

iang Y, Zhu Z, Tan X, Kong X, Zhong H, Zhang J, Xiong R, Yuan Y, Zeng J, Morgan IG, He M. Effect of Repeated Low-Level Red-Light Therapy for Myopia Control in Children: A Multicenter Randomized Controlled Trial. Ophthalmology. 2022 May;129(5):509-519.
Zhang X, Huang J, Xu X, He X. Application of low-level red light in myopia and amblyopia in children and adolescents. Chinese Journal of School Health. 2022 July; 1120(7): 1112-1115.
Dong J, Zhu Z, Xu H, He M. Myopia control effect of repeated low-level red-light therapy in Chinese children: A randomized, double-blind, controlled clinical trial. Ophthalmology. 2023;130(2):198-204.
He X, Wang J, Zhu Z, Xiang K, Zhang X, Zhang B, & Xu X. Effect of Repeated Low-level Red Light on Myopia Prevention Among Children in China With Premyopia: A Randomized Clinical Trial. JAMA Network Open, 2023: 6(4), e239612-e239612.



Eyerising International indicates that the RLRL device has approximately **70,000-80,000 daily users in China**

DOSE

650±10nm at a laser power of 0.29mW going through a 4-mm pupil and is used for **180 seconds at a time twice a day for 5 days per week**

Participants: n= 264 children randomly assigned to the intervention group [RLRL treatment plus single vision spectacle (SVS)] and control group (SVS).

- 12 months

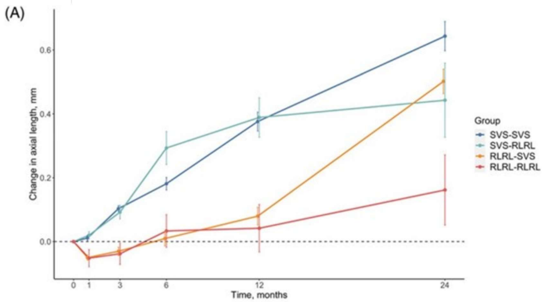
TTX: desktop light therapy device (red light of 650 nm wavelength with illuminance level of ~1600 lux and a power of 0.29 mW for a 4-mm pupil.

- At home under the supervision of parents, three minutes per session, twice per day with a minimum interval of four hours, five days per week.

Outcome: RLRL treatment slowed axial elongation by 0.26 mm and SER progression by 0.59D compared with SVS

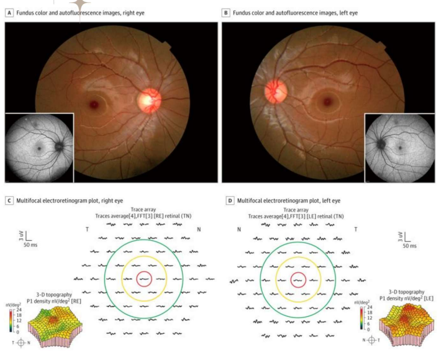
- 69.4% and 76.6% slowing axial elongation and myopic refraction progression.

Jiang, Y., Zhu, Z., Tan, X., Kong, X., Zhong, H., Zhang, J., ... & He, M. (2021). Effect of Repeated Low-Level Red-Light Therapy in Myopia Control in Children: A Multicenter Randomized Controlled Trial. Ophthalmology.



One-year and two-year data indicated a 75% reduction in axial length progression in children undergoing RLRL treatment.

1. Xiong R, Zhu Z, Jiang Y, Kong X, Zhang J, Wang W, Kiburg K, Yuan Y, Chen Y, Zhang S, Xuan M. Sustained and rebound effect of repeated low-level red-light therapy on myopia control: A 2-year post-trial follow-up study. Clinical & Experimental Ophthalmology. 2022;50(9):1013-24.
Xiong R, Zhu Z, Jiang Y, Kong X, Zhang J, Wang W, Kiburg K, Yuan Y, Chen Y, Zhang S, Xuan M. Sustained and rebound effect of repeated low-level red-light therapy on myopia control: A 2-year post-trial follow-up study. Clinical & Experimental Ophthalmology. 2022;50(9):1013-24.



12 year old female with bilateral vision loss after 5-month use of RLRL laser exposure

Vision: BCVA declined from 20/20 to 20/30 OU

Ocular Health Findings:

- Darkened foveae with hypoautofluorescent plaque in autofluorescence images
- Foveal ellipsoid zone disruption, OU
- Interdigitation zone discontinuity
- ERG: moderately reduced response in macula

3 months later:
Bilateral outer retinal damage partially recovered
BCVA improved to 20/25 OU

Low-Level Red Light Therapy: Safety Concerns Continue

reviewofmm.com/low-level-red-light-therapy-safety-concerns-continue/

February 15, 2024

February 15, 2024

By Dwight Akerman, OD, MBA, FAAO, FBCLA, FIACLE

Photo Credit: Prostockstudio, Dreamstime Photos

The use of **low-level red light** (LLRL) therapy has gained popularity as a treatment for myopia in children, especially in China. However, concerns have been raised about the safety of these devices, as their output may exceed the recommended safety limits. A recent study conducted by Lisa Ostrin and Alexander Schill aimed to characterize the output of two LLRL devices and determine their thermal and photochemical maximum permissible exposure (MPE) for myopia control.

The study examined two LLRL devices — the Sky-n1201a and the Future Vision — and measured their optical power using an integrating sphere radiometer through a 7-mm diameter aperture. The retinal spot sizes of the devices were obtained using a model eye and high-resolution beam profiler. The corneal irradiance, retinal irradiance, and MPE were then

"Data supplied by Eyerising International indicates that the RLRL device has approximately **70,000-80,000 daily users in China**: of those, **these 5 cases are the only adverse events that have been reported to the company's side-effect reporting centre, constituting a rare side effect rate of 0.0067%**.17

The published case report cited several possibilities for this adverse outcome, such as the device's light power stability, extended exposure, or the patient's light sensitivity.16

The device does include a stringent control system whereby users must log in with specific credentials, and the system regulates the duration of light exposure, making prolonged exposure virtually impossible. **A possible reason for adverse outcomes may be sensitivity to phototoxicity.**

While determining those that may be susceptible to this could be difficult, Eyerising International recommends that **children who notice an afterimage persisting longer than 5 minutes should cease use and contact their clinician for further advice**"

Treating Pre-Myopia

RISK FACTORS FOR DEVELOPING MYOPIA

- Lower baseline hyperopia than expected for their age
- A family history of myopia
- Visual environment factors which increase risk of myopia, such as reduced time spent outdoors and intensive near work habits.

Age (years)	Refraction cut point
6	< +0.75
7 to 8	< +0.50
9 to 10	< +0.25
11	< 0.00

Morgan IG, Wu PC, Ostrin LA, Tideman JWL, Yam JC, Lee W, Hassan BC, Ho X, Sankaridurg P, Saw SM, French AN, Hunt KA, Guggenheim JA. IMI Risk Factors for Myopia. Invest Ophthalmol Vis Sci. 2021 Apr 28;62(5):3.

Flitcroft DI, He M, Jonas JB, Jong M, Naidoo K, Ohno-Matsui K, Rahi J, Resnikoff S, Vitale S, Yannuzzi L. IMI – Defining and Classifying Myopia: A Proposed Set of Standards for Clinical and Epidemiologic Studies. Invest Ophthalmol Vis Sci. 2019 Feb 28;60(3):M20-M30.

Zadnik K, Sinnott LT, Cotter SA, Jones-Jordan LA, Kleinstein RN, Manny RE, Twelker JD, Mutti DO; Collaborative Longitudinal Evaluation of Ethnicity and Refractive Error (CLEERE) Study Group. Prediction of Juvenile-Onset Myopia. JAMA Ophthalmol. 2015;133(6):683-9.

Protective Effect of outdoor time on reducing onset of myopia:

- 1 hr/day or 7 hr/week = **Reduction of incident myopia by 45%.**
- Aiming for at least 2 hrs/day or 13 hours per week places children out of the highest risk category
- Recent research has shown this effect is most powerful in children aged **3 to 9 years, to reduce onset of myopia between ages 10 to 15 years.**

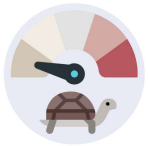
Xiong S, Sankaridurg P, Naduvilath T, Zang J, Zou H, Zhu J, Lv M, He X, Xu X. Time spent in outdoor activities in relation to myopia prevention and control: a meta-analysis and systematic review. Acta Ophthalmol. 2017 Sep;95(6):551-566.

Shah RL, Huang Y, Guggenheim JA, Williams C. Time Outdoors at Specific Ages During Early Childhood and the Risk of Incident Myopia. Invest Ophthalmol Vis Sci. 2017 Feb 1;58(2):1258-1266.

LAMP2 (2023)

- Randomised clinical trial
- 474 Hong Kong Chinese children
- 4-9 (mean 6.8) years
- Does atropine 0.05% and 0.01% delay myopia onset?
- Nightly use of 0.05% atropine eye drops significantly reduced the 2-year cumulative incidence of myopia to 28.4%, and fast myopic shift to 25.0%
- Nightly use of 0.01% atropine group showed no significant difference from placebo, with a myopia incidence of 45.9% and a fast myopic shift of 45.1%.
- **Conclusion**: 0.05% atropine as effective in preventing early myopia onset.7

Yam JC, Zhang XJ, Zhang Y, Yip BHK, Tang F, Wong ES, Bui CHT, Kam KW, Ng MPH, Ko ST, Yip WWK, Young AL, Tham CC, Chen LJ, Pang CP. Effect of Low-Concentration Atropine Eyedrops vs Placebo on Myopia Incidence in Children: The LAMP2 Randomized Clinical Trial. JAMA. 2023 Feb 14;329(6):472-481.



The clinical impact of **delaying myopia onset by one year** is the potential to reduce a patient's final level of myopia by around 0.75D, which is **comparable to the impact of two to three years of treatment to slow down myopia progression after onset.**

Presented By :
Ariel Cerenzie, OD, FAAO, FSLS

When to Stop Treatment?

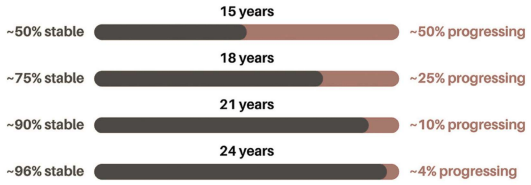
Baseline Age (y)	Frequency of Progression of At Least -0.75D (%)
20 - 25	48.2 (40/83)
25 - 30	35.3 (36/102)
30 - 35	27.3 (18/66)
35 - 40	25.0 (10/40)
Total	35.7 (104/291)

SPAN (Study of Progression of Adult Nearsightedness) Study
The highest risk factor for progression in adults was extensive near work

Consensus between these studies that **one-fifth of myopes in their 20s** will experience significant **progression of at least 1D.**

Lee SS, Lingham G, Sanfilippo PG, Hammond CJ, Saw SM, Guggenheim JA, Yazar S, Mackey DA. Incidence and Progression of Myopia in Early Adulthood. JAMA Ophthalmol. 2022 Feb 1;140(2):162-169.

Age at myopia stabilization



COMET Group. Myopia stabilization and associated factors among participants in the Correction of Myopia Evaluation Trial (COMET). Invest Ophthalmol Vis Sci. 2013 Dec 3;54:7871-7884.

CONSIDER TREATMENT SIDE EFFECTS OF TREATMENTS

Atropine 0.01% is considered to have low side effects in children, but unsure of effects in adults.
Niathi Kona et al. conducted 8 Hour Survey of 0.01% Atropine Induced Changes in Pupil Size and Accommodative Function

- ~50% young adult subjects found their accommodation was most impaired at the 8 hour mark after instillation.
- Along with adults night driving and frequently having high visual demands - as university students and/or in screen based work - this could mean that adults may not tolerate atropine as well as children.

Orthokeratology may be effective in adult myopia stabilization
Two small studies:

1. Orthokeratology (OK) wear in 18-29 year old myopes stabilized refraction and axial length.
2. Paper reported similar results in a case series of three adults wearing OK over three years.
3. Two studies are small and present limited data - there are no randomized controlled trials for any type of myopia control treatment in young adults.

Gong Q, Janowski M, Luo M, Wei H, Chen B, Yang G, Liu L. Efficacy and Adverse Effects of Atropine in Childhood Myopia: A Meta-analysis. JAMA Ophthalmol. 2017 Jun 1;135(6):624-630. (link)
Fu A, Stapleton F, Wei L, Wong W, Zhao B, Watt K, Ji N, Ayu Y. Effect of low-dose atropine on myopia progression, pupil diameter and accommodative amplitude: low-dose atropine and myopia progression. Br J Ophthalmol. 2020 Nov;104(11):1535-1541. (link)
Kona, N. 8 Hour Survey of 0.01% Atropine Induced Changes in Pupil Size and Accommodative Function. American Academy of Ophthalmology Online Abstracts (2018). (link)
Gifford KL, Gifford P, Hendicott PL, Schmid KL. Zone of Clear Single Binocular Vision in Myopic Orthokeratology. Eye Contact Lens. 2020 Mar;46(2):82-90. (link)
González-Méijome JM, Carracedo G, Lopes-Ferreira D, Faria-Ribeiro MA, Peixoto-de-Matos SC, Queirós A. Stabilization in early adult-onset myopia with corneal refractive therapy. Cont Lens Anterior Eye. 2016 Feb;39(1):72-7.

Myopia Profile

Review of MM

Thank you

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