OPTICS AND CLINICAL PERFORMANCE: MONO, EDOF, PINHOLE, DIFF/REF BIFOCAL & TRIFOCAL IOLS

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12/10/2021 JTH 1

NO FREE LUNCH "COMPROMISE"

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12/10/2021 JTH 2

Financial Disclosure

I have the following financial interests or relationships to disclose:

- **AcuFocus, Inc.: C,O;**
- **Alcon Laboratories, Inc.: C;**
- **Carl Zeiss Inc: C;**
- **Clerio Vision: C,O;**
- **Oculus, Inc.: C;**
- **OcuPhire: C,O;**
- **RX Vision: C,O;**
- **M & S Technologies: C;**
- **Visiometrics: C,O;**

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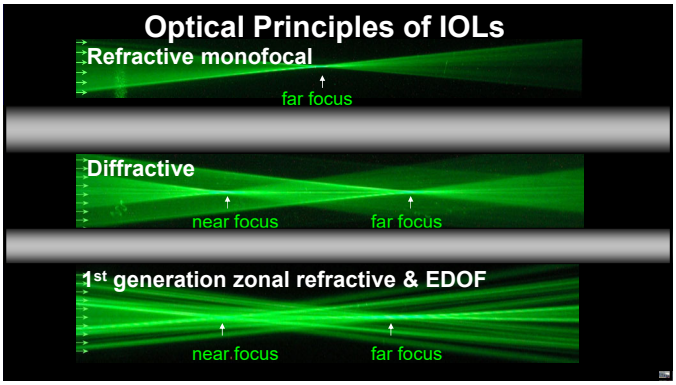
Optical Principles of IOLs



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Holladay Handouts

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1. Pentacam BKFST Symposium 16x9 - 2018 (1.250 KB)
2. Holladay Report 2018 - Interpretation Guidelines - 2018 (1,100 KB)
3. TORIC IOL CALCULATIONS: Minimizing & Managing Residual Astig - 2018 (2,043 KB)
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9. Optics and Clinical Performance of Mono IC8 EDOF Bif Tri – 2022 (2,831 KB)
10. HOLLADAY IOL Outcomes Optics We Need to Know – 2018 (1,820 KB)
11. HOLLADAY IOL CALCS JCAHPO – 2018 (3,203 KB)
12. Negative Dysphotopsia Causes & Treatment – 2018 (696 KB)
13. Optics and Clinical Performance of EDOF & Multifocal – 2018 (1,068 KB)
14. Optics and Clinical of Mono IC8 EDOF Bif Tri - 2018 (1,309 KB)

#9

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12/10/2021

How do we compare Optical Performance ?

1. High Contrast BDCVA @ distance (4 – 6 M)
2. High Contrast BDCVA @ intermed (66 cm)
3. High Contrast BDCVA @ near (40 cm)
4. Stereopsis (9/9 circles – 40 sec of arc)
5. Contrast Sensitivity Function (CSF)
6. Visual Disturbances (Halos, Glare, …)

10/24/97 –Jack T. Holladay, M.D.

IOL Types

- Aspheric Mono: Tecnis, Acrysof, EnVista
- EDOF: Symphony, Eyehance
- Pinhole: IC8
- Bifocal: Diffractive & Refractive
- Trifocal: Panoptic

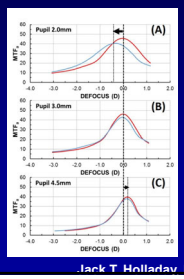
2018 Jack T. Holladay, M.D.

IOL Optical Comparsion

IOL Type	Theoretical BSCVA	Actual BSCVA	Contrast Loss	Halos & Glare	Forward Light Scatter
Aspherical Mono	20/09	20/17	0%	-	0%
IC8 Pinhole IOL	20/12	20/16	0%	⬇	0%
EDOF 1.75 D, 0.50 D (1.16, 0.37)	20/16	20/18	20%	+	10%
Diff Bifocal 3.00 D (2.00)	20/20	20/22	25%	+++	18%
Ref Bifocal 3.00 D (2.00)	20/20	20/22	25%	++	0%
Diff Trif 3.75, 1.87 D (2.50, 1.25)	20/20	20/22	30%	+++	18%

LA Dodgers 1993-1995: 1.7% from 20/8.9 to 20/9.2
42% ≤ 20/12.5 AJO 1996; Oct 122 (4): 476-85.

Tecnis Eyehance ICB00
ZCB00 w +0.50 D in central 2.0 mm



EDOF

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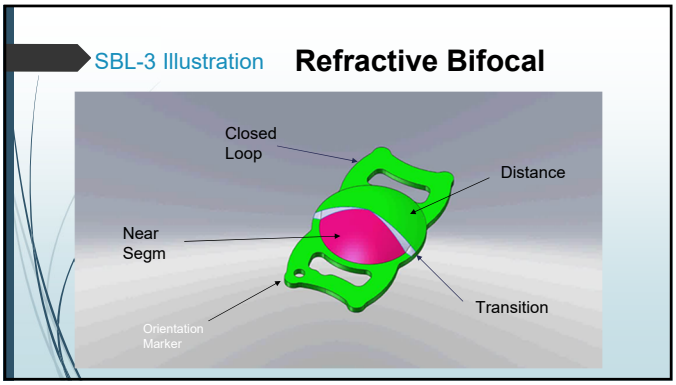
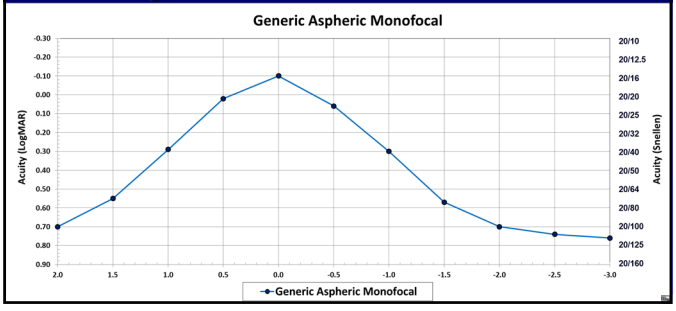
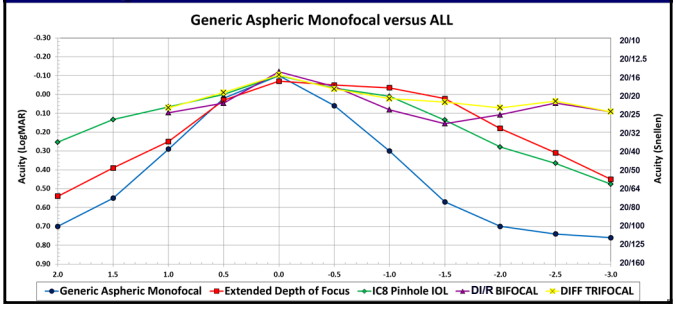
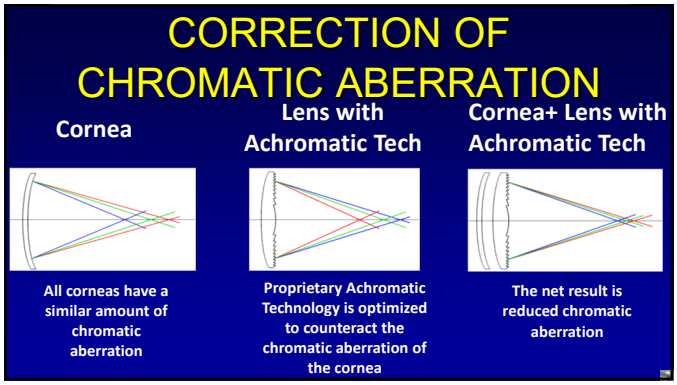


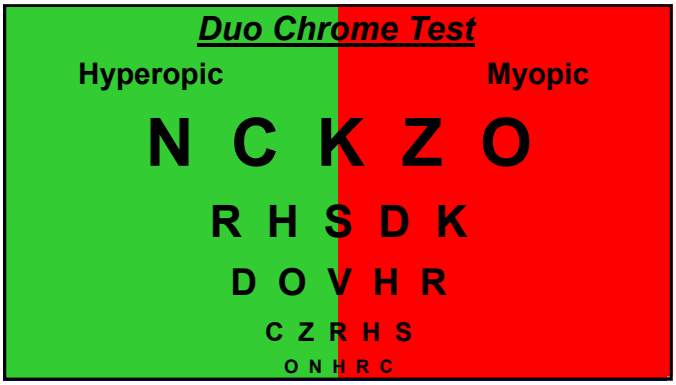
Aspheric Mono

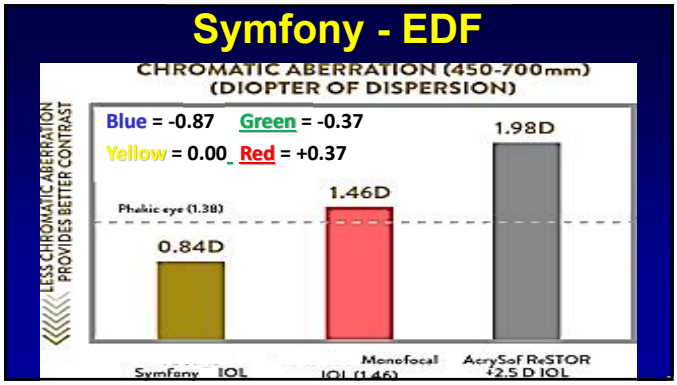


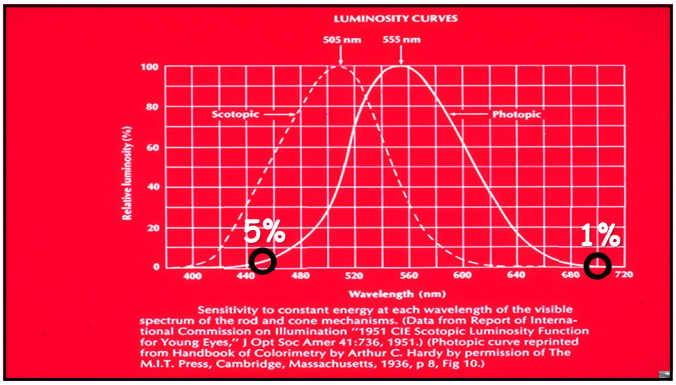
Aspheric Mono vs ALL

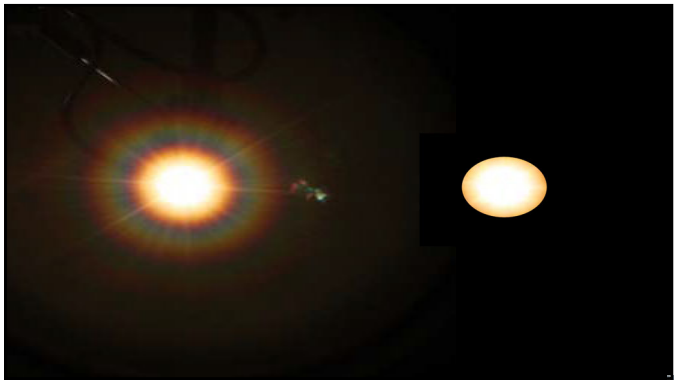


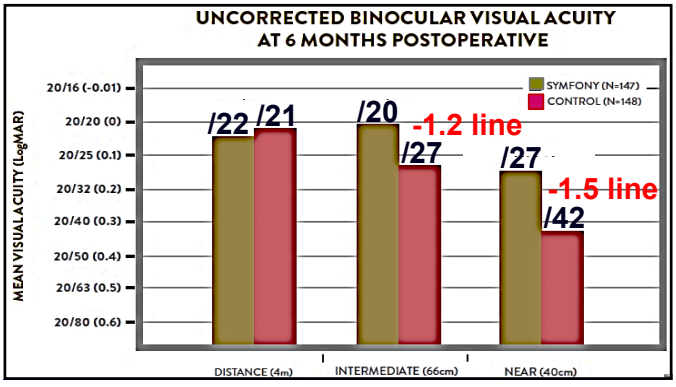

CORRECTION OF CHROMATIC ABERRATION
Cornea
Lens with Achromatic Tech
Cornea+ Lens with Achromatic Tech
All corneas have a similar amount of chromatic aberration
Proprietary Achromatic Technology is optimized to counteract the chromatic aberration of the cornea
The net result is reduced chromatic aberration

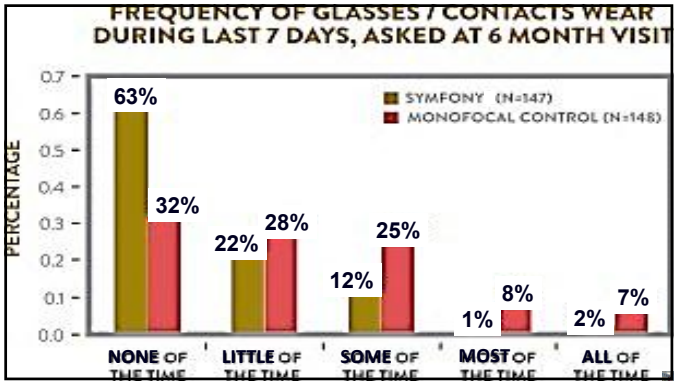

Duo Chrome Test
Hyperopic
Myopic
N C K Z O
R H S D K
D O V H R
C Z R H S
O N H R C


Symfony - EDF
CHROMATIC ABERRATION (450-700mm)
(DIOPTER OF DISPERSION)
LESS CHROMATIC ABERRATION PROVIDES BETTER CONTRAST
Blue = -0.87 Green = -0.37
Yellow = 0.00 Red = +0.37
Phakic eye (1.38)
0.84D
1.46D
1.98D
Symfony IOL
Monofocal IOL (1.46)
AcrySof ReSTOR +2.5 D IOL

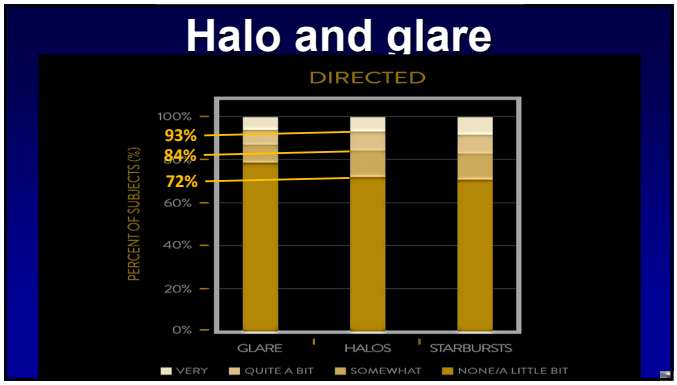

LUMINOSITY CURVES
505 nm
555 nm
Scotopic
Photopic
Relative luminosity (%)
5%
1%
Wavelength (nm)
Sensitivity to constant energy at each wavelength of the visible spectrum of the rod and cone mechanisms. (Data from Report of International Commission on Illumination "1951 CIE Scotopic Luminosity Function for Young Eyes," J Opt Soc Amer 41:736, 1951.) (Photopic curve reprinted from Handbook of Colorimetry by Arthur C. Hardy by permission of The M.I.T. Press, Cambridge, Massachusetts, 1936, p 8, Fig 10.)

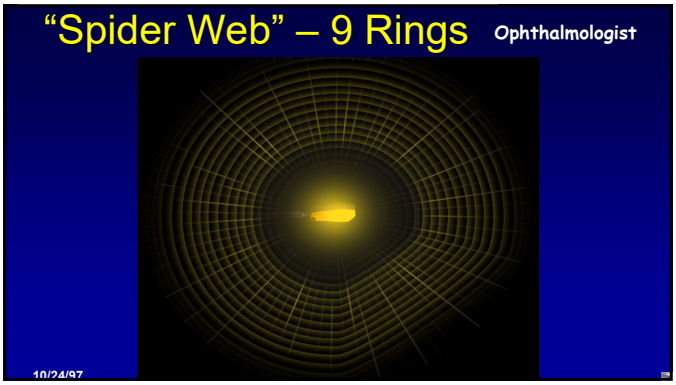


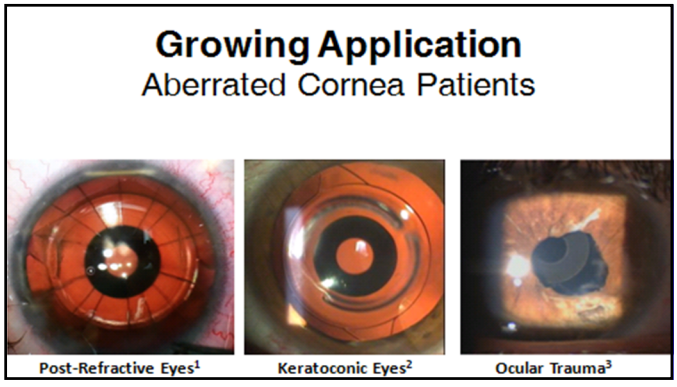

UNCORRECTED BINOCULAR VISUAL ACUITY
AT 6 MONTHS POSTOPERATIVE
SYMFONY (N=147)
CONTROL (N=148)
MEAN VISUAL ACUITY (LogMAR)
20/16 (-0.01)
20/20 (0)
20/25 (0.1)
20/32 (0.2)
20/40 (0.3)
20/50 (0.4)
20/63 (0.5)
20/80 (0.6)
/22
/21
/20
-1.2 line
/27
/27
-1.5 line
/42
DISTANCE (4m)
INTERMEDIATE (66cm)
NEAR (40cm)

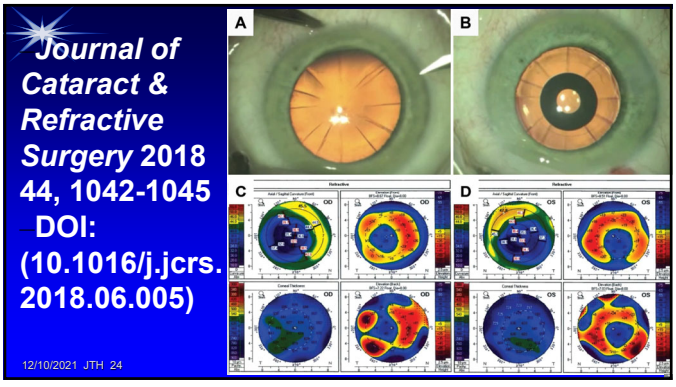

FREQUENCY OF GLASSES / CONTACTS WEAR
DURING LAST 7 DAYS, ASKED AT 6 MONTH VISIT
PERCENTAGE
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
SYMFONY (N=147)
MONOFOCAL CONTROL (N=148)
63%
32%
22%
28%
12%
25%
1%
8%
2%
7%
NONE OF THE TIME
LITTLE OF THE TIME
SOME OF THE TIME
MOST OF THE TIME
ALL OF THE TIME


Diff Multi


Halo and glare
DIRECTED
PERCENT OF SUBJECTS (%)
100%
93%
84%
72%
60%
40%
20%
0%
GLARE
HALOS
STARBURSTS
VERY
QUITE A BIT
SOMEWHAT
NONE/A LITTLE BIT


"Spider Web" – 9 Rings
Ophthalmologist
10/24/97


Growing Application
Aberrated Cornea Patients
Post-Refractive Eyes1
Keratoconic Eyes2
Ocular Trauma3


Journal of Cataract & Refractive Surgery 2018 44, 1042-1045 –DOI: (10.1016/j.jcrs.2018.06.005)
A
B
C
D
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Presby Rx	Binoc DVA	Binoc NVA	3D	CSF	Halo	Glare
Binocular Mono Distance	**20/16**	**20/30**	**9**	**+40% +2dB**	--	--
Traditional Mono (1.5)	**20/20**	**20/25**	6	0%	--	--
IC8 Pinhole	**20/20**	**20/30**	8	0%	--	--
EDOF 1.75 D, 0.50 D **(1.16, 0.37)**	**20/20**	**20/25**	9	-21% -1dB	**1+**	11%
Diff Bifocal 3.50 D **(2.50)**	**20/20**	**20/20**	8	-37% -2dB	**2+**	18%
Ref Bifocal 3.50 D **(2.50)**	**20/20**	**20/20**	8	-37% -2dB	**2+**	--
Diff Trif 3.75, 1.87 D **(2.50, 1.25)**	**20/20**	**20/20**	8	-37% -2dB	**2+**	18%