NEGATIVE DYSPHOTOPSIA: A BETTER UNDERSTANDING

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NOA 2026

FINANCIAL DISCLOSURES:

- Speaker for Haag Streit (webinar)

NEGATIVE VS POSITIVE DYSPHOTOPSIA

POSITIVE DYSPHOTOPSIA:

- Halos, flares starbursts, streaks of light
- Something unwanted "added" to the visual experience

Usually caused by scattering of light, reflections off the edge and surface of the lens.

POSITIVE DYSPHOTOPSIA: RISK FACTORS

- High refractive index IOLs
- Sharp truncated edge (especially if exposed)
- Small IOL optic, large pupil
- Decentered or tilted IOL
- Pupil abnormalities that allow light to interact the the edge more
- Cornea/vitreous abnormalities that scatter light (guttata, dry eye, asteroid)
- Scratched or damaged IOLs
- Diffractive optics
- Zonular instability (pseudophacodonesis increases the effect of all the above factors)

Persistant PD: high refractive index Acrysof being exchanged for low refractive index Silicone IOL

Intraocular lens surfaces and their relationship to postoperative glare

Jay C. Erie, MD, Mark H. Bandhauer, MS

Purpose: To estimate the potential for surface reflections in recently introduced intraocular lenses (IOLs) and to determine optic surface designs that will reduce surface reflections.

Setting: Mayo Clinic, Rochester, Minnesota, USA.

Methods: Surface-reflected glare in the unaccommodated human crystalline lens and in 6 IOLs (Bausch & Lomb SoFlex® LI61U, Pharmacia CeeOn® 911A, Allergan Sensar® AR40, Bausch & Lomb Hydroview® H60M, Alcon AcrySof® MA60BM, Alcon AcrySof SA30AL) was examined in a physiologic eye model using the ZEMAX optical design program. Internal and external surface reflections were described and compared in terms of IOL surface reflectivity (%), area of the reflected glare image (mm^2), and relative intensity of the reflected glare image.

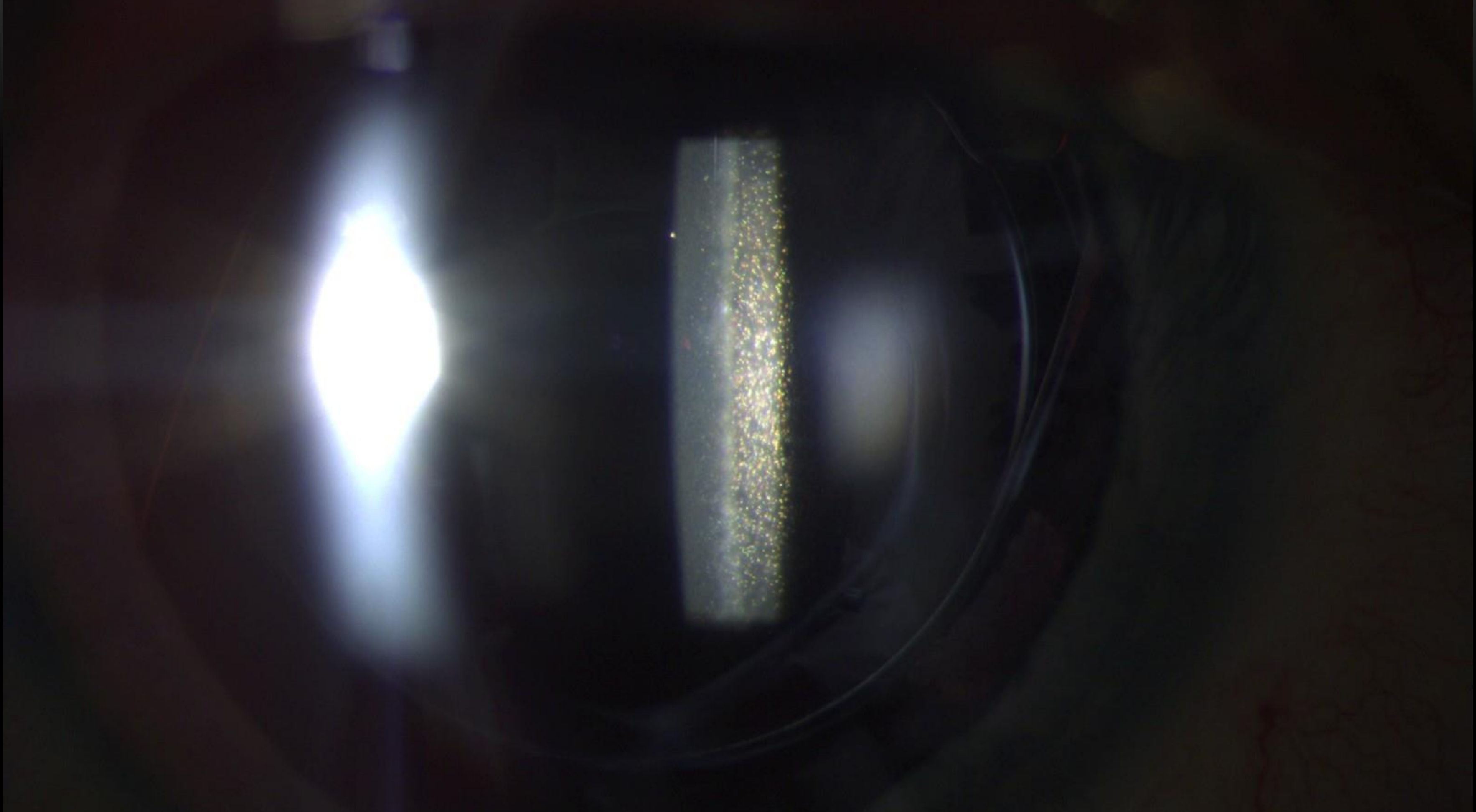
Results: Compared to surface reflections from the unaccommodated human lens with a corneal power of 43.0 diopters, all the IOLs increased the relative intensity of internal and external reflections by 3- to 36-fold except the MA60BM and the SA30AL, which increased the relative intensity of internal and external reflections by 730- to 1090-fold.

Conclusions: All the IOLs studied variably increased internal and external surface reflections when compared to the human crystalline lens. Surface reflections were minimized in optic designs with an anterior radius of curvature of approximately

Table 2. Internal reflectivity, area of retinal glare image, and relative intensity ratio at the retina for the unaccommodated human lens and various IOLs of 19.0 D power.*

Optic Design	Optic Material (RI)	IOL Model	Reflectivity (%)	Corneal Power (D)	Area of Retinal Glare Image (mm^2)	Relative Intensity Ratio
Human lens	Cortex (1.386)	Unaccommodated clear lens	0.03 (decimal 0.000337)	48	24.0	1.5
				46	28.0	1.3
				43	36.0	1.0
				40	45.0	0.8
				38	53.0	0.7
Equi-biconvex	Silicone (1.43)	Bausch & Lomb SoFlex L161U	0.11	48	20.0	6.1
				46	24.0	5.1
				43	31.0	3.9
				40	40.0	3.1
				38	47.0	2.6
Equi-biconvex	Silicone (1.46)	Pharmacia CeeOn 911A	0.19	48	6.8	30.0
				46	8.5	24.0
				43	12.1	17.0
				40	16.7	12.0
				38	21.0	10.0
Equi-biconvex	Acrylic (1.47)	Allergan Sensar AR40	0.23	48	4.2	58.0
				46	5.4	44.0
				43	8.1	30.0
				40	11.7	21.0
				38	14.9	16.0
Equi-biconvex	Hydrogel (1.474)	Bausch & Lomb Hydroview H60M	0.24	48	3.5	73.0
				46	4.6	56.0
				43	7.0	36.0
				40	10.3	25.0
				38	13.2	19.0
Unequal biconvex	Acrylic (1.55)	Alcon AcrySof MA60BM	0.55	48	1.30	460.0
				46	1.01	580.0
				43	0.58	1020.0
				40	0.24	2500.0
				38	0.07	8000.0
Unequal biconvex	Acrylic (1.55)	Alcon AcrySof SA30AL	0.55	48	0.04	14 000.0
				46	0.17	3500.0
				43	0.59	1000.0
				40	1.36	430.0
				38	2.20	270.0

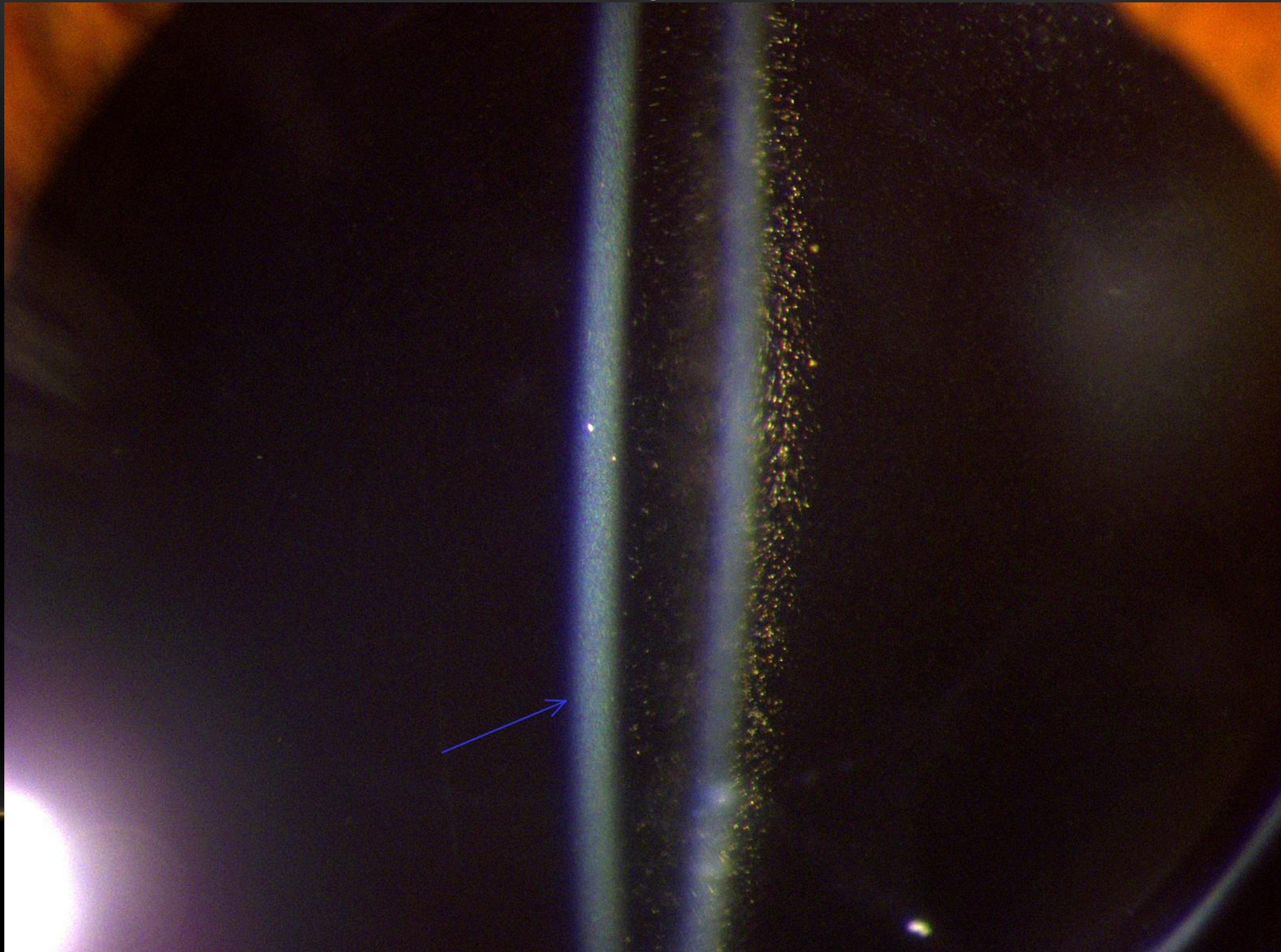
Acrysof Glistenings



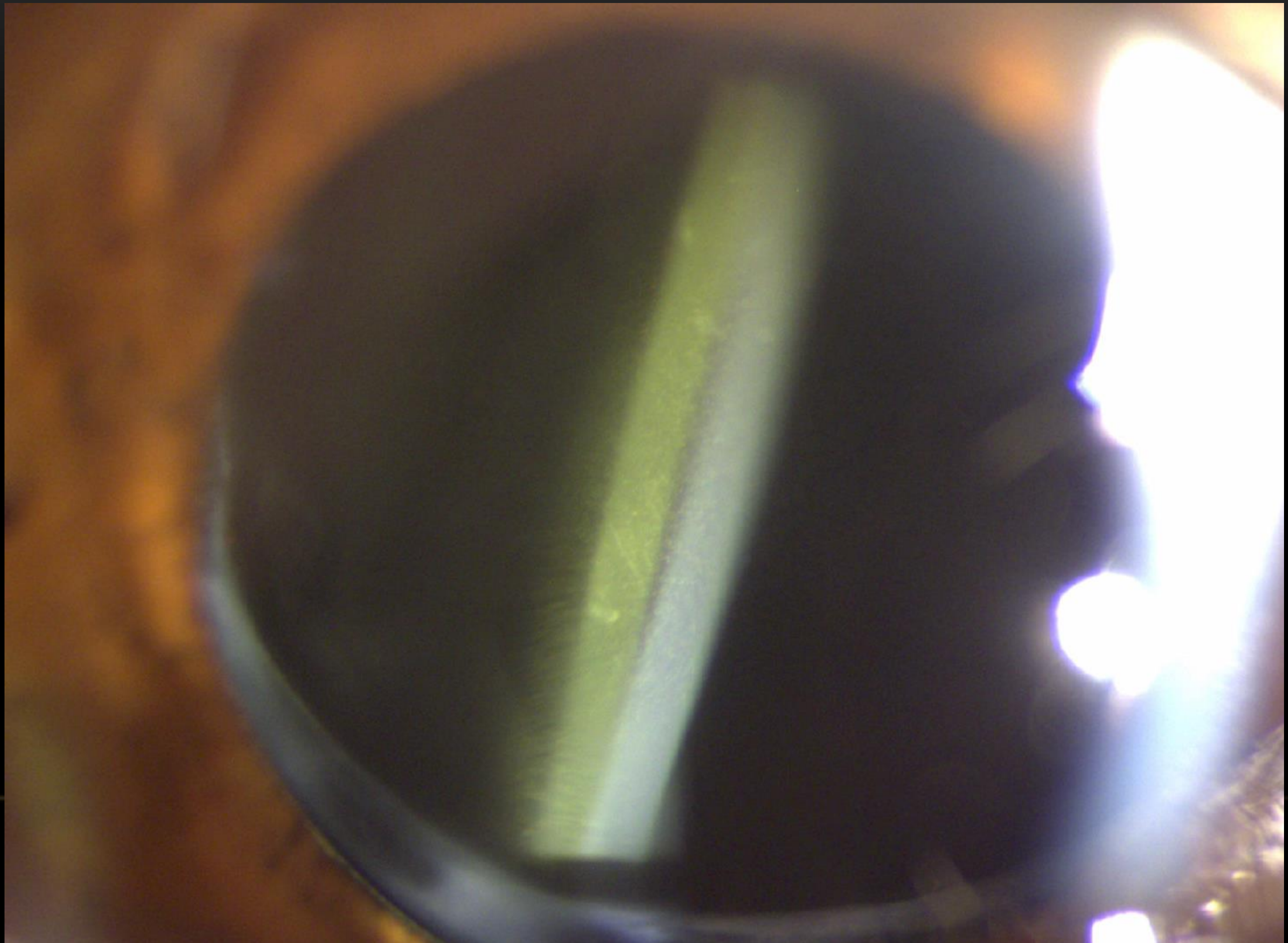
SSNG = Sub Surface Nano Glistenings in Acrysof

Glistenings = raindrops

Sub surface nano glistenings
SSNG = Fog



ACRYSOF SUB SURFACE NANO GLISTENINGS

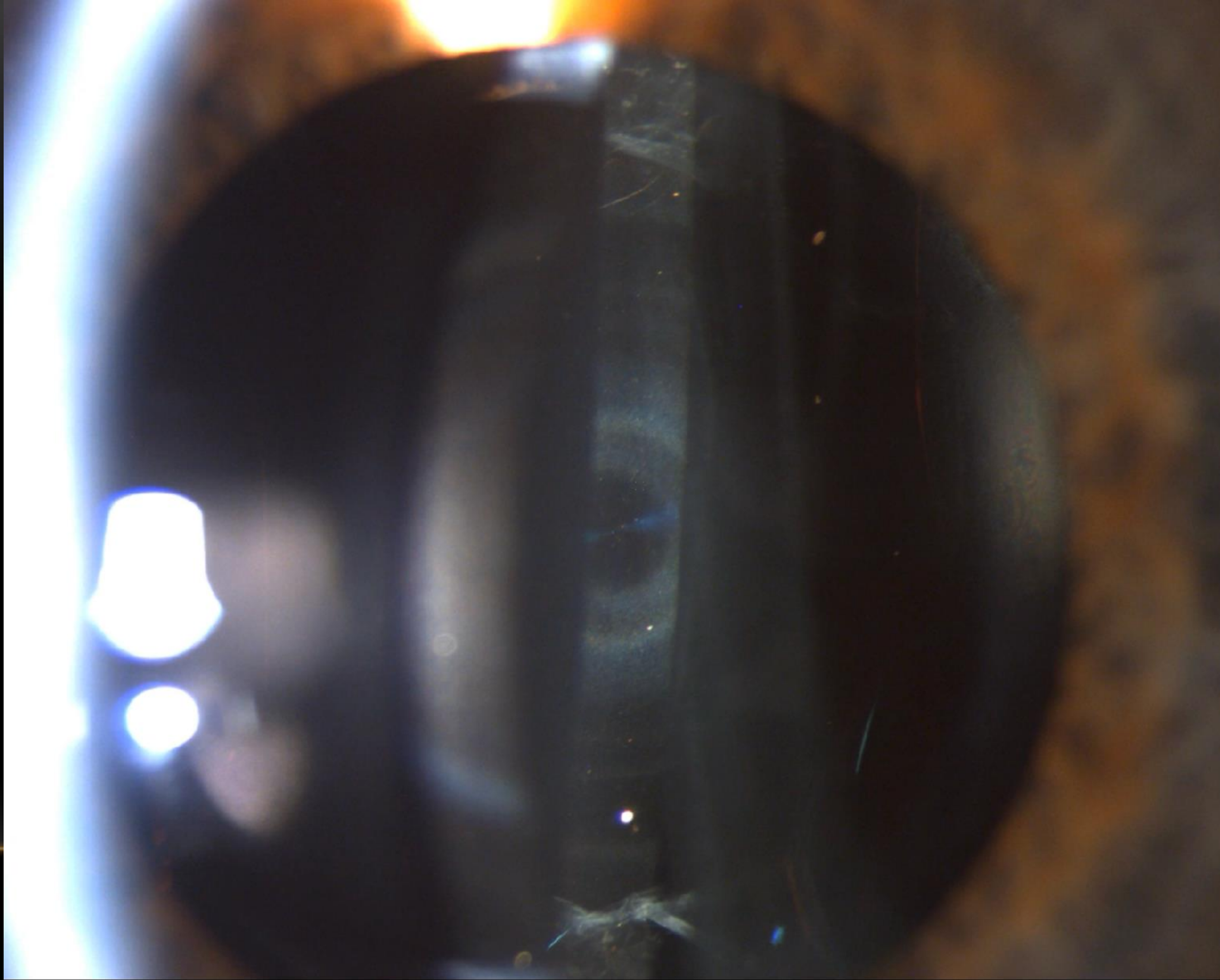


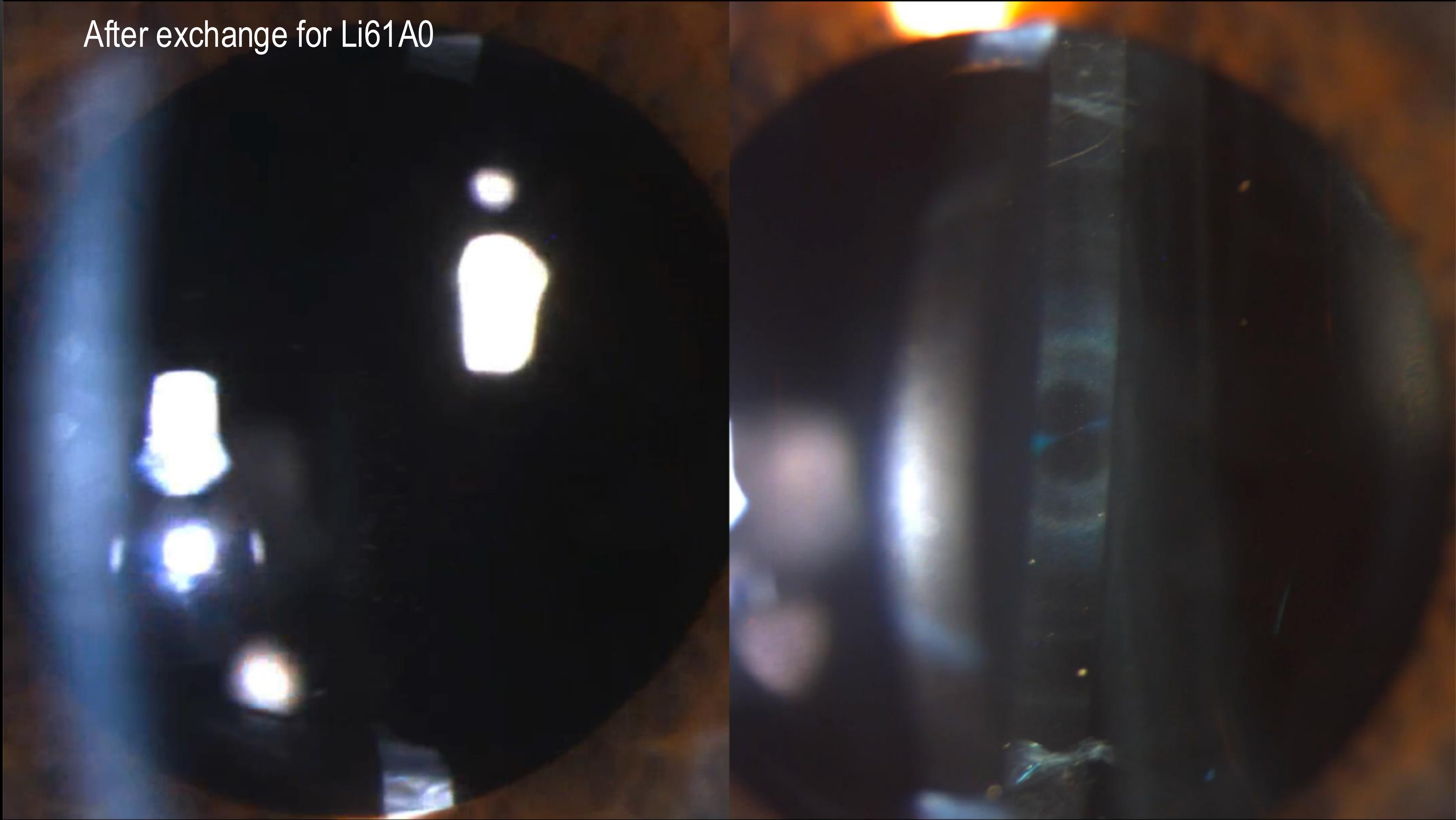
LIGHT ADJUSTABLE LENS

"Rings of Saturn" annular haze

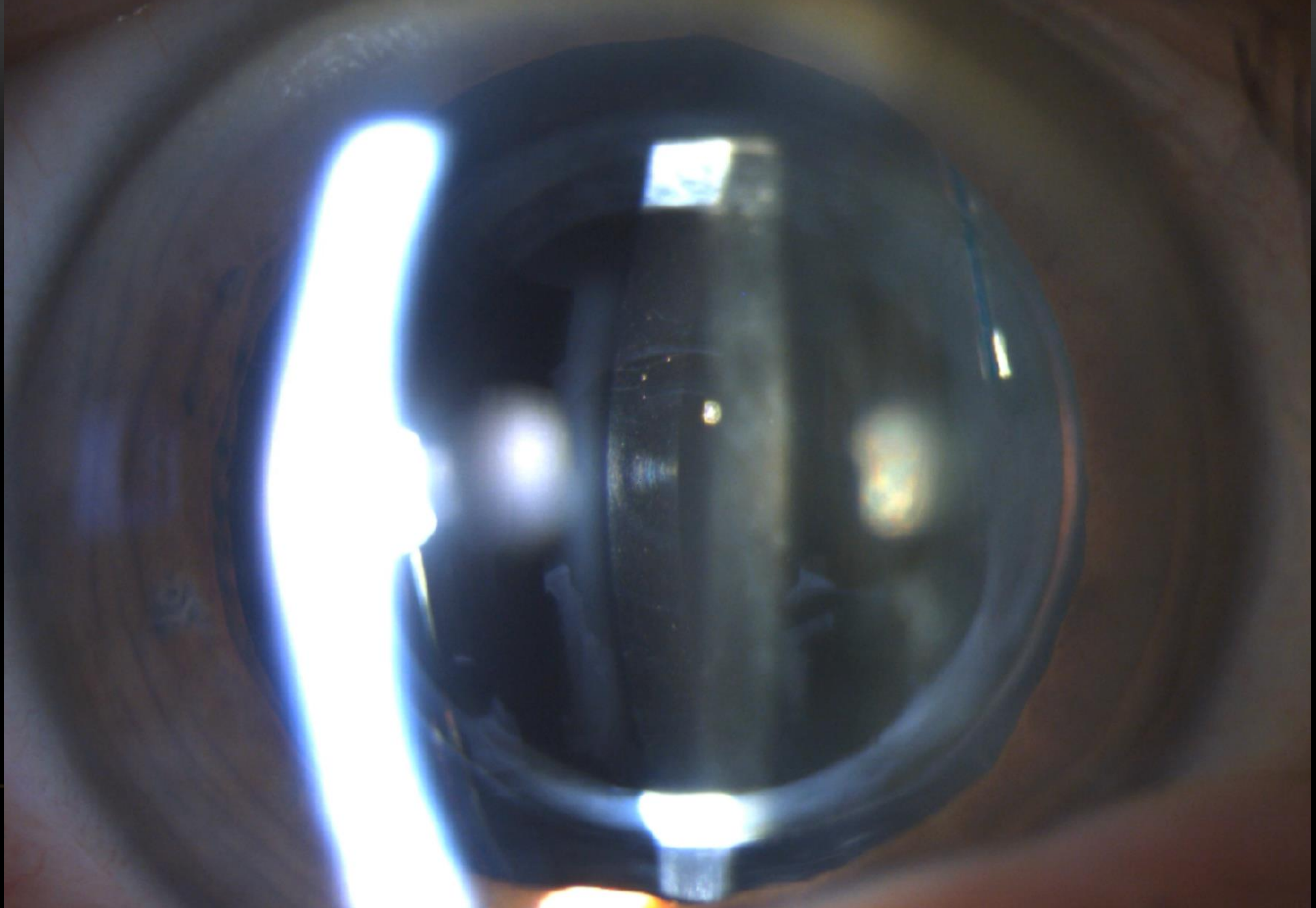
"halos, glare and a pinwheel effect around lights at night"

Also slightly decreased vision



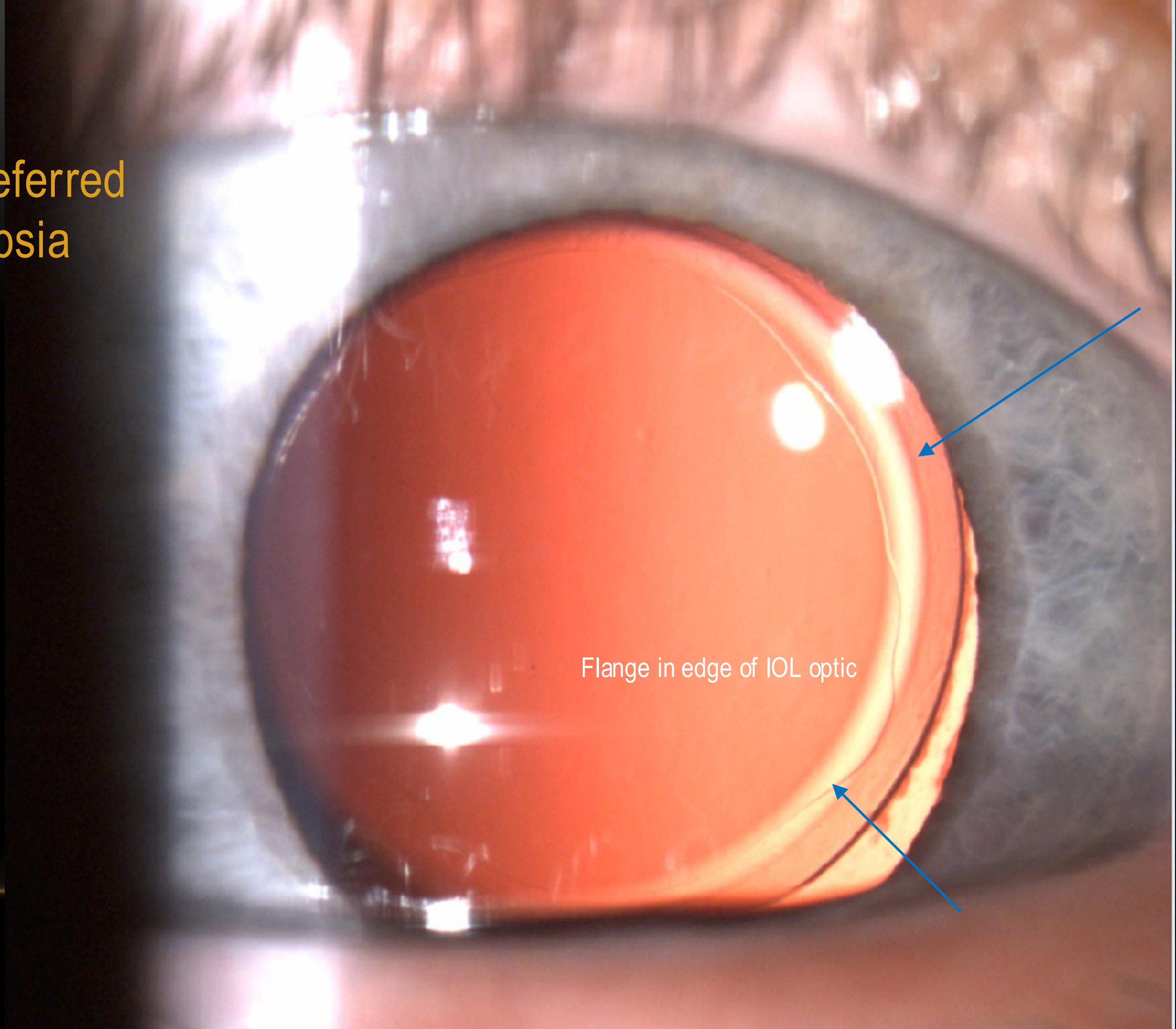

After exchange for Li61A0

LAL annular haze



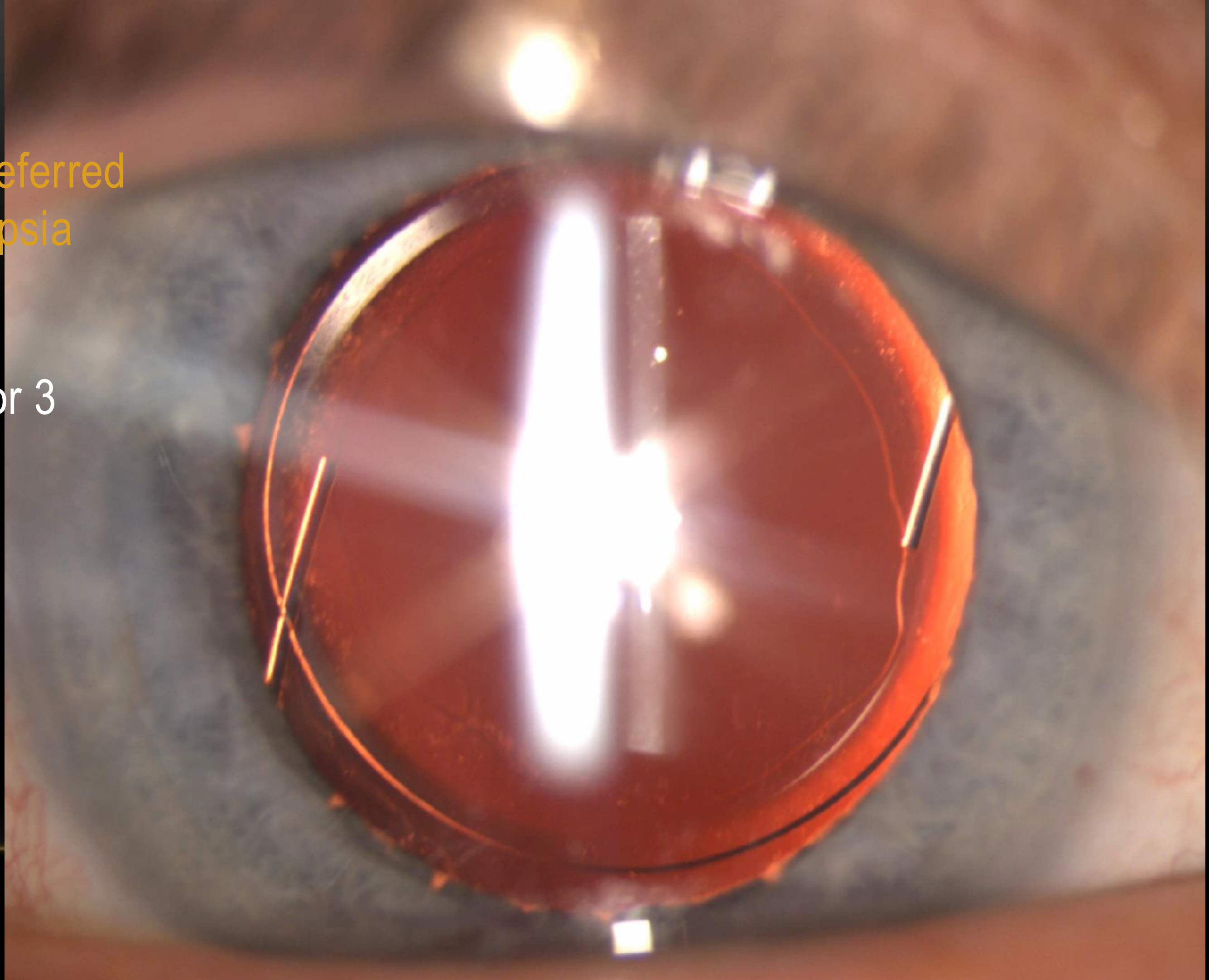
LAL annular haze

Patient with ZCB00 referred for positive dysphotopsia



Patient with ZCB00 referred for positive dysphotopsia

After IOL exchange for 3 piece Silicone IOL



Kim et al. BMC Ophthalmology (2020) 20:180
https://doi.org/10.1186/s12886-020-01446-5

BMC Ophthalmology

RESEARCH ARTICLE Open Access

How does the world appear to patients with multifocal intraocular lenses?: a mobile model eye experiment

Eun Chul Kim[1], Kyung-Sun Na[1], Hyun Seung Kim[1] and Ho Sik Hwang[1,2*]

Abstract

Background: To show how the world appear to patients with multifocal intraocular lens (IOL) using a novel mobile model eye.

Methods: The mobile model eye was composed of an artificial cornea, IOL, IOL chamber, and a camera. A monofocal IOL (Tecnis monofocal IOL) and two diffractive multifocal IOL (ReSTOR, Tecnis multifocal IOL) were used in the study. We went outside to take a picture of the scenery. At night, we stood on a road and took pictures to see how the traffic lights and headlights of cars looked. For an indoor analysis, we approached the Early Treatment Diabetic Retinopathy Study (ETDRS) chart to the model eye from a distance of 95 cm to check the multifocal function of the lenses. In the car, we took pictures of the street and a cell phone in turn to check the multifocal function of the lenses.

Results: Two multifocal IOLs showed definite multifocal function. Far objects appeared either similarly clear or slightly hazier (depending on the IOL model) than those with the monofocal IOL. In the night vision, there was a mild or severe halo around light sources compared to those with the monofocal IOL.

Conclusion: We believe that this mobile model eye can be used to evaluate how the real world appear to a patient with a multifocal IOL, to explain multifocal function of the IOLs, and possible complications in the patients, before performing a surgery.

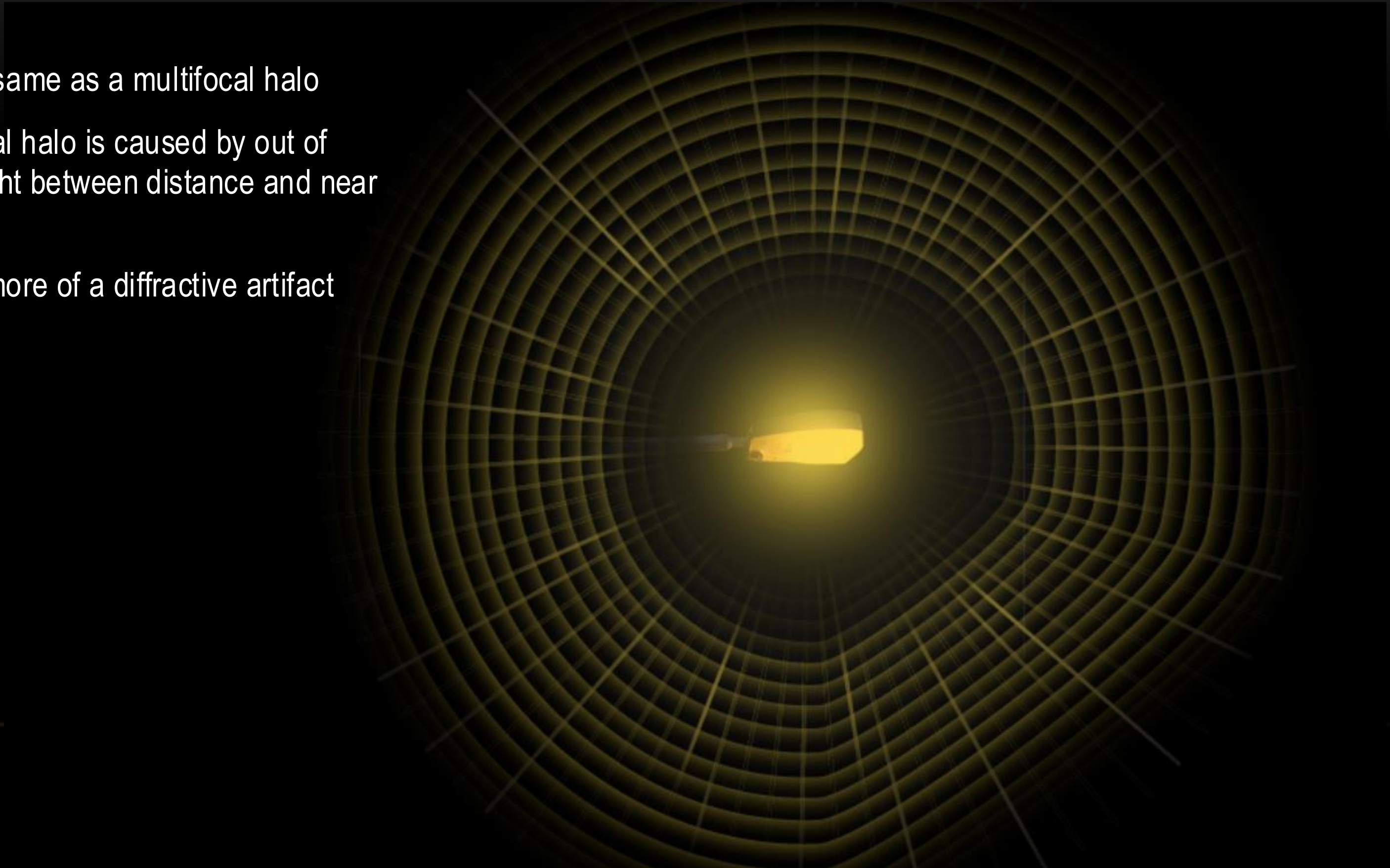
Keywords: Multifocal intraocular lens, Model eye, Mobile model eye, Simulation, Multifocal function, Halo

RESTOR

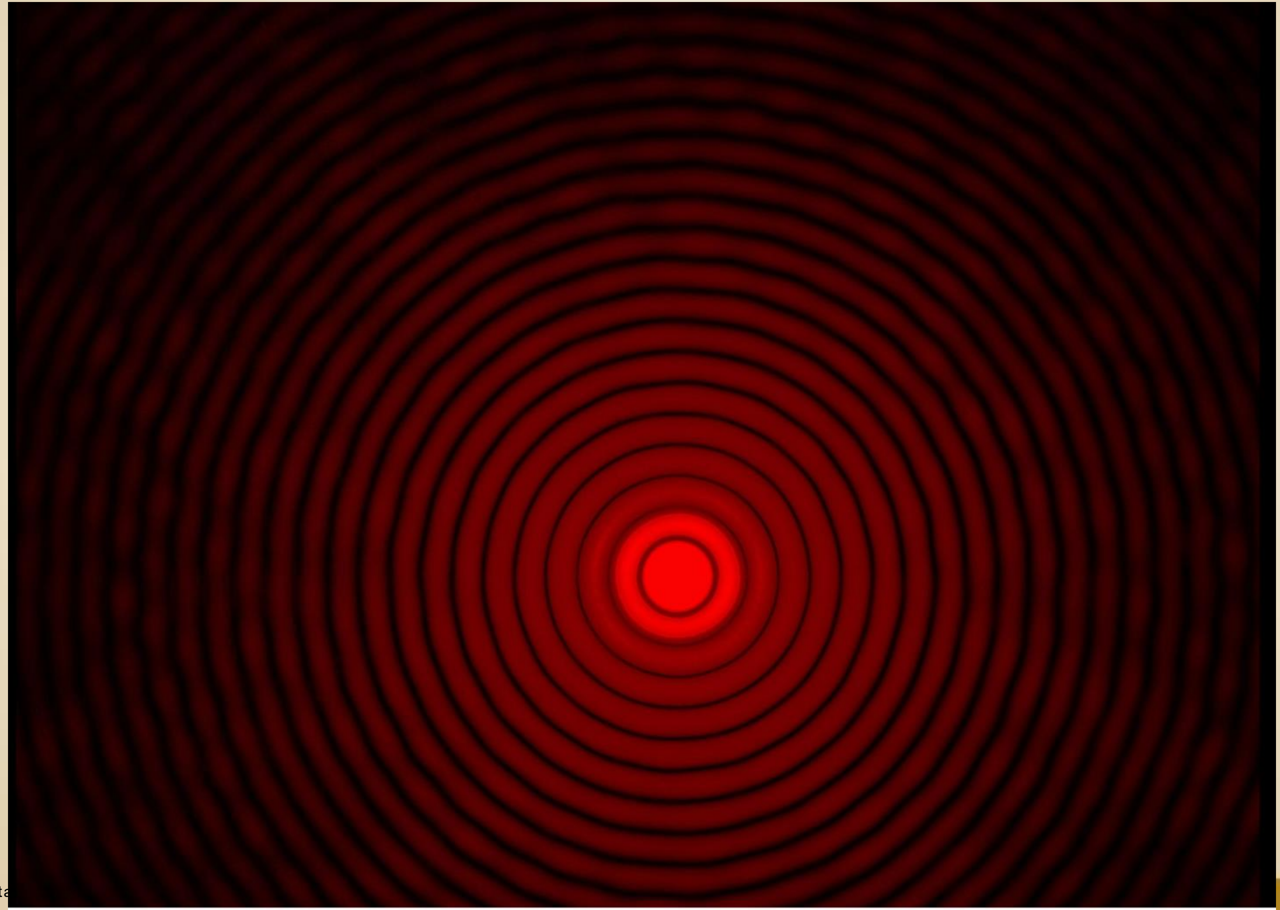
TECNIS MTF

ANIMATION OF "SPIDER WEB" AS SEEN BY SYMFONY PATIENT.

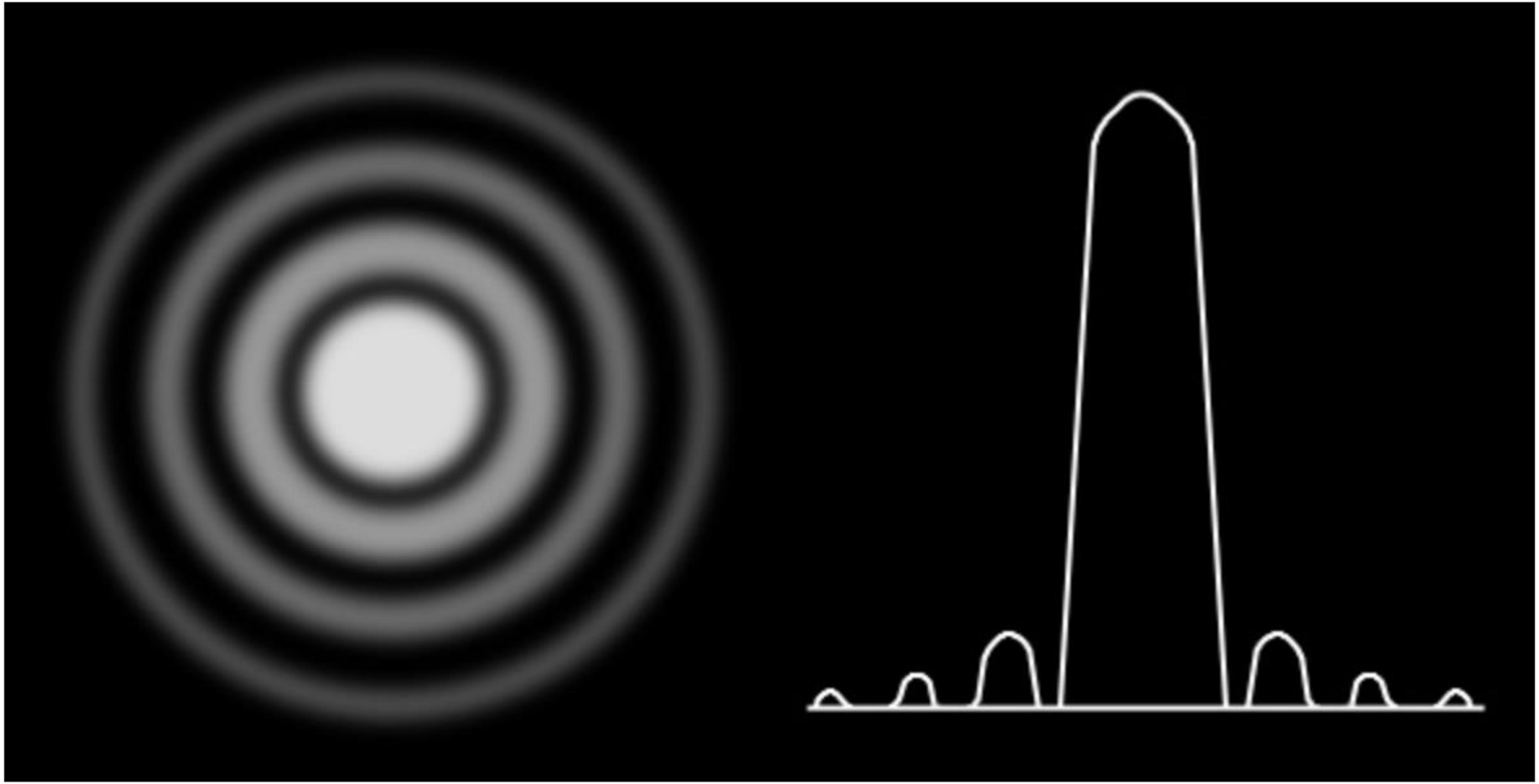
- Not the same as a multifocal halo
- Multifocal halo is caused by out of focus light between distance and near images
- This is more of a diffractive artifact

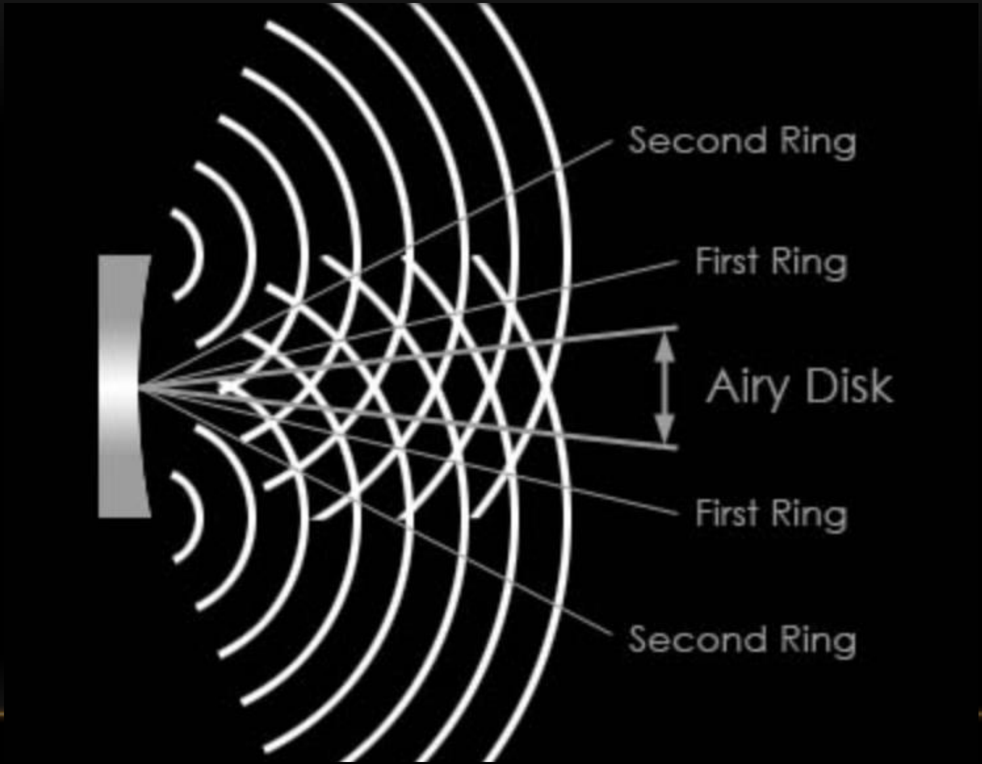


AIRY DISK PATTERN: LASER PASSED THROUGH A 90 MICRON PINHOLE.



AIRY DISK: THE DIFFRACTION PATTERN CAUSED BY A UNIFORMLY LIT CIRCULAR APERTURE.

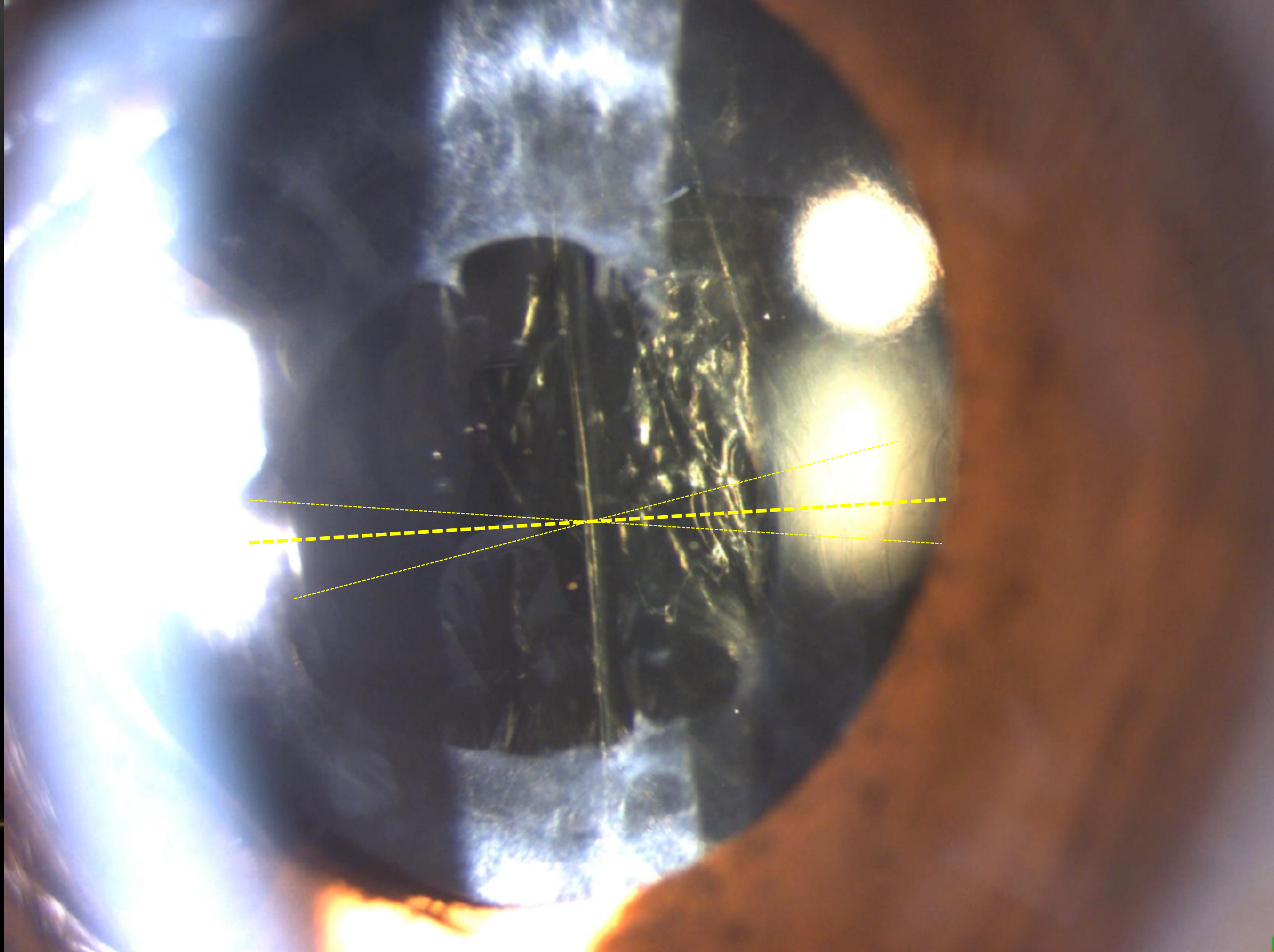



Second Ring
First Ring
Airy Disk
First Ring
Second Ring

Streaks perpendicular to the fold

Maddox rod effect from posterior capsule fold

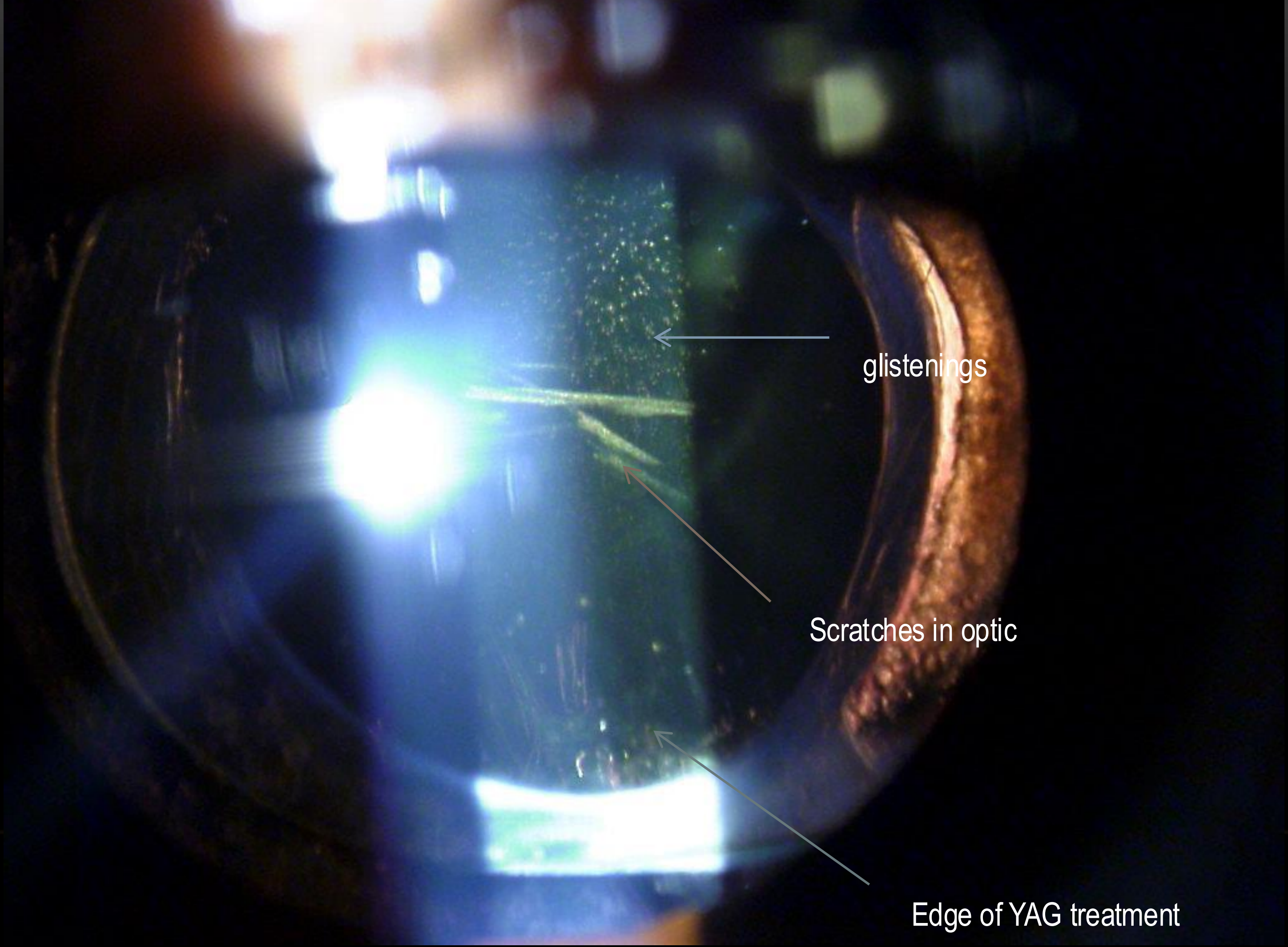
Resolves with YAG!



POSITIVE DYSPHOTOPSIA

Usually made WORSE by pupil dilation and or pupil defects!

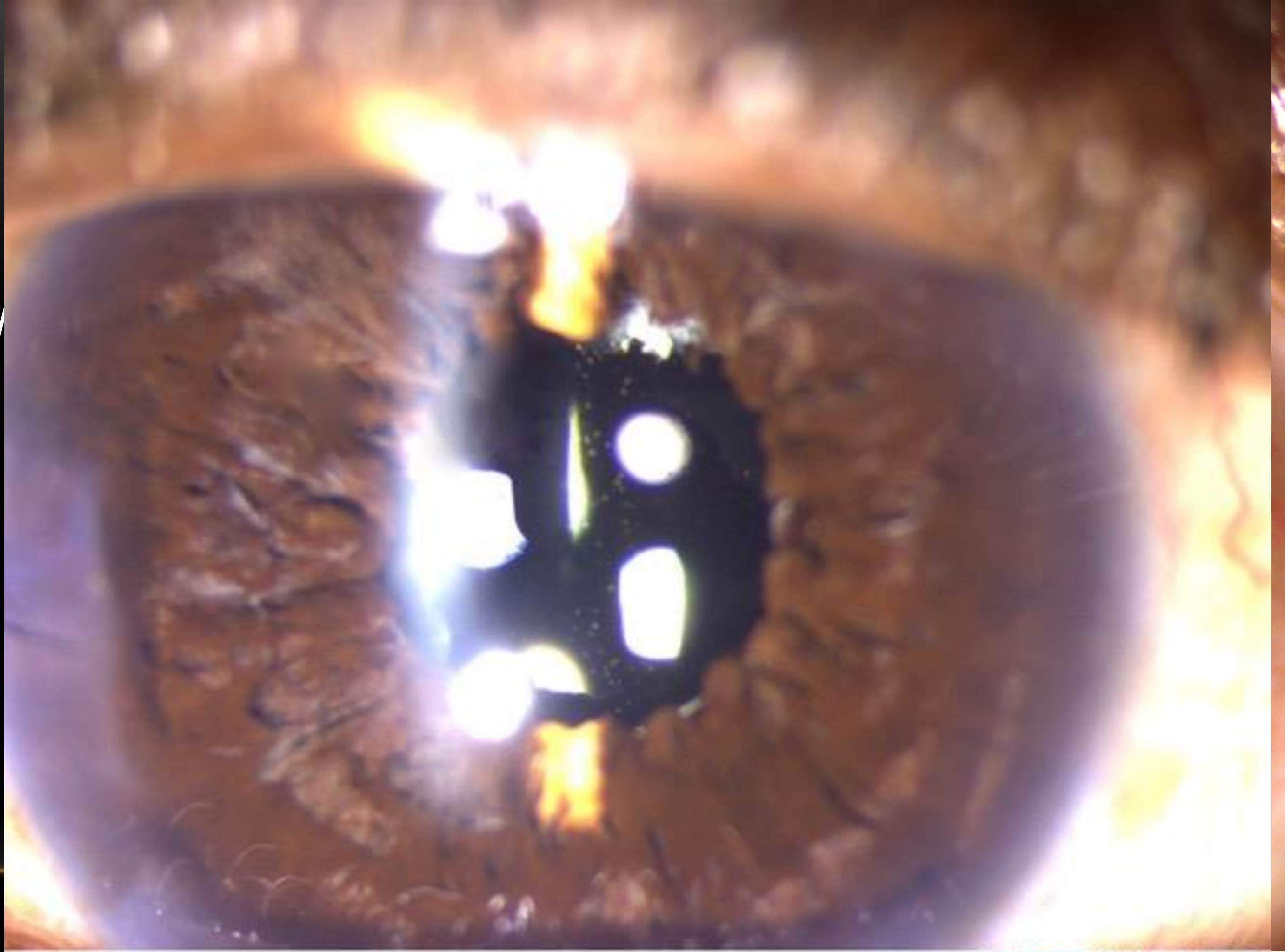

55 year old referred in with persistant glare
/starbursts 2 years after cataract surgery
Fixed dilated
atonic,pupil


glistenings
Scratches in optic
Edge of YAG treatment

Day 1 post op

IOL exchange/PPV/
iris cerclage

3 piece silicone IOL
optic captured



“Cat’s eye” reflection: Observer dysphotopsia

My friends tell me it looks like I have a “glass eye”

”Am I gonna have that “twinkling ” that some of my friends have after cataract surgery?”

> J Refract Surg. 2021 Jun;37(6):398-402. doi: 10.3928/1081597X-20210310-01. Epub 2021 Jun 1.

Intraocular Lens Refractive Index and Its Impact on External Surface Reflections

George D Kymionis, Jaeryung Kim, Myrsini Petrelli, Michael A Grentzelos, Kattayoon Hashemi, Georges Wagnières

PMID: 34170772 DOI: 10.3928/1081597X-20210310-01

Abstract

Purpose: To determine and compare the origin of the external surface reflections produced by commonly used intraocular lenses (IOLs).

Methods: The specular reflection taking place at the anterior surface of eight types of IOLs (IOL power = 22.00 diopters [D]) with different refractive indices (RIs), optical design, and ultraviolet and blue light-filtering function were measured. The experimental set-up included a laser beam light source (3.5 mW, 532 nm) and a saline-filled model eye containing the IOL to be examined. External surface reflections were measured using a power meter, and the IOL surface reflectance (%) was compared among the eight IOLs investigated.

Results: External reflections from the anterior surface of the studied implants increased as the RI of the IOL material increased. The IOL models composed of high RI material (RI = 1.56 ± 0.02) were found to have a more than threefold higher external surface reflections compared to those with low RI (RI = 1.45 ± 0.02). Ultraviolet or blue light-filtering functions showed no significant correlation with the external reflectance.

Conclusions: IOLs with a high RI are associated with external surface reflections that are more than threefold higher than those with lower RI. The "cat's eye" phenomenon seen in pseudophakic eyes by an outside observer strongly depends on the RI, but is independent of the filter incorporated in the IOL. **[*J Refract Surg*. 2021;37(6):398-402.]**.

NEGATIVE DYSPHOTOPSIA

What is it and when do you see it?

A dark geometric arc the patient is aware of in the temporal visual field under many normal lighting conditions.

Early ND after cataract surgery is fairly common and usually resolves spontaneously within a few weeks.

WHAT CAUSES NEGATIVE DYSPHOTOPSIA?

Many different theories….

Osher- incision

Masket; shadow cast by the rhexis

Holladay 2012 : posterior surface of the lens edge

Coroneo 2003

Ray Tracing study of Dysphotopsia

Off-axis edge glare in pseudophakic dysphotopsia

Minas T. Coroneo, MD, FRANZCO, FRACS, Therese Pham, L. Stephen Kwok, PhD

Purpose: To characterize peripheral light focusing of oblique off-axis light in the edge-glare phenomenon associated with pseudophakic dysphotopsia.

Setting: Department of Ophthalmology, Prince of Wales Hospital, The University of New South Wales, Sydney, Australia.

Methods: Nonsequential optical ray-tracing (OptiCAD) was performed on a model pseudophakic human eye with an intraocular lens (IOL). The acrylic IOL had an anterior radius of 14.23 mm, posterior radius of 25.00 mm, center thickness of 0.72 mm, diameter of 6.00 mm, and refractive index of 1.5597. Peripheral light focusing caused by off-axis light was calculated for light rays incident on the temporal cornea at angles between 0 degrees and 120 degrees to the sagittal plane.

Results: Light incident on the temporal cornea at oblique angles was able to strike the nasal portion of the IOL and the nasal retina. The focusing gain was 2.56 times the incident intensity. The critical incidence window at the temporal cornea was between 71 degrees and 89 degrees to the sagittal plane. The light-focusing effect created foci of light in the nasal edge region of the IOL. In the mid range of permissive angles, up to 3 secondary images were formed, some of which may be apparent only under scotopic conditions.

Conclusion: Off-axis light incident at the temporal cornea formed intense foci in the nasal edge of the IOL. Multiple secondary images can be formed. These spots constitute glare sources and may be of sufficient intensity to disturb vision. These findings indicate that off-axis light may be an important contributor to some disability glare problems and that IOL edge design should be reevaluated to minimize dysphotopsia associated with peripheral focusing effects.

J Cataract Refract Surg 2003; 29:1969–1973 © 2003 ASCRS and ESCRS

Coroneo 2003

Ray Tracing study of Dysphotopsia

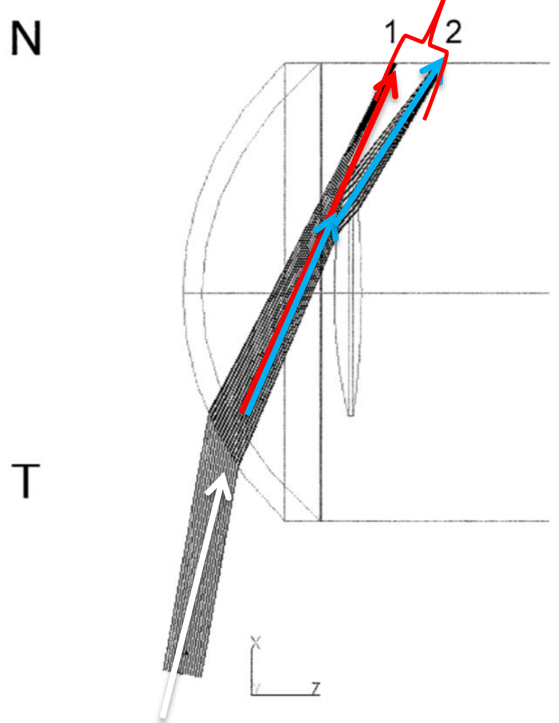
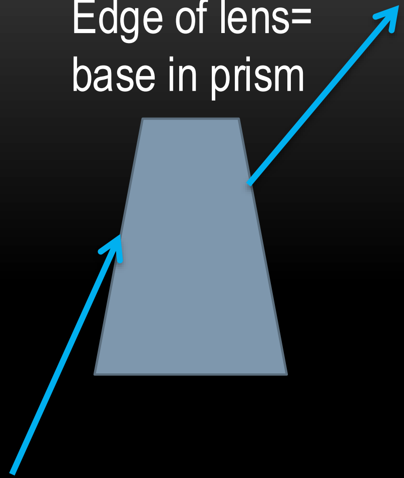
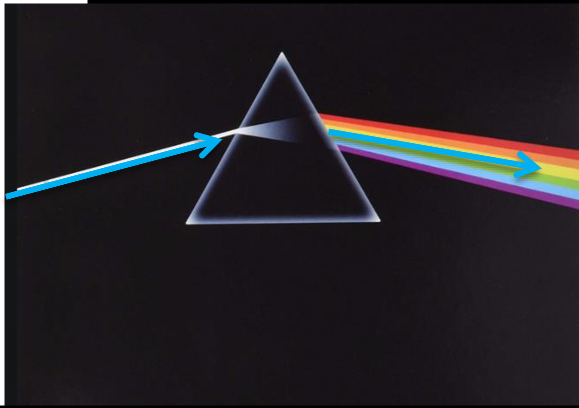


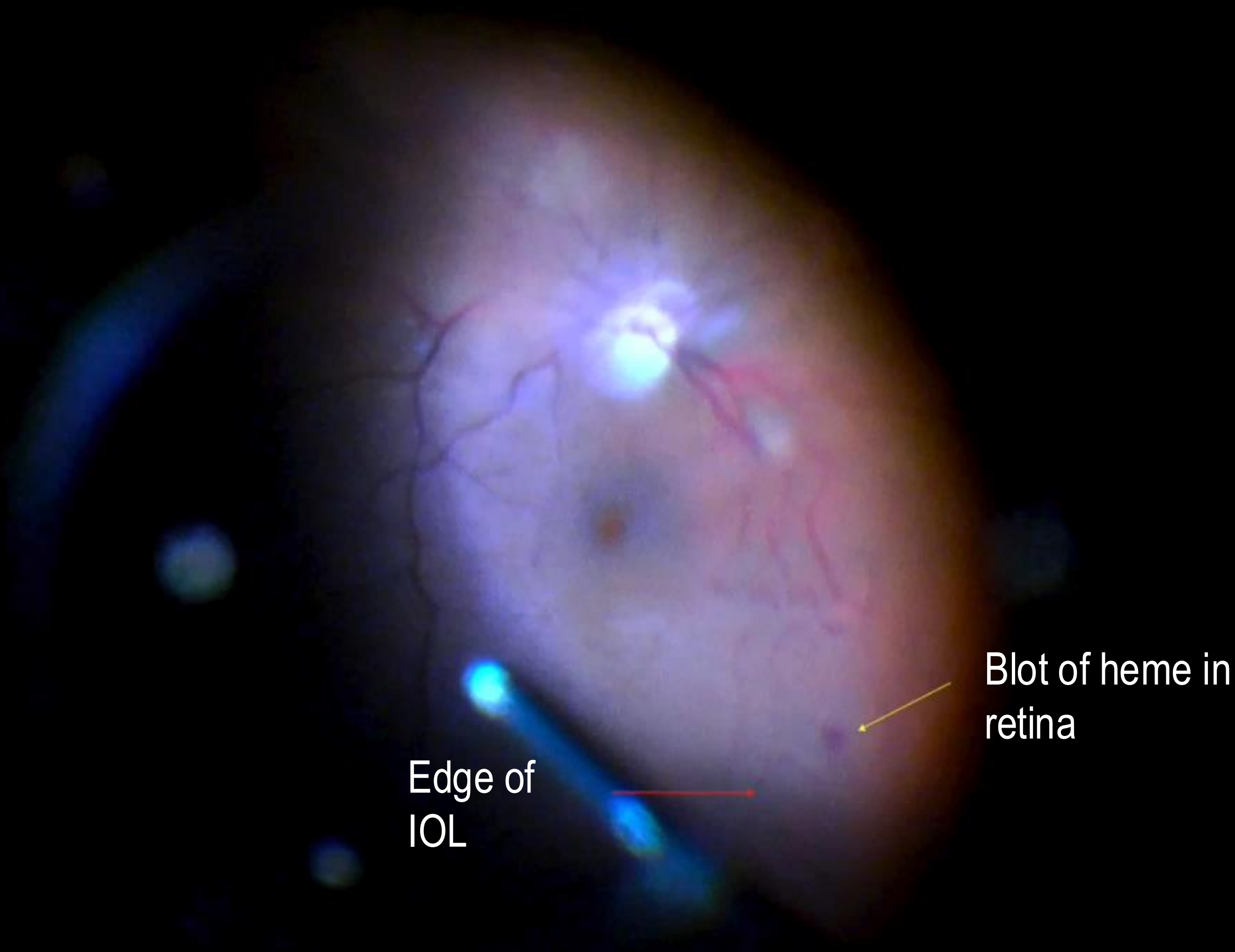
Figure 2. (Coroneo) Layout of model calculation showing oblique rays striking temporal limbus (T) and converged by the limbal convexity to intense foci on the nasal side (N) of the eye. In this bundle of rays (incident at an 80-degree angle to the visual *z*-axis), many bypass the front of the IOL optic to form focal area 1 while the rest strike the front surface of the IOL optic and are refracted to form focal area 2. Note the penumbra between the 2 foci.

Edge of lens= base in prism





Intraoperative view during PPV (SPA lens)



Holladay
2012

Negative dysphotopsia: The enigmatic penumbra

Jack T. Holladay, MD, MSEE, Huawei Zhao, PhD, Carina R. Reisin, PhD

PURPOSE: To determine the cause of negative dysphotopsia and the location, appearance, and relative intensity of such images in pseudophakic eyes.

SETTING: Baylor College of Medicine, Houston, Texas, USA.

DESIGN: Reporting available data addressing a specific clinical question.

METHODS: Negative dysphotopsia was simulated using the Zemax optical design program. The nominal values for the pseudophakic eye model were as follows: IOL power, 20.0 diopters (D); corneal power, 43.5 D; Q value, −0.26; axial IOL depth behind pupil, 0.5 mm; external anterior chamber depth (corneal vertex to iris plane), 4.0 mm; optic diameter, 6.0 mm; pupil diameter, 2.5 mm.

RESULTS: From the first ray-tracing simulation, analysis of the image for the nominal parameters showed 2 annuli (ring-shaped) shadows. The inner annulus shadow was located from a retinal visual field angle of 86.0 to 100.0 degrees (width 14.0 degrees), and the outer annular shadow was located from 105.9 to 123.3 degrees (width 17.4 degrees). Superimposing the inner annulus on the human visual field showed that the shadow would be apparent only temporally, where it is within the limits of the visual field and functional retina. The patient would perceive this as a temporal dark crescent-shaped partial shadow (penumbra).

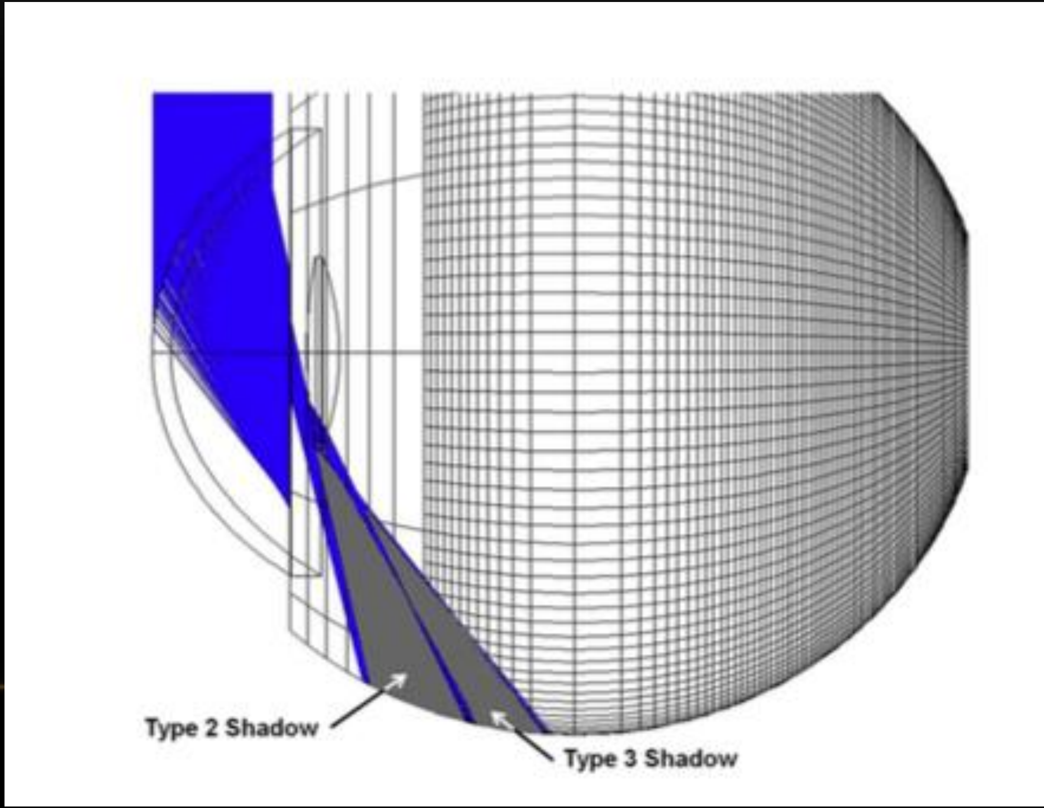
CONCLUSIONS: Primary optical factors required for negative dysphotopsia are a small pupil, a distance behind the pupil of 0.06 mm or more and 1.23 mm or less for acrylic, a sharp-edged design, and functional nasal retina that extends anterior to the shadow. Secondary factors include a high index of refraction optic material, angle α, and the nasal location of the pupil relative to the eye's optical axis.

Financial Disclosure: Drs. Zhao and Reisin are employees of and Dr. Holladay is a consultant to Abbott Medical Optics, Inc. No author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2012; 38:1251–1265 © 2012 ASCRS and ESCRS

HOLLADAY 2012: RAY TRACING

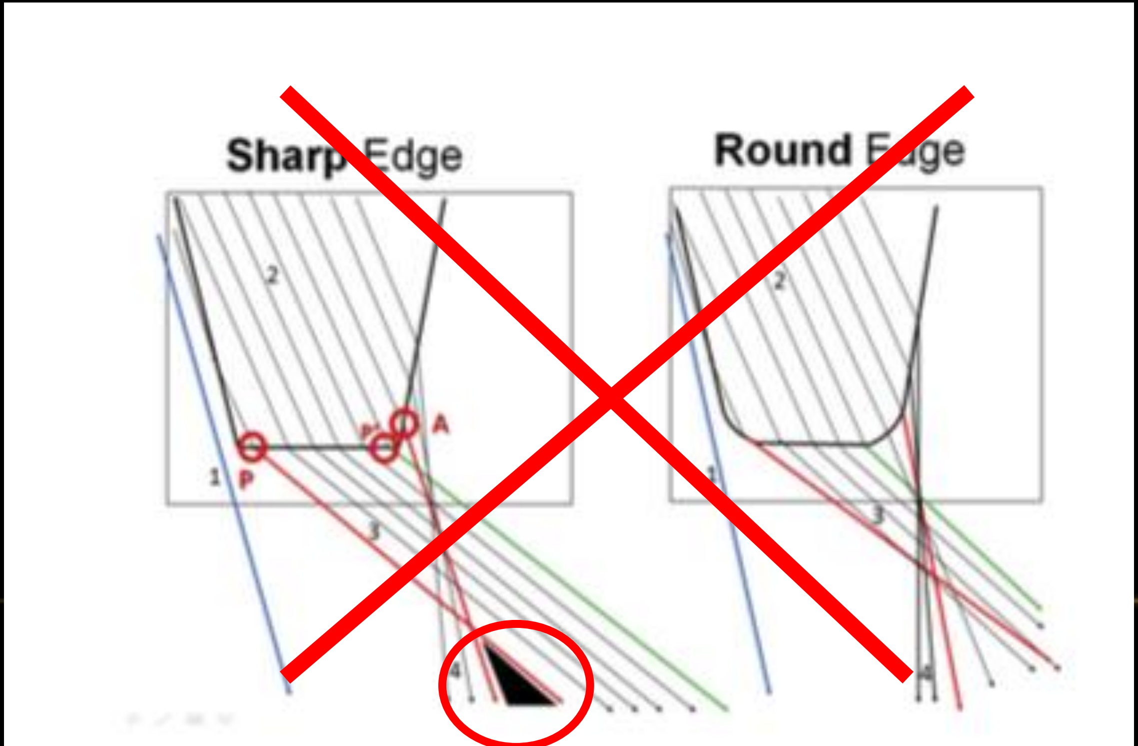
TYPE 3 SHADOW From light hitting posterior surface of nasal IOL edge " causes ND shadow"



TYPE 3 SHADOW FROM SHARP POSTERIOR EDGE

2012 Holladay believed this was cause of ND shadow

In 2017 he throws this idea out!



Negative dysphotopsia: Causes and rationale for prevention and treatment

Jack T. Holladay, MD, MSEE, Michael J. Simpson, PhD

Purpose: To determine the cause of negative dysphotopsia using standard ray-tracing techniques and identify the primary and secondary causative factors.

Setting: Department of Ophthalmology, Baylor College of Medicine, Houston, Texas, USA.

Design: Experimental study.

Methods: Zemax ray-tracing software was used to evaluate pseudophakic and phakic eye models to show the location of retinal field images from various visual field objects. Phakic retinal field angles (RFAs) were used as a reference for the perceived field locations for retinal images in pseudophakic eyes.

Results: In a nominal acrylic pseudophakic eye model with a 2.5 mm diameter pupil, the maximum RFA from rays refracted by the intraocular lens (IOL) was 85.7 degrees and the minimum RFA for rays missing the optic of the IOL was 88.3 degrees, leaving a dark gap (shadow) of 2.6 degrees in the extreme temporal field. The width of the shadow was more prominent for a smaller pupil, a larger angle kappa, an equi-biconvex or plano-convex IOL shape, and a smaller axial distance from iris to IOL and with the anterior capsule overlying the nasal IOL. Secondary factors included IOL edge design, material, diameter, decentration, tilt, and aspheric surfaces.

Conclusions: Standard ray-tracing techniques showed that a shadow is present when there is a gap between the retinal images formed by rays missing the optic of the IOL and rays refracted by the IOL. Primary and secondary factors independently affected the width and location of the gap (or overlap). The ray tracing also showed a constriction and double retinal imaging in the extreme temporal visual field.

J Cataract Refract Surg 2017; 43:263–275

HOLLADAY 2017 RAY TRACING STUDY EXAMINED LIGHT RAYS THAT PASS THROUGH THE NASAL EDGE OF THE IOL VS LIGHT RAYS THAT GO AROUND IT

With certain IOLs under certain conditions there is a gap between the two and a shadow is created.

Coroneo 2003

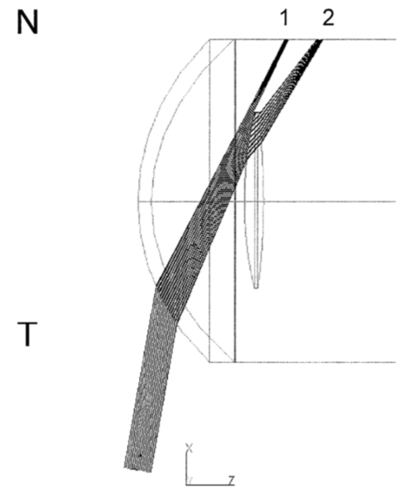
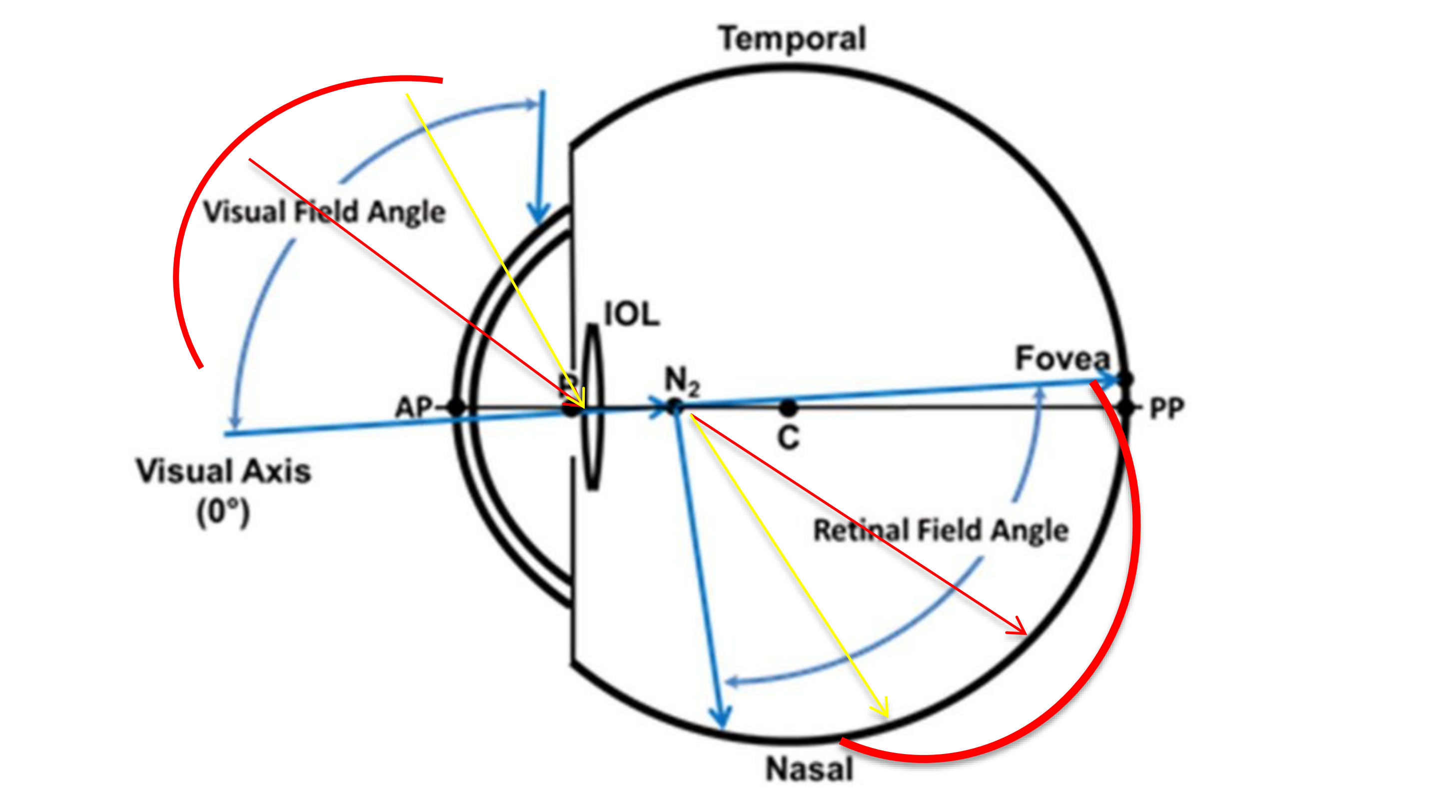


Figure 2. (Coroneo) Layout of model calculation showing oblique rays striking temporal limbus (T) and converged by the limbal convexity to intense foci on the nasal side (N) of the eye. In this bundle of rays (incident at an 80-degree angle to the visual *z*-axis), many bypass the front of the IOL optic to form focal area 1 while the rest strike the front surface of the IOL optic and are refracted to form focal area 2. Note the penumbra between the 2 foci.

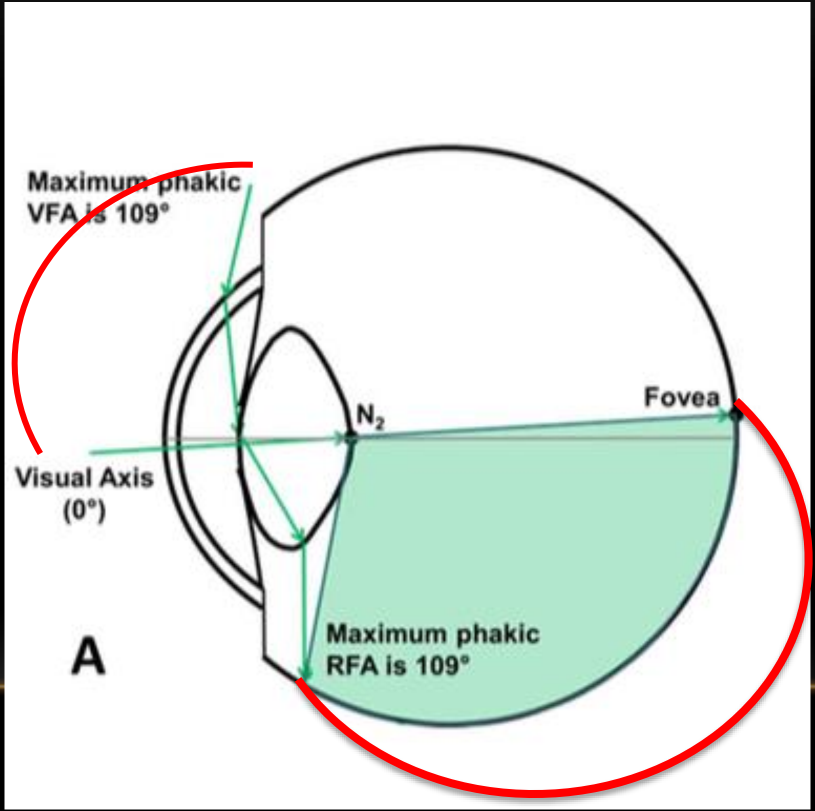
RAY TRACING ANALYSIS:

VISUAL FIELD ANGLE= angle at which light hits the cornea= VFA

RETINA FIELD ANGLE=angle at which light is projected onto the retina= RFA

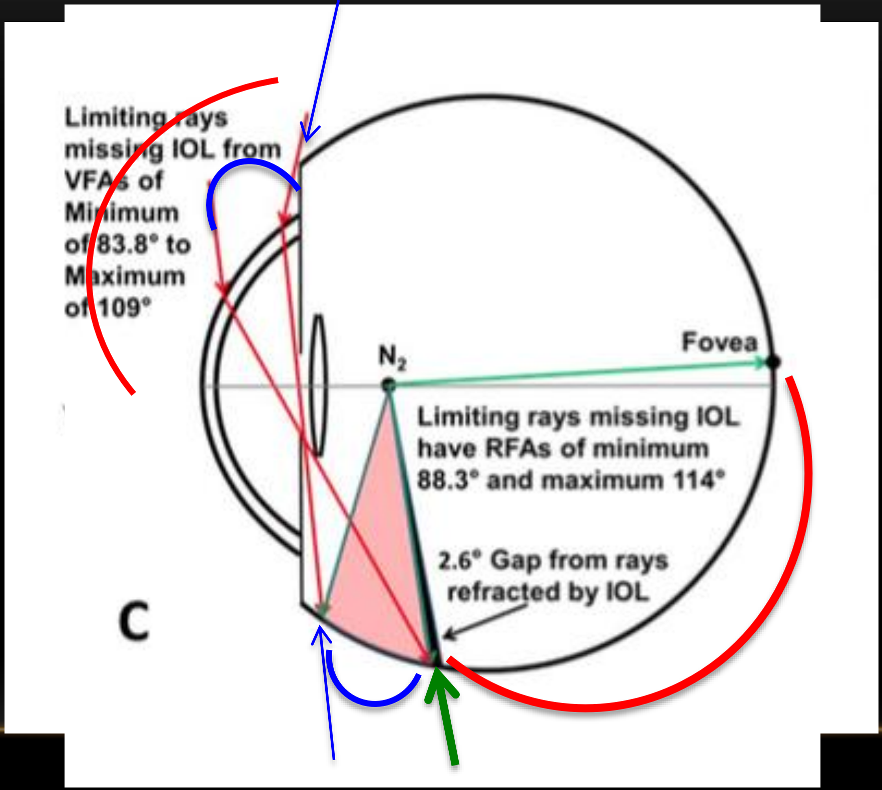


PHAKIC EYE: LIGHT CAN'T GET AROUND THE LENS



PSEUDOPHAKIC EYE: BEYOND A CERTAIN VFA YOU MISS THE LENS.....LIGHT GOES AROUND IT

2.5mm pupil



RED Curve= light rays passing through IOL

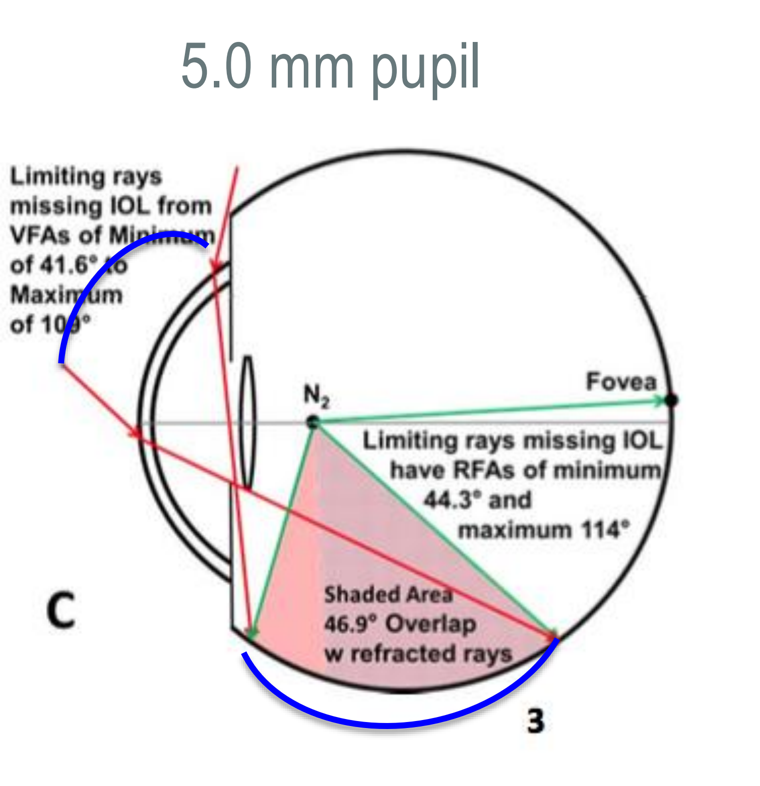
Blue Curve= light rays missing the IOL

Green gap is the ND shadow!

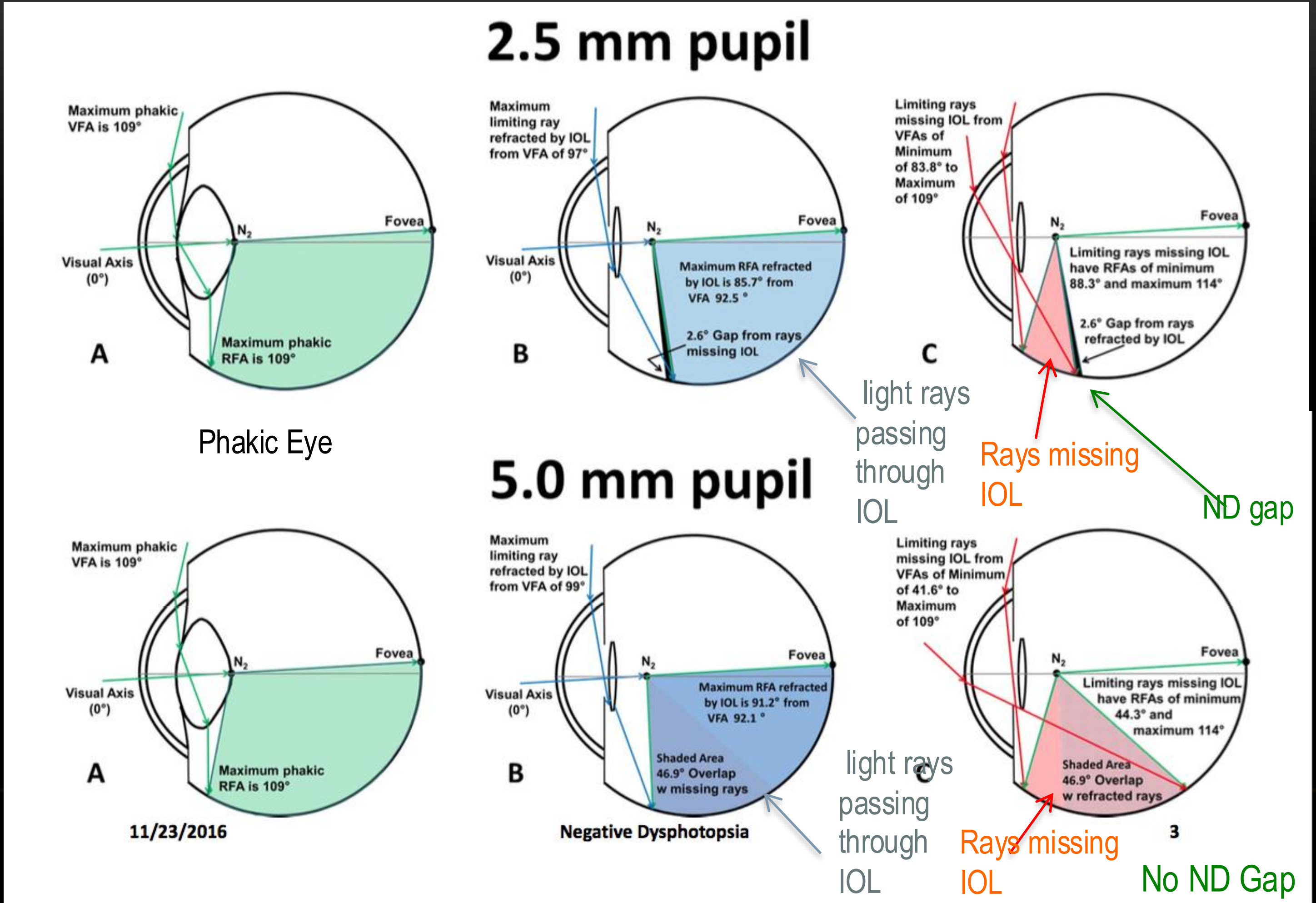
ND SHADOW IS THE GAP (SCOTOMA) BETWEEN THE MOST ANTERIOR LIGHT RAY THAT HAS PASSED THROUGH THE EDGE OF THE IOL AND THE MOST POSTERIOR RAY LIGHT RAY THAT GOES AROUND THE IOL (I.E. THROUGH THE PERIPHERAL CAPSULE)

Think of doing indirect Ophthalmoloscopy with a 20D lens….trying to look around the edge of an IOL to see something

LARGER PUPIL : THIS GAP CHANGES!



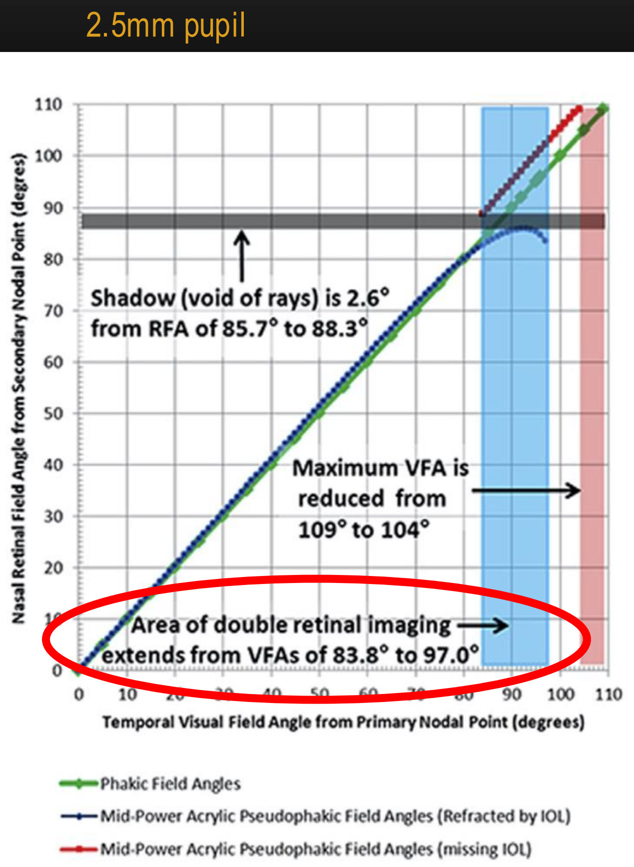
Light can now get past the iris edge, around the lens and fill in the ND gap!

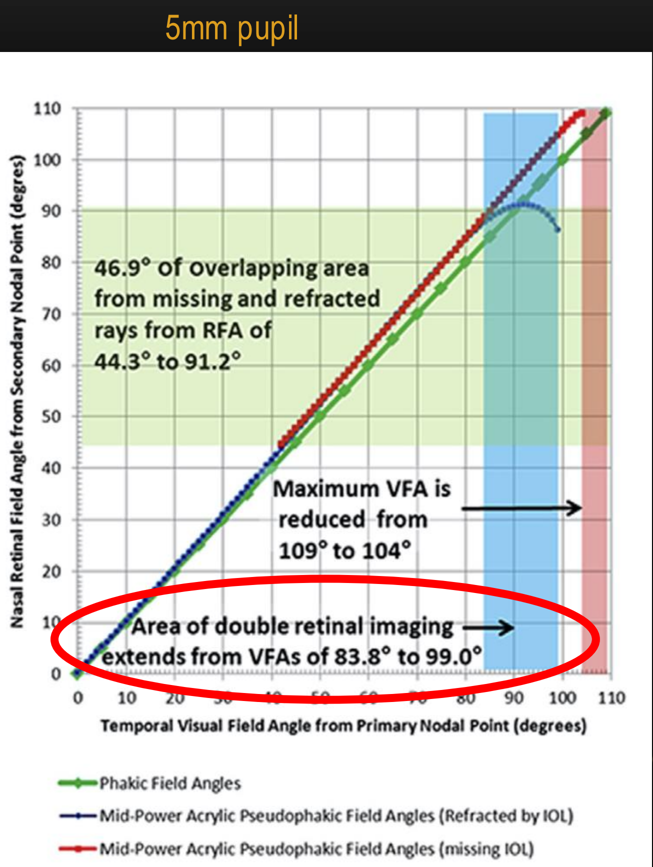

2.5 mm pupil
Maximum phakic VFA is 109°
Visual Axis (0°)
N_2
Fovea
Maximum phakic RFA is 109°
A
Phakic Eye
Maximum limiting ray refracted by IOL from VFA of 97°
Visual Axis (0°)
Maximum RFA refracted by IOL is 85.7° from VFA 92.5 °
2.6° Gap from rays missing IOL
B
Limiting rays missing IOL from VFAs of Minimum of 83.8° to Maximum of 109°
Limiting rays missing IOL have RFAs of minimum 88.3° and maximum 114°
2.6° Gap from rays refracted by IOL
C
light rays passing through IOL
Rays missing IOL
ND gap
5.0 mm pupil
Maximum phakic VFA is 109°
Visual Axis (0°)
Maximum phakic RFA is 109°
A
11/23/2016
Maximum limiting ray refracted by IOL from VFA of 99°
Visual Axis (0°)
Maximum RFA refracted by IOL is 91.2° from VFA 92.1 °
Shaded Area 46.9° Overlap w missing rays
B
Negative Dysphotopsia
Limiting rays missing IOL from VFAs of Minimum of 41.6° to Maximum of 109°
Limiting rays missing IOL have RFAs of minimum 44.3° and maximum 114°
Shaded Area 46.9° Overlap w refracted rays
C
light rays passing through IOL
Rays missing IOL
3
No ND Gap

SMALL PUPIL MAKES ND SHADOW MORE PROMINENT

True negative dysphotopsia almost always relieved by dilating the pupil…..washes out the ND shadow.

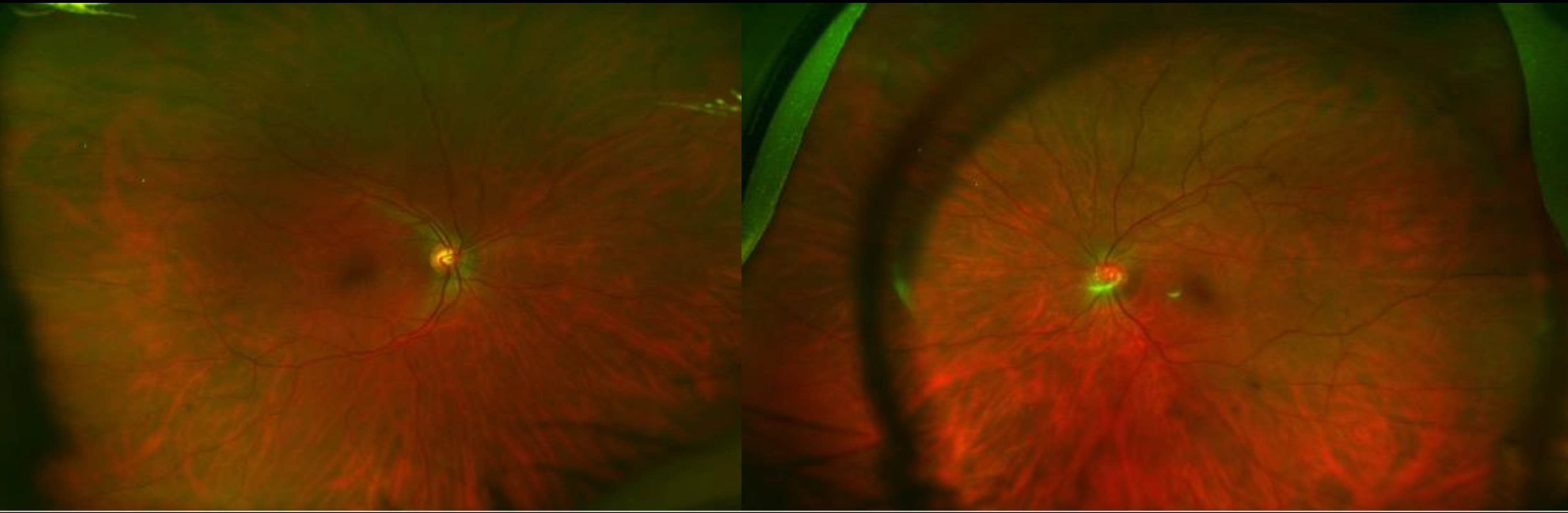
HOLLADAY 2017 SHOWED AREA OF PERIPHERAL DOUBLE IMAGING ON RETINA





THINK OF EDGE OF IOL AS A 360 DEGREE BASE IN PRISM

Many patients are also bothered by a sense of visual field constriction or “distortion”



A modified intraocular lens design to reduce negative dysphotopsia

Jay C. Erie, MD, Michael J. Simpson, PhD, Mark H. Bandhauer, MS

Purpose: To use ray-tracing analysis and simulated retinal illumination profiles to design an intraocular lens (IOL) that prevents or reduces negative dysphotopsia after cataract surgery.

Setting: Mayo Clinic, Rochester, Minnesota, and Simpson Optics LLC, Arlington, Texas, USA.

Design: Experimental study.

Methods: Ray-tracing software was used to simulate peripheral retina illumination from an extended light source for a pseudophakic eye with a biconvex high refractive index IOL. Ray intensities were adjusted to include the effects of the surface reflections and the energy reduction caused by pupil obliquity at high incident angles. The results were compared with similar optical modeling of a modified IOL design with a concave region on the peripheral posterior surface.

Results: For a standard biconvex high refractive index IOL, simulated retina illumination profiles showed an area of nonilluminated peripheral nasal retina at a relative visual angle of approximately 85 degrees to 93 degrees. Using a modified IOL optic with a peripheral concave posterior surface, ray-tracing diagrams showed that peripheral input rays were redirected anteriorly into the nonilluminated dark area of the peripheral retina. Simulated retina illumination images confirmed that the redirected input rays improved illumination to the peripheral retina, including the dark area.

Conclusions: Optical modeling showed that the new IOL design provides more uniform illumination of the peripheral nasal retina and specifically illuminates the dark region of the nasal retina associated with negative dysphotopsia. This modified IOL design could prevent or reduce negative dysphotopsia after cataract surgery.

J Cataract Refract Surg 2019; 45:1013–1019 © 2019 ASCRS and ESCRS

MODIFICATION TO EDGE OF LENS: REDUCES BASE IN PRISM

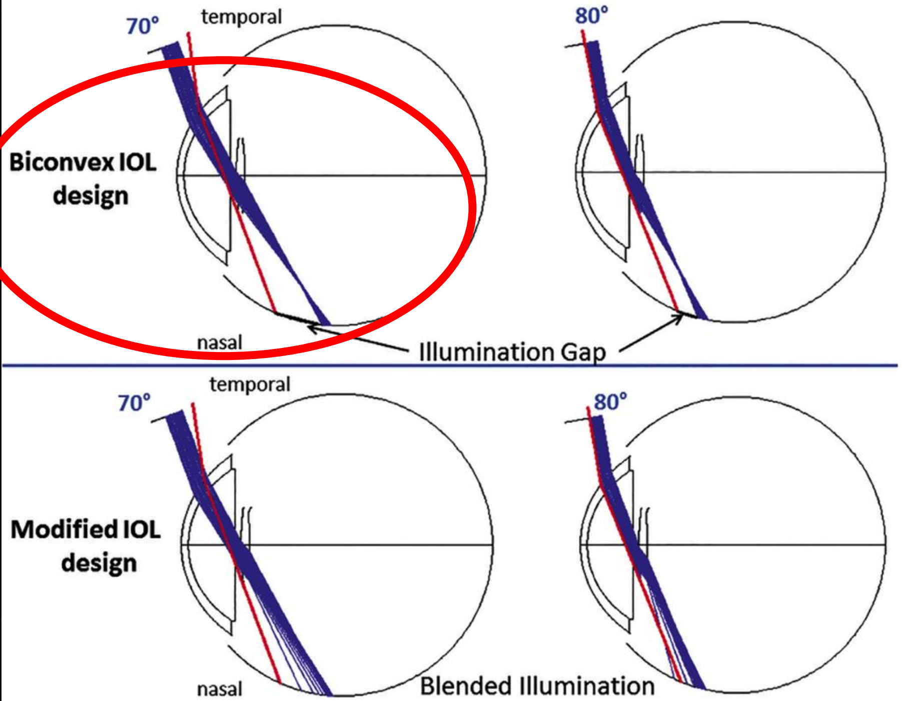
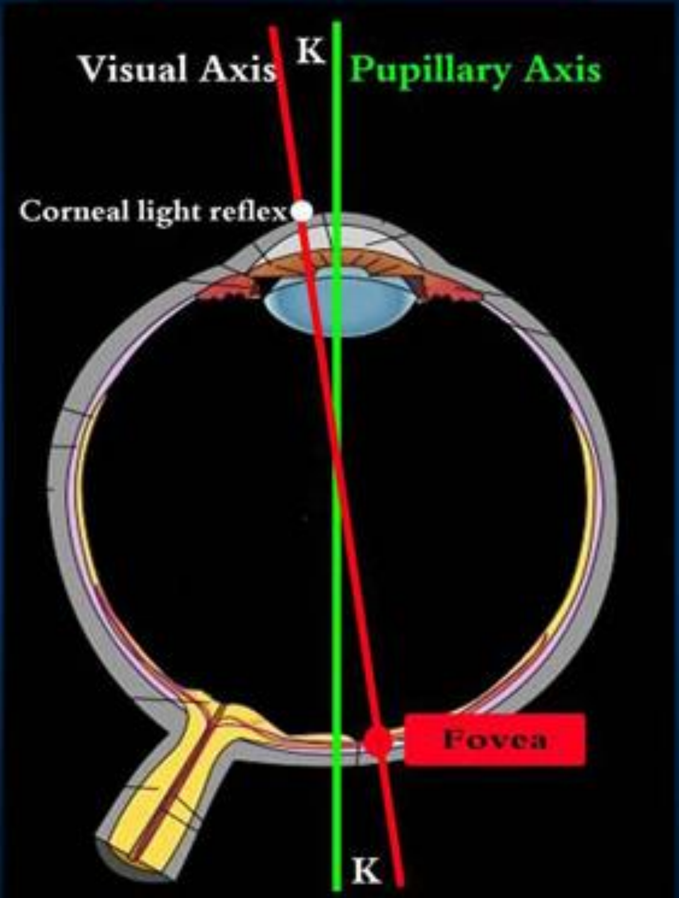


Figure 4. Ray-tracing diagrams of input light rays at 70 degrees and 80 degrees to the visual axis in a standard biconvex IOL (*top*) and in our modified IOL with a peripheral posterior concave surface (*bottom*). The thinner red lines represent the first rays missing the IOL and reaching the retina. The thicker bundles of blue lines represent the last rays refracted by the IOL optic. The black retina regions between the red and blue ray bundles in the top drawings represent an area absent of light rays, or an illumination gap. The modified IOL's peripheral posterior concave surface (*bottom*) redirects some input light rays anteriorly into the illumination gap. These eye and ray drawings are horizontal cross-sections, viewed from the top looking down (IOL = intraocular lens).

OTHER FACTORS LOOKED AT IN 2017 HOLLADAY RAY TRACING STUDY:

- Angle Kappa
- Rhexis overlap
- Distance of lens from iris
- IOL power
- IOL material
- IOL shape

Angle Kappa



Large +ve angle Kappa

Apparent XT

- Decentered light reflex
- No shift on cover test

HIGH ANGLE KAPPA: INCREASED ND SHADOW

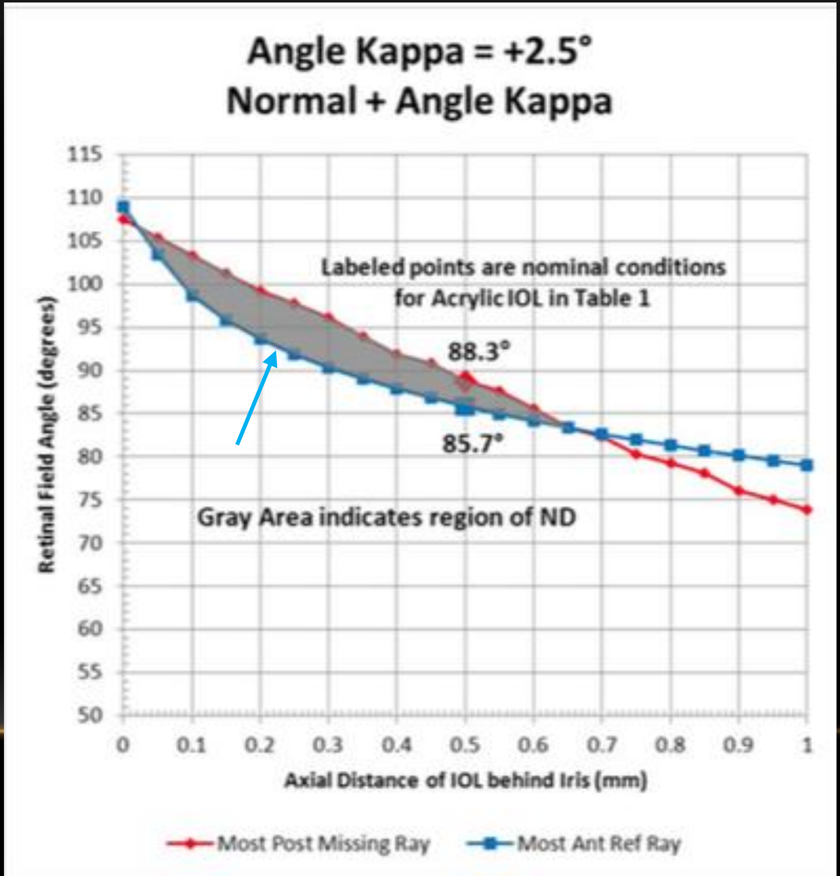
Visual axis closer to nasal pupil edge so harder for light to get around edge of lens to wash out the ND shadow….like having a smaller pupil

IOL DISTANCE FROM IRIS PLAYS A ROLE IN SIZE AND POSITION OF SHADOW

Blue : Most anterior ray passing through IOL RFA

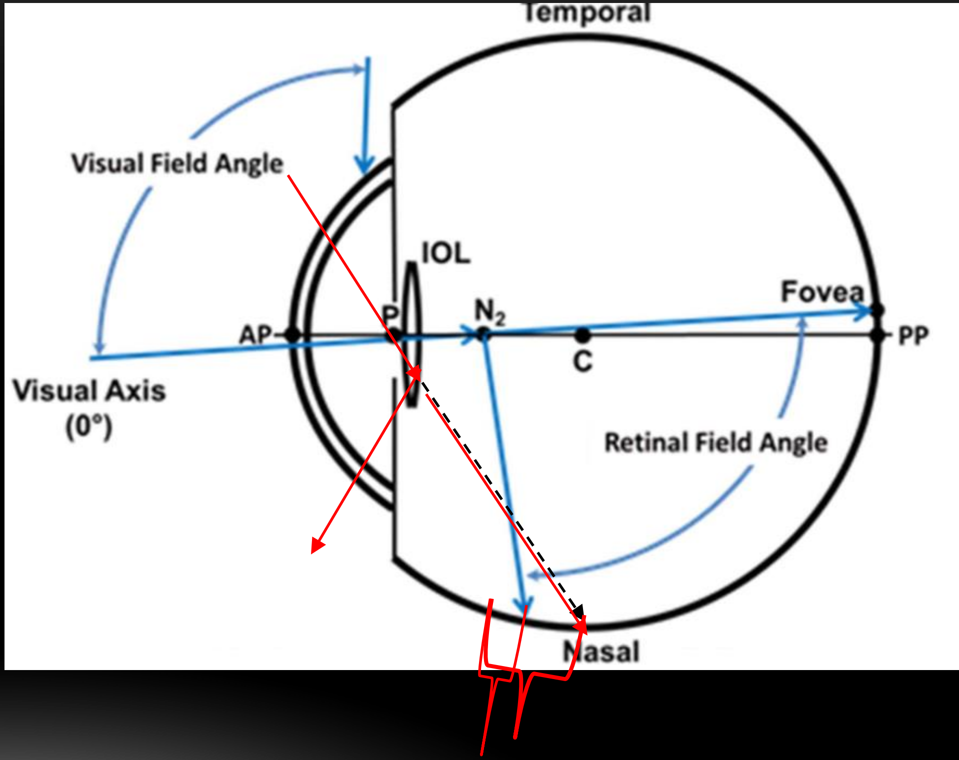
Red: Most posterior ray that goes around the IOL RFA

Grey= area of ND



Rhexis Overlap

- Rhexis increases reflectance of light hitting the IOL at an incident angle.
- If light rays reflect off rather than pass through edge of lens this potentially increases the size of the negative dysphotopsia shadow.
- Removing the nasal capsule over the optic may improve the situation (but not always…may highlight the shadow!)



HIGHER REFRACTIVE INDEX LENS MATERIALS ASSOCIATED WITH AN INCREASED ND GAP ON RAY TRACING

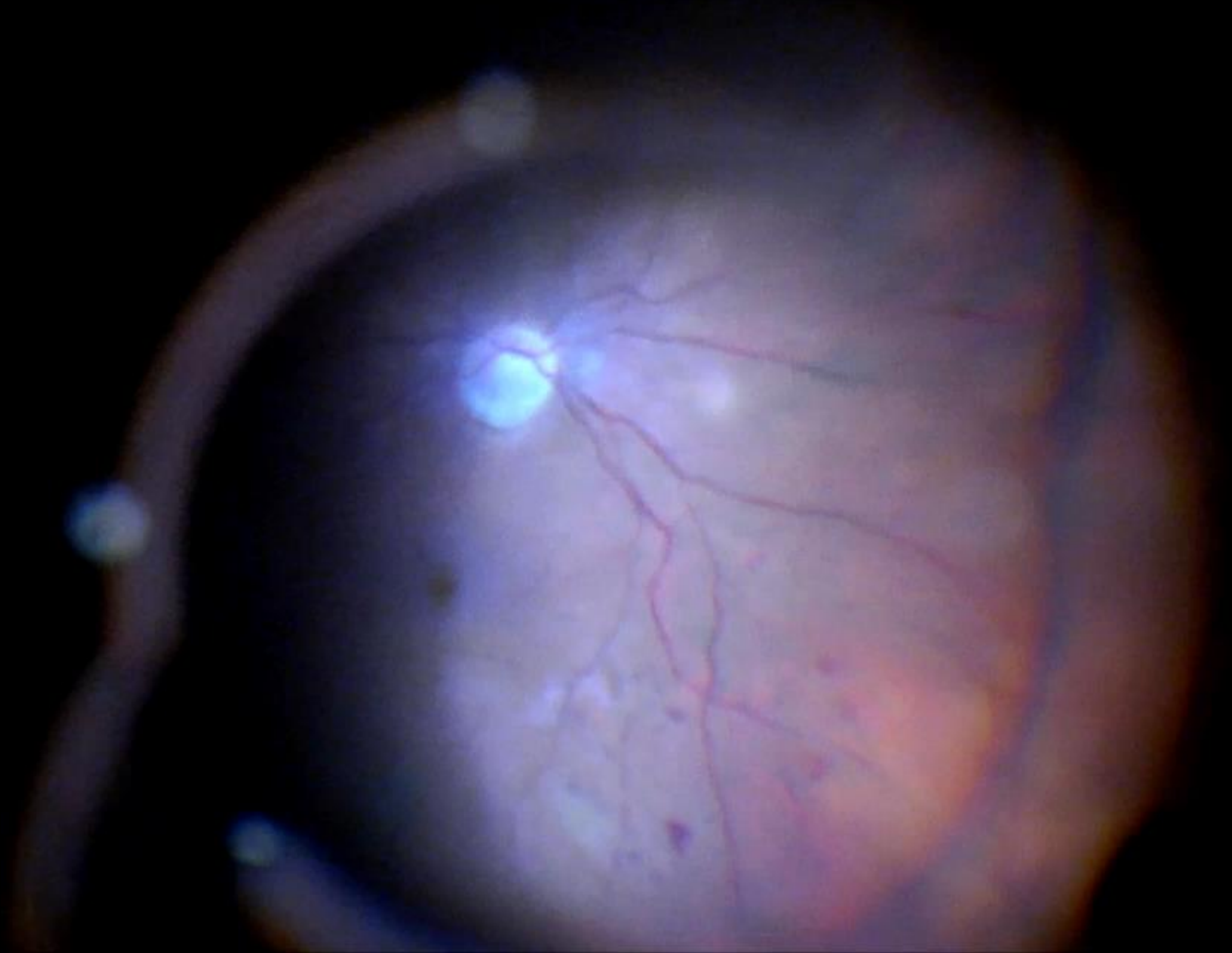
Lower risk of ND with Silicone than Acrylic

Alcon Acrysof acrylic =1.55 refractive index   J&J Tecnis Acrylic =1.47

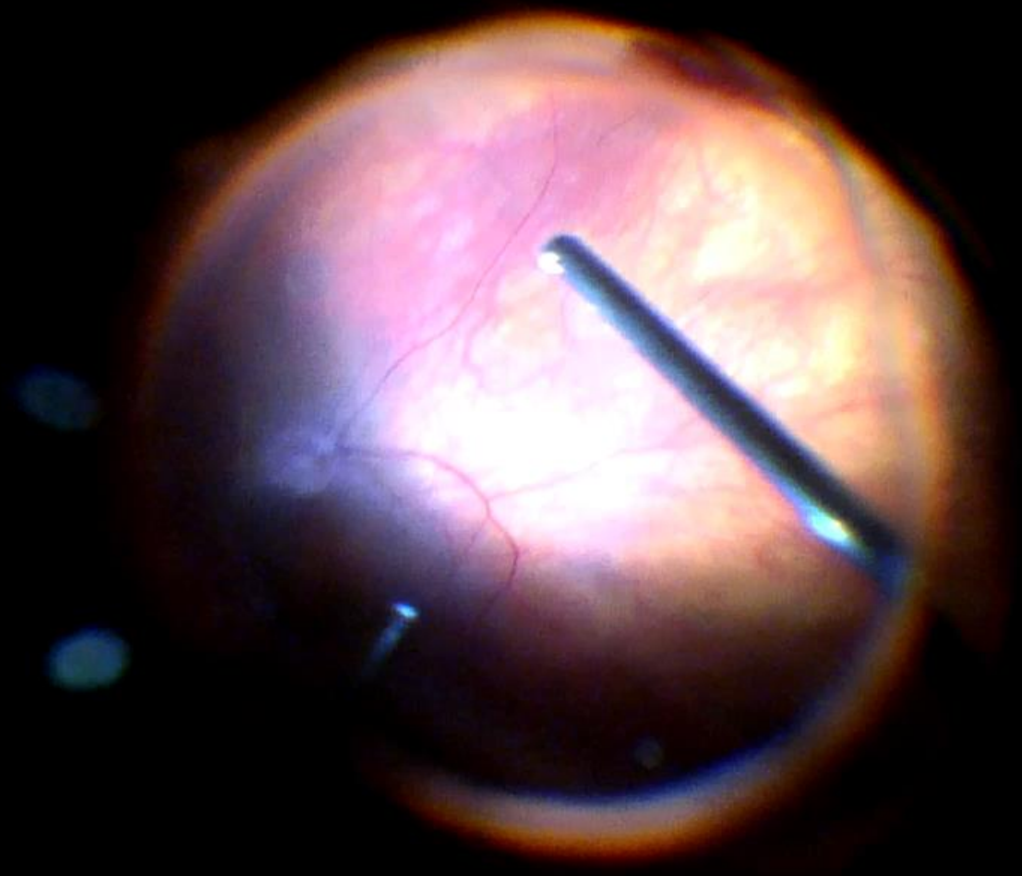
J&J Silicone = 1.46   B&L Silicone Li61A0 =1.429

Dysphotopsia killer!

Single
piece
acyrlic

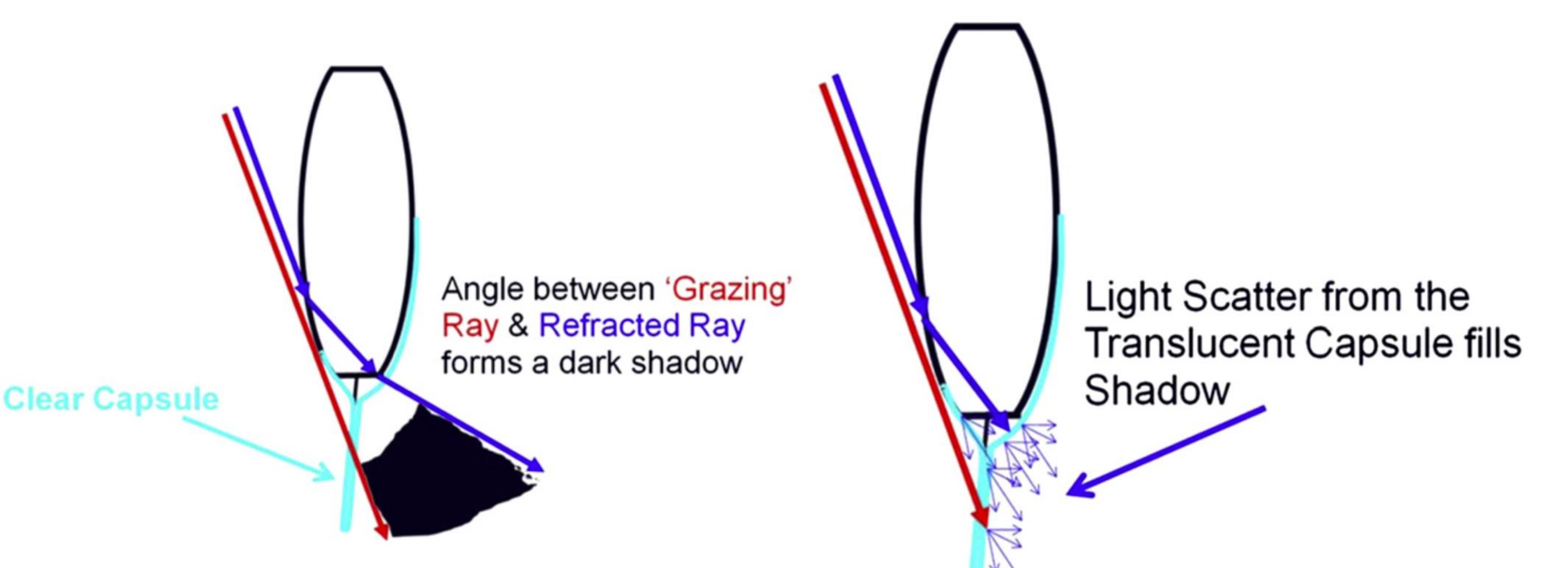


Softport A0
Silicone IOL
PPV



ANYTHING THAT ALLOWS LIGHT TO FILL IN THE SHADOW POTENTIALLY ELIMINATES IT

Dilating the pupil, diffusing the light , etc.



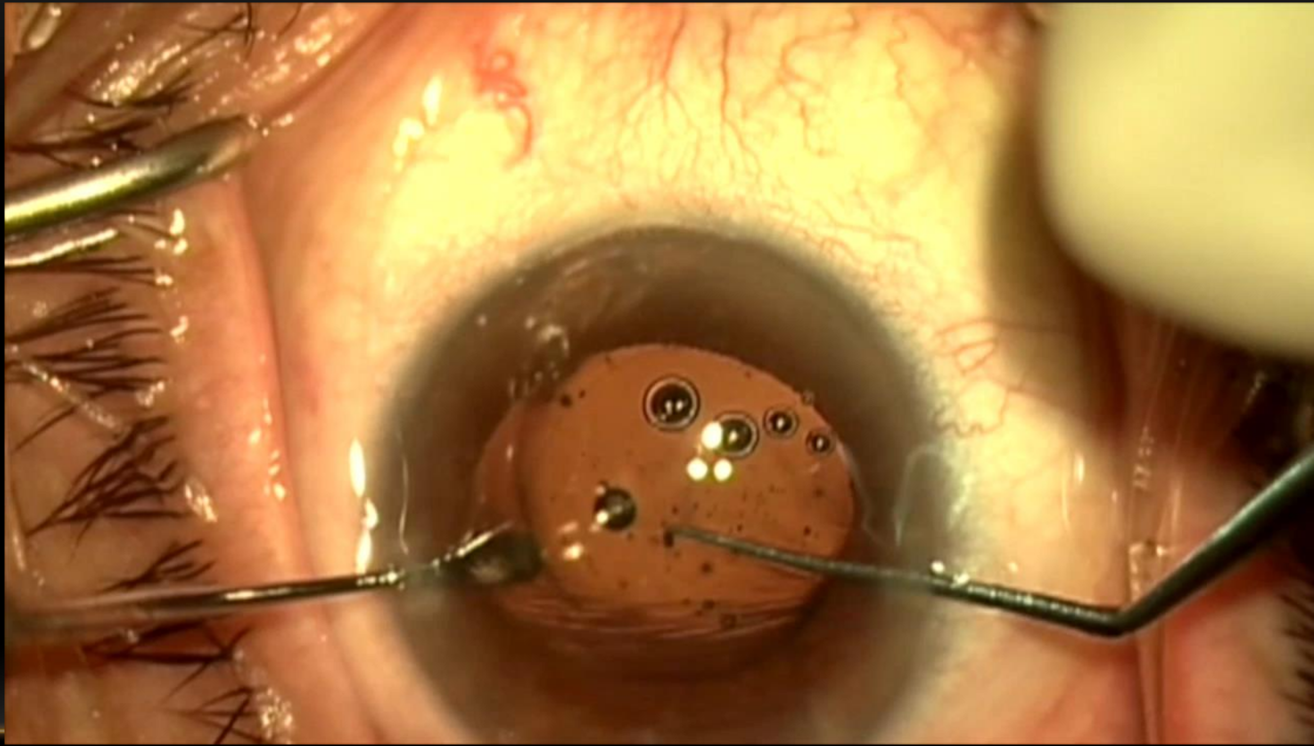
MOVING THE SHADOW MORE ANTERIORLY MAY REDUCE OR ELIMINATE IT AS WELL

Reverse optic capture, sulcus placement

“Classic Roc”

REVERSE OPTIC CAPTURE (ROC)

Haptics in the bag /optic prolapsed in front of anterior capsule most stable and effective IOL placement to avoid/treat ND

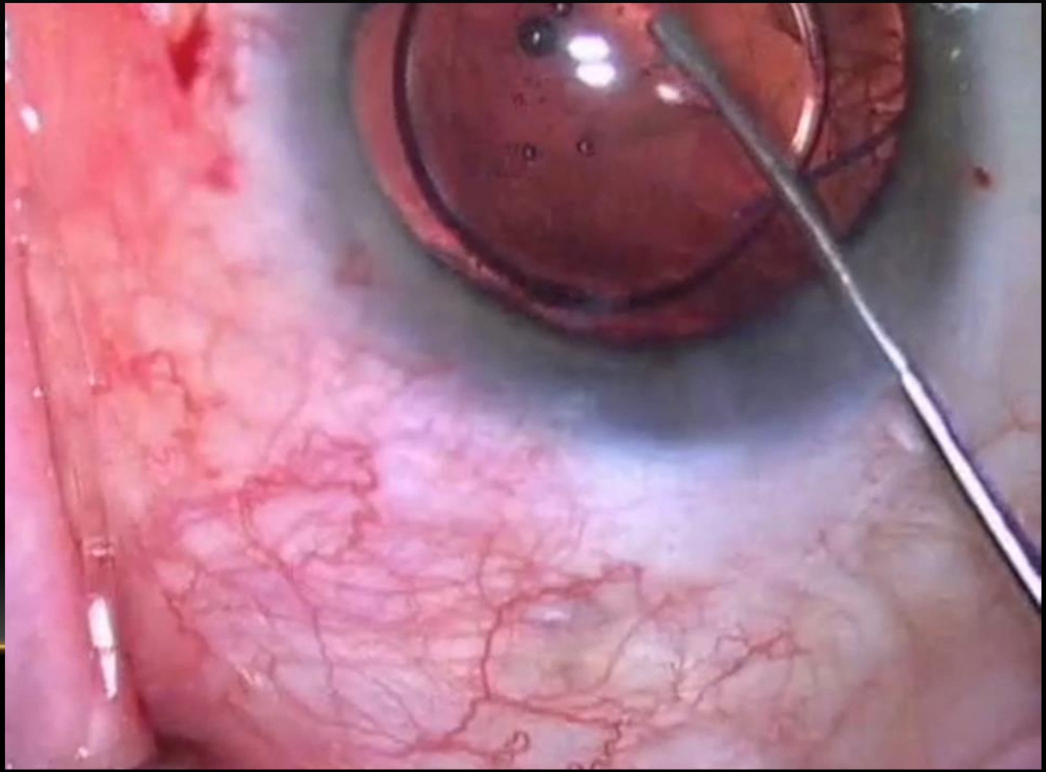


Optically equivalent to sulcus placement but with greater stability

NOT TO BE CONFUSED WITH STANDARD OPTIC CAPTURE (SOC)

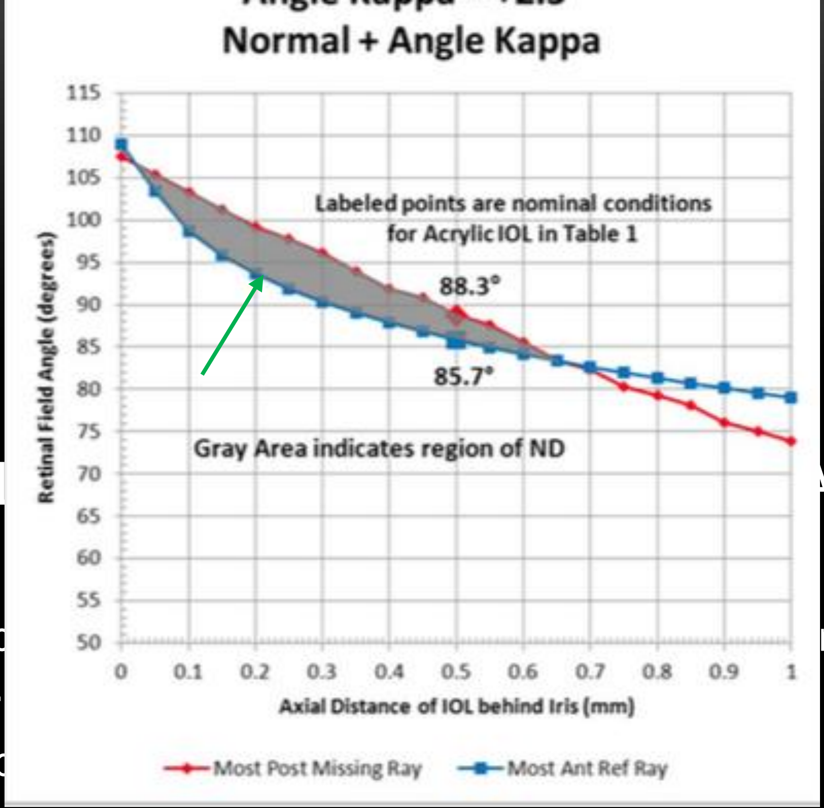
SOC- haptics in sulcus with optic behind the anterior capsule

This is optically equivalent to ”in the bag”



WHY IS ROC /SULCUS PLACEMENT EFFECTIVE FOR ELIMINATING ND?

ROC /SULCUS PL AYS



- Allows anterior and po n act to scatter/diffuse light….
- Moves the shadow mo
- Moves IOL anterior to the “optical sweet spot” distance from iris where shadow is greatest

HOW ABOUT A SULCUS PIGGYBACK LENS?

ARTICLE

Effect of a sulcus-fixated piggyback intraocular lens on negative dysphotopsia: Ray-tracing analysis

Jay C. Erie, MD, Michael J. Simpson, PhD, Mark H. Bandhauer, MS

Purpose: To use optical modeling to demonstrate how a sulcus-fixated piggyback intraocular lens (IOL) affects negative dysphotopsia.

Setting: Mayo Clinic, Rochester, Minnesota, USA.

Design: Retrospective case series.

Methods: Optical modeling was performed on 3 patients with negative dysphotopsia who were treated with a sulcus-fixated piggyback IOL. Ray-tracing software was used to simulate peripheral retina illumination preoperatively and postoperatively. Biometric data and ultrasound biomicroscopy images were used to construct eye models. Ray intensities were adjusted for surface reflections and normalized by cosine function to compensate for pupil obliquity at high incident angles.

Results: Preoperatively, retinal illumination profiles showed a region of dim or nonilluminated peripheral nasal retina at visual angles of approximately 83 to 95 degrees. A piggyback IOL shifted the iris anteriorly (mean 0.41 mm; range 0.37 to 0.47 mm) and the primary IOL posteriorly (mean 0.10 mm; range 0.05 to 0.19 mm) and increased the mean distance between the iris and primary IOL from 0.46 mm preoperatively to 0.75 mm postoperatively. This increased distance allowed input rays to begin missing the primary IOL at lower incident angles (≥76 degrees) compared with preoperatively (≥84 degrees), resulting in increased illumination of the peripheral retina. Illumination of the peripheral retina, including the preoperative dark area, was increased in 2 patients. The negative dysphotopsia shadow resolved in 2 eyes and was unchanged in 1 eye.

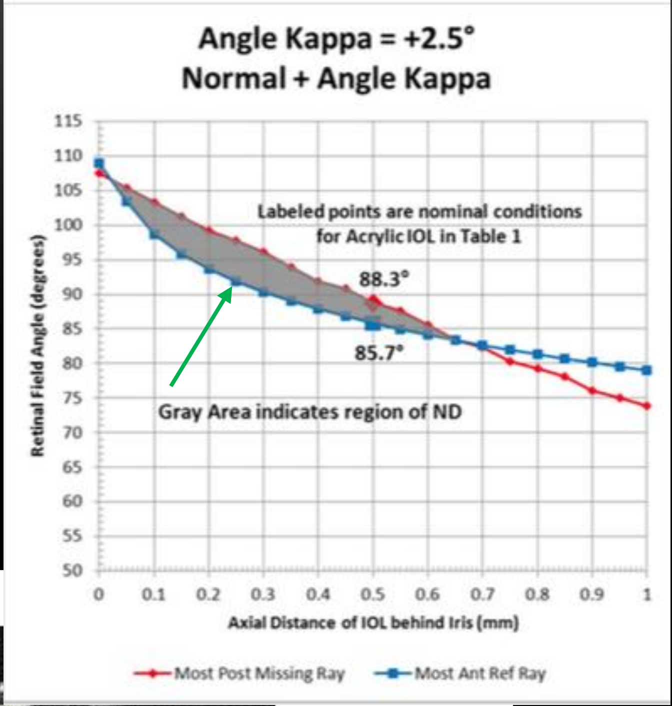
Conclusions: In negative dysphotopsia patients, a secondary piggyback IOL allowed additional light to miss the primary IOL and illuminate larger areas of peripheral retina. Increased illumination of the peripheral retina that included the preoperative dark region was associated with improved negative dysphotopsia postoperatively.

J Cataract Refract Surg 2019; 45:443–450

SULCUS PIGGYBACK:

Inconsistently effective

- Pushes iris forward slightly anteriorly (variable effect)
- Pushes primary IOL slightly posteriorly (variable effect)
- Increases distance between iris and primary IOL slightly



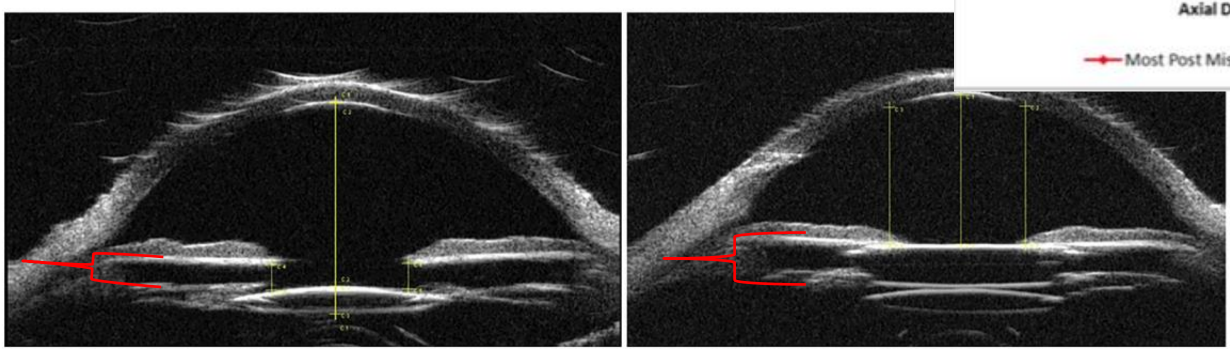


Figure 1. High-frequency ultrasound biomicroscopy measurements of patients with negative dysphotopsia used to construct ray-tracing and retina illumination models. *Left*: Preoperative image in Case 1. *Right*: Six weeks after a sulcus-fixated piggyback intraocular lens implantation.

What about haptic orientation?

Henderson 2016

ARTICLE

New preventative approach for negative dysphotopsia

Bonnie A. Henderson, MD, David Hyungjun Yi, MD, John B. Constantine, MD, Ivayla I. Geneva, MD, PhD

PURPOSE: To evaluate whether positioning the intraocular lens (IOL) to decrease the entry of inferotemporal light would decrease the incidence of negative dysphotopsia.

WHAT WAS KNOWN

- Negative dysphotopsia poses a great challenge to cataract surgeons because of the highly multifactorial nature of its occurrence and the unpredictable response to treatment, often resulting in multiple surgeries.

WHAT THIS PAPER ADDS

- Positioning a 1-piece acrylic IOL to decrease inferotemporal light entry resulted in a 2.3-fold decrease in the incidence of negative dysphotopsia after cataract surgery.

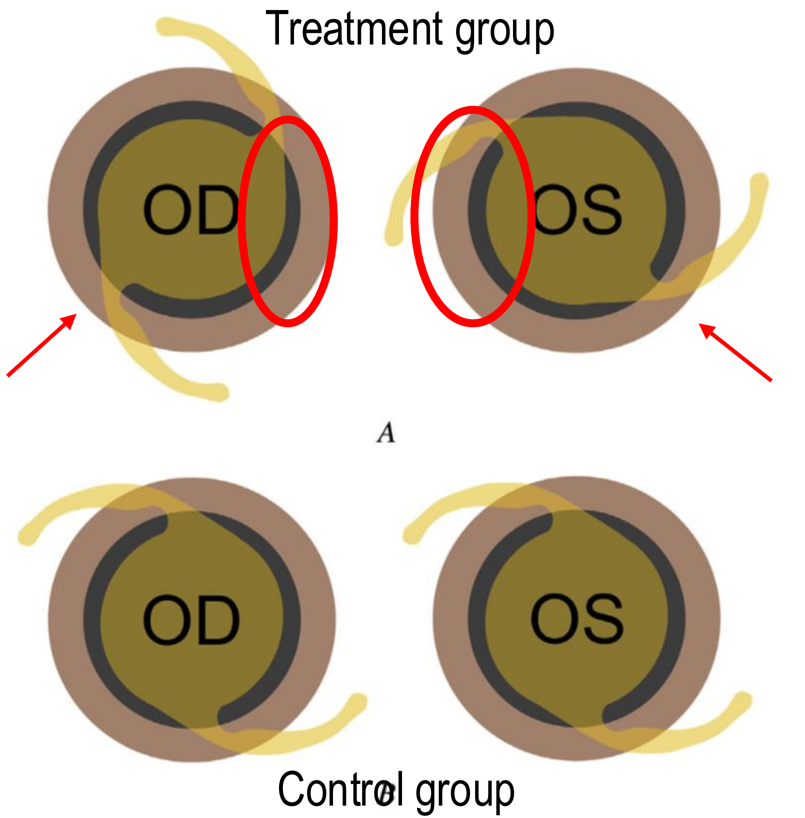


Figure 2. The orientations of the acrylic IOL. *A*: Inferotemporal 2 o'clock and 8 o'clock orientations in right eyes and 4 o'clock and 10 o'clock in left eyes. *B*: Control orientation 6 o'clock and 12 o'clock in right control eyes and left control eyes.

In this paper the focus was on maintaining a constant INFEROTEMPORAL haptic position

IT IS THE LIGHT INTERACTING WITH THE THE NASAL OPTIC (NOT INFERO TEMPORAL) THAT CAUSES THE ND SHADOW

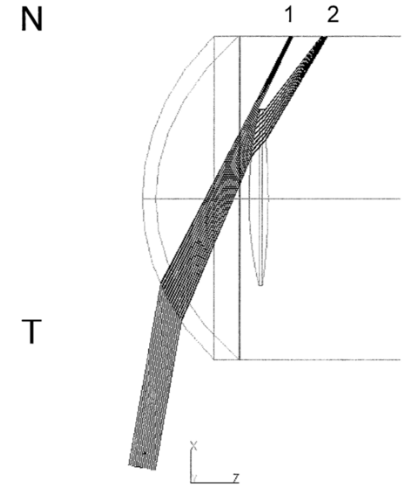
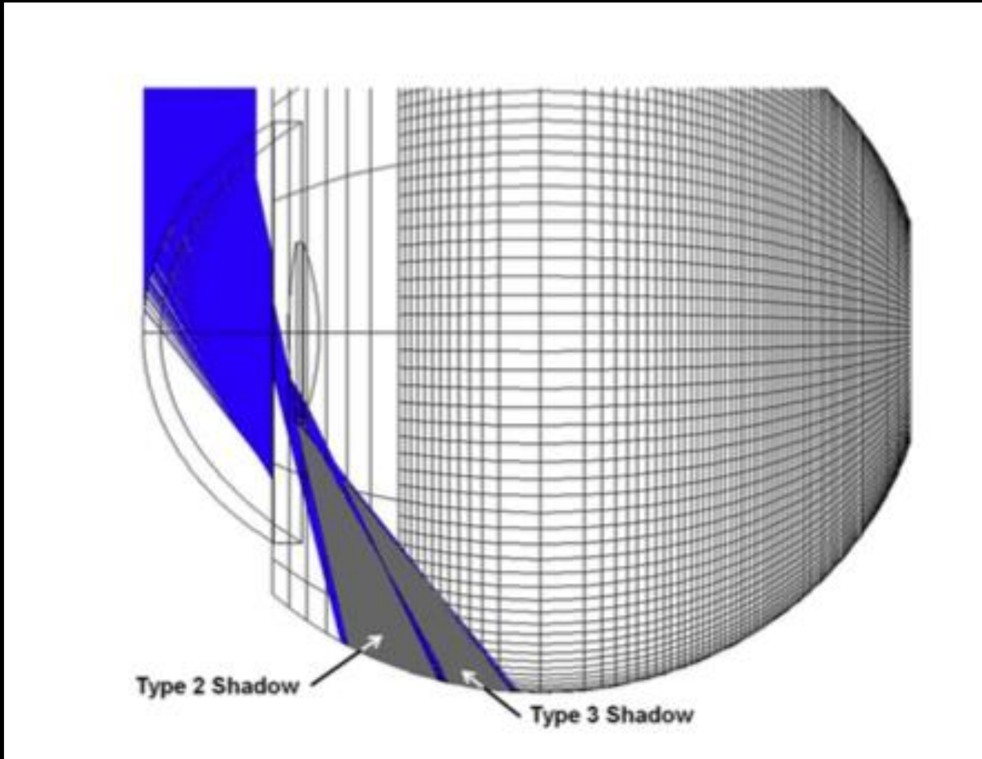


Figure 2. (Coroneo) Layout of model calculation showing oblique rays striking temporal limbus (T) and converged by the limbal convexity to intense foci on the nasal side (N) of the eye. In this bundle of rays (incident at an 80-degree angle to the visual *z*-axis), many bypass the front of the IOL optic to form focal area 1 while the rest strike the front surface of the IOL optic and are refracted to form focal area 2. Note the penumbra between the 2 foci.



HENDERSON 2016: ND WAS ACTUALLY HIGHER AT ONE MONTH IN TREATMENT GROUP!

This paper does NOT provide evidence that haptic position can be modified to decrease persistent ND with SPA lenses

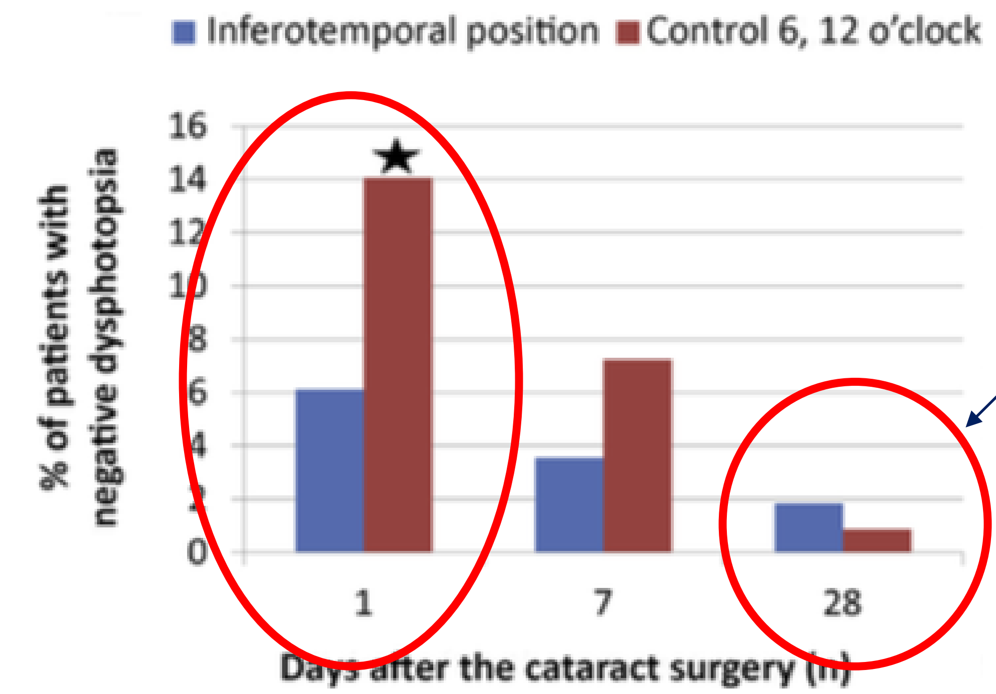


Figure 3. Incidence of negative dysphotopsia. The asterisk represents a significant difference between the inferotemporal and the 6 o'clock and 12 o'clock control IOL orientation 1 day postoperatively ($P < .05$).

ND greater in treatment group than controls!

Negative dysphotopsia: A persistent problem

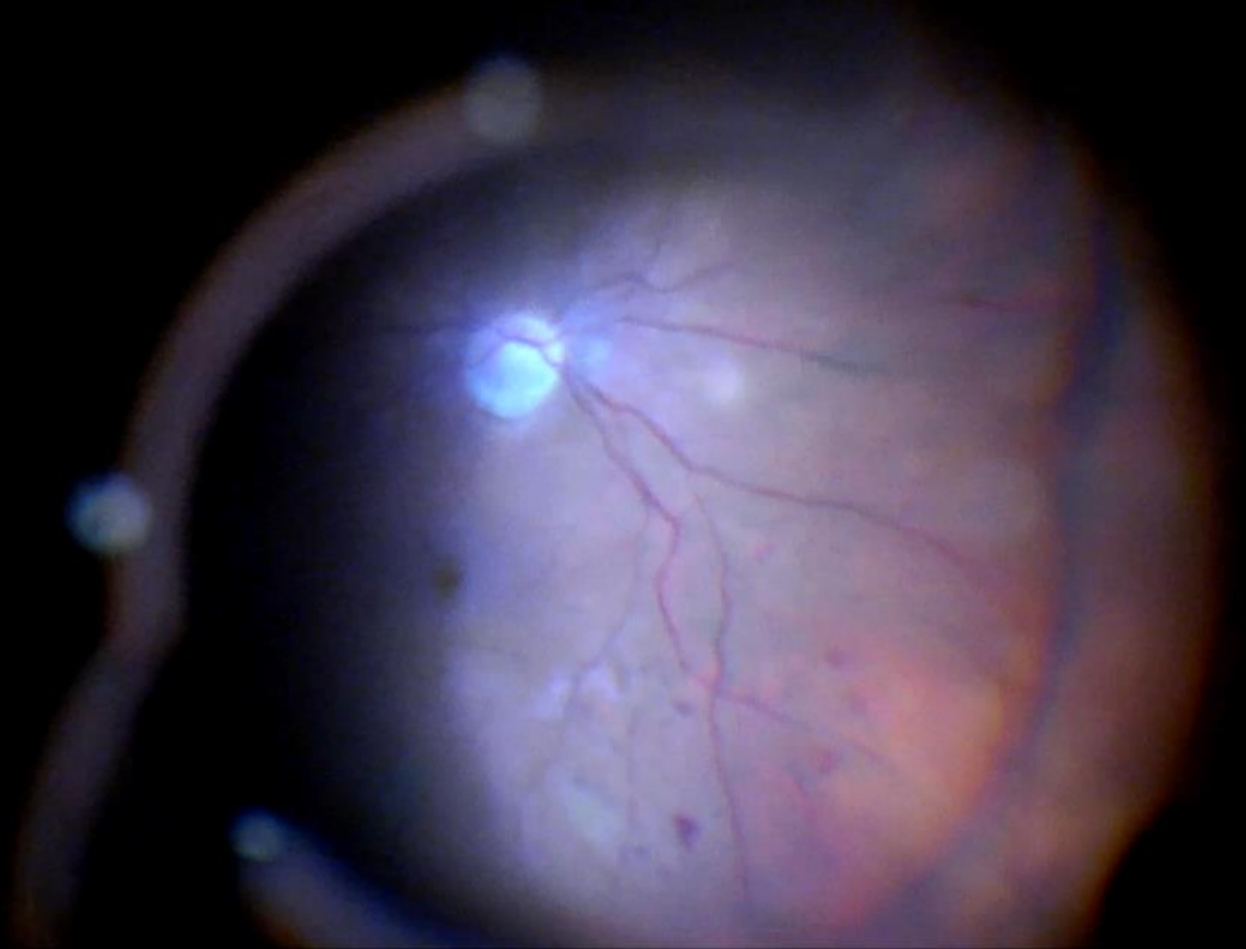
In their well-done study of haptic position and the negative dysphotopsia rate after cataract surgery, Henderson et al.[1] conclude that placing the haptics so that an optic–haptic junction is oriented inferotemporally rather than vertically resulted in a “2.3-fold decrease in the incidence of negative dysphotopsia after cataract surgery.” This statement is repeated in the “what this paper adds” conclusion section at the end of the paper. It is clear, however, from reading the article that the reduction in negative dysphotopsia was seen at 1 day and 1 week only. At 28 days, the incidence of negative dysphotopsia in both the study group and control group had dropped significantly but was actually higher in the inferotemporal position group (1.46%) than in the vertical position group (0.88%). Although early negative dysphotopsia after cataract surgery is relatively common, it resolves spontaneously in most cases,[2] and it is only the more rare persistent negative dysphotopsia that continues to bother patients and require secondary intervention. This study showed no reduction in persistent negative dysphotopsia with inferotemporal optic–haptic junction placement and if anything, a trend toward an increase rather than a decrease in negative dysphotopsia at 1 month with the proposed strategy. The conclusion that there was a 2.3-fold decrease in negative dysphotopsia “after cataract surgery” without qualifying that this reduction was limited to 1 week postoperatively might be misleading to a casual reader. My own clinical experience in treating patients with persistent negative dysphotopsia is that haptic orientation does not appear to play much of a role in mitigating this problem, and that is consistent with the results in this study, despite the wording of the conclusions that might make things appear otherwise.

Furthermore, in the discussion section the authors elaborate, “We observed a 2.3-fold decrease in the incidence of negative dysphotopsia when the optic–haptic junction of the implanted IOL was placed in the inferotemporal quadrant, which blocks light entering at that angle.” The authors also reproduce an image from Holladay et al.[3] and cite the “type 3 shadow” as the etiology of the negative dysphotopsia shadow in Figure 1 of their paper.[1] In fact Holladay et al.[3] do state that the type 3 shadow resulting from light interacting with the posterior optic edge was the one associated with negative dysphotopsia in their work; however, they are referring to it being caused by light hitting the nasal, not the temporal edge of the IOL optic. This is clear from Figure 4 in that paper. The temporal optic edge does not appear to play a direct role in the creation of the negative dysphotopsia shadow.

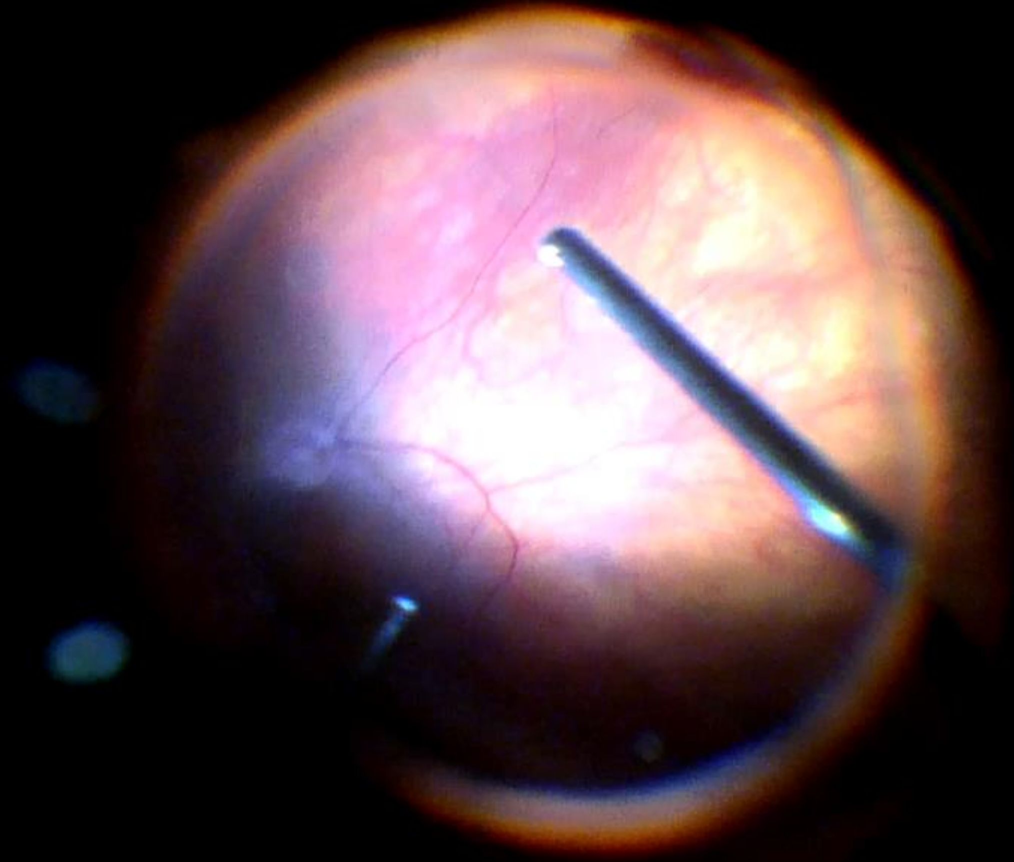
Finally, the authors are to be commended for their excellent work in demonstrating the absence of negative dysphotopsia seen with silicone IOLs. This validates my observation that negative dysphotopsia occurs much more frequently with higher index of refraction 1-piece acrylic IOLs and that the best strategy to reduce the incidence of negative dysphotopsia is by using 3-piece silicone IOLs.

Steven G. Safran, MD
Lawrenceville, New Jersey, USA

Tecnis
SPA



Softport A0
Silicone IOL
PPV



Randomized Controlled Trial of Intraocular Lens Orientation for Dysphotopsia

SAAGAR V. PAMULAPATI, JORDAN M. SAEED, NICHOLE POMPEY, KAYÉROMI D.
MITUL R. VAKHARIA

TABLE 3. Number of Eyes With Dysphotopsia by IOL Orientation at 1 and 4-6 Weeks Postop

IOL Orientation	Number (%) of Eyes With Positive Dysphotopsia at 1 wk	Number (%) of Eyes With Negative Dysphotopsia at 1 wk[a]	Number (%) of Eyes With Positive Dysphotopsia at 4-6 wk	Numb Dysphotopsia at 4-6 wk[b]
Horizontal	13 (18.1)	10 (13.9)	12 (16.7)	2 (2.8)
Vertical	15 (18.3)	8 (9.8)	21 (25.6)	4 (4.9)
Inferonasal	15 (19.2)	8 (10.3)	15 (19.2)	12 (15.4)
Superonasal	25 (26.6)	21 (22.3)	20 (21.3)	16 (17.0)

IOL = intraocular lens.
[a] Significance, $P = .019$.
[b] Significance, $P = .002$.

Superonasal=inferotemporal :contradicts Henderson study

WHY WOULD OBLIQUE ORIENTATION BE SO MUCH MORE PRONE TO POS/NEG DYSPHO THAN HORIZONTAL OR VERTICAL?

Think of saccadic eye movements

2 KINDS OF FAST SACCADE EYE MOVEMENTS

Horizontal

- Very fast
- 450 degrees/second
- Most common: reading/scanning

Vertical

- Less fast
- 270 degrees per second
- Less common

RAISE YOUR HAND.....STILL NOT RECOGNIZED?

Wave your hand to get attention!

LIKE SHIMMERING PD, ND LESS NOTICED AS CAPSULAR BAG CONTRACTS: LESS MICROPHACODONESIS

IOL placement in the horizontal meridian stabilizes it more in that plane with saccadic eye movements.

Oblique positioning adds less stabilization in plane of saccadic eye movements

Effect of total lens epithelial cell destruction on intraocular lens fixation in the human capsular bag

David J. Spalton, FRCS, FRCP, Sarah L. Russell, PhD, Richard Evans-Gowing, Julie A. Eldred, PhD, I. Michael Wormstone, PhD, FRSM

PURPOSE: To evaluate the effect of complete destruction of lens epithelial cells (LECs) in the capsular bag on intraocular lens (IOL) stability.

SETTING: School of Biological Sciences, University of East Anglia, Norwich, United Kingdom.

DESIGN: Comparative evaluation.

METHODS: An in vitro organ culture model using the bag–zonule–ciliary body complex isolated from fellow human donor eyes was prepared. A capsulorhexis and fiber extraction were performed, and an Acrysof IOL was implanted. Preparations were secured by pinning the ciliary body to a silicone ring and maintaining it in 6 mL Eagle minimum essential medium supplemented with 5% v/v fetal calf serum and 10 ng/mL transforming growth factor-β2 for 3 weeks or more. One bag of each pair was treated with 1 μM thapsigargin to destroy all LECs. Observations of LEC growth were captured by phase-contrast microscopy, IOL stability by video microscopy, and endpoint analysis through scanning electron microscopy and immunocytochemistry.

RESULTS: The LECs in control capsular bags migrated centrally, closing the bag and fixating the IOL between the anterior and posterior capsules, as seen clinically. These events were not observed in the thapsigargin-treated group. After a period of controlled orbital movement, the IOL in the control group stabilized quicker than in the treated bags. There was no IOL rotation in the bag; however, the IOLs in the treated group rocked with axial movement.

CONCLUSIONS: The LECs appeared to aid stabilization of current IOL designs in the capsular bag. The results have clinical implications for IOL design and for strategies to prevent posterior capsule opacification.

Financial Disclosure: No author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2014; 40:306–312 © 2014 ASCRS and ESCRS

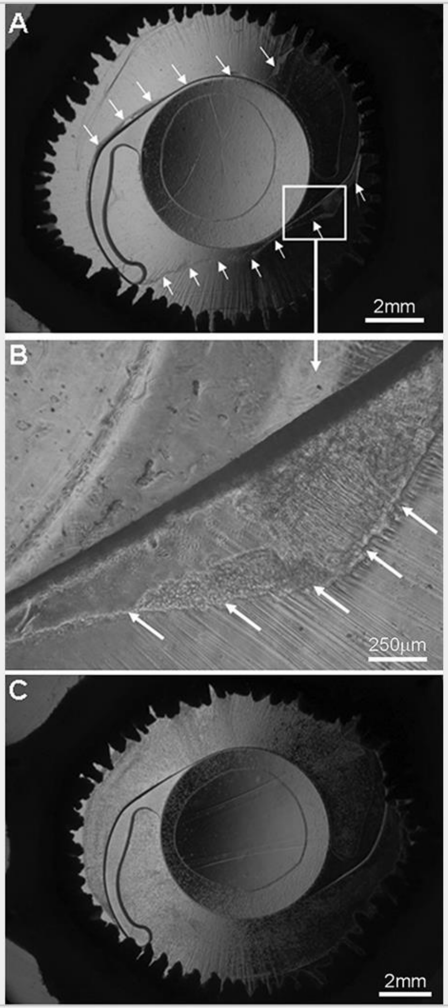


Figure 2: Low-power modified dark-field images showing gross changes in control and thapsigargin-treated capsular bags. *A* and *B*: Distinct regions of adhesion (*arrows*) between the anterior capsule and posterior capsule can be observed in control preparations. *C*: No adhesion between opposing capsule surfaces can be seen in thapsigargin-treated capsular bags.

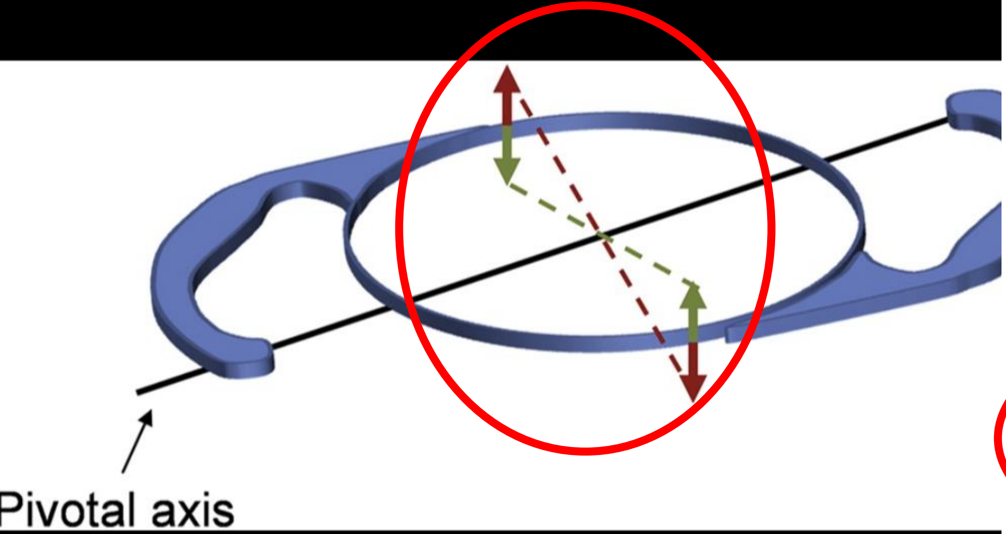


Figure 6

WHAT WAS KNOWN

- Complete LEC destruction is a possible strategy for the total prevention of PCO.

WHAT THIS PAPER ADDS

- The LECs appeared to aid stabilization of current IOL designs in the capsular bag.
- In an acellular capsular bag, there was minimal rotation of the IOL in the *x*–*y* plane.
- However, there was greater movement in the *z*-plane against a pivotal axis, which is created by physical interactions of opposing haptics with the capsular bag.
- This study indicates IOL/haptic designs have to be developed to improve stability in an acellular capsular bag, which will improve the therapeutic value of future strategies to prevent PCO.

CILIARY SULCUS/BAG NOT ROUND …..A VERTICAL OVAL

Placing haptics horizontal may stabilize in that plane more…..

Reduce z plane movement with horizontal saccades

FREE

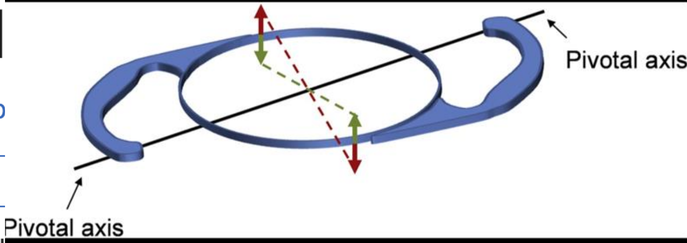
Lens | October 2015

Predicting Lens Diameter
Biometry With High-Resol

Katharina Erb-Eigner; Nino Hirnschall; Christoph Hackl; Christop

+ Author Affiliations & Notes

Investigative Ophthalmology & Visual Science October 2015, Vol
doi:https://doi.org/10.1167/iovs.15-17228



In all cases, the vertical diameter was found to b

diameter (mean difference, 0.7 mm; SD: 0.43; range, 0.0–1.8 mm, or: 7.5%; SD: 4.90%, range, 0.0%–20.0%), respectively. This difference was found to be significant (Wilcoxon signed rank test: $P < 0.001$).

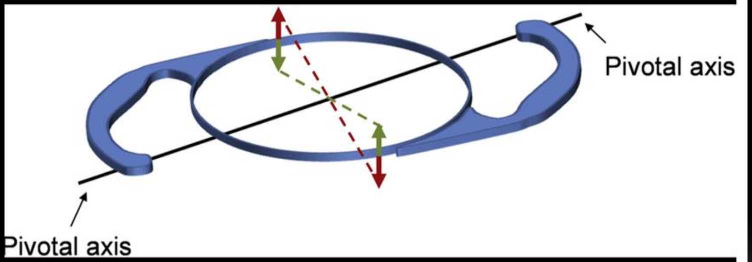
($r^2 = 0.86$) in emmetropic eyes but weak between 0-degree STS and 0-degree WTW in myopic eyes ($r^2 = 0.36$ and $r^2 = 0.40$, respectively).

CONCLUSIONS: Sulcus diameter measurements were most precise using UBM. The ciliary sulcus is vertically oval. The WTW diameter is not suitable for calculating a PC pIOL diameter, particularly in myopic eyes.

Oblique placement Not stabilized in either saccade meridian= most movement

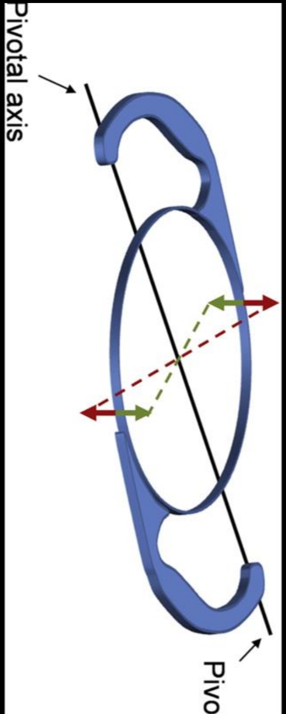
HORIZONTAL

Smaller bag/sulcus : stabilized for fast horizontal saccades



VERTICAL

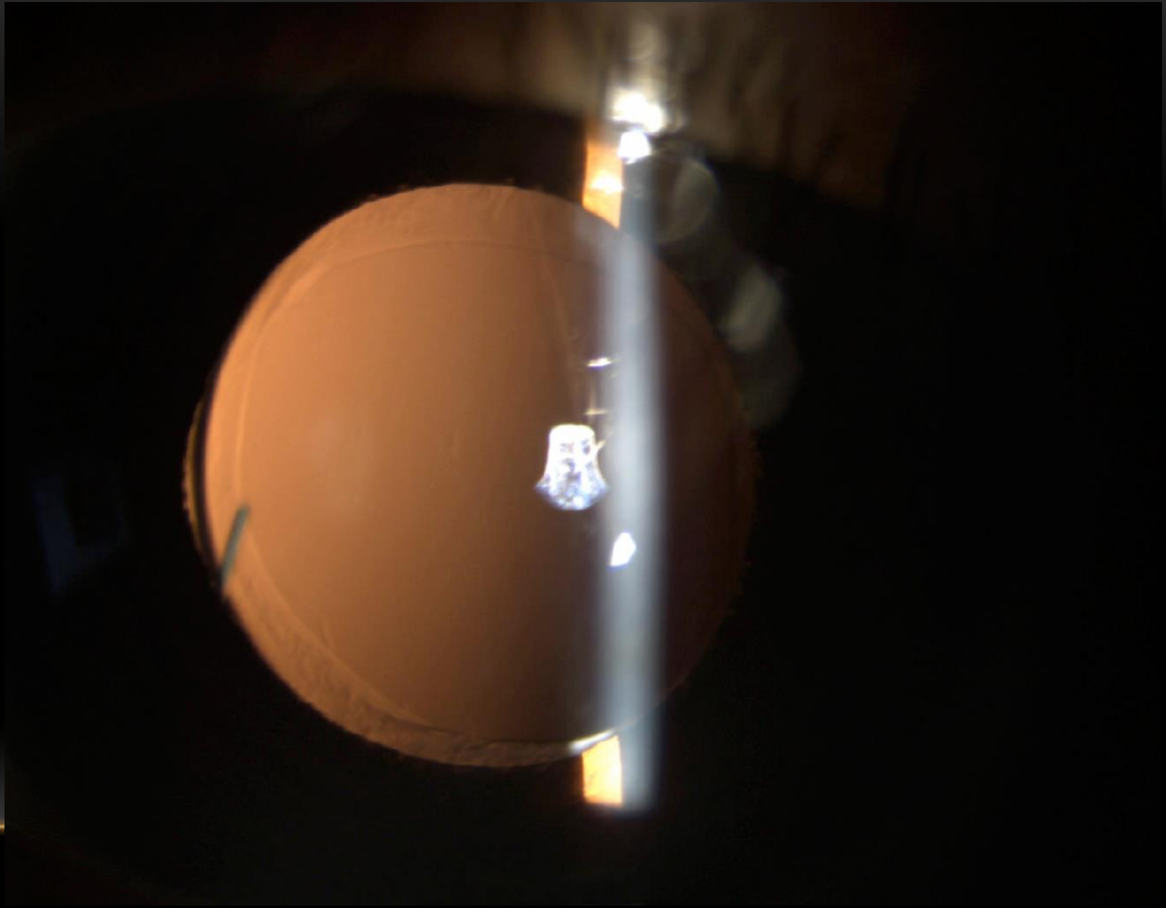
Larger bag sulcus: NOT stabilized for fast horizontal saccades



52 YEAR OLD REFERRED WITH SEVERE BILATERAL NEGATIVE DYSPHTOPSIA

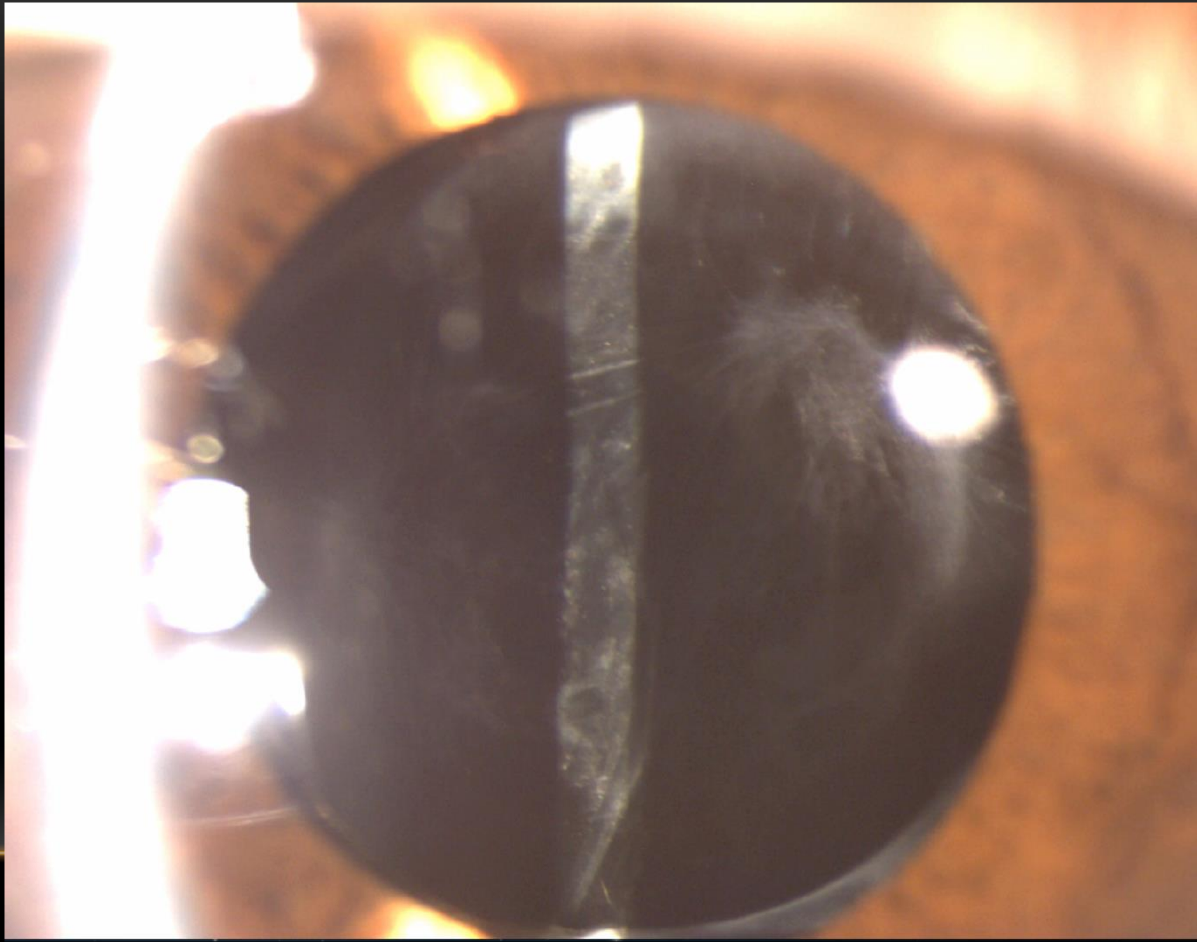
OD has 3 piece lens in the bag

Rhexis covers optic 360

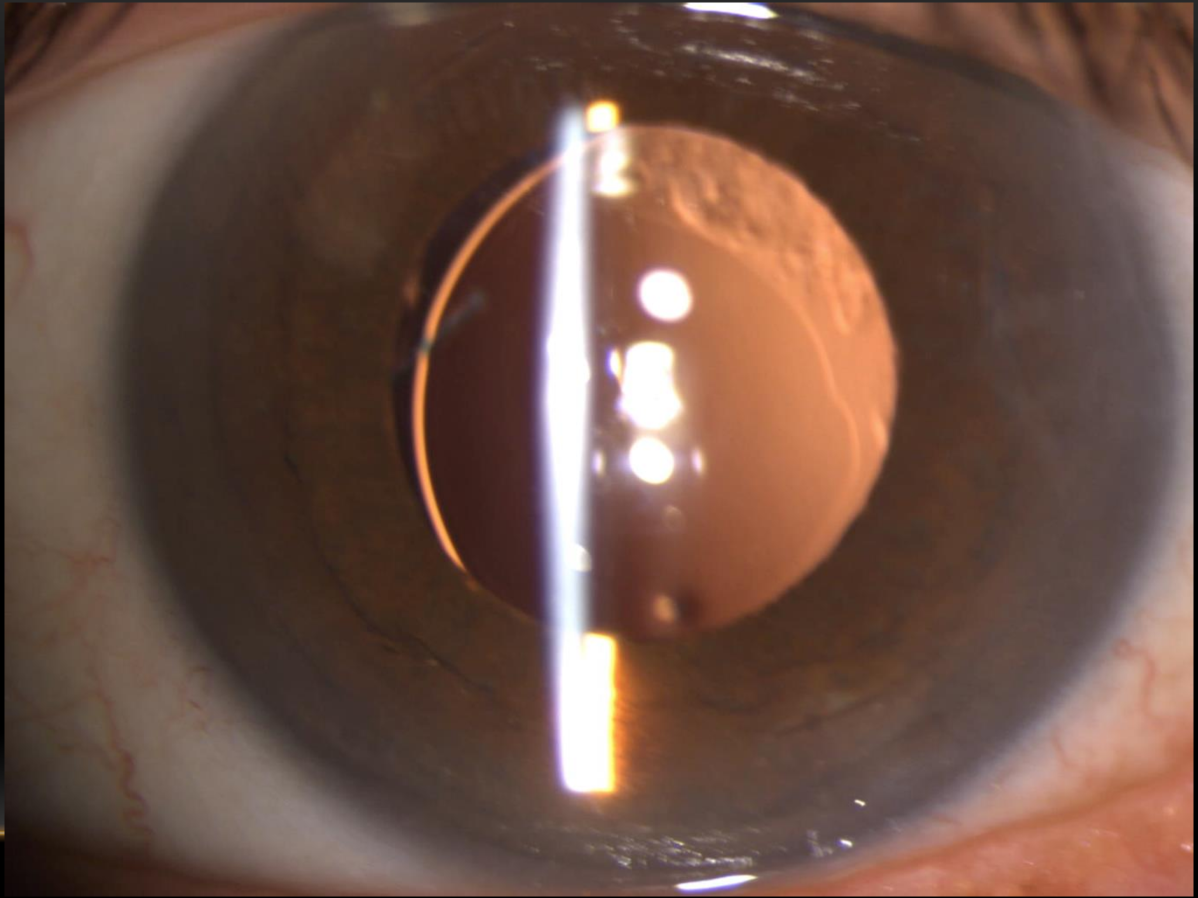


SOLUTION IS CLEAR……

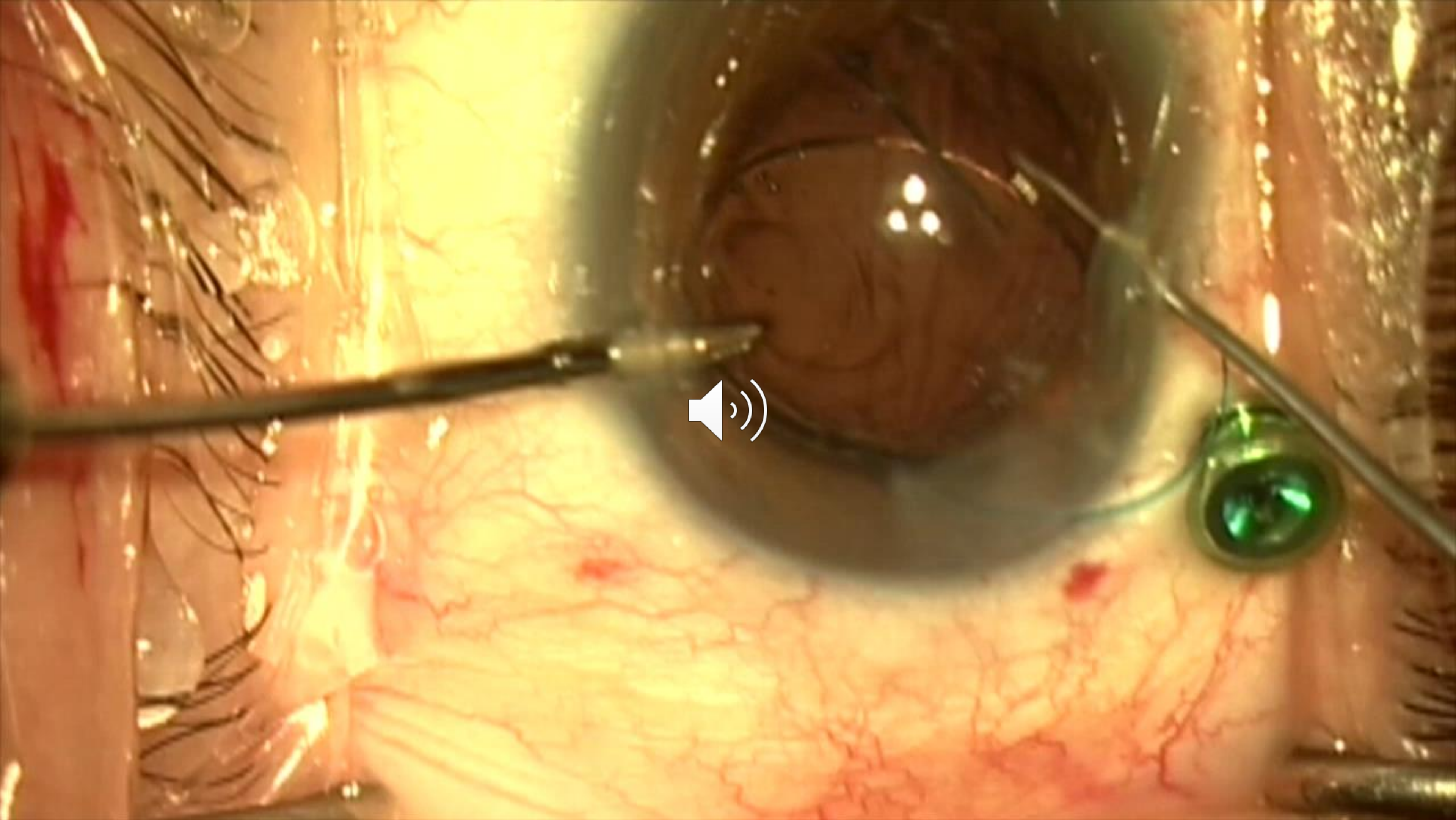
Reverse optic capture (ROC) solves the problem!



BUT WHAT ABOUT OUR PATIENT'S LEFT EYE?

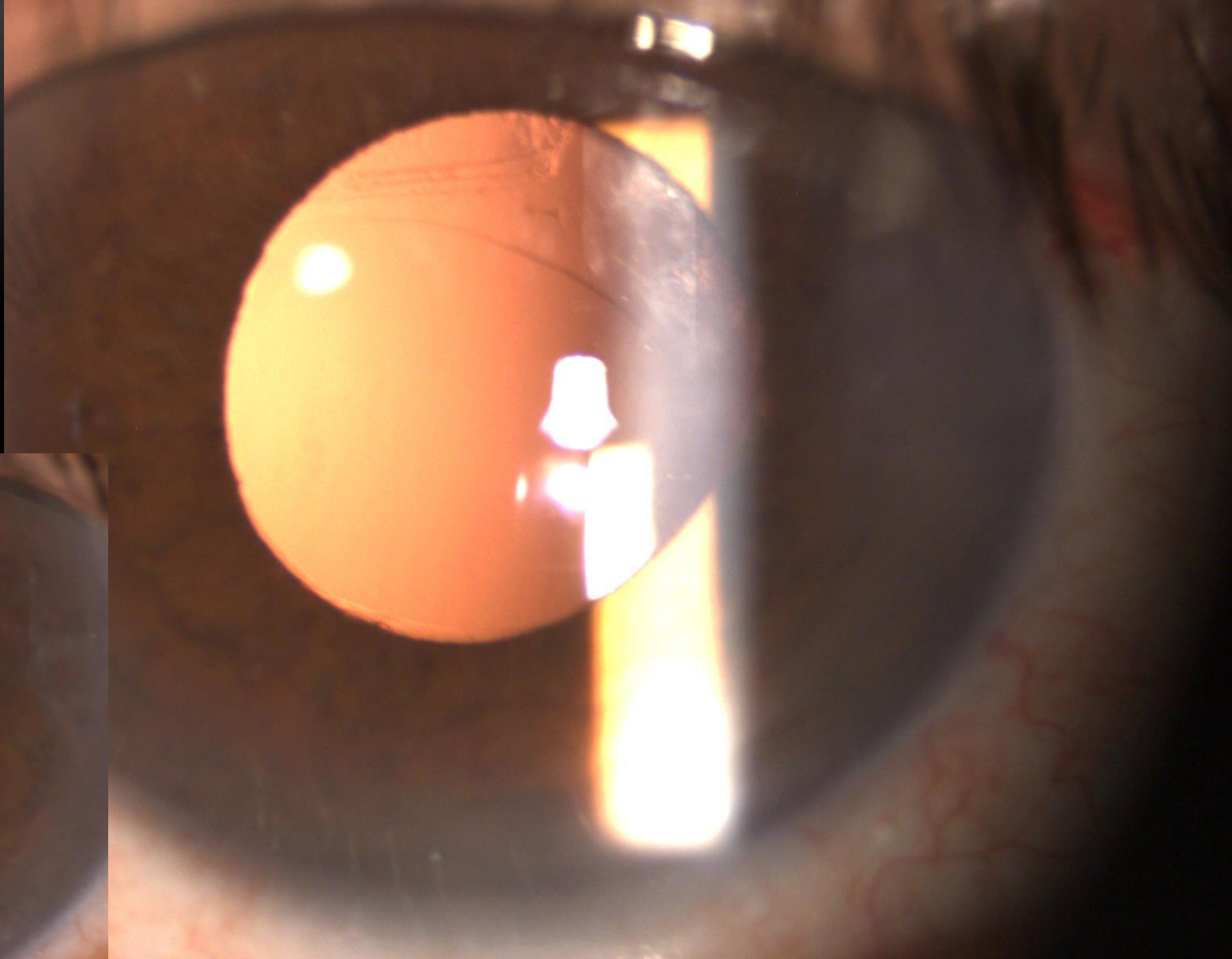


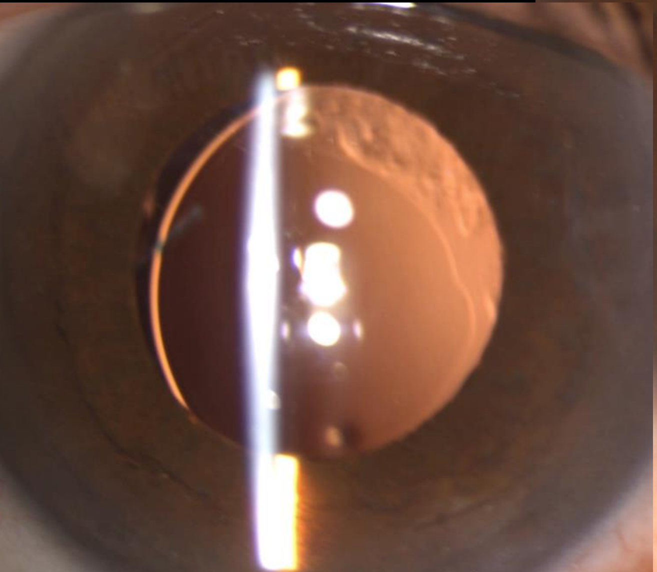

Reverse Optic Capture
To get rid of the ND we don’t want disco……we need ROC!
ted From



DAY 1 POST OP: IOL CENTERED AND “ROC” STABLE

ND and PD resolved

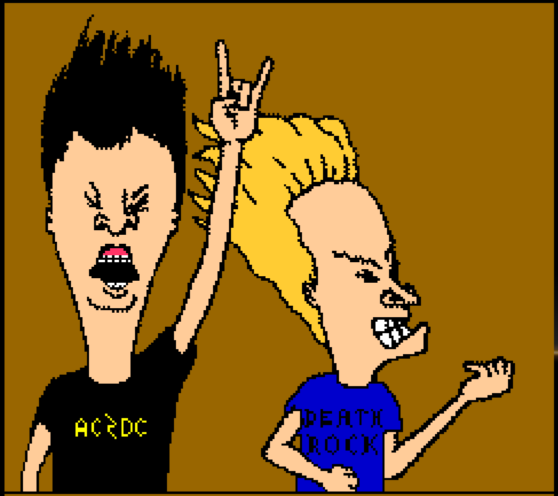


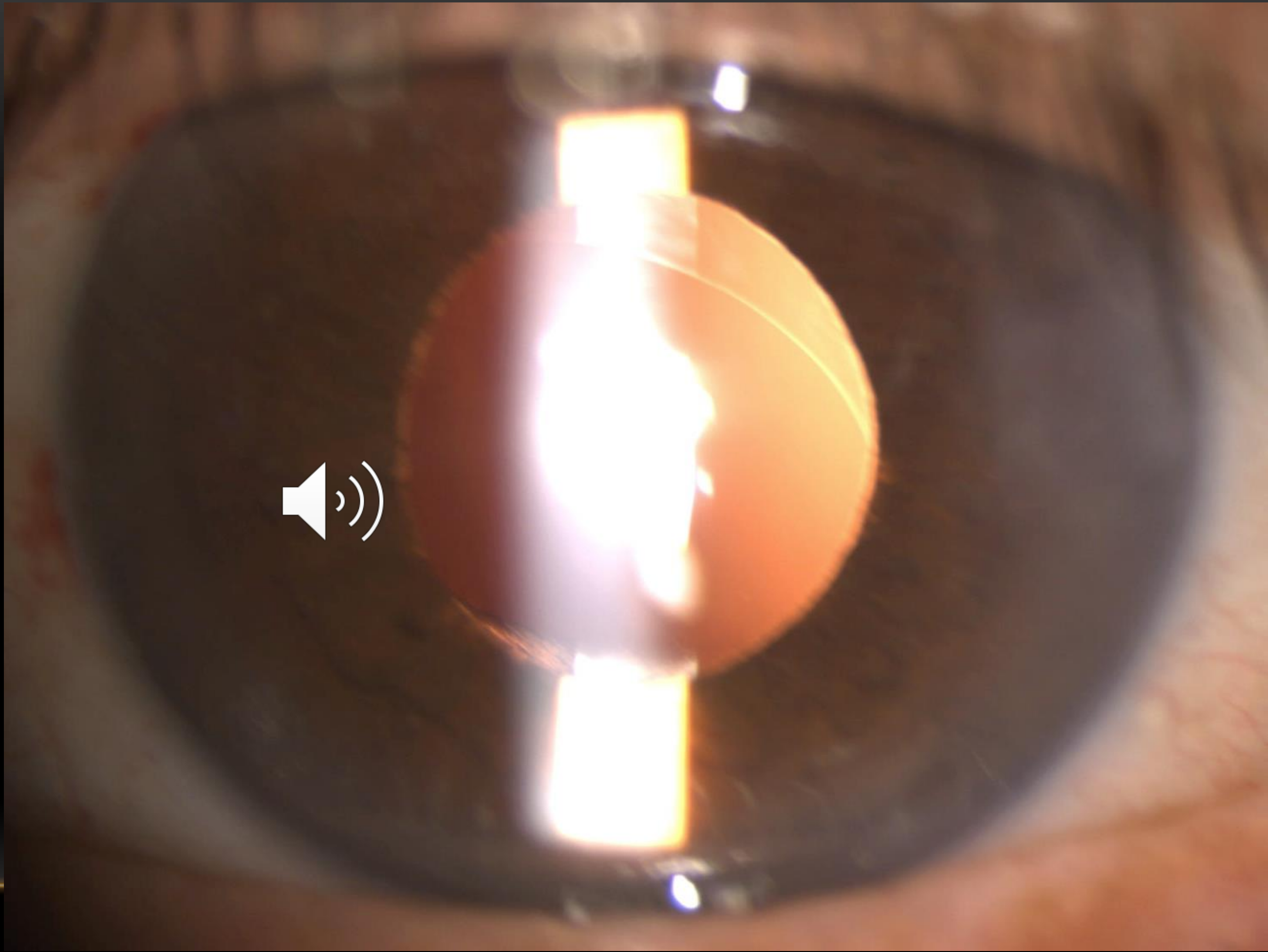


1 MONTH POST OP

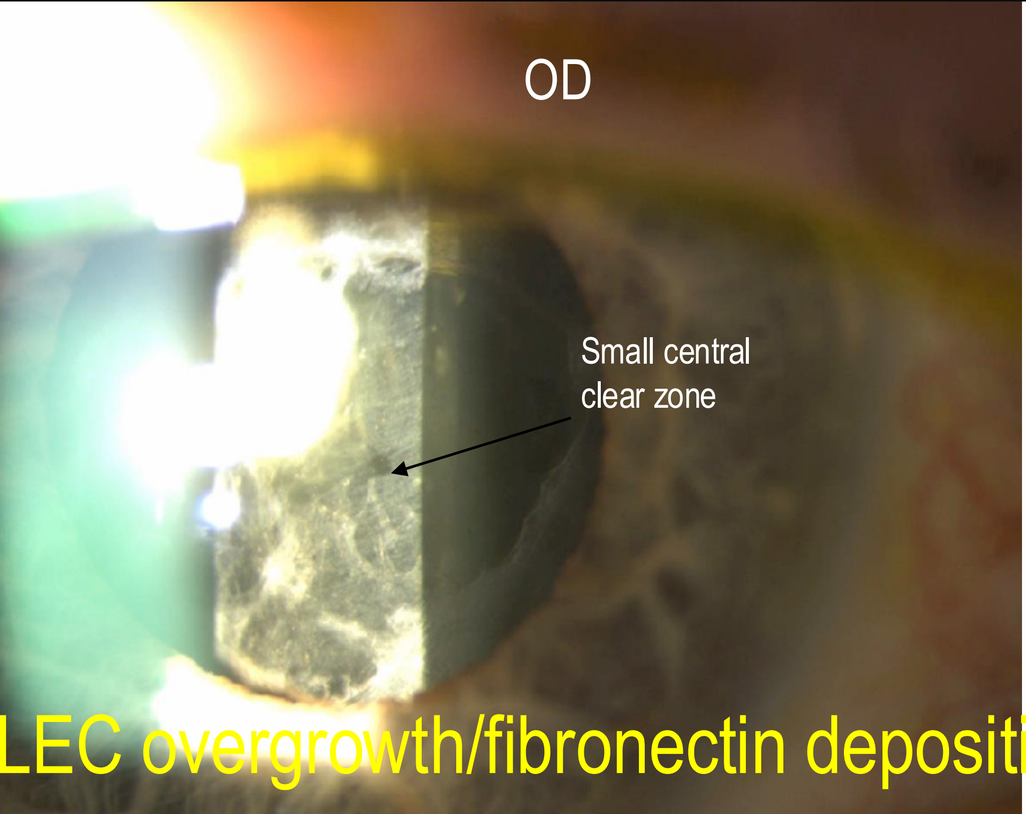
Still ROC stable

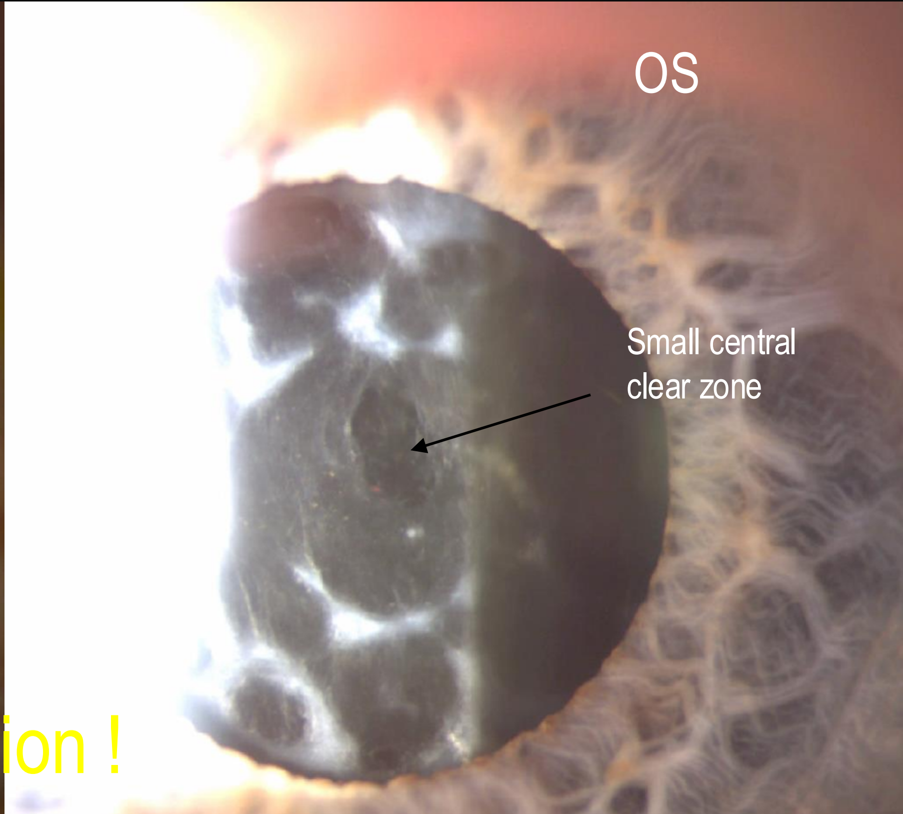
. Still Roc'in ON!





PATIENT REFERRED 5 MONTHS POST CE WITH SEVERE BILATERAL NEGATIVE DYSPHOTOPSIA: ACRYSOF IOLS





LEC overgrowth/fibronectin deposition !

Clinical Ophthalmology

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COMMENTARY

Proliferative Anterior Optic Membranes in Hydrophobic Acrylic Intraocular Lenses

This article was published in the following Dove Press journal:
Clinical Ophthalmology

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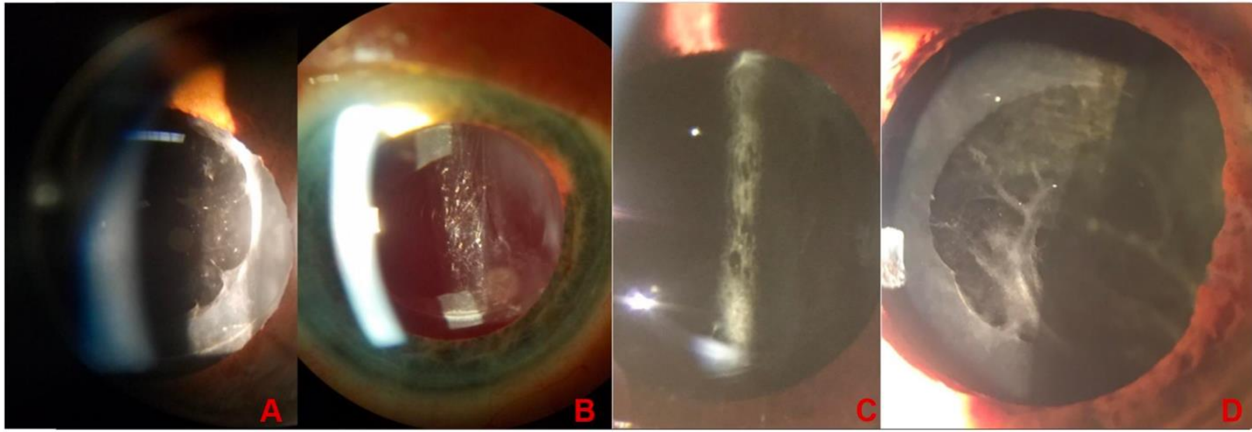
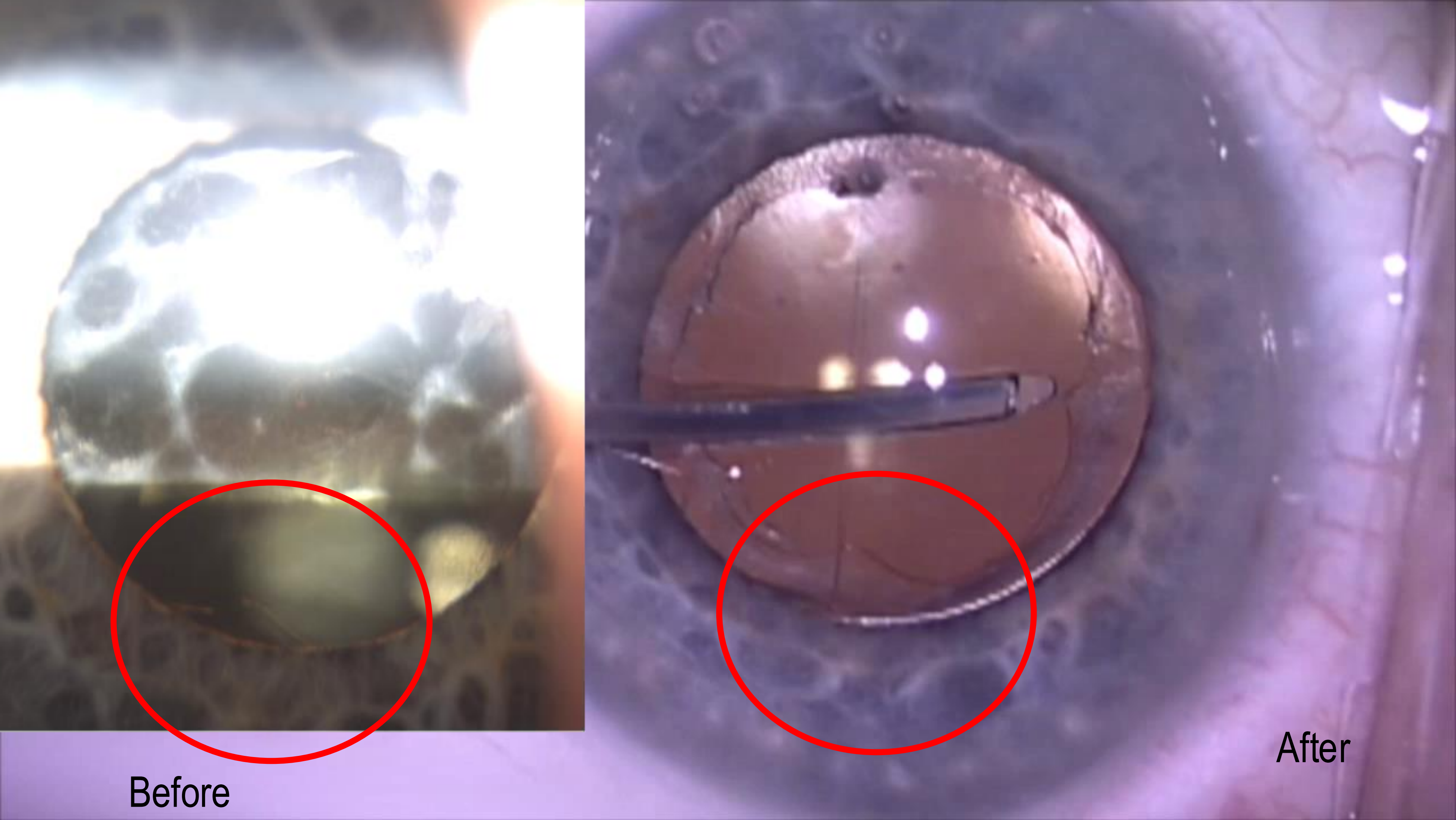


Figure 1 Stages of anterior optic membrane (AOM) appearance. Stage 1 AOM (**A**) features an extension of diaphanous membranous material from the capsulorrhexis edg onto the anterior optic without incursion into the visual axis. Stage 2 AOM (**B**) is characterized by a slightly denser, cellophane-like membrane with extension into the visu axis. Best corrected visual acuity (BCVA) is minimally affected in Stage 1–2. Stage 3 AOM (**C**) is a denser, partial light-blocking membrane with full involvement of th anterior optic, with or without focal and/or intervening clear spaces. BCVA may be minimally affected. Stage 4 AOM (**D**) is characterized by an opaque, disorganized fibrot growth accompanied by moderate-severe loss of BCVA. Stage 3 and 4 AOMs may require YAG laser treatment.

Opened up with YAG laser

OS SUBSEQUENTLY TREATED WITH YAG LASER AS WELL….

completely clearing fibronectin/LEC overgrowth from anterior capsule


Before
After

ND resolved:
case closed

"Why did the patient have persistent ND after YAG treatment in the OS and not the OD?"

NEGATIVE DYSPHOTOPSIA MUCH MORE COMMON IN LEFT EYE THAN RIGHT EYE…….

Positive and negative dysphotopsia in patients with acrylic intraocular lenses

James A. Davison, MD

ABSTRACT

Purpose: To report the incidence, management, and prevention of patient reports and streaks around a point source of light or a dark shadow in the temporal field after acrylic intraocular lens (IOL) implantation.

Setting: A private practice.

Methods: Cases in which patients complained vigorously of dysphotopsia we logued prospectively during the implantation experience in 6668 consecuti having surgery between January 1995 and June 1999. The techniques of topical–intracameral anesthesia, temporal clear corneal incisions, and phacoemulsification were used in all cases. Alternate IOL styles were selected for use from July 1999 to April 2000.

Results: Fourteen cases (0.2%) were identified. The complaints resolved in 1, were diminished in 1, and were tolerated without change in 7. Five eyes of 4 patients required IOL exchange with capsular bag placement of a poly(methyl methacrylate) (PMMA) or silicone lens for resolution of symptoms. Selecting alternate IOL styles reduced the incidence of dysphotopsia.

Conclusions: Glare and streaks from a point source of light represent positive photic expressions of dysphotopsia, and temporal dark shadows represent similar negative photic expressions. Both appear to be associated with shiny square-edge optics made of high-refractive-index acrylic polymer. Intraocular lenses of PMMA and silicone with rounded edges, along with square-edge acrylic IOLs with nonreflective edges, appear less likely to cause clinically significant pseudophakic dysphotopsia. *J Cataract Refract Surg 2000; 26:1346–1355 © 2000 ASCRS and ESCRS*

Davison 2000

All 8 cases of negative dysphotopsia plus the 2 patients with SA30AL lenses experienced darkness or haziness in the temporal field of vision in their left eyes. The

NEGATIVE DYSPHOTOPSIA MUCH MORE COMMON IN LEFT EYE THAN RIGHT EYE…….

Osher 2008

Negative dysphotopsia: Long-term study and possible explanation for transient symptoms

Robert H. Osher, MD

PURPOSE: To study the incidence, course, and common factors of patients with negative dysphotopsia and consider the possible role of the corneal incision in cases in which symptoms are transient.

SETTING: Private practice and the University of Cincinnati, College of Medicine, Cincinnati, Ohio, USA.

METHODS: Phacoemulsification with implantation of a single-piece acrylic intraocular lens (IOL) was performed in 250 consecutive routine cataract procedures. Patients were asked whether they noticed a temporal shadow on the day after surgery and were followed by serial evaluations for 3 years. Evaluations included subjective questionnaires and objective testing.

RESULTS: The incidence of negative dysphotopsia was 15.2% on the first postoperative day, decreasing to 3.2% after 1 year, then 2.4% after 2 and 3 years. Common findings included a shallow orbit, prominent globe, space greater than 0.45 mm between the iris and IOL by ultrasound biomicroscopy, and perimetric comet-shaped light in the area corresponding to the shadow. Slitlamp revealed a transparent peripheral capsule and a shadow sign in which a linear shadow on the iris became curvilinear as the light from the slit beam was projected through the incision toward the pupil.

CONCLUSIONS: Two groups of patients experienced negative dysphotopsia that rapidly resolved or remained unchanged from the first postoperative day. It is hypothesized that the corneal edema associated with a beveled temporal incision contributes to transient negative dysphotopsia.

J Cataract Refract Surg 2008; 34:1699–1707 © 2008 ASCRS and ESCRS

"In the present study, left eyes were far more likely to develop negative dysphotopsia in the early postoperative period (more than 23.0% compared with less than 8.3% in right eyes"

NEGATIVE DYSPHOTOPSIA MUCH MORE COMMON IN LEFT EYE THAN RIGHT EYE…….

ARTICLE

Surgical management of negative dysphotopsia

Samuel Masket, MD, Nicole R. Fram, MD, Andrew Cho, BS, Isaac Park, BA, Don Pham, BS

Purpose: To evaluate curative and preventative surgical strategies for negative dysphotopsia.

Setting: Private practice, Los Angeles, California, USA.

Design: Retrospective case series.

Methods: Patients with self-reported chronic negative dysphotopsia had corrective surgery as the therapeutic group. Second eye surgery, in cases with negative dysphotopsia in the previously operated eye, comprised the preventative group. Chronologically, several surgical strategies were used, including bag-to-bag intraocular lens (IOL) exchange, reducing posterior chamber depth, piggyback secondary IOL placement, bag-to-sulcus IOL exchange, and reverse optic capture. The primary outcome measure was improvement of negative dysphotopsia by 3 months postoperatively.

Results: The therapeutic group comprised 40 eyes of 37 patients; 76.6% of causative IOLs were acrylic and 23.4% were silicone and all were bag-fixated. There were 21 eyes in the preventative group of which 11 were second eyes from the therapeutic group; the remaining 10 did not require surgery for the symptomatic eye. Successful outcomes for each surgical strategy were as follows: bag-to-bag IOL exchange (0/5), a reduction in posterior chamber depth with iris suture fixation of the bag–haptic complex (0/1), piggyback secondary IOL (8/11), secondary reverse optic capture (21/22), ciliary sulcus posterior chamber IOL exchange (7/8), and primary reverse optic capture (21/21).

Conclusions: Negative dysphotopsia was associated with acrylic or silicone IOLs of either square- or round-edge design. Negative dysphotopsia was reduced, eliminated, or prevented when the IOL optic overlaid the anterior capsulotomy rather than when the capsule edge overlaid the optic. Bag-to-sulcus IOL exchange and reverse optic capture were highly successful in managing or preventing negative dysphotopsia.

J Cataract Refract Surg 2018; 44:6–16 © 2018 Published by Elsevier Inc. on behalf of ASCRS and ESCRS.

Masket 2017

"there is no obvious explanation for the greater preponderance (70%) of negative dysphotopsia in left eyes"

Or is there???

ANSWER LIES IN NEURAL PROCESSING

Neuroimage. 2011 Feb 14;54(4):3010-20. doi: 10.1016/j.neuroimage.2010.10.078. Epub 2010 Nov 5.

Spatio-temporal indications of sub-cortical involvement in leftward bias of spatial attention.

Okon-Singer H[1], Podlipsky I, Siman-Tov T, Ben-Simon E, Zhdanov A, Neufeld MY, Hendler T.

Author information

Abstract

A leftward bias is well known in humans and animals, and commonly related to the right hemisphere dominance for spatial attention. Our previous fMRI study suggested that this bias is mediated by faster conduction from the right to left parietal cortices, than the reverse (Siman-Tov et al., 2007). However, the limited temporal resolution of fMRI and evidence on the critical involvement of sub-cortical regions in orienting of spatial attention suggested further investigation of the leftward bias using multi-scale measurement. In this simultaneous EEG-fMRI study, healthy participants were presented with face pictures in either the right or left visual fields while performing a central fixation task. Temporo-occipital event related potentials, time-locked to the stimulus onset, showed an association between faster conduction from the right to the left hemisphere and higher fMRI activation in the left pulvinar nucleus following left visual field stimulation. This combined-modal finding provides original evidence of the involvement of sub-cortical central attention-related regions in the leftward bias. This assertion was further strengthened by a DCM analysis designated at cortical (i.e., inferior parietal sulcus; IPS) and sub-cortical (pulvinar nucleus) attention-related nodes that revealed: 1. Stronger inter-hemispheric connections from the right to left than vice versa, already at the pulvinar level. 2. Stronger connections within the right than the left hemisphere, from the pulvinar to the IPS. This multi-level neural superiority can guide future efforts in alleviating attention deficits by focusing on improving network connectivity.

ANSWER LIES IN NEURAL PROCESSING

Neuropsychologia. 2013 Nov;51(13):2611-9. doi: 10.1016/j.neuropsychologia.2013.09.005. Epub 2013 Sep 9.

Symmetry detection in typically and atypically speech lateralized individuals: a visual half-field study.

Verma A[1], Van der Haegen L, Brysbaert M.

Author information

Abstract

Visuospatial functions are typically lateralized to the right cerebral hemisphere, giving rise to a left visual field advantage in visual half-field tasks. In a first study we investigated whether this is also true for symmetry detection off fixation. Twenty right-handed participants with left hemisphere speech dominance took part in a visual half-field experiment requiring them to judge the symmetry of 2-dimensional figures made by joining rectangles in symmetrical or asymmetrical ways. As expected, a significant left visual field advantage was observed for the symmetrical figures. In a second study, we replicated the study with 37 left-handed participants and left hemisphere speech dominance. We again found a left visual field advantage. Finally, in a third study, we included 17 participants with known right hemisphere dominance for speech (speech dominance had been identified with fMRI in an earlier study; Van der Haegen, Cai, Seurinck, & Brysbaert, 2011). Around half of these individuals showed a reversed pattern, i.e. a right visual half-field advantage for symmetric figures while the other half replicated the left visual-field advantage. These findings suggest that symmetry detection is indeed a cognitive function lateralized to the right hemisphere for the majority of the population. The data of the participants with atypical speech dominance are more in line with the idea that language and visuospatial functions are lateralized in opposite brain hemispheres than with the idea that different functions lateralize independently, although there seems to be more variability in this group.

Vision Res. 2012 Jan 1;52(1):11-9. doi: 10.1016/j.visres.2011.10.004. Epub 2011 Oct 23.

Effects of spatial attention on motion discrimination are greater in the left than right visual field.

Bosworth RG[1], Petrich JA, Dobkins KR.

Author information

Abstract

In order to investigate differences in the effects of spatial attention between the left visual field (LVF) and the right visual field (RVF), we employed a full/poor attention paradigm using stimuli presented in the LVF vs. RVF. In addition, to investigate differences in the effects of spatial attention between the dorsal and ventral processing streams, we obtained motion thresholds (motion coherence thresholds and fine direction discrimination thresholds) and orientation thresholds, respectively. The results of this study showed negligible effects of attention on the orientation task, in either the LVF or RVF. In contrast, for both motion tasks, there was a significant effect of attention in the LVF, but not in the RVF. These data provide psychophysical evidence for greater effects of spatial attention in the LVF/right hemisphere, specifically, for motion processing in the dorsal stream.

We grasp objects more accurately when presented to the left visual field

Exp Brain Res. 2013 Oct;230(2):187-96. doi: 10.1007/s00221-013-3643-9. Epub 2013 Jul 16.

Left visual field preference for a bimanual grasping task with ecologically valid object sizes.

Le A[1], Niemeier M.

Author information

Abstract

Grasping using two forelimbs in opposition to one another is evolutionary older than the hand with an opposable thumb (Whishaw and Coles in Behav Brain Res 77:135-148, 1996); yet, the mechanisms for bimanual grasps remain unclear. Similar to unimanual grasping, the localization of matching stable grasp points on an object is computationally expensive and so it makes sense for the signals to converge in a single cortical hemisphere. Indeed, bimanual grasps are faster and more accurate in the left visual field, and are disrupted if there is transcranial stimulation of the right hemisphere (Le and Niemeier in Exp Brain Res 224:263-273, 2013; Le et al. in Cereb Cortex. doi: 10.1093/cercor/bht115, 2013). However, research so far has tested the right hemisphere dominance based on small objects only, which are usually grasped with one hand, whereas bimanual grasping is more commonly used for objects that are too big for a single hand. Because grasping large objects might involve different neural circuits than grasping small objects (Grol et al. in J Neurosci 27:11877-11887, 2007), here we tested whether a left visual field/right hemisphere dominance for bimanual grasping exists with large and thus more ecologically valid objects or whether the right hemisphere dominance is a function of object size. We asked participants to fixate to the left or right of an object and to grasp the object with the index and middle fingers of both hands. Consistent with previous observations, we found that for objects in the left visual field, the maximum grip apertures were scaled closer to the object width and were smaller and less variable, than for objects in the right visual field. Our results demonstrate that bimanual grasping is predominantly controlled by the right hemisphere, even in the context of grasping larger objects.

We recognize faces better when presented to the left visual field

J Cogn Neurosci. 2003 Apr 1;15(3):462-74.

Neural correlates of the left-visual-field superiority in face perception appear at multiple stages of face processing.

Yovel G[1], Levy J, Grabowecky M, Paller KA.

Author information

Abstract

Studies in healthy individuals and split-brain patients have shown that the representation of facial information from the left visual field (LVF) is better than the representation of facial information from the right visual field (RVF). To investigate the neurophysiological basis of this LVF superiority in face perception, we recorded event-related potentials (ERPs) to centrally presented face stimuli in which relevant facial information is present bilaterally (B faces) or only in the left (L faces) or the right (R faces) visual field. Behavioral findings showed best performance for B faces and, in line with the LVF superiority, better performance for L than R faces. Evoked potentials to B, L, and R faces at 100- to 150-msec poststimulus showed no evidence of asymmetric transfer of information between the hemispheres at early stages of visual processing, suggesting that this factor is not responsible for the LVF superiority. Neural correlates of the LVF superiority, however, were manifested in a shorter latency of the face-specific N170 component to L than R faces and in a larger amplitude to L than R faces at 220-280 and 400-600 msec over both hemispheres. These ERP amplitude differences between L and R faces covaried across subjects with the extent to which the face-specific N170 component was larger over the right than the left hemisphere. We conclude that the two hemispheres exchange information symmetrically at early stages of face processing and together generate a shared facial representation, which is better when facial information is directly presented to the right hemisphere (RH; L faces) than to the left hemisphere (LH; R faces) and best when both hemispheres receive facial information (B faces).

Cortex. 2018 May 21. pii: S0010-9452(18)30165-5. doi: 10.1016/j.cortex.2018.05.011. [Epub ahead of print]

The left cradling bias: An evolutionary facilitator of social cognition?

Forrester GS[1], Davis R[2], Mareschal D[2], Malatesta G[3], Todd BK[4].

Author information

Abstract

A robust left side cradling bias (LCB) in humans is argued to reflect an evolutionarily old left visual field bias and right hemisphere dominance for processing social stimuli. A left visual field bias for face processing, invoked via the LCB, is known to reflect a human population-level right cerebral hemisphere specialization for processing social stimuli. We explored the relationship between cradling side biases, hand dominance and socio-communicative abilities. Four and five year old typically-developing children (N = 98) participated in a battery of manual motor tasks interspersed by cradling trials comprising a(n): infant human doll, infant primate doll, proto-face pillow and no-face pillow. Mean social and communication ability scores were obtained via a survey completed by each child's key teacher. We found a population-level LCB for holding an infant human doll that was not influenced by hand dominance, sex, age or experience of having a younger sibling. Children demonstrating a LCB, did however, obtain a significantly higher mean social ability score compared with their right side cradling counterparts. Like the infant human doll, the proto-face pillow's schematic face symbol was sufficient to elicit a population-level LCB. By contrast, the infant primate doll elicited a population-level right side cradling bias, influenced by both hand dominance and sex. The findings suggest that the LCB is present and visible early in development and is likely therefore, to represent evolutionarily old domain-specific organization and function of the right cerebral hemisphere. Additionally, results suggest that a LCB requires minimal triggering but can be reversed in some situations, possibly in response to species-type or levels of novelty or stress as perceived by the viewer. Patterns of behavioral biases within the context of social stimuli and their associations with cognitive ability are important for understanding how socio-communication abilities emerge in developing children.

J Cogn Neurosci. 2009 Sep;21(9):1782-9. doi: 10.1162/jocn.2009.21120.

Mind your left: spatial bias in subcortical fear processing.

Siman-Tov T[1], Papo D, Gadoth N, Schonberg T, Mendelsohn A, Perry D, Hendler T.

Author information

Abstract

Hemispheric lateralization of emotional processing has long been suggested, but its underlying neural mechanisms have not yet been defined. In this functional magnetic resonance imaging study, facial expressions were presented to 10 right-handed healthy adult females in an event-related visual half-field presentation paradigm. Differential activations to fearful versus neutral faces were observed in the amygdala, pulvinar, and superior colliculus only for faces presented in the left hemifield. Interestingly, the left hemifield advantage for fear processing was observed in both hemispheres. These results suggest a leftward bias in subcortical fear processing, consistent with the well-documented leftward bias of danger-associated behaviors in animals. The current finding highlights the importance of hemifield advantage in emotional lateralization, which might reflect the combination of hemispheric dominance and asymmetric interhemispheric information transfer.

IS THERE ANY WONDER WHY MOST PEOPLE WOULD BE MORE LIKELY TO NOTICE AND REACT MORE TO A SHADOW IN THE LEFT VS THE RIGHT VISUAL FIELD?

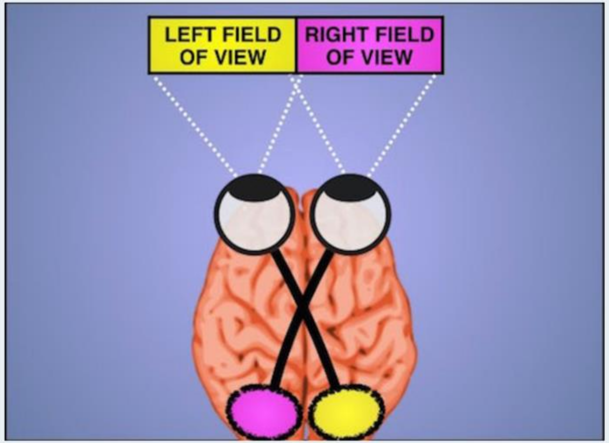
This is the way we are programmed for visual spatial awareness!

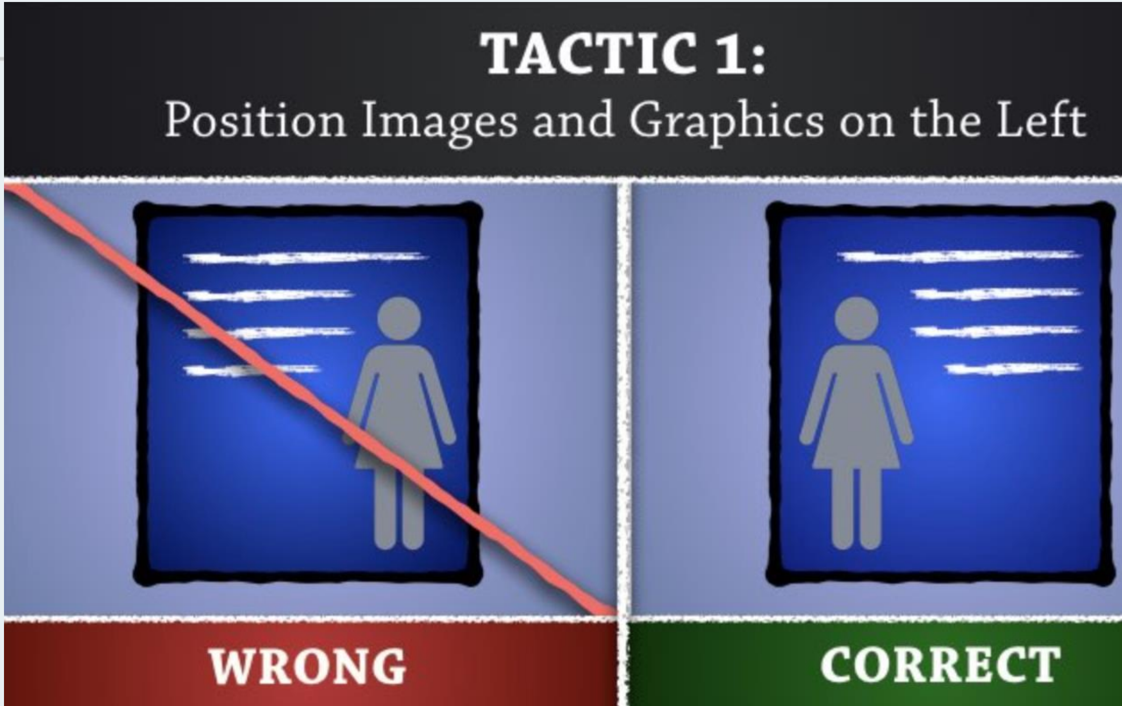
Marketing people know this!

Advertising Psychology

Tactic 1: Position Images and Graphics on the Left

When creating your ad, you need to consider the spatial positioning of images and text. Those elements should coincide with the anatomy of your visual pathway:





Avoid the Corner of Death!

By **Roger Dooley**

1 19

What's the worst place to put your logo, and where do advertisers most often put their logo in print ads, TV spots, and direct mail pieces? The answer is the same: the lower right corner, an area dubbed the "Corner of Death" by facial coding expert Dan Hill.

Hill's comments stem from an interesting eyetracking study by Steve Outing and Laura Rule, reported in The Best of Eyetrack III. This illustration shows a composite average of how people scan a typical web page:

BOTH POSITIVE AND NEGATIVE DYSPHOTOPSIA ARE INCREASED WITH HIGH REFRACTIVE INDEX, SHARP TRUNCATED EDGE IOLS

BOTH POSITIVE AND NEGATIVE DYSPHOTPSIA DRIVE ALL OF US:

THANKS!