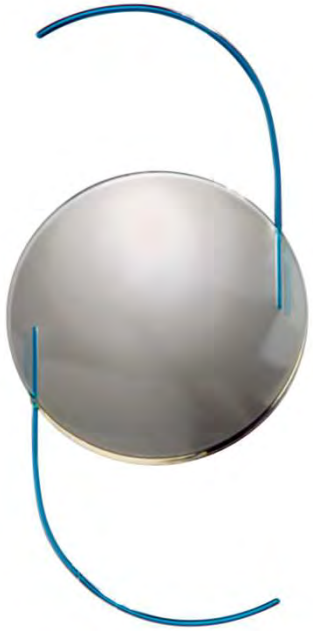

# CUSTOMIZING VISION WITH THE LIGHT ADJUSTABLE LENS

Gregory Searcy, M.D.
Erdey Searcy Eye Group
Columbus, Ohio

# The World's First Adjustable Intraocular Lens

Better clinical outcomes for cataract patients

Glare / halo profile of monofocal lens

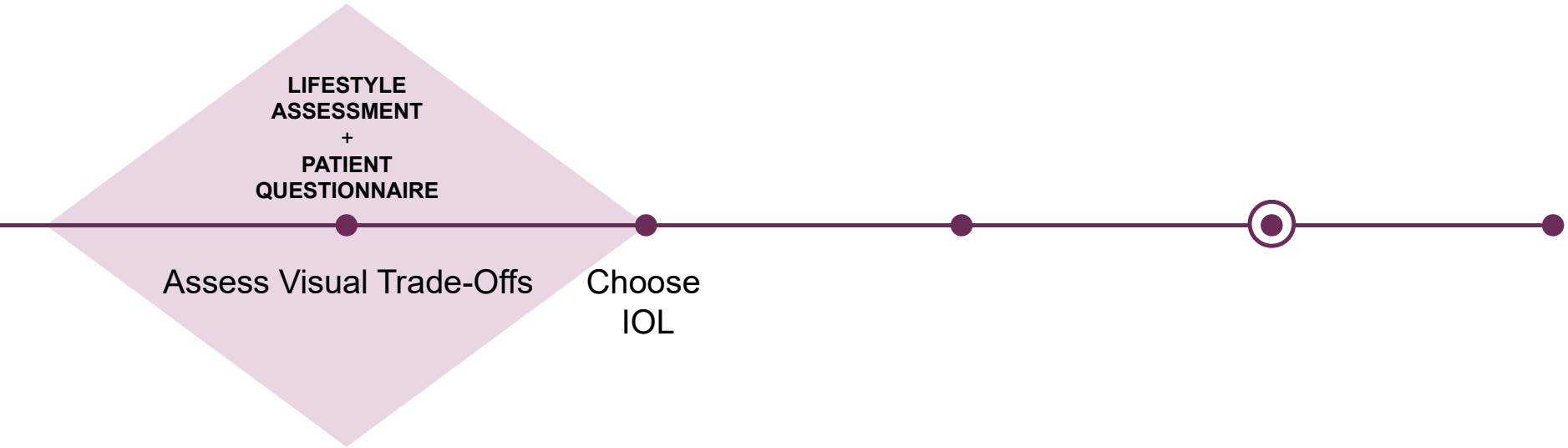


Premium customized blended vision

ActivShield UV protection
Reduces concern of patient compliance

CURRENT PREMIUM CATARACT SURGERY

# High Stakes Decisions



# CURRENT PREMIUM CATARACT SURGERY

**LIFESTYLE ASSESSMENT + PATIENT QUESTIONNAIRE**

Assess Visual Trade-Offs

Choose IOL

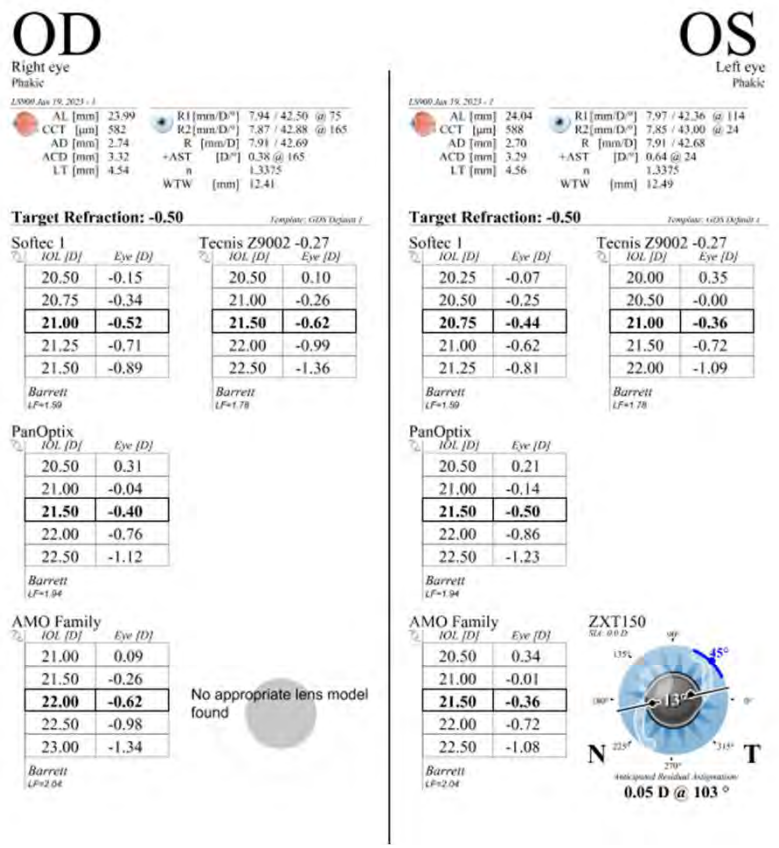
| LENS OPTIONS |  |  |  |
|---|---|---|---|
| Design | STANDARD LENS | TORIC LENS | LIFESTYLE LENS (Symfony) |
| DISTANCE improvement | +++ | +++ | +++ |
| "HIGH DEFINITION" | | +++ | +++ |
| COMPUTER without glasses | | | +++ |
| NEAR without glasses | | | ++ |
| GLARE improvement | ++ | +++ | ++ |
| ASTIGMATISM improvement | | +++ | +++ |
| Benefits | Bifocals typically required afterward | Corrects astigmatism<br>Readers are typically required<br>Bifocals are possible | Greater range of vision<br>Low power readers possible for fine print<br>Subtle glare at night (pilots, truck drivers) |

CURRENT PREMIUM CATARACT SURGERY

# High Stakes Decisions

**LIFESTYLE ASSESSMENT + PATIENT QUESTIONNAIRE**

Assess Visual Trade-Offs → Choose IOL → Predict IOL power



**OD**
Right eye
Phakic

| | | | |
|---|---|---|---|
| AL [mm] | 23.99 | R1 [mm/D/°] | 7.94 / 42.50 @ 75 |
| CCT [µm] | 582 | R2 [mm/D/°] | 7.87 / 42.88 @ 165 |
| AD [mm] | 2.74 | R [mm/D] | 7.91 / 42.69 |
| ACD [mm] | 3.32 | +AST [D/°] | 0.38 @ 165 |
| LT [mm] | 4.54 | n | 1.3375 |
| | | WTW [mm] | 12.41 |

**Target Refraction: -0.50**

Softec 1

| IOL [D] | Eye [D] |
|---|---|
| 20.50 | -0.15 |
| 20.75 | -0.34 |
| **21.00** | **-0.52** |
| 21.25 | -0.71 |
| 21.50 | -0.89 |

Barrett LF=1.59

Tecnis Z9002 -0.27

| IOL [D] | Eye [D] |
|---|---|
| 20.50 | 0.10 |
| 21.00 | -0.26 |
| **21.50** | **-0.62** |
| 22.00 | -0.99 |
| 22.50 | -1.36 |

Barrett LF=1.78

PanOptix

| IOL [D] | Eye [D] |
|---|---|
| 20.50 | 0.31 |
| 21.00 | -0.04 |
| **21.50** | **-0.40** |
| 22.00 | -0.76 |
| 22.50 | -1.12 |

Barrett LF=1.94

AMO Family

| IOL [D] | Eye [D] |
|---|---|
| 21.00 | 0.09 |
| 21.50 | -0.26 |
| **22.00** | **-0.62** |
| 22.50 | -0.98 |
| 23.00 | -1.34 |

Barrett LF=2.04

No appropriate lens model found

**OS**
Left eye
Phakic

| | | | |
|---|---|---|---|
| AL [mm] | 24.04 | R1 [mm/D/°] | 7.97 / 42.36 @ 114 |
| CCT [µm] | 588 | R2 [mm/D/°] | 7.85 / 43.00 @ 24 |
| AD [mm] | 2.70 | R [mm/D] | 7.91 / 42.68 |
| ACD [mm] | 3.29 | +AST [D/°] | 0.64 @ 24 |
| LT [mm] | 4.56 | n | 1.3375 |
| | | WTW [mm] | 12.49 |

**Target Refraction: -0.50**

Softec 1

| IOL [D] | Eye [D] |
|---|---|
| 20.25 | -0.07 |
| 20.50 | -0.25 |
| **20.75** | **-0.44** |
| 21.00 | -0.62 |
| 21.25 | -0.81 |

Barrett LF=1.59

Tecnis Z9002 -0.27

| IOL [D] | Eye [D] |
|---|---|
| 20.00 | 0.35 |
| 20.50 | -0.00 |
| **21.00** | **-0.36** |
| 21.50 | -0.72 |
| 22.00 | -1.09 |

Barrett LF=1.78

PanOptix

| IOL [D] | Eye [D] |
|---|---|
| 20.50 | 0.21 |
| 21.00 | -0.14 |
| **21.50** | **-0.50** |
| 22.00 | -0.86 |
| 22.50 | -1.23 |

Barrett LF=1.94

AMO Family

| IOL [D] | Eye [D] |
|---|---|
| 20.50 | 0.34 |
| 21.00 | -0.01 |
| **21.50** | **-0.36** |
| 22.00 | -0.72 |
| 22.50 | -1.08 |

Barrett LF=2.04

ZXT150



Anticipated Residual Astigmatism
**0.05 D @ 103 °**

# IOL FORMULAS

- 1970s
- Refraction based

- Myopia 15 D
- Emmetropia 21 D
- Hyperopia 25 D

- Large errors commonplace

# IOL FORMULAS

- 1970s
- Refraction based

- 1977
- Add 19.0 D to pre-cataract Rx

- Large errors commonplace

# IOL FORMULAS

- 1980s
- **2 variable formulas**

- SRK formula (1981)

(Sanders, Retzlaff, and Kraff)

# IOL FORMULAS

- 1980s
- **2 variable formulas**

P = A – (2.5 L) – (0.9 K)

P = IOL power (diopters)
A = A constant (specific to IOL)
L = axial **L**ength (mm)
K = average **K** reading (diopters)

# CURRENT IOL CALCULATIONS

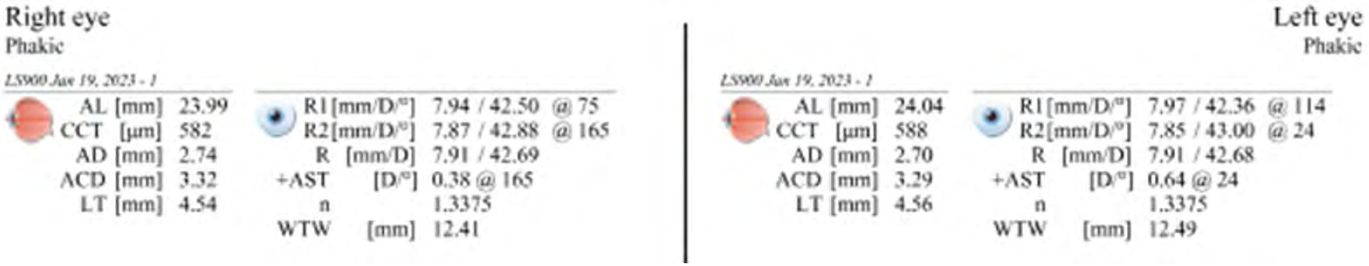
## THEORETICAL FORMULAS, OPTICAL BIOMETRY


IOLMaster 700


LENSTAR LS 900

# CURRENT IOL CALCULATIONS
## THEORETICAL FORMULAS, OPTICAL BIOMETRY

**Now … 5 variable formulas**



Right eye
Phakic

LS900 Jan 19, 2023 - 1

| | | |
|---|---|---|
| AL | [mm] | 23.99 |
| CCT | [µm] | 582 |
| AD | [mm] | 2.74 |
| ACD | [mm] | 3.32 |
| LT | [mm] | 4.54 |

| | | |
|---|---|---|
| R1 | [mm/D/°] | 7.94 / 42.50 @ 75 |
| R2 | [mm/D/°] | 7.87 / 42.88 @ 165 |
| R | [mm/D] | 7.91 / 42.69 |
| +AST | [D/°] | 0.38 @ 165 |
| n | | 1.3375 |
| WTW | [mm] | 12.41 |

Left eye
Phakic

LS900 Jan 19, 2023 - 1

| | | |
|---|---|---|
| AL | [mm] | 24.04 |
| CCT | [µm] | 588 |
| AD | [mm] | 2.70 |
| ACD | [mm] | 3.29 |
| LT | [mm] | 4.56 |

| | | |
|---|---|---|
| R1 | [mm/D/°] | 7.97 / 42.36 @ 114 |
| R2 | [mm/D/°] | 7.85 / 43.00 @ 24 |
| R | [mm/D] | 7.91 / 42.68 |
| +AST | [D/°] | 0.64 @ 24 |
| n | | 1.3375 |
| WTW | [mm] | 12.49 |

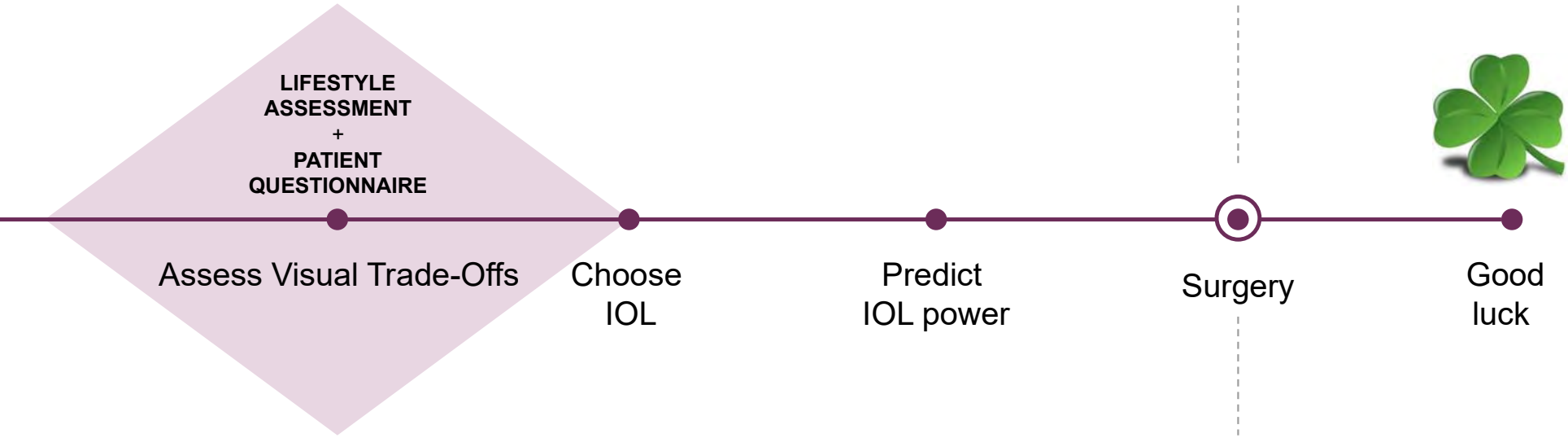
- Axial length, AC Depth, Lens Thickness, Ks, WTW

Patients +/- 0.5 diopters of intended target

- Old 2 variable formulas 70%
- Current 5 variable formulas **90%**

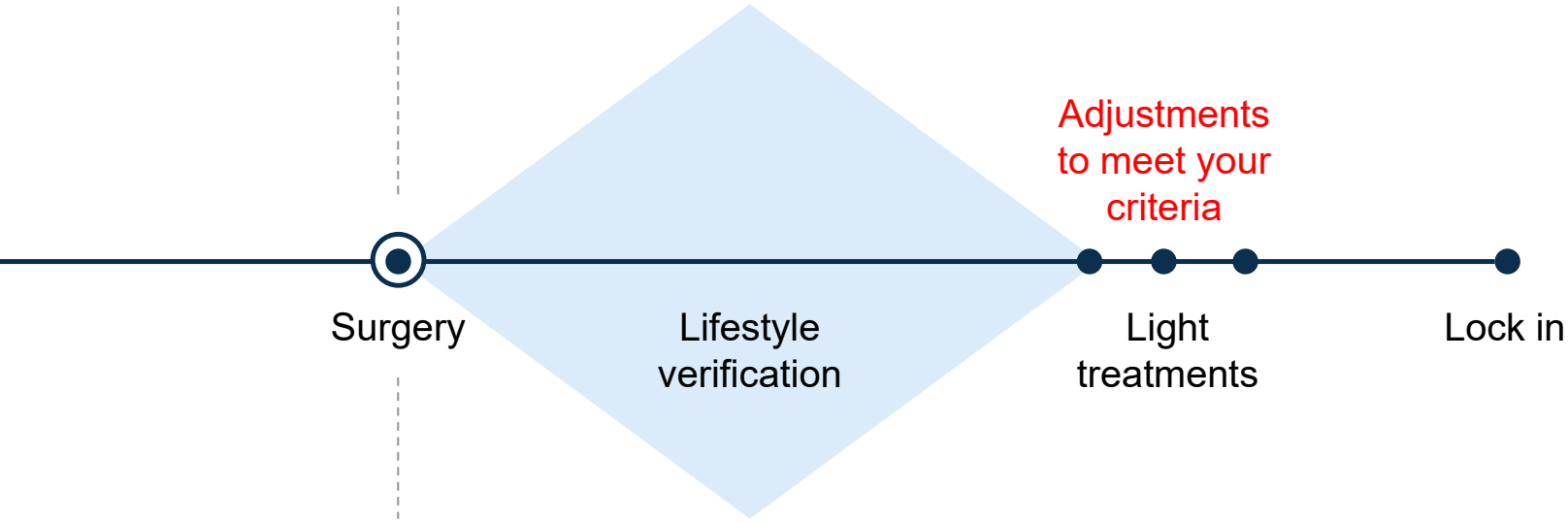
CURRENT PREMIUM CATARACT SURGERY

# High Stakes Decisions



A BETTER WAY TO DELIVER PREMIUM CATARACT SURGERY

# LASIK-Level Precision



DIGITAL CORRECTION OF VISION

# Light Treatment After LAL Implantation

**Adjustment Beam**

Light from LDD directed to LAL

(365 nm)

**Photopolymerization**

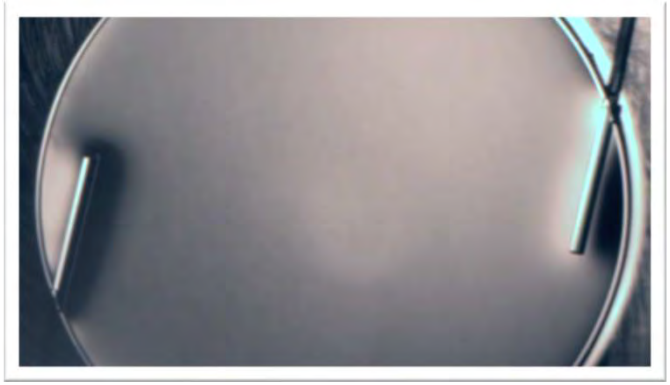
Macromers in light path are photopolymerized

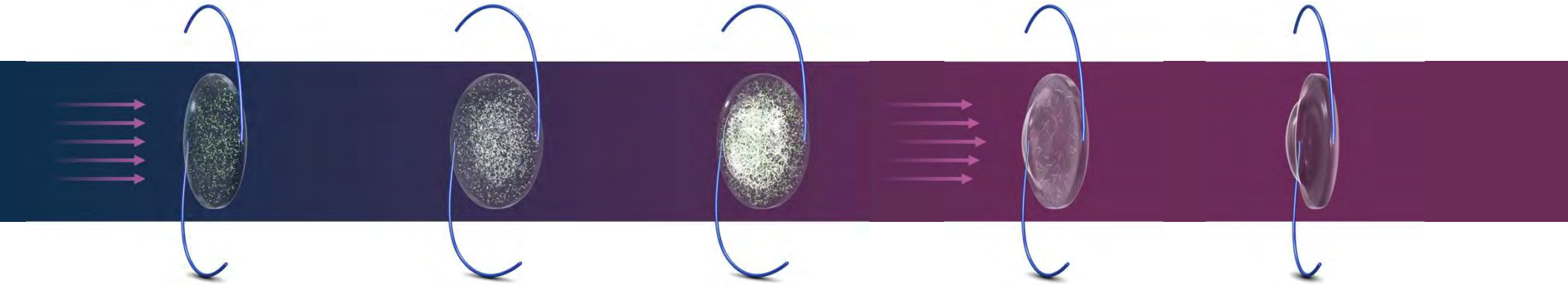
**Macromer**

Relatively high molecular weight molecule with one end which permits linking together

DIGITAL CORRECTION OF VISION

# Light Treatment After LAL Implantation





**Adjustment Beam**

Light from LDD directed to LAL

(365 nm)

**Photopolymerization**

Macromers in light path are photopolymerized

**Power Change**

Unpolymerized macromers move into exposed area
=
precise shape and power change

**Lock-In Beam**

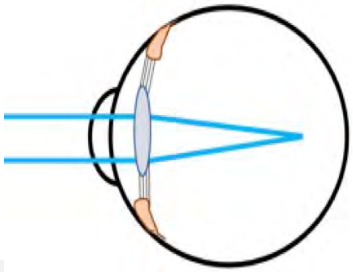
Entire lens exposed to light
=
polymerizing all remaining macromers

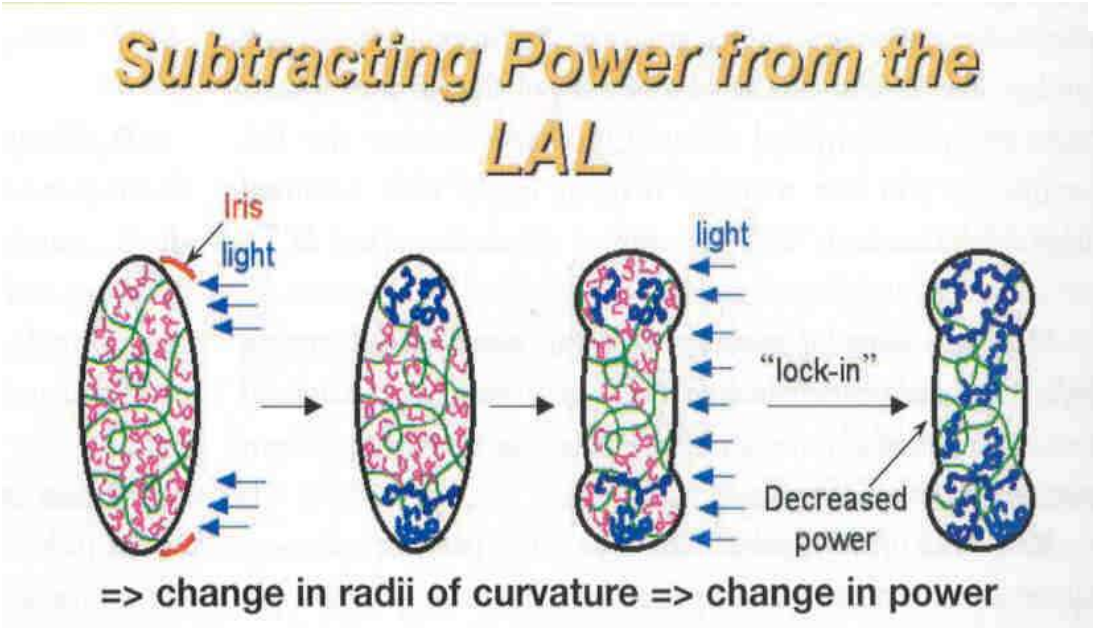
**Final Result**

Precise change in LAL power
=
match individual's desired prescription

# ADJUSTMENT (TOO MYOPIC)

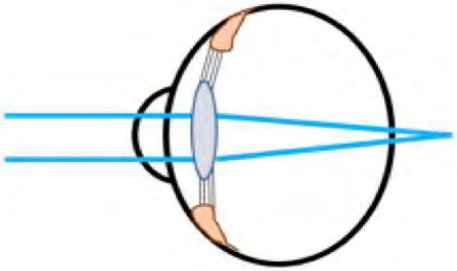
- IOL power is too high
- Light pattern delivered more intensely to the LAL's periphery
  = flattening of central IOL = decreased overall IOL power

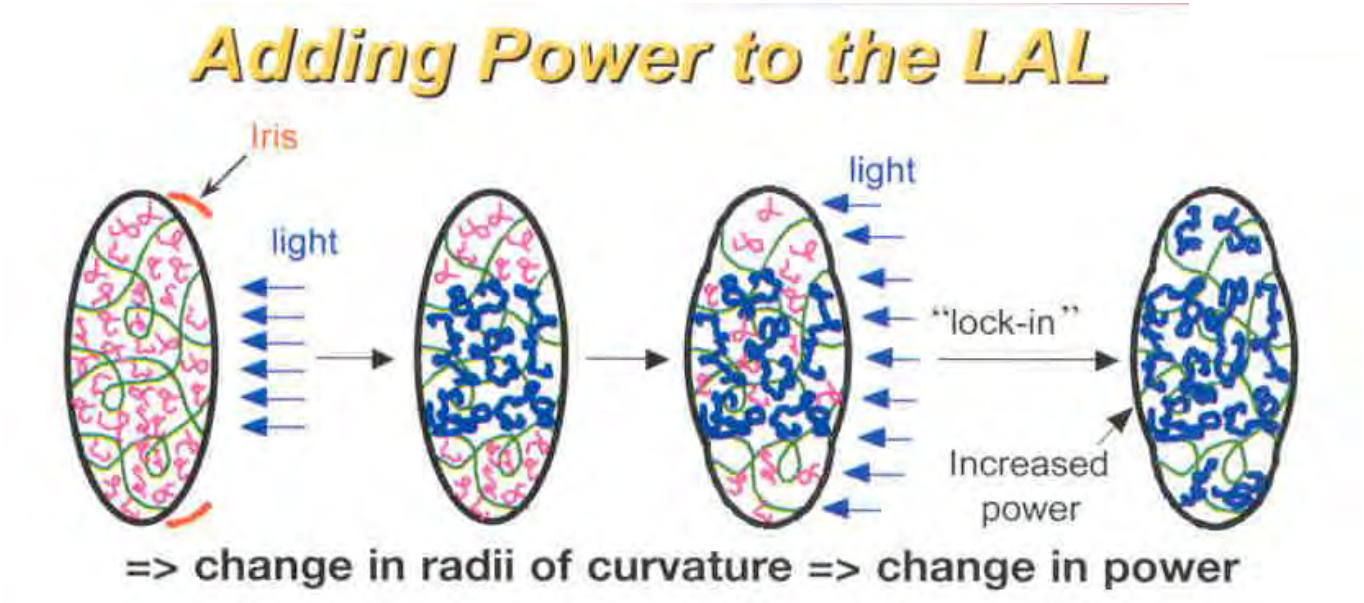




# ADJUSTMENT (TOO HYPEROPIC)

- IOL power is too low
- Light pattern delivered more intensely to the LAL's center
  = thickening of central IOL = increasing overall IOL power

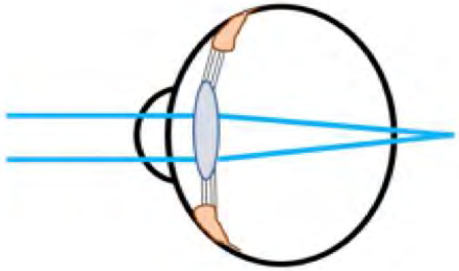


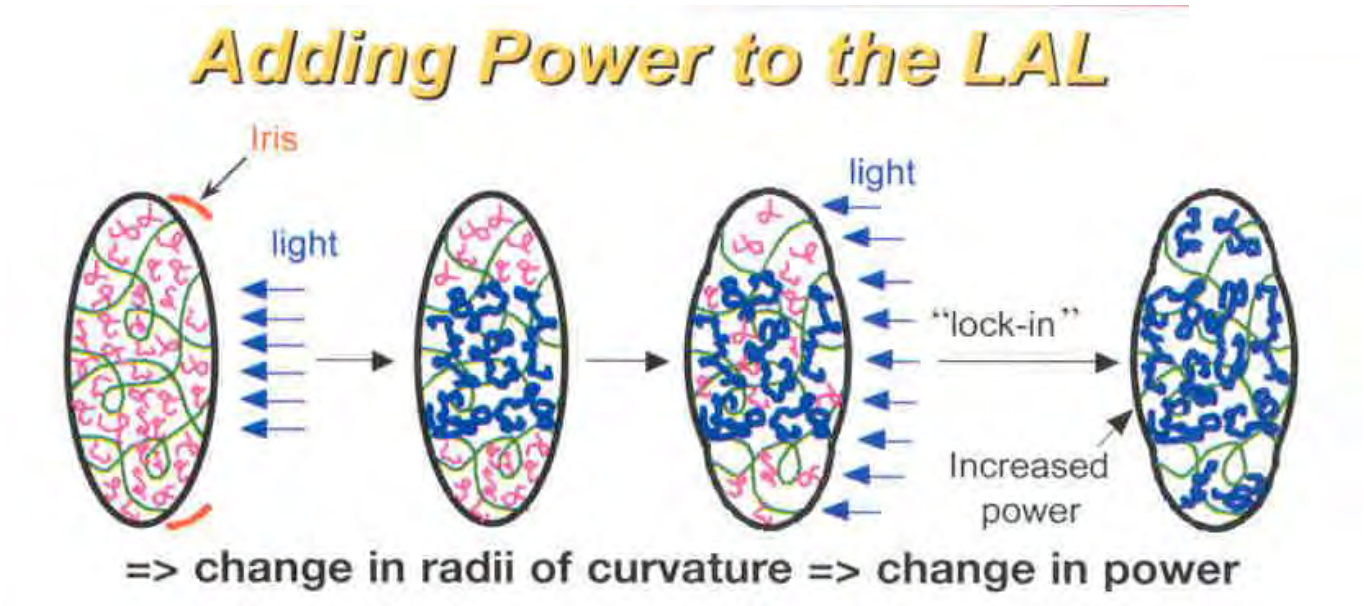


# ADJUSTMENT (TOO HYPEROPIC)

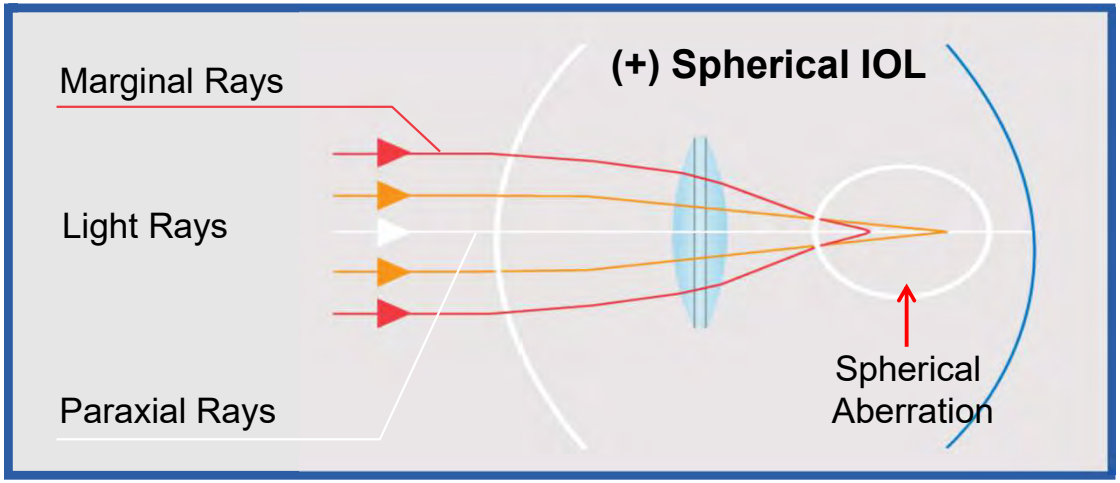
- IOL power is too low
- Light pattern delivered more intensely to the LAL's center

  = **INDUCES POSITIVE SPHERICAL ABERRATION**





# POSITIVE SPHERICAL ABERRATION

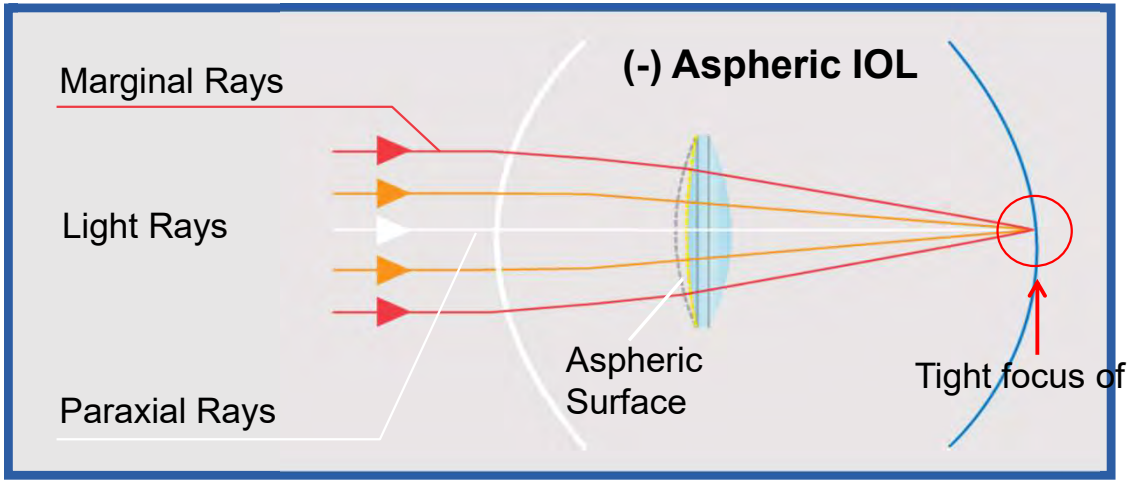



Light rays are over-refracted at periphery of a lens system

= increases depth of focus

*Smith, G., Atchinson D.A., (1997) The Eye and Visual Optical Instruments. Cambridge University Press, Cambridge, United Kingdom, pp. 667.

# NEGATIVE SPHERICAL ABERRATION




Flatter central aspheric optic (by comparison)

= tighter focus of light

= decreases depth of focus

*Smith, G., Atchinson D.A., (1997) The Eye and Visual Optical Instruments. Cambridge University Press, Cambridge, United Kingdom, pp. 667.

## LIGHT TREATMENTS

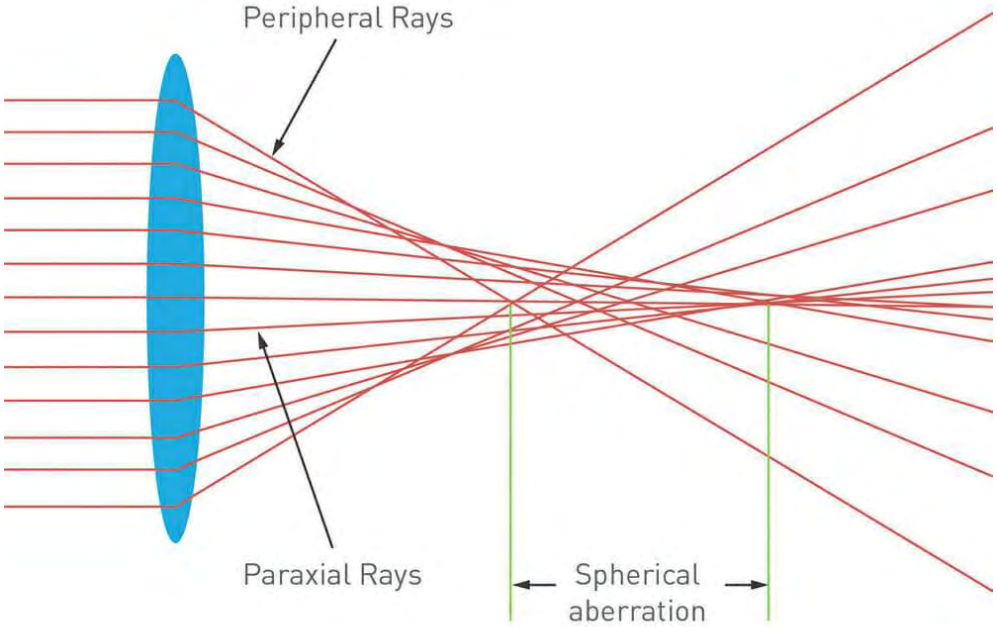
- Target slight hyperopia each eye (20/25)

  = myopic treatment is needed

  = steepens the center of the IOL

  increased depth of focus

  (positive spherical aberration)




- LAL -0.50 ~ monofocal -1.50

  ** without the loss of stereopsis **

LIGHT TREATMENTS

# Painless, non-invasive
# Take approximately 90 seconds

### Initial Light Treatment

At least 17 days after surgery

Single exposure consumes
up to 20% free monomers

Shape change occurs
over 12-15 hours

### Secondary Light Treatment

At least 3 days after initial treatment

### Additional Light Treatments

PRN

At least 3 days after
each prior light treatment

# First ever “patient trial” of final cataract outcome

## Optimized Refraction

After healing is complete and ocular media is clear

## Initial Light Treatment

MYOPIC treatment to plano (to increase depth of focus)

## Patients Select Their Final Rx

~ 80% of LAL patients select some myopia

Can demonstrate some myopia to every patient

# Every patient who dilates can be upgraded to LAL

- Patients who want the best quality of vision
- Toric patients become “Custom Toric”
- Patients who want vision at all distances
- Post-LASIK patients

# FROM 2004 ….

- Clinical trials began in Mexico 9/2002
- 3-month data to be submitted for US/European approval to begin clinical trials
- Anticipated LAL commercial availability
  - Europe 2004
  - United States 2007

# BUT ACTUALLY ….

- Clinical trials began in Mexico 9/2002
- 3-month data to be submitted for US/European approval to begin clinical trials
- Actual LAL release
  - Europe 2012
    - Stable LAL Rx after 7.2 years per European study JCRS Jan 2020,46(1)8-13
      ** NOT FOR ASTIGMATISM when launched **
  - United States 2019
    - Spherical adjustment range 4.0 D + 2.0 D to -2.0 D
    - Astigmatism adjustment range 3.0 D

ACTIVSHIELD
UV PROTECTION BUILT INTO THE LAL

# CUSTOM BLENDED VISION

# LASIK-LIKE REFRACTIVE PRECISION AND ACCURACY

**Adjustments**
**0.25 D increments of sphere and cylinder**

| More Patients with Excellent Results | Comparison IOL | LAL (121 eyes) |
|---|---|---|
| Within 0.50 diopter of sphere | **74%** | **93.4%** |
| Within 0.50 diopter of cylinder | **62 - 64%** | **90.6%** |
| Eyes UCVA 20/20 or better | **38 - 41%** | **80.2%** |


1. Lundstrom M. Changing Practice Patterns in EuropeJ Cataract Refract Surg 2021; 47:373–378
2. Tecnis® Toric PMA P980040/S039: FDA Summary of Safety and Effectiveness Data. 2013.
3. AcrySof® Toric P930014/S15: FDA Summary of Safety and Effectiveness Data. 2011
4. RxSight PMCS-002 Clinical Outcomes of Patients Bilaterally Implanted with LAL.

# LASIK-LIKE REFRACTIVE PRECISION AND ACCURACY

## Toric Correction

**Patient Satisfaction is Highly Correlated with Residual Astigmatism**

**Dissatisfaction rate twice as high in subjects with 1.0 D residual astigmatism**

| | Toric IOL (17,386 eyes) | LAL (All Study Eyes) | |
|---|---|---|---|
| Mean post-op MR cylinder | 0.43 D | 0.20 D | > 2x Reduction |
| % within 0.50 D cylinder | 73.0% | 90.6% | |
| % more than 1.00 D cylinder | 5.2% | 1.3% | 4x Reduction |

**2x Reduction in Mean Residual Cylinder**
**1/4 of Eyes with > 1.0 D of Residual Cylinder**

*Subjects in "Conventional Astigmatism Management" group received monofocal IOLs, surgical incisions or toric IOLs appropriate to their pre-operative astigmatism


1. https://crstoday.com/articles/2020-jan/the-importance-of-astigmatism-in-premium-iols
2. RxSight PMCS-002 Clinical Outcomes of Patients Bilaterally Implanted with LAL

# LASIK-LIKE REFRACTIVE PRECISION AND ACCURACY

| Fewer Patients with Poorer Results | Comparison IOL | LAL |
|---|---|---|
| More than 1.0 D of sphere | 6% | 0.8% |
| More than 1.0 D of cylinder | 10-11% | 1.3% |
| Eyes 20/40 or worse | 11-17% | 0.8% |

10X

**LAL Patients 10x Less Likely to See 20/40 or Worse**


1. RxSight PMCS-002 Clinical Outcomes of Patients Bilaterally Implanted with LAL.
2. Lundstrom M. Changing Practice Patterns in EuropeJ Cataract Refract Surg 2021; 47:373–378
3. Tecnis® Toric PMA P980040/S039: FDA Summary of Safety and Effectiveness Data. 2013.
4. AcrySof® Toric P930014/S15: FDA Summary of Safety and Effectiveness Data. 2011.

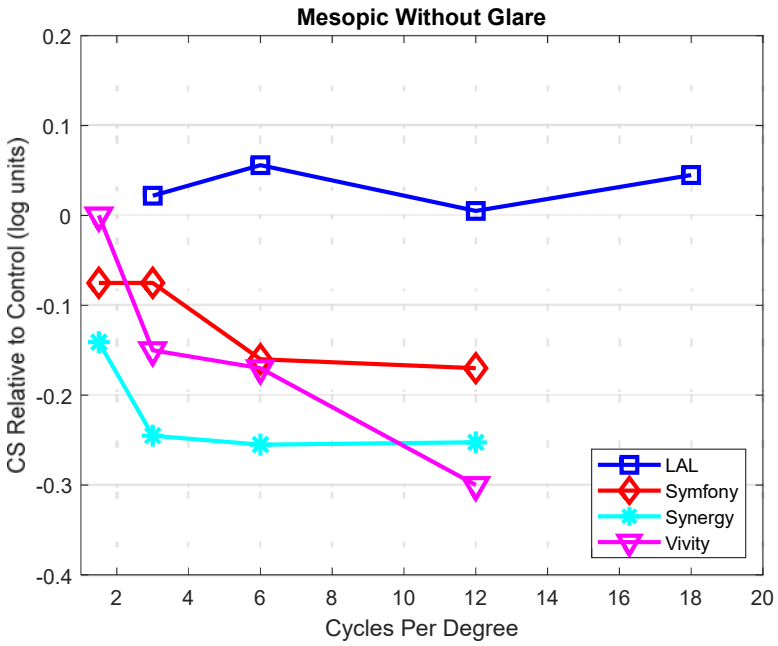
# CONTRAST SENSITIVITY

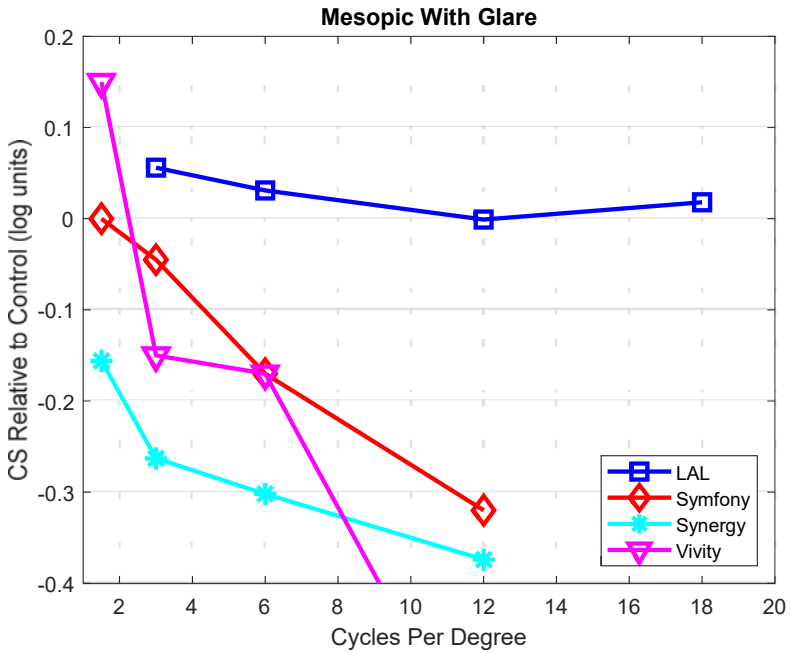
## LAL

Slightly superior contrast sensitivity compared to control at all frequencies and test conditions

## Vivity, Symfony, Synergy

Dramatic drop in contrast sensitivity compared to control and to LAL



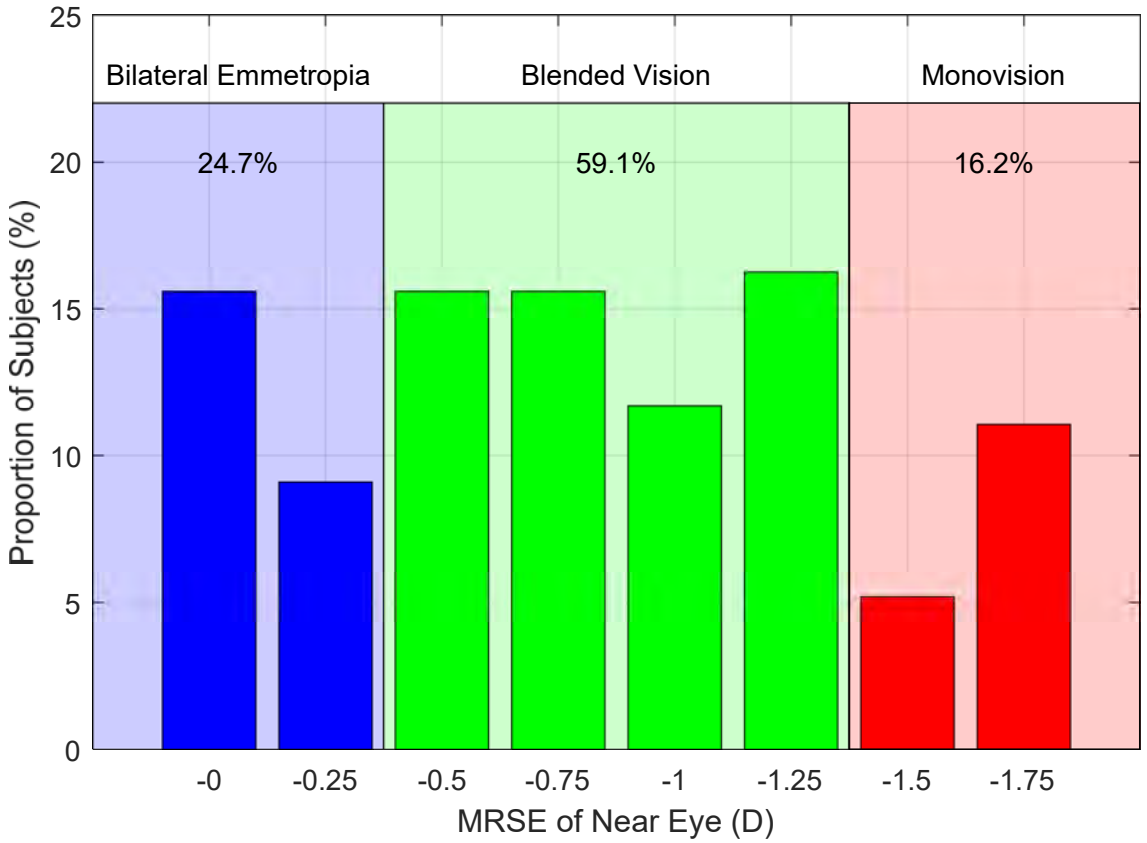




1. RxSight P160055: FDA Summary of Safety and Effectiveness Data
2. Symfony (P980040/S065)
3. Vivity (P930014/S126)
4. Synergy (P980040/S124)

CPD = how many lines able to distinguish in a degree of visual field

# OPTIMIZED VISION AT ALL DISTANCES

## 75% of Patients are Selecting Blended or Monovision




1. RxSight PMCS-002 Clinical Outcomes of Patients Bilaterally Implanted with LAL

# OPTIMIZED VISION AT ALL DISTANCES

- Single surgeon, multi-center study
- 86 patients (172 eyes)
- Emmetropia targeted in both eyes during cataract surgery
- After wound healing, distance eye fine-tuned for plano, and near eye for myopia in order to optimize blended vision

| RESULTS | LAL Series[1] |
|---|---|
| Number of Subjects | **86** |
| Difference between eyes | **Custom (1.3 D Mean)** |
| Percent 20/20 at distance & J1 near (binocular vision) | **80%** |

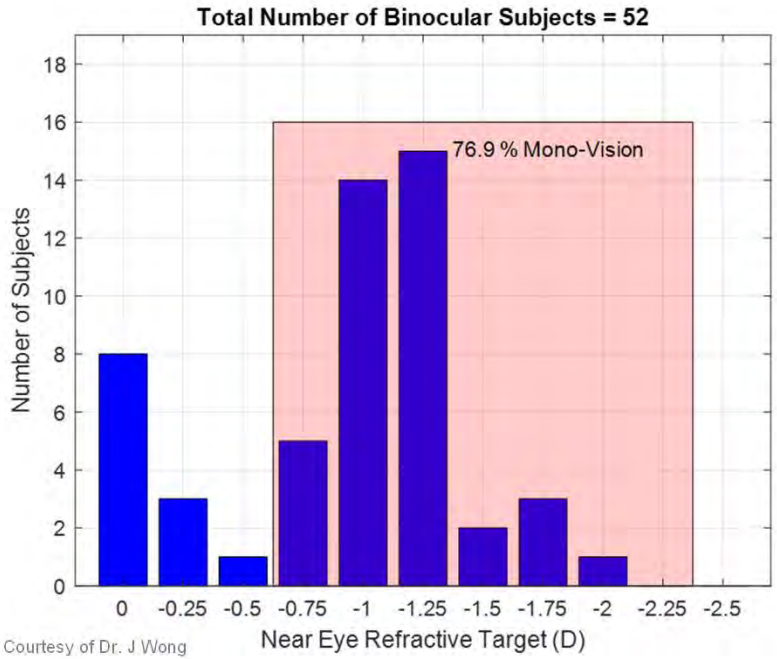
1. Newsom, H. Data Submitted for Presentation at AAO
2. Panoptix PMA P040020/S087. FDA Summary of Safety and Effectiveness Data. 2019 (https://www.accessdata.fda.gov/cdrh_docs/pdf4/P040020S087B.pdf)

# SINGLE SITE BINOCULAR OUTCOMES

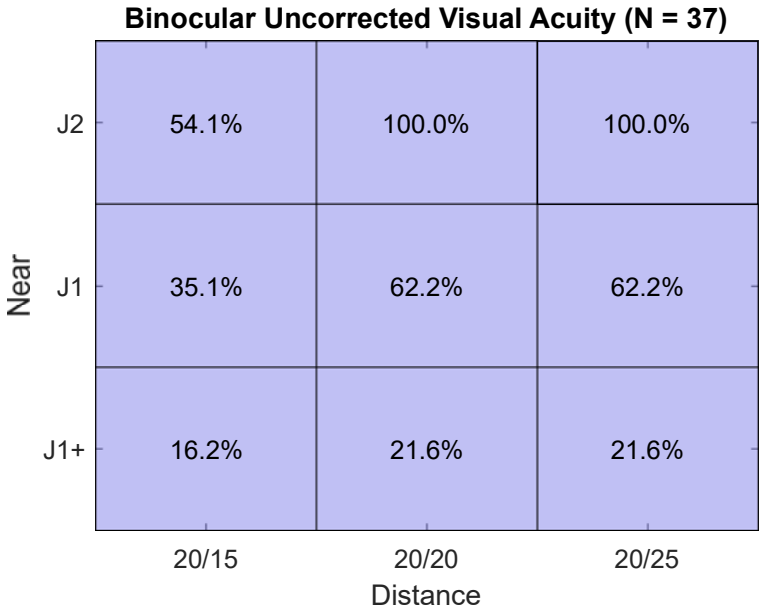
**At Summit Eye Care, over 10 surgeons refer patients to a central location for post-operative adjustment**

**Over 75% of subjects select some form of blended/monovision**

**100% see 20/20 at distance and J2 at near unaided**




1. Data on Courtesy of Dr. J Wong



SUMMARY

## LASIK-like Refractive Precision & Accuracy

- 1.5% have UCDVA worse than 20/30 with both eyes open
- 93.4% within 0.5 D MRSE, 90.6% within 0.5 D Cylinder

## Quality of Vision

- Minimized residual refractive error
- Monofocal = no increased glare or halo, no loss of contrast

## Optimized Vision at all Distances

- Patients select preferred trade-off between distance, intermediate, and near visual acuity
- 80% are 20/20 (distance) and J1 (near) … and 100% are 20/20 J2 (recent 52 patient study)


1. RxSight PMCS-002 Clinical Outcomes of Patients Bilaterally Implanted with LAL
2. RxSight P160055: FDA Summary of Safety and Effectiveness Data.
3. Newsom, H. Data Submitted for Presentation at AAO

# INTEGRATING THE LAL TECHNOLOGY

## LAL SIMPLIFIES PREMIUM OFFERING

**Prior to LAL**

- Lifestyle, psychology considerations
- Premium fees = high expectations
- Confusion over terminology

**LAL completely changes the game**

- No guessing who will be bothered most by glare/halos
- Simply implant lens and patient trials ideal lens ‘type’ postop without cataract

## LAL SIMPLIFIES PREMIUM OFFERING

**With LAL**

- Prior “10 Units” of IOL discussion
- Now “1-2 Units” of LAL discussion
- Already 5% of the IOL market

**LAL completely changes the game**

- No guessing who will be bothered most by glare/halos
- Simply implant lens and patient trials ideal lens ‘type’ postop without cataract

# SUMMARY

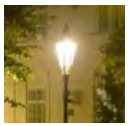
| LENS OPTIONS |  |  |  |
|---|---|---|---|
| Design | STANDARD LENS | TORIC LENS | LIFESTYLE LENS (Symfony) |
| DISTANCE improvement | +++ | +++ | +++ |
| "HIGH DEFINITION" | | +++ | +++ |
| COMPUTER without glasses | | | +++ |
| NEAR without glasses | | | ++ |
| GLARE improvement | ++ | +++ | ++ |
| ASTIGMATISM improvement | | +++ | +++ |
| Benefits | Bifocals typically required afterward | Corrects astigmatism<br>Readers are typically required<br>Bifocals are possible | Greater range of vision<br>Low power readers possible for fine print<br>Subtle glare at night (pilots, truck drivers) |

# PREDICTION

## Choose Optics of IOL *Before* Surgery

Increasing Range Of Vision
Decreases Quality Of Vision

Distance



High Quality

Distance/Intermediate

Medium Quality

Distance/Intermediate/Near

Lower Quality

## Predict Powers of IOL *Before* Surgery

Sphere



Astigmatism

Anisometropia

## Manage Dissatisfaction *After* Surgery

Residual Refractive Error

Reduced Contrast Vision

Secondary Surgical Procedure

# SUMMARY

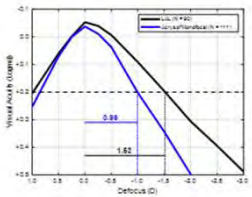
| LENS OPTIONS |  |  |  |
|---|---|---|---|
| Design | STANDARD LENS | TORIC LENS | LIGHT ADJUSTABLE LENS |
| DISTANCE improvement | +++ | +++ | +++ |
| "HIGH DEFINITION" | | +++ | +++ |
| COMPUTER without glasses | | | +++ |
| NEAR without glasses | | | ++ / +++ |
| GLARE improvement | ++ | +++ | +++ |
| ASTIGMATISM improvement | | +++ | +++ |
| Benefits | Bifocals typically required afterward | Corrects astigmatism<br>Readers are typically required<br>Bifocals are possible | Adjusted to your desired prescription after surgery<br>May have some degree of myopia in one eye |

# ADJUSTABILITY

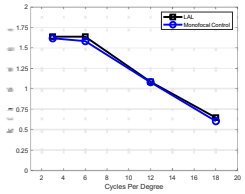
## Choose Monofocal Optic & Power IOL *Before* Surgery

Light Adjustable Lens

Broadened & Elevated Defocus Curve



No Reduction in Contrast



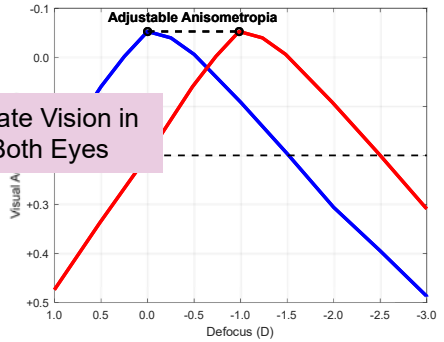

## Optimize Vision with Light Treatments *After* Surgery

Standard Postoperative Refraction

Light Treatment to Modify LAL

## Patient Verifies Satisfaction *After* Light Treatments

Titrate Vision in Both Eyes

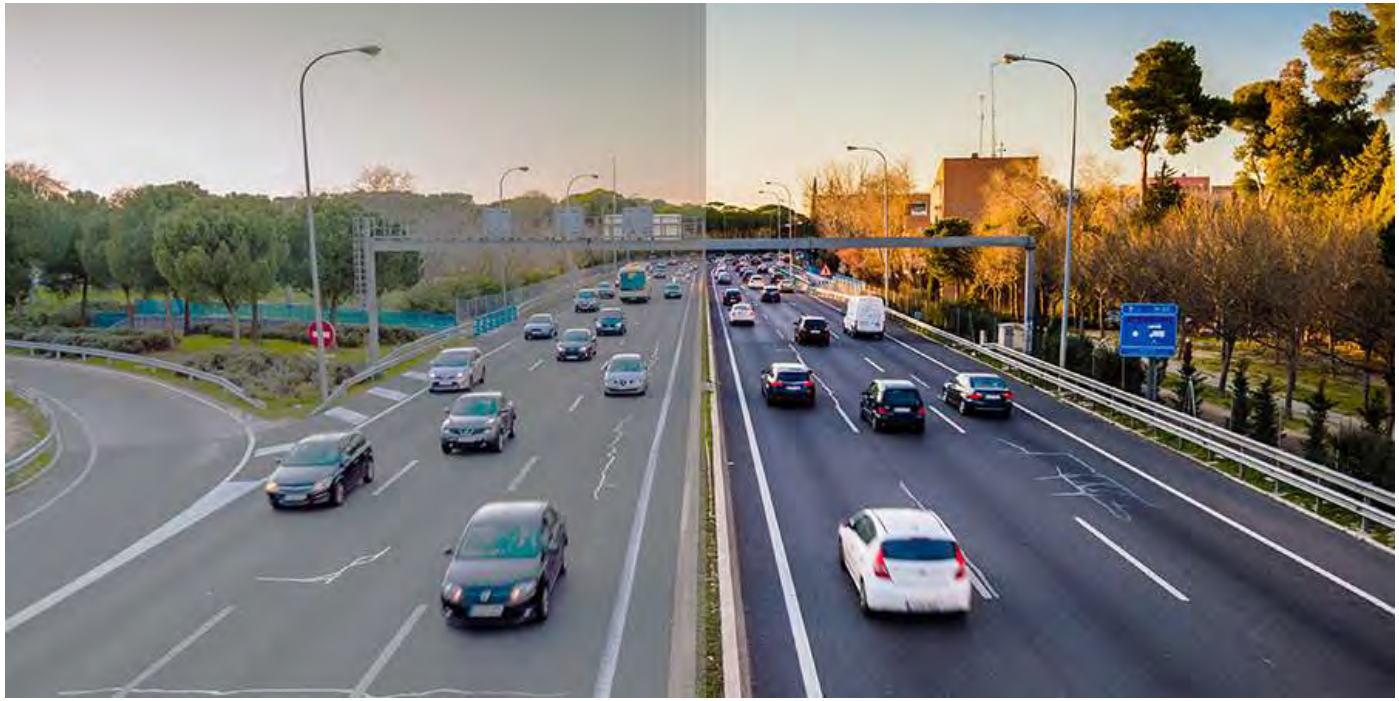




1. RxSight Data on File.
2. Chayet, A. Single Center Study (Data on File).
3. RxSight P160055: FDA Summary of Safety and Effectiveness Data.
4. Newsome, AAO 2021 presentation on file.

# ADJUSTABILITY

**Thank you !!!**



Patient Verifies Satisfaction *After* Light Treatments

Titrate Vision in Both Eyes