


# Premium IOLs and the Light Adjustable Lens

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## “Standard” vs. “Premium” IOLs

- All modern IOLs have the same advanced optics
- Monofocal IOLs are covered by insurance
  - Single focal point, distance or near
- “Premium” IOLs add additional features
  - Toric corrects astigmatism
    - Toric is *also* monofocal
  - Multifocal (MFIOL)
    - Creates multiple focal points
  - Extended depth of focus (EDOF)
    - Extends the focal point continuously



[https://en.wikipedia.org/wiki/Intraocular\\_lens](https://en.wikipedia.org/wiki/Intraocular_lens)



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## Presbyopia

- What is it?
  - Loss of accommodation as the crystalline lens hardens
  - Begins to affect most people after age 40
- In 2015, an estimated 1.8 billion people affected
  - 25% of the world's population<sup>1</sup>
- Near vision is *crucial* in modern society

1. "Global Prevalence of Presbyopia and Vision Impairment from Uncorrected Presbyopia: Systematic Review, Meta-analysis, and Modelling"; Fricke et al., Ophthalmology 2018.



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## Treating Presbyopia

- Spectacles!
  - Reading glasses
  - Bifocals/Trifocals/Progressives
- Monovision
  - One eye for distance, one eye for near
- Corneal Inlays
  - Kamra, Raindrop, etc.



<https://www.hindawi.com/journals/bmr/2013/154593/fig1/>



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## Can an IOL accommodate? Maybe!

- Bausch & Lomb Crystalens
  - Ciliary muscle contraction creates increased pressure in vitreous
  - Hinged haptics move optic forward, power is increased
- Issues:
  - Minimal effectiveness at near
  - "Z-syndrome" - rare

<https://www.youtube.com/watch?v=B00dHypgpiI>



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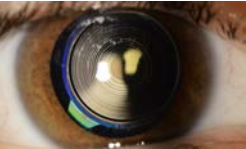
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## Multifocal IOLs



- Multiple simultaneous images on the retina
- When focused on distance target, near image is defocused/blurred
- When focused on near target, distance image is defocused/blurred
- Neuroadaptation allows brain to ignore blurred image

<https://jshedden.co.uk/should-i-have-a-multifocal-intraocular-lens-implant-for-my-cataract-surgery/>



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### Diffractive Multifocals

- Alcon PanOptix Trifocal
- J&J Tecnis Synergy Trifocal
  - Focal points at distance, intermediate, and near



<https://ophthalmologymanagement.com/issue/2022/february/insight-on-new-iol-technologies/>



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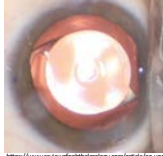
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### Extended Depth of Focus

- EDOF IOLs give distance and intermediate vision
- J&J Tecnis Symfony
  - Diffractive
- Alcon Vivity
  - Waveform shaping



<https://www.reviewofophthalmology.com/article/an-update-on-monofocal-plus-edof>



<https://asifeye.com/library/hccis-symfony-plus-intraocular-lens>



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### Problem Solved?

TNSTAAFL!

There's no such thing as a free lunch!



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## Diffractive Optics

- Diffractive IOLs "lose light" when it is split or extended
- Contrast sensitivity is reduced
  - Lower "quality of vision"
- PanOptix loses 12% of incoming light to diffraction
- Symphony loses 18% of incoming light
- In a perfectly healthy eye, this may be imperceptible



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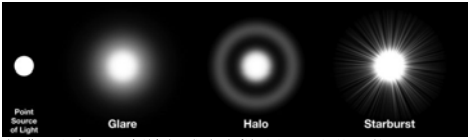
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## Dysphotopsias Glare, Halos, Starbursts

➢ The rings have an effect!



<https://www.reviewofoptometry.com/article/understanding-the-role-of-iol-optics-in-postoperative-vision-complaints>



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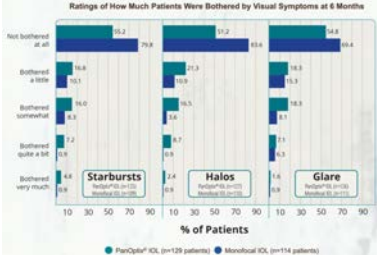
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## This Bothers Many Patients!

➢ PanOptix Initial Study



Symptom	Bothered very much	Bothered quite a bit	Bothered somewhat	Bothered a little	Not bothered at all
Starbursts (PanOptix IOL, n=129)	6.6	15.5	25.6	38.8	13.5
Starbursts (Monofocal IOL, n=114)	0.8	2.7	8.8	25.3	62.4
Halos (PanOptix IOL, n=129)	1.4	5.4	15.5	38.8	38.9
Halos (Monofocal IOL, n=114)	0.8	2.7	8.8	25.3	62.4
Glare (PanOptix IOL, n=129)	1.4	5.4	15.5	38.8	38.9
Glare (Monofocal IOL, n=114)	0.8	2.7	8.8	25.3	62.4

Source: myalcon.com



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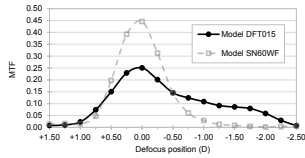
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### What about Vivivity?

- Not diffractive, so no additional glare, halos, or starbursts
- Similar or worse loss of contrast sensitivity to diffractive IOLs



[https://www.accessdata.fda.gov/cdrh\\_docs/pdf/P9300145126C.pdf](https://www.accessdata.fda.gov/cdrh_docs/pdf/P9300145126C.pdf)



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### Contraindications to MF/EDOF IOLS

- Cornea
  - Dry Eye / Blepharitis
  - High astigmatism
  - Higher order aberrations
  - Post-refractive (RK, LASIK, PRK)
- Retina
  - ARMD - absolute contraindication
  - ERM/Pucker
  - Macular edema (DM, RVO, MacTel, etc)
- Others
  - Uveitis
  - Moderate or severe glaucoma
  - ?



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### MFIOs Can Be Great

- Many patients hate glasses
- Most dysphotopsias are well-tolerated
- Patients who do well LOVE these lenses
  
- But... a small percentage do poorly



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## We've Been Making a Big Assumption

➤ IOL selection is based on biometry and lens calculation formulas



<https://www.mylens.com/2022/03/23/news-401-watson-2022/>
<https://www.mylens.com/2022/03/23/news-401-watson-2022/>
<https://www.mylens.com/2022/03/23/news-401-watson-2022/>



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## How Good Are We?

Moffa et al. • Accuracy of IOL Formulas

**Accuracy of Intraocular Lens Calculation Formulas**

**Purpose:** To compare the accuracy of intraocular lens (IOL) calculation formulas (Barrett Universal II, Haigis, Holladay 1, Holladay 2, Olsen, and SPOCT) in the prediction of postoperative refraction using a single optical biometry device.

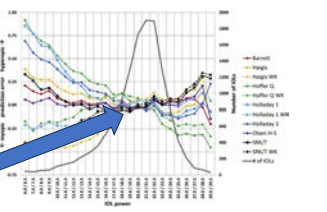



Figure 5. Smoothed line graph of prediction error (in diopters) versus intraocular lens (IOL) power (SNOW) and frequency distribution of eyes used in the study. (gray line) IOL = Haag-Streit; (WK) = Wang-Koch.



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## But Look Closer...

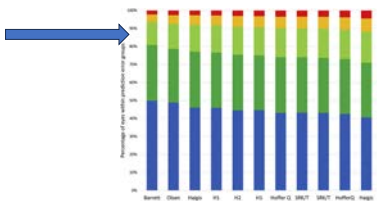



Figure 2. Stacked histogram comparing the percentage of cases within a given diopter range of predicted spherical equivalent refraction outcomes for the SPOCT (Alcon Laboratories, Inc., Fort Worth, TX) axial intraocular lens. H1 = Holladay 1; H2 = Holladay 2; H3 = Haag-Streit; WK = Wang-Koch.

With our most accurate formula, nearly 20% of cases outside of 0.5 D of target



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### What if we just had to get it close?



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### RxSight Light Adjustable Lens

- > 3-piece silicone IOL
- > "Macromers"
  - Mobile photosensitive subunits
- > UV light interacts with macromers causing the IOL to change shape



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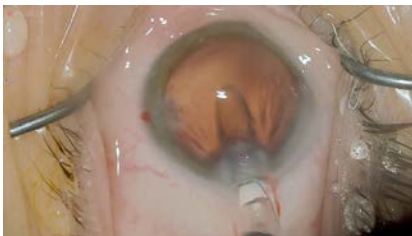
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### LAL Insertion



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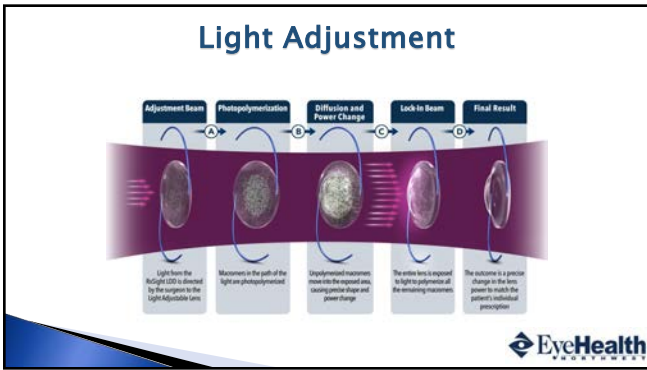
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### LAL has EDof

- Targeting -0.5 D Sphere or more minus on the first treatment induces EDof effect
  - Non-dominant eye
- This adds about double the near vision as the MRx suggests
  - E.g. MRx of -0.75 D would have equivalent near vision as typical -1.50 D
- The Light Delivery Device (LDD) adds negative spherical aberration to the center of the lens
  - No rings, so no additional glare or halos
  - Minimal reduction in contrast sensitivity
  - Patients who are not diffractive MF candidates can be LAL candidates

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### Light Adjustment Process

- Patient must wear UV-protecting glasses
- First adjustment at least 21 days after surgery
- Can adjust 3D of combination sphere and cylinder
- Up to 3 adjustments per lens
- At least 72 hours between adjustments
- 2 final "lock-ins"

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### The Importance of Refraction

- The LDD will do what you tell it to do
- If the refraction is incorrect, results will be incorrect
- MUST be confident in the refraction before light treatment



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### Light Adjustment



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### Great LAL Candidates

- Post-refractive surgery: LASIK, PRK, and even some RK
- Highly demanding
- Pathology that contraindicates diffractive EDOF or MF IOLs
  - Dry Eye, AMD, POAG, etc.
- Glare/Halo/Dysphotopsia concerns



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### Not LAL Candidates

- Poor dilation
  - Dilation needs to be at least 5.5mm, ideally >6mm
- Astigmatism > 3D
  - Ideally < 2D
- Highly aberrant corneas (e.g. keratoconus, some RK, scars, etc.)



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### LAL Considerations

- Very Expensive
- Many post-op appointments (generally 4 to 6)
- Wearing UV glasses until lock-ins are complete
- No instant gratification
  - Vision doesn't "come in" until first adjustment



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### LAL and Near Vision

- With both eyes, ~90% of LAL patients are 20/20 and J2<sup>1</sup>
- Need to tolerate some monovision to get near
  - About 80% of LAL patients choose "blended" vision
- May still need some reading glasses for small print
  - Those who want full range of vision with both eyes may do better with MFIOI

1. RxSight Combined PMCS-001 & PMCS-002 Clinical Outcomes of Patients Bilaterally Implanted with LAL



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## Summary

- We don't have an accommodating IOL... yet
- There are some great options for treating presbyopia
- Diffractive multifocal IOLs can provide a full range vision
  - But many are not candidates
  - Need to be able to deal with glare and halos
  - Need to nail the refractive outcome
- The LAL is the most accurate IOL
  - Best glasses-free outcomes for distance
  - No glare or halos
  - Need to tolerate some blended vision for near, may still need readers rarely



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## Thank You!

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