Updates in IOL Technology

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Financial Disclosure

- I have the following financial interests or relationships to disclose:
  - Alcon
  - Zeiss
  - Bausch + Lomb
  - Johnson & Johnson
  - Allergan
  - Visus
  - Vista
  - Ocular Therapeutix
  - Tarsus
  - Dompe
  - Kala
  - BVI
  - Trefoil
  - CorneaGen
  - Ocuphire

Introduction

- Increasing expectations

- Cataract surgery now a refractive procedure

- Accuracy, repeatability, and consistency

Expectations

I choose ONE of the following vision correction options for this eye: (RIGHT) LEFT

1. Basic cataract surgery with a single-vision lens for best:
   - Distance vision (e.g., driving, watching TV)
   - Intermediate vision (e.g., computer, dashboard)
   - Near vision (e.g., reading a book)

I realize that I may need to wear glasses or contact lenses even after surgery to get best vision at my preferred choice (listed above) and will certainly require glasses (or contact lenses) to see at the other two distances.

2. *Astigmatism correction with either incisions in the cornea or a special lens implant ("toric" lens) and additional procedures (as indicated) to aim for best vision without glasses for:
   - Distance vision (e.g., driving, watching TV)
   - Intermediate vision (e.g., computer, dashboard)
   - Near vision (e.g., reading a book)

My goal is to have good vision without glasses at my preferred choice (listed above). I understand that I may still require glasses or contact lenses to get my absolute best vision at my preferred distance. In addition, I understand that I will still require glasses or contact lenses to see at other distances.

Avoid Refractive Errors

- Accurate keratometry & biometry

- Optimize IOL calculations

- Rule out ocular pathology
  - Cornea
  - Retina

- Set appropriate expectations & educate
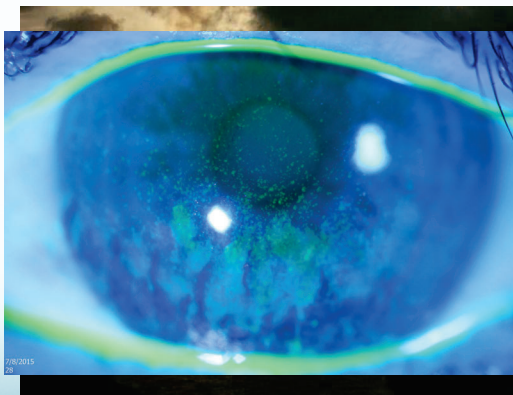
Causes and correction of dissatisfaction after implantation of presbyopia-correcting intraocular lenses

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Tayyeba K Ali
Daniel P Waren
Kendall E Donaldson

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Purpose: The purpose of this study was to assess the causes and possible solutions for patient dissatisfaction after the implantation of presbyopia-correcting intraocular lenses (IOLs).
Methods: This study was a retrospective review of clinical records. All patients who were seen between January 2009 and December 2013 whose primary reason for consultation was dissatisfaction with visual performance after presbyopia-correcting IOL implantation were included in the study. A single treating physician, who determined the most probable cause of dissatisfaction, decided which interventions to pursue following the initial consultation.
Results: Data from 74 eyes of 49 patients were analyzed. The most common cause for complaint was blurry or foggy vision both for distance and near (68%). Complaints were most frequently attributed to residual refractive error (57%) and dry eye (35%). The most common interventions pursued were treatment of refractive error with glasses or contact lenses (46%) and treatment for dry eye (24%). Corneal laser vision correction was done in 8% of eyes; 7% required an IOL exchange. After the interventions, 45% of patients had completed resolution of symptoms, 23% of patients were partially satisfied with the results, and 32% remained completely dissatisfied with the final results.
Conclusion: The most identifiable causes of dissatisfaction after presbyopia-correcting IOL implantation are residual refractive error and dry eye. Most patients can be managed with conservative treatment, though a significant number of patients remained unsatisfied despite multiple measures.
Keywords: intraocular lens, cataract, presbyopia, multifocal intraocular lens
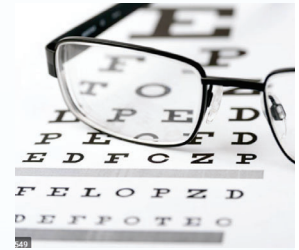
Testing

- Refraction
- Topography
- Biometry
- OCT macula

Measurements of cornea before manipulation or drops applied

Testing: Refraction

- Make sure vision commiserate with cataract
- Outcomes of first eye
- Evaluate axis of astigmatism
- Ensure IOL power makes sense
- Posterior corneal astigmatism

Hyperopia (Farsight, Wilmington, Delawa

Testing: Topography

Importance of Topography

- To rule out corneal pathology
  - Ocular surface disease
  - Salzmann's
  - EBMD
  - Fuchs
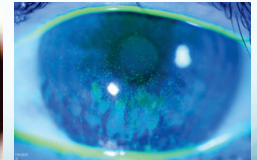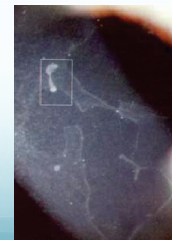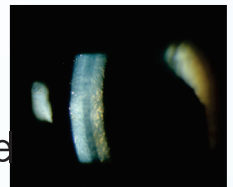
Why Does it Matter?

- 77% had corneal staining; 63% had decreased TBUT
- Many of these patients were asymptomatic
- Can impact topography and biometry
- Can negatively affect surgical outcomes
  - Decrease goblet cell density, TBUT, & corneal sensitivity

Trattler WB, et al. Clinical Study Report: Cataract and Dry Eye: prospective health assessment of cataract patients ocular surface study. 2010.
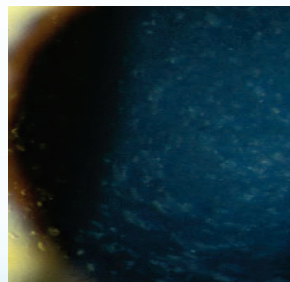
Screen for Retinal Abnormalities

- ERM
- Macular degeneration
- Drusen
- Results in decreased contrast sensitivity—compounded with multifocals
- Can initially evaluate with IOL Master 700
- Importance of OCT macula for premium expectations

Lens Technology

- Multifocal IOLs
  - Alcon Clareon Panoptix
  - J&J Odyssey

- Light Adjustable Lens for Post-Refractive

- Aphthera Pinhole Optic for Irregular Corneas

Take Home Points- PanOptix

- Newer generation diffractive optic multifocal IOL (quadfocal)
- Likely the most versatile range of focus of diffractive optic IOL's
- Not all patients are candidates, requires a clean visual axis
- Quality of distance vision may be decreased compared with monofocal
- Newer Clareon material may improve quality of distance vision

WHITSETT VISION GROUP

Patient Case

- **65 y/o male**

- **CC:** Decreased distance vision in the recent year with more difficulty seeing street signs and watching TV, which has been gradually progressing over the past 3-4 years. He sees ghosting of images and is bothered by glare from lights.

- **MRx: OD:** - 3.75 + 1.25 x 176   **OS:** - 4.50 + 0.75 x 130

- **Ocular/Medical/Surgical History:**
  - Myopia OU
- **Patient's desired visual outcomes:**
  - Prefers no glasses after surgery; has never worn glasses for reading.
  - Want to able to drive comfortably at night and will tolerate slight imperfections (halos, or rings around lights)

Exam Data

	OD	OS
WEARING:	- 3.75 + 1.25 x 176 **ccVA**: 20/70	- 4.50 + 0.75 x 130 **ccVA**: 20/30
MRX:	- 3.75 + 1.25 x 170 **ccVA**: 20/40+2	- 2.50 + 0.75 x 005 **ccVA**: 20/30 NI
PUPILS:	PERRLA, **Bright:** 3.5 mm, **Dim:** 4.0 mm	PERRLA, **Bright:** 3.5 mm, **Dim:** 4.0 mm
IOP:	13	13
SLE: L/C/S: Cornea: A/C: Iris: Lens:	conjunctivochalasis, meibomian gland dysfunction clear and compact cornea normal depth and quiet iris flat 2+ milky NS	conjunctivochalasis, meibomian gland dysfunction clear and compact cornea normal depth and quiet iris flat 2+ milky NS
DFE: Optic Nerve: Vitreous: Retina:	no disc edema or pallor, C/D 0.3 posterior vitreous detachment normal macula and retina, no holes or tears	no disc edema or pallor, C/D 0.3 posterior vitreous detachment normal macula and retina, no holes or tears

iTrace

iTrace

IOL Master 700

Pentacam

Pentacam

OCT Macula

Diagnosis/ Treatment Plan

- Treatment:

	OD	**OS**
	DRN00V +21.0 D	DRN00V +21.0 D
	One 40 degree LRI @ 349 meridian	One 35 degree LRI @ 210

Case Outcome

1 MTH PO	OD			OS		
UCVA:	DVA: 20/20	IVA: 20/25 @ 32"	NVA: J1 @ 14"	DVA: 20/25-2	IVA: 20/20 @ 32"	NVA: J1 @ 14"
UCVA OU:	DVA: 20/20-2		IVA: 20/20 @ 32"		NVA: J1+ @ 14"	
MRX:	Plano sph	**VA:** 20/20		- 0.25 + 0.50 x 012		**VA:** 20/20+1
IOP:	13			11		
IOL USED:	DRN00V +21.D, LRI @ 349			DRN00V +21.D, LRI @ 210		
SLE:	WNL			WNL		
DFE:	WNL			WNL		

Patient states vision is doing well and he can see without needing glasses for any distance. Halos and glare has decreased with little glare issues since surgery. Colors are very vibrant now!

Technologies and what they can deliver

TECNIS Odyssey™ all-new smooth diffractive design

TECNIS Synergy™ | **TECNIS Odyssey™**

Distance visual acuity

Binocular UCDVA[1]
- Mean visual acuity 20/20
- 81.2% **20/20 or better**
- 92.8% **20/25 or better**

Binocular BCDVA[1]
- Mean visual acuity 20/20
- 92.5% **20/20 or better**

TECNIS Odyssey™ Binocular Distance VA (1-month)

Retrospective analysis of reported outcomes: Binocular UCDVA n=69; Binocular BCDVA n=53

Slide: Near visual acuity

Near visual acuity

Binocular UCNVA[1]
- Mean visual acuity J1
- 77.1% J1 or better
- 92.9% J2 or better
- 97.1% J3 or better

Binocular DCNVA[1]
- Mean visual acuity J1
- 86.0% J1 or better
- 97.7% J2 or better
- 100% J3 or better

TECNIS Odyssey™ Binocular Near VA (1 month)

Retrospective analysis of reported outcomes: Binocular UCDVA n=69; Binocular BCDVA n=53

Legend: 20/25 or Better · 20/32 or Better · 20/40 or Better
UCNVA 40 cm Binocular (n=70) · DCNVA 40cm Binocular (n=43)

Slide: Spectacle independence

Spectacle independence

Spectacle Wear at 1 Month

96.4%
Patients did not need prescription glasses at 1 month*[1]

Over 96% of TECNIS Odyssey™ IOL patients did not require spectacles at any distance.[1]

*Q: "Was the patient prescribed glasses at the conclusion of the 1-month visit?" Three subjects 3/83 (1 subject for distance, 1 subject for near, and 1 subject for both distance and near)

Johnson&Johnson

1. Data on File (2023) DOF2023CT4051

Slide: Dysphotopsias

Dysphotopsias

TECNIS Odyssey™ IOL Dysphotopsias At 1M[1]

Legend: Mild · Moderate · Severe
Halo · Night Glare · Starburst
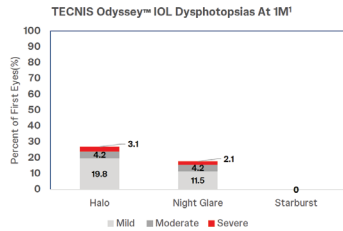
Retrospective analysis of reported outcomes, n=96; Three subjects reported severe halo (n=3/96) in both eyes. Two subjects reported severe night glare (n=2/96) in both eyes. For subjects who reported a symptom but did not specify a severity in the chart (8.3%), data were classified as mild in the graph above.

3.1% Severe halo

2.1% Severe night glare

0% Severe starburst

Majority of symptoms were mild, if present

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Slide: Patient Case

Patient Case

- 58 y/o male S/P myopic LASIK OU with cataracts
- Pre Op:
  - OD: Dsc: 20/30 Nsc: J10
  - OS: Dsc: 20/30 Nsc: J6
    - MRX OD: -0.50 + 1.00 X 170
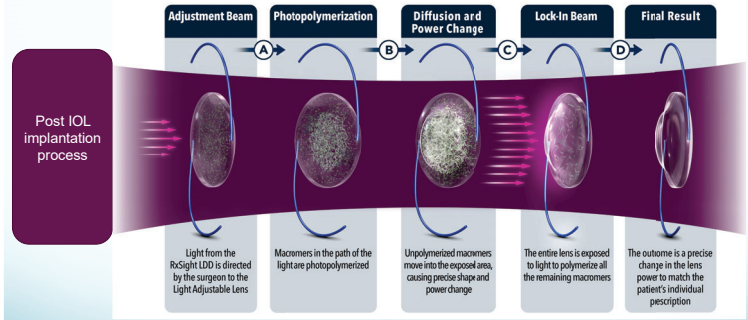   - MRX OS: -0.75 + 0.25 X 180

Slide: Topography OD/OS
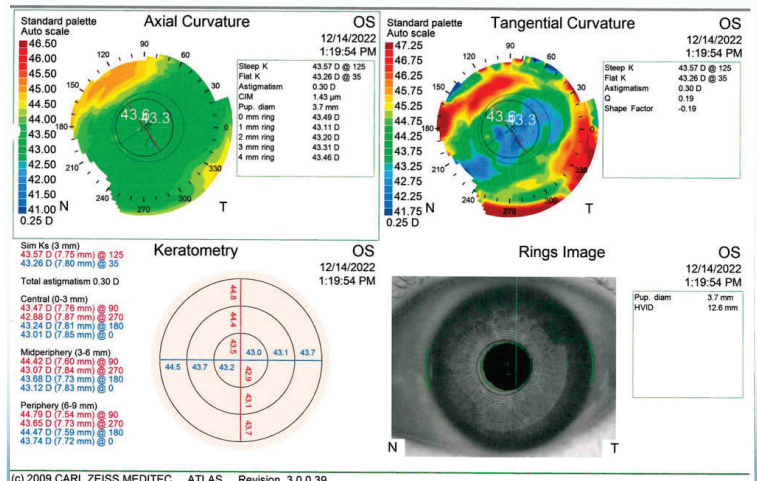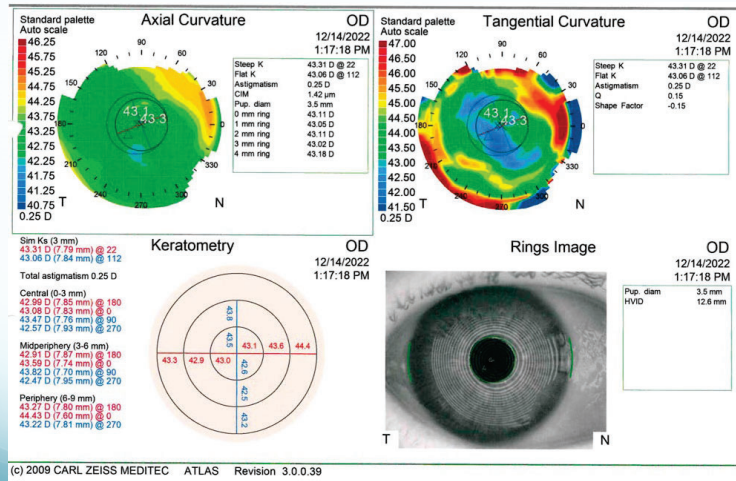
THE LIGHT ADJUSTABLE LENS (LAL)

HAPTICS

- Photo-reactive UV absorbing silicone
- Biconvex
- Anterior surface – rounded edge
- Posterior surface – squared edge
- 6-mm diameter
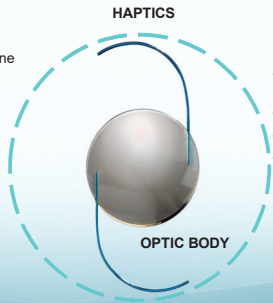
- Blue core polymethylmethacrylate (PMMA) monofilament
- Modified 'C'
- Haptic angle – 10°
- 13mm – LAL total diameter

OPTIC BODY

LAL METHOD OF ACTION

Post IOL implantation process

| Adjustment Beam | Photopolymerization | Diffusion and Power Change | Lock-In Beam | Final Result |

A — B — C — D

Light from the RxSight LDD is directed by the surgeon to the Light Adjustable Lens

Macromers in the path of the light are photopolymerized

Unpolymerized macromers move into the exposel area, causing precise shape and power change

The entire lens is exposed to light to polymerize all the remaining macromers

The outcome is a precise change in the lens power to match the patient's individual prescription

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As the LAL is postoperatively adjusted to deliver customized vision, there are two major differences in the period after cataract surgery

1 Required wear of ultraviolet (UV) protective glasses

2 Completion of light treatments

- 3 treatments
- 2 lock-ins

The RxSight Light Adjustable Lens (LAL) is the world's first adjustable intraocular lens (IOL) that allows office-based optimization of vision after lens implantation and healing

- The LAL delivers excellent outcomes for cataract patients
- Overcomes limitations of both pre-operative and intra-operative prediction processes
- Drives blended vision process without glare and halos
- Niche- post-refractive

Corrects in 0.25D increments of sphere and cylinder

Corrects down to 0.5 diopters of astigmatism

More Patients with Excellent Results	Comparison IOL	Commercial Data LAL[4] (n=121) *Distance Eyes
Percent eyes within 0.50 diopter of sphere	74%[1]	93.4%
Percent eyes within 0.50 diopter of cylinder	62-64%[2,3]	90.6%
Percent of eyes 20/20 or better	38-41%[2,3]	80.2%

2x

➡ **LAL Patients 2x More Likely to See 20/20**

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.

SUMMARY

Refractive Outcomes

- 93.4% within 0.5 D MRSE
- 90.6% within 0.5 D Cylinder
- 2x More LAL Patients See 20/20 UCVA
- 10x Reduced Poor Outcomes (20/40 or worse)

Dysphotopsia profile

- Due to minimized residual refractive error
- No increased glare or halo, no loss of contrast

Intermediate/Reading

- Patients select preferred trade-off between distance, intermediate, and near visual acuity
- Symmetrically broadened defocus curve compared to traditional monofocal IOLs
- 80% 20/20 (distance) and J1 (near) possible
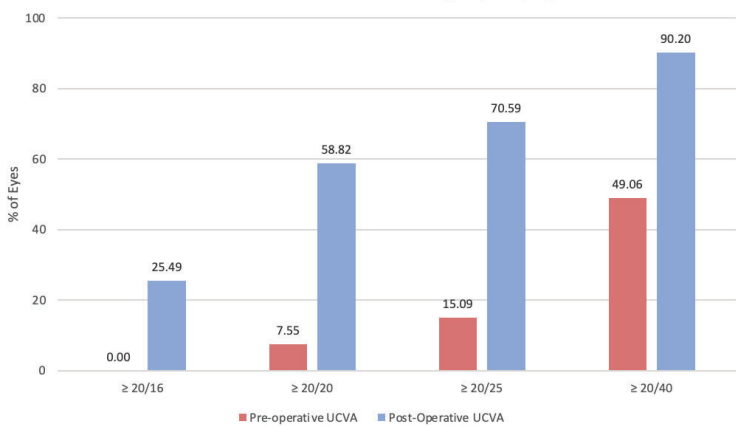
Patient Case Outcome

- LAL both eyes implanted
- Post Op: Very happy patient
- OD: Dsc: 20/20 Int: 20/30 Nsc: J5
- OS: Dsc: 20/30 Int: 20/20 Nsc: J2
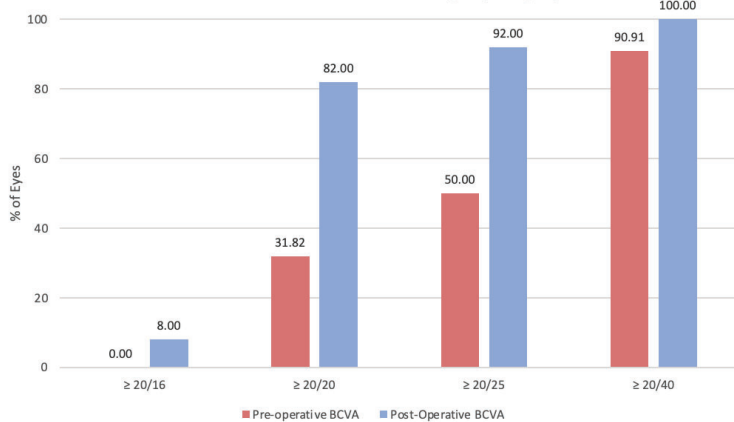
LAL Outcomes in Post - Refractive Eyes

Number of Eyes

- Total: 154
- S/P RK: 56
- Myopic LASIK/PRK: 66 eyes
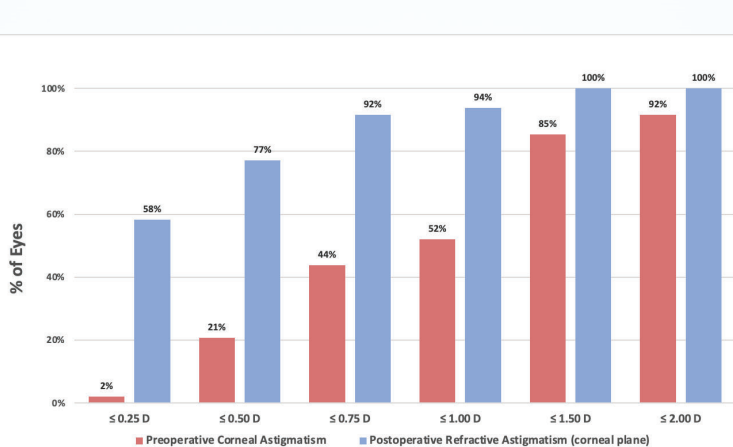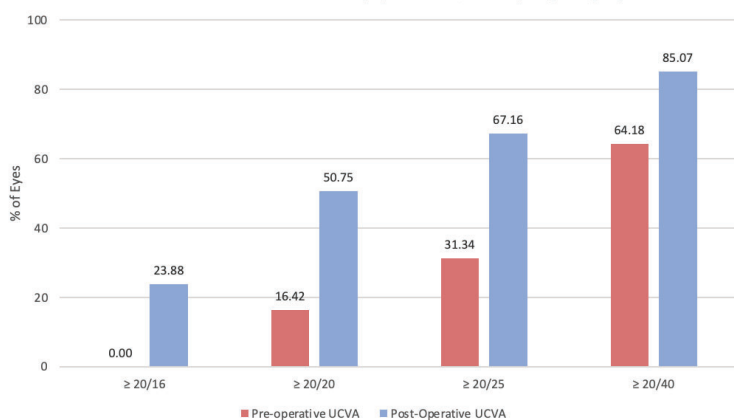- Hyperopic LASIK/PRK: 32 eyes

UCVA with LAL IOL in Post RK Eyes (56 eyes)

	≥ 20/16	≥ 20/20	≥ 20/25	≥ 20/40
Pre-operative UCVA	0.00	7.55	15.09	49.06
Post-Operative UCVA	25.49	58.82	70.59	90.20

BCVA with LAL IOL in Post RK Eyes (56 eyes)

	≥ 20/16	≥ 20/20	≥ 20/25	≥ 20/40
Pre-operative BCVA	0.00	31.82	50.00	90.91
Post-Operative BCVA	8.00	82.00	92.00	100.00

Astigmatism with LAL IOL in Eyes with RK (56 eyes)

	≤ 0.25 D	≤ 0.50 D	≤ 0.75 D	≤ 1.00 D	≤ 1.50 D	≤ 2.00 D
Preoperative Corneal Astigmatism	2%	21%	44%	52%	85%	92%
Postoperative Refractive Astigmatism (corneal plane)	58%	77%	92%	94%	100%	100%

UCVA with LAL IOL in Post Myopic LASIK/PRK Eyes (66 eyes)

	≥ 20/16	≥ 20/20	≥ 20/25	≥ 20/40
Pre-operative UCVA	0.00	16.42	31.34	64.18
Post-Operative UCVA	23.88	50.75	67.16	85.07

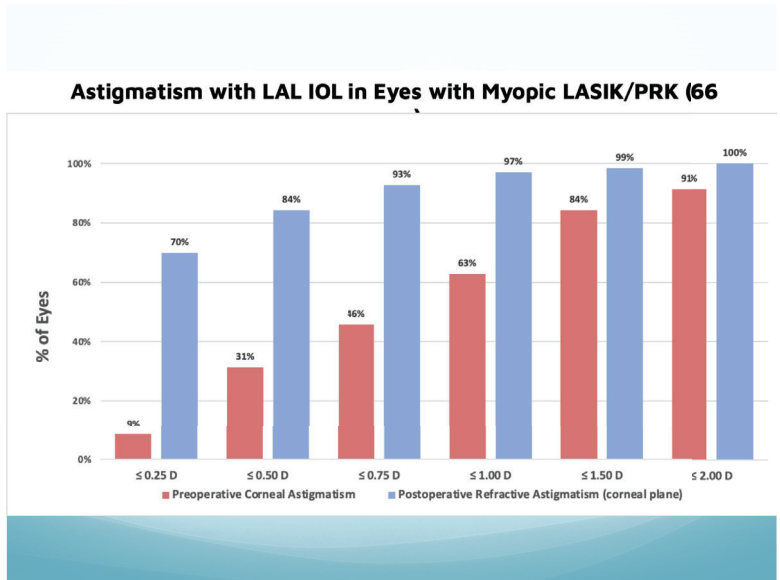## BCVA with LAL IOL in Post Myopic LASIK/PRK Eyes (66 eyes)

Astigmatism with LAL IOL in Eyes with Myopic LASIK/PRK (66

UCVA with LAL IOL in Post Hyperopic LASIK/PRK Eyes (32 eyes)

BCVA with LAL IOL in Post Hyperopic LASIK/PRK Eyes (32 eyes)

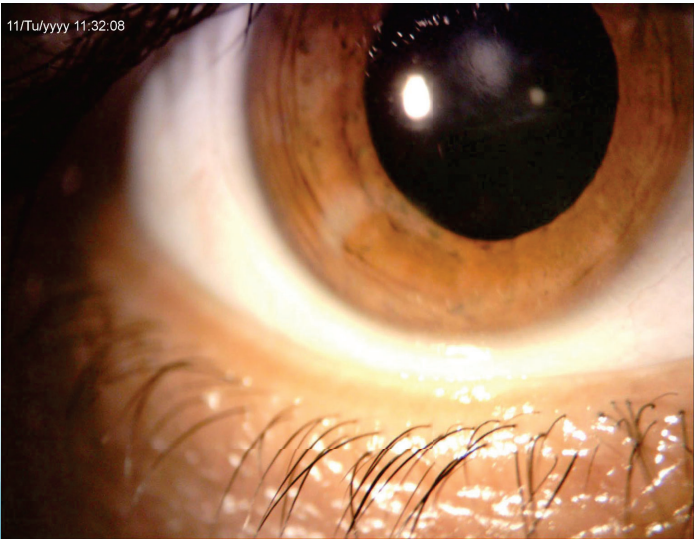
Astigmatism with LAL IOL in Eyes with Hyperopic LASIK/PRK (32 eyes)

Patient Case

- 53 year old male with chief complaint of blurry vision in the right eye

- Pre Op:
  - OD: Dsc: 20/80 Nsc: J1
  - OS: Dsc: 20/25 Nsc: J1+
    - MRX OD: -1.75 + 2.75 x 171   20/40
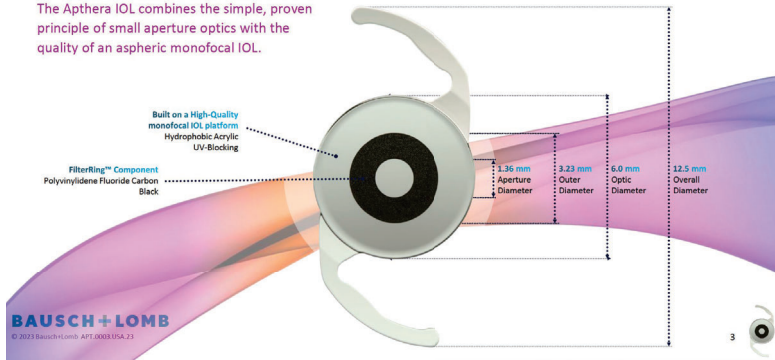   - MRX OS: -1.50 + 1.25 x 005   20/20

Patient Exam

PACHYMETRY	510	515
PUPILS	No APD	No APD
C/S	White & Quiet	White & Quiet
CORNEA	LASIK Flap, Semi-circular mid stromal scar (paracentral-inferior)	LASIK Flap
ANTERIOR CHAMBER	Normal Depth, Quiet	Normal Depth, Quiet
LENS	1+ NS, Diffuse Cortical Changes	1+ NS
FUNDUS	WNL	WNL

Apthera™ IOL Wavefront-Filtering Design

The Apthera IOL combines the simple, proven principle of small aperture optics with the quality of an aspheric monofocal IOL.
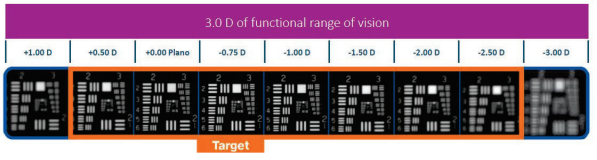
Built on a High-Quality monofocal IOL platform
Hydrophobic Acrylic
UV-Blocking

FilterRing™ Component
Polyvinylidene Fluoride Carbon Black

1.36 mm Aperture Diameter
3.23 mm Outer Diameter
6.0 mm Optic Diameter
12.5 mm Overall Diameter

IC-8™ Apthera IOL

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3

Small Aperture Optics

Large Aperture
Equivalent to a monofocal IOL with a 4.0 mm pupil

Small Aperture
~1.36mm

| 3.0 D of functional range of vision								
+1.00 D	+0.50 D	+0.00 Plano	-0.75 D	-1.00 D	-1.50 D	-2.00 D	-2.50 D	-3.00 D

Apthera IOL[1]

Target

Wavefront-Filtering technology

The IC-8 Apthera IOL is the first small aperture lens that delivers extended depth of focus through its distinctive wavefront-filtering design.

EXTENDED DEPTH OF FOCUS, free from "blurry zones"

EXCELLENT RESULTS REGARDLESS OF ASTIGMATISM
in eyes with as much as 1.5 D of corneal astigmatism

MONOFOCAL-LIKE BINOCULAR CONTRAST SENSITIVITY
in bright and low light conditions

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1
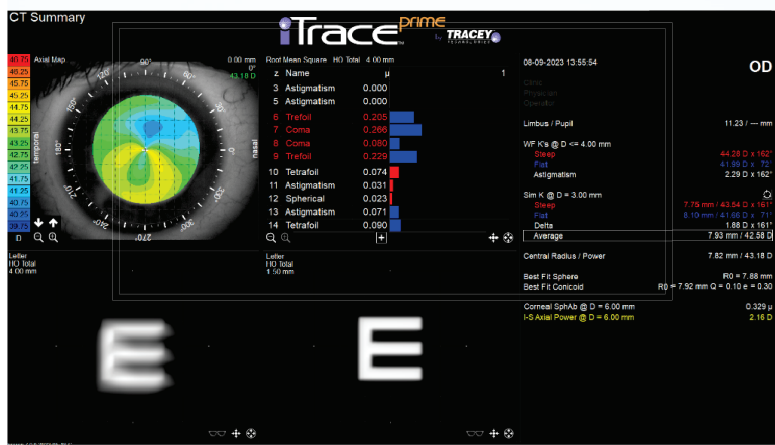
Patient Post op

- Apthera implanted in OD
- 1 Week Post Op: Very happy patient
- OD: Dsc: 20/25 Nsc: J1

Patient Case

- 66 year old female with chief complaint of increasingly blurry vision

- Pre Op:
  - OD: Dsc: 20/200; Dcc: 20/70
  - OS: Dsc: 20/400; Dcc: 20/80
    - With contact lenses; no improvement in refraction

Exam

PACHYMETRY	511	519
IOP	15	15
PUPILS	No APD	No APD
C/S	White & Quiet	White & Quiet
CORNEA	LASIK Flap, 8 Radials	LASIK Flap,16 Radials with nasal T cuts
ANTERIOR CHAMBER	Normal Depth, Quiet	Normal Depth, Quiet
LENS	2+ NS, 1+ Cortical	2+ NS, 1+ Cortical
FUNDUS	WNL	WNL
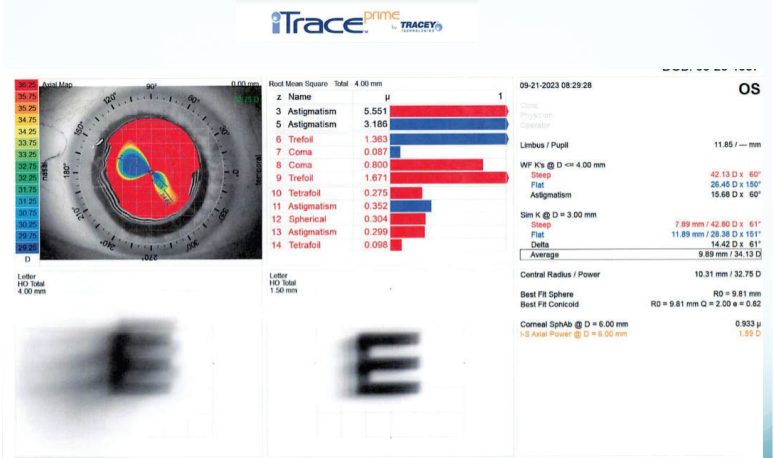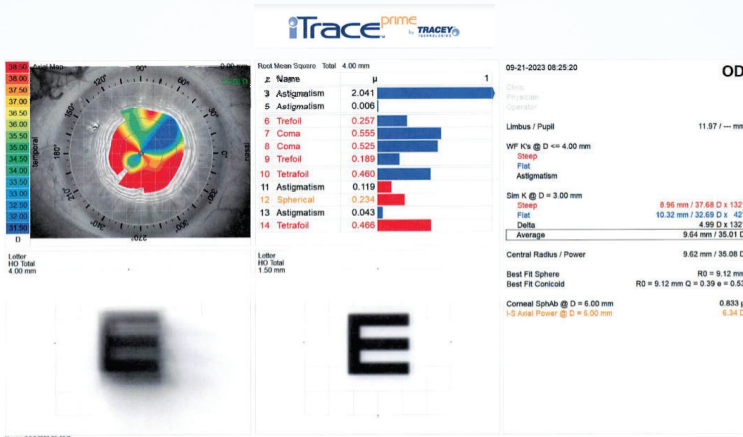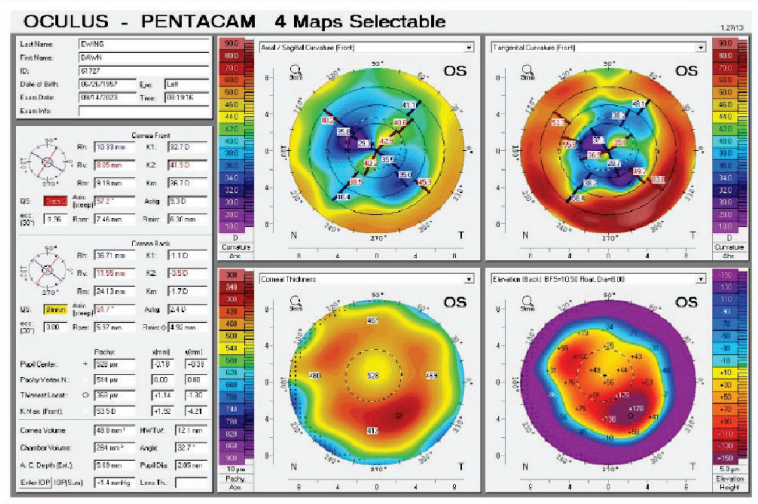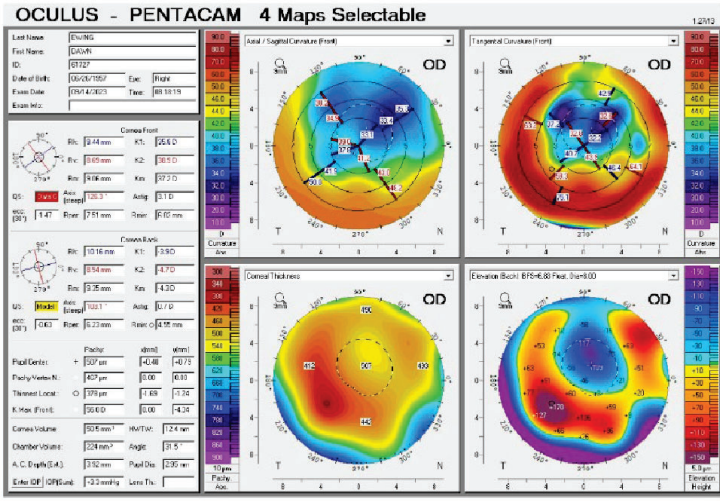
Post-Op

- Apthera implanted in OU
- Post Op: happy patient
- OD: Dsc: 20/30
- OS: Dsc: 20/200
 - MRX OD: no improvement
  - MRX OS: -4.00 +6.00 x 075   20/80
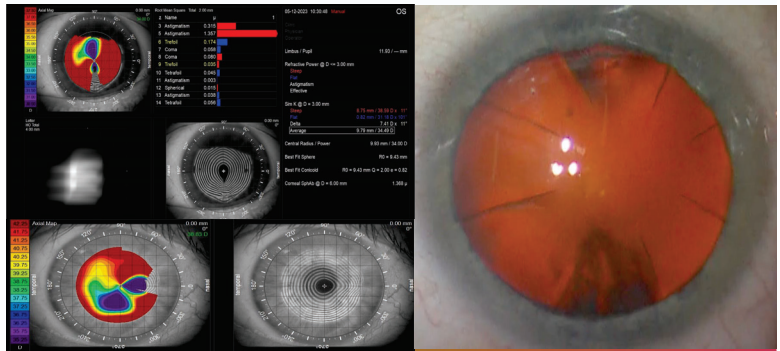
Clinical Outcomes of the Small Aperture IOL for Complex Corneas with Irregular Astigmatism

Hasan Alsetri, BS, Nicole Fram, MD, Elizabeth Yeu, MD, Eric Donnenfeld,MD, Brandon Ayres, MD, Zaina Al-Mohtaseb, Marisa Schoen, MD, Stephen Kwong, BS, Matthew Santos, MD, Emily Rodgers BS


Small Aperture IOL: Apthera/IC-8

- Corrects 1.5 astigmatism
- Non dominant -0.75D-1.00 aim
- 1.36mm aperture
- Pinhole test and pilo test
- Ray tracing simulation of small aperture (Itrace)
- May not correct all of the cylinder but will decrease HOA
- Make sure they dilate to 6.5mm-7.0mm for Nd:YAG posterior capsulotomy

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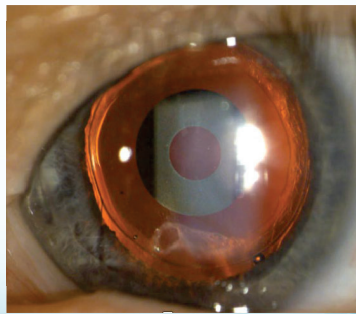
Methods

- Non-randomized, multicenter retrospective case series of **51 eyes (46 patients)** who received a small aperture IOL in the setting of corneal disease.
- **IOL Master 700 Barrett True K-RK/Post LVC and Barrett True K Toric (KCN)** with a -0.75 to -1.00 D refractive target were used for planning of IOL power
- **Primary outcomes:** Mean and median absolute errors (AE) and % eyes within 0.50 D, 1.00 D, 1.50D of refractive target were analyzed. Lines of improvement of UCDVA, BCDVA, UCNVA and BCNVA and Refractive Prediction Error.
- **Secondary outcome measures:** symptomatic dimming requiring explanation, need for scleral lens or topography guided PRK
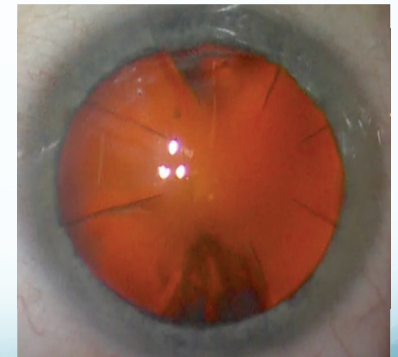
Results

Number of Patients	46
Number of Eyes	51
Age, mean ± SD	66.2 ± 7.8 years
Cyl, mean (range)	-1.65 (-5.5 to 0.76)
RK eyes	16
LASIK eyes	14
KCN eyes	14
Other	7

Clinical Outcomes of the Small Aperture IOL for Complex Corneas with Irregular Astigmatism

Uncorrected Distance: 81% are 20/50 or better
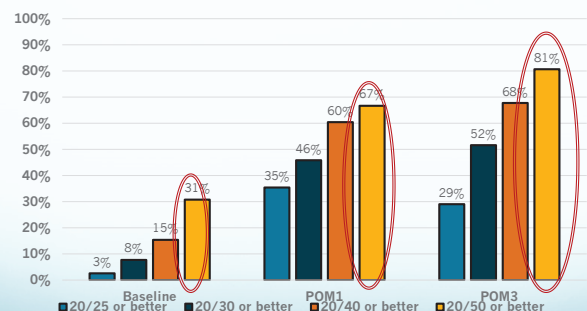
Best Corrected Distance: 75% are 20/30 or better
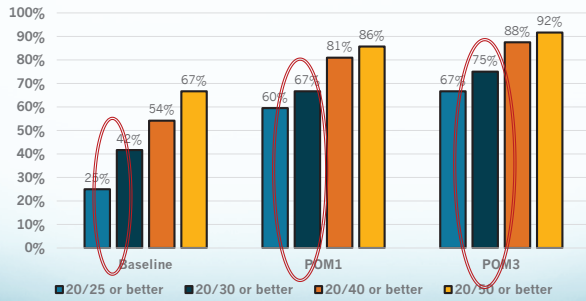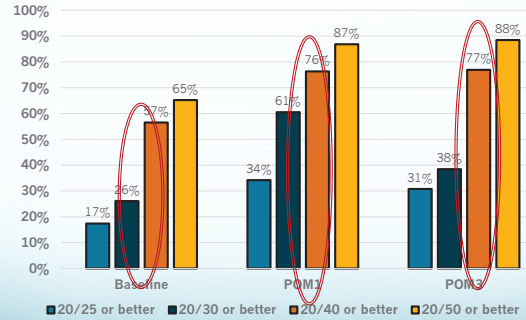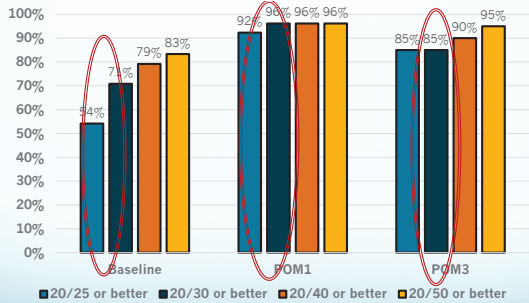
Uncorrected Near: 77% are 20/40 or better

Best Corrected Near: 85% are 20/30 or better

Visual Acuity/ Lines of Improvement

	Uncorrected Near	Best Corrected Near	Uncorrected Distance	Best Corrected Distance
Baseline	20/62 (0.49)	20/39 (0.29)	20/110 (0.74)	20/46 (0.36)
POM1	20/36 (0.26)	20/25 (0.1)	20/44 (0.34)	20/30 (0.17)
POM3	20/38 (0.28)	20/25 (0.1)	20/38 (0.28)	20/29 (0.16)
Baseline-POM1 (lines improved)	2.6	1.4	6.6	1.6
Baseline-POM3 (lines improved)	2.4	1.4	7.2	1.7
Need for removal due to Dimming	3 patients			

Conclusions

- UCDVA improved by **7.2 lines** and UCNVA improved by **2.4** at 3 months
- **The off-label** use of the small aperture IOL appears to be safe and effective in patients with corneal pathology (and without central scarring).
- Counsel patients regarding the possibility of dimming
- This technology may offer more **hope for contact lens independence** and better spectacle correction in these complex eyes.
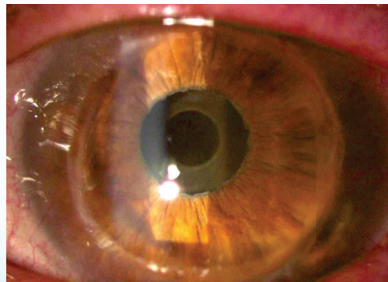
65 yold with Restor OU

Vacc	HM	20/40
VA w/ MRX	+10.25 sph 20/20	+0.25 +0.75 x 178 20/20
IOP (central, tonopen)	23	23
Pupils	no apd	No apd
C/S	White and quiet	White and quiet
Cornea	Clear	Clear
Anterior chamber	Vitreous Prolapse	Normal, quiet
Iris	WNL	WNL
Lens	Sunset IOL shifted inferiorly, large anterior capsular opening	Centered PC IOL, PC Intact
Vitreous	WNL	WNL
Fundus exam	WNL	WNL

Accuracy of Intraocular Lens Calculation Formulas for Flanged Intrascleral Intraocular Lens Fixation with Double-Needle Technique

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Abstract

Purpose: To evaluate the refractive prediction error of intraocular lens calculation formulas in eyes that have undergone the Yamane technique for scleral fixation of intraocular lenses (IOL).

Setting: Alkek Eye Center, Cullen Eye Institute, Baylor College of Medicine, Houston, TX DESIGN:: Retrospective case series from electronic chart review.

Methods: Patients who had undergone scleral fixation of secondary IOLs were selected. The IOL refractive prediction errors (RPE) for 4 IOL prediction formulas - Barrett Universal II, Holladay 1, Hoffer-Q, and SRK/T - were obtained by subtracting the predicted spherical equivalent from post-operative spherical equivalent. The arithmetic mean RPE, mean absolute error (MAE), and percentages of eyes with prediction error of ≤0.5 D and ≤1.0 D were calculated and compared.

Results: 40 eyes of the 40 patients met inclusion criteria. All formulas produced hyperopic mean arithmetic RPE. MAE values were 0.73 D for Holladay 1, 0.76 D for Barrett, 0.80 D for SRK/T, and 0.86 D for Hoffer Q. The percentage of eyes with prediction error of ≤0.5 D and ≤1.0 D with these formulas were: 45% (18 eyes) and 75% (30 eyes) for Holladay 1, 38.5% (15 eyes) and 77% (30 eyes) for Barrett, 32.5% (13 eyes) and 67.5% (27 eyes) for SRK/T, and 27.5% (11 eyes) and 62.5% (25 eyes) with Hoffer-Q. There were no significant differences in prediction errors between the 4 formulas.

Conclusion: Refractive outcomes of the Yamane technique are less predictable than standard cataract surgery. Arithmetic RPE is hyperopic to predicted for all formulas tested.

LAL Yamane Exchange

Thank You

What Questions Do you Have?

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