



Differences in Wavefront Refraction and Higher Order Aberration Measurements between Three Different Aberrometers

Ronald R. Krueger, M.D.

Jerome C. Ramos-Esteban, M.D.

Karolinne Maia Rocha, M.D.

Sonya Bamba, M.D.

Wavefront
Presbyopic
Refractive Corrections

February 14-17, 2008
Argonaut Hotel, San Francisco, California



Commercial Disclosures

- Ronald R. Krueger, M.D.
 - Consultant Alcon
- Jerome Ramos-Esteban, M.D.
 - None
- Karolinne Maia Rocha, M.D.
 - None
- Sonya Bamba, M.D.
 - None



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Cleveland Clinic



Purpose

- To evaluate differences in wavefront refraction (WFR) and higher order aberration measurements (HOA) in normal subjects between three commercially available aberrometers under room light illumination before and after cycloplegia

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Methods

- 10 healthy volunteers, divided into 2 groups (n=5)
- Group 1:
 - Young presbyopes (age 45 to 55)
 - Mean SE -1.45 D
- Group 2:
 - Pre-presbyopes (age 20 to 40)
 - Mean SE -1.75 D

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HOA Assessment

- Testing conditions:
 - Room light illumination
 - Measurements before/after Tropicamide 1%
- Evaluated parameters:
 - Pupil diameter (PD)
 - Wavefront Refraction (WFR)
 - Higher order aberrations (HOA)
- Wavefront information determined for two predetermined PD of 5.0 and 6.5 mm

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Aberrometers

LADARWave 4000 (ALCON)



WaveScan (VISX/AMO)



Maxwell Ocular Wavefront
(Ziemer/Imagine Eyes)



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Technical Specifications

	WaveScan	LADAR	Maxwell
Principle	HS	HS	HS
Pupil Diameter (mm)	5 - 6	2.5 -10	2 -10
Dynamic Range (D)	+6 to -8	+15 to -15	-15 to +20
Laser Wavelength (nm)	785	820	780
HOA	6 th order	8 th order	6 th order
HOA PD Adjustable*	NO	YES	YES
Corneal Aberrations	NO	NO	YES

* Zernicke Tool Software used to obtain HOA information at pupil diameters (5.0 and 6.5 mm) for WaveScan

Statistical Analysis

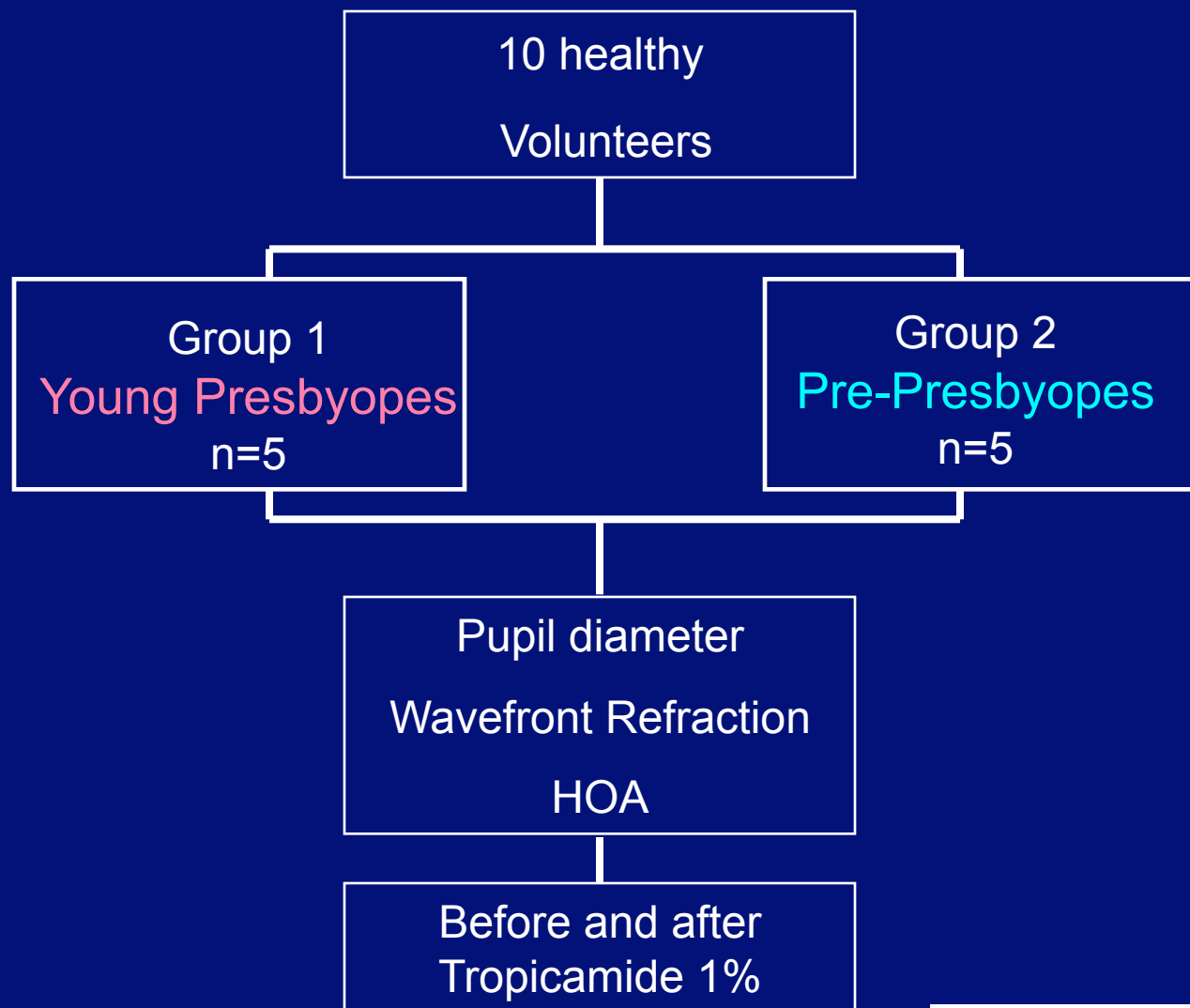
- The average of three consecutive measurements was used for statistical analysis
- Descriptive statistics were used to summarize numerical data
- Differences in PD, WFR, and HOA measurements between aberrometers were assessed using paired T-test

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Experimental Design



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Patient Demographics

	MEAN AGE	SD	M	F	n
GROUP 1	48.4	5.13	0	5	5
GROUP 2	26.4	5.32	2	3	5



Undilated Pupil Diameter Presbyopes

	Maxwell	LADAR	WaveScan
Mean (mm)	5.41	5.59	5.85
SD	0.93	0.80	1.02

WaveScan PD measurement > 0.26 mm over LADAR $p=0.19$
0.44 mm over Maxwell $p=0.015$



Undilated Pupil Diameter Pre-presbyopes

	Maxwell	LADAR	WaveScan
Mean (mm)	5.42	5.66	5.95
SD	0.77	0.37	0.65

Wavescan PD measurement > 0.29 mm over LADAR $p=0.23$
0.53 mm over Maxwell $p=0.025$



Mean Undilated Wavefront Refraction Presbyopes

	Maxwell	LADAR	WaveScan
Sphere (D)	-0.97 (0.5)	-1.37 (1.7)	-0.71 (1.6)
Cylinder (D)	-0.91 (0.5)	-0.75 (0.6)	-0.81 (0.6)
Axis (Degrees)	81 (75)	89 (67)	121 (64)

LADAR Sphere measurement > 0.4 D over Maxwell $p=0.039$
0.6 D WaveScan $p=0.003$ *



Mean Dilated (6.5 mm) Wavefront Refraction Presbyopes

	CR	Maxwell	LADAR	WaveScan
Sphere (D)	-1.15 (1.7)	-1.54 (2.6)	-1.52 (1.7)	-0.99 (1.8)
Cylinder (D)	-0.2 (0.3)	-0.46 (0.2)	-0.43 (0.3)	-0.39 (0.6)
Axis (Degrees)	72 (98)	71 (74)	73 (67)	110 (69)



Mean Dilated (5.0 mm) Wavefront Refraction Presbyopes

	CR	Maxwell	LADAR	WaveScan
Sphere (D)	-1.15 (1.6)	-1.32 (2.4)	-1.21 (2.1)	-0.80 (1.6)
Cylinder (D)	-0.20 (0.3)	-0.42 (0.3)	-0.5 (0.3)	-0.40 (0.3)
Axis (Degrees)	72 (98)	74 (71)	72 (72)	113 (72)

CR SE 0.47 D > WaveScan WFR SE p=0.03



Mean Undilated Wavefront Refraction Pre-presbyopes

	Maxwell	LADAR	WaveScan
Sphere (D)	-1.49 (1.8)	-1.84 (1.9)	-1.54 (1.7)
Cylinder (D)	-0.46 (0.2)	-0.51 (0.2)	-0.55 (0.2)
Axis (Degrees)	124.8 (56)	90 (68)	120 (52)

WaveScan cylinder measurement > 0.09 D over Maxwell * p=0.04



Mean Dilated (6.5 mm) Wavefront Refraction Pre-presbyopes

	CR	Maxwell	LADAR	WaveScan
Sphere (D)	-1.45 (1.6)	-1.31 (1.8)	-1.71 (1.9)	-1.46 (1.8)
Cylinder (D)	-0.4 (0.1)	-0.49 (0.2)	-0.44 (0.2)	-0.41 (0.1)
Axis (Degrees)	130 (51)	94 (64)	126 (56)	121 (51)



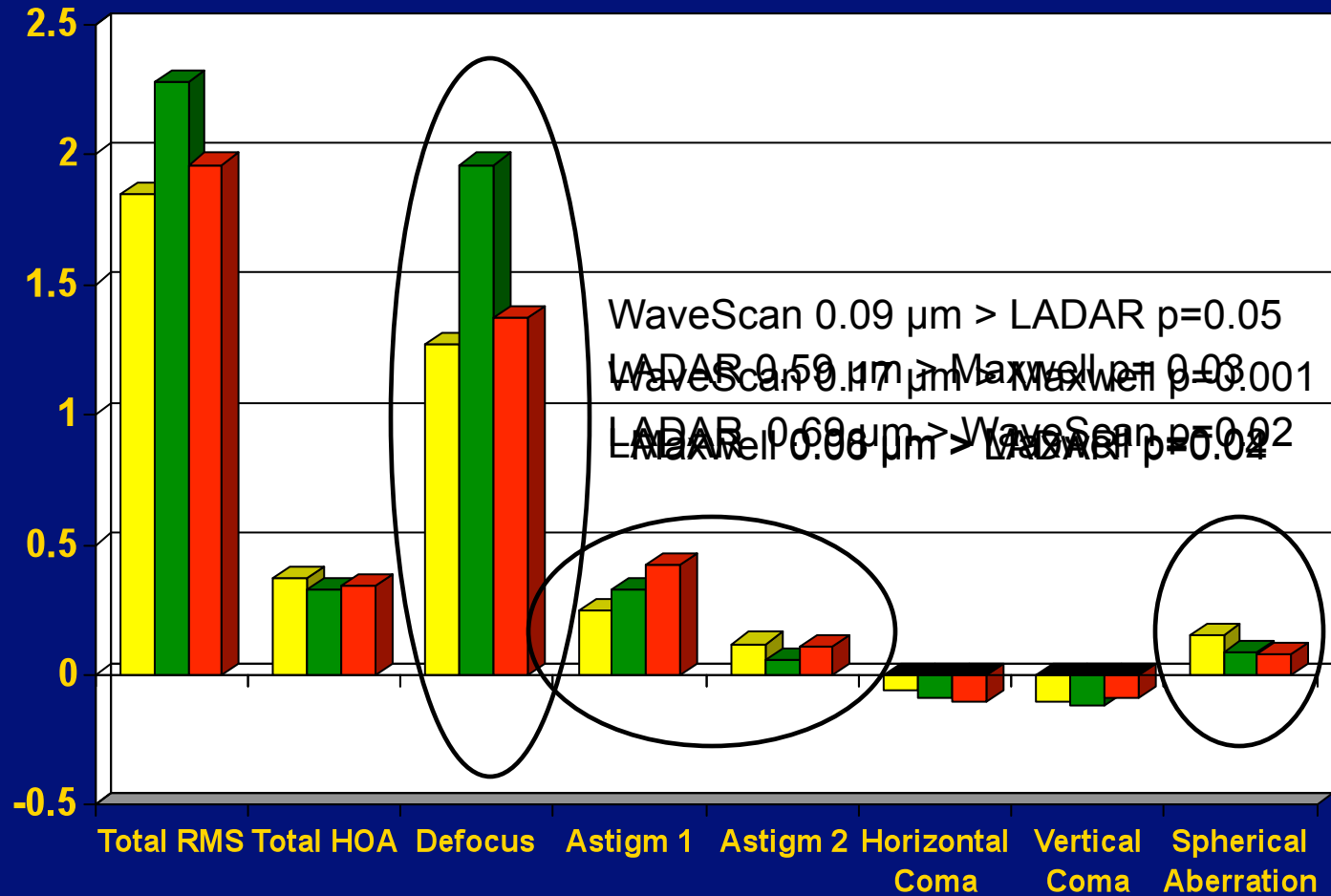
Mean Dilated (5.0 mm) Wavefront Refraction Pre-presbyopes

	CR	Maxwell	LADAR	WaveScan
Sphere (D)	-1.45 (1.6)	-1.07 (1.9)	-1.81 (1.9)	-1.28 (1.9)
Cylinder (D)	-0.45 (0.1)	-0.61 (0.1)	-0.43 (0.2)	-0.65 (0.4)
Axis (Degrees)	130 (52)	90.3 (70)	94 (69)	96 (73)

LADAR WFR SE 0.84 D > Maxwell WFR SE $p=0.004$

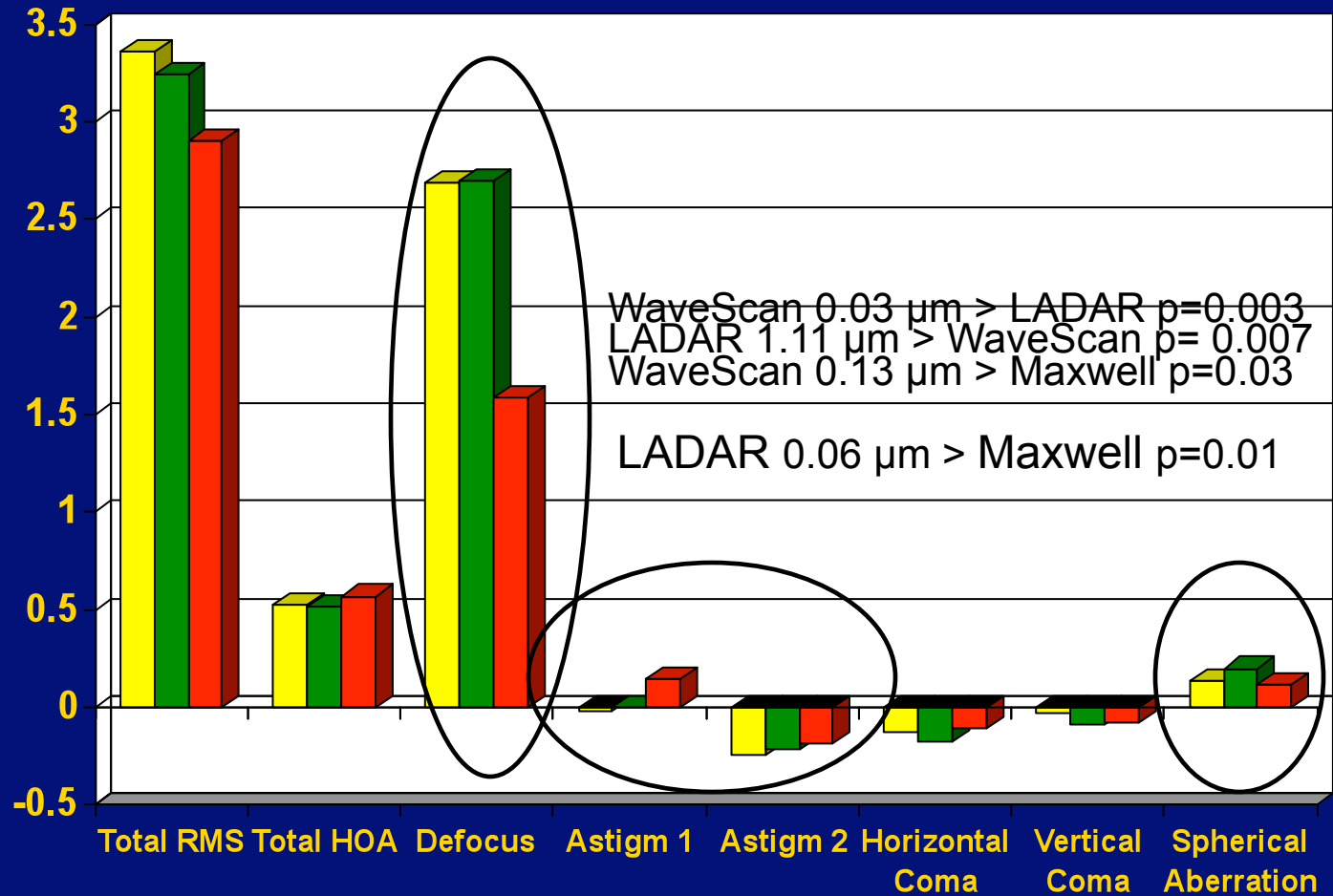


Mean Undilated HOA Presbyopes



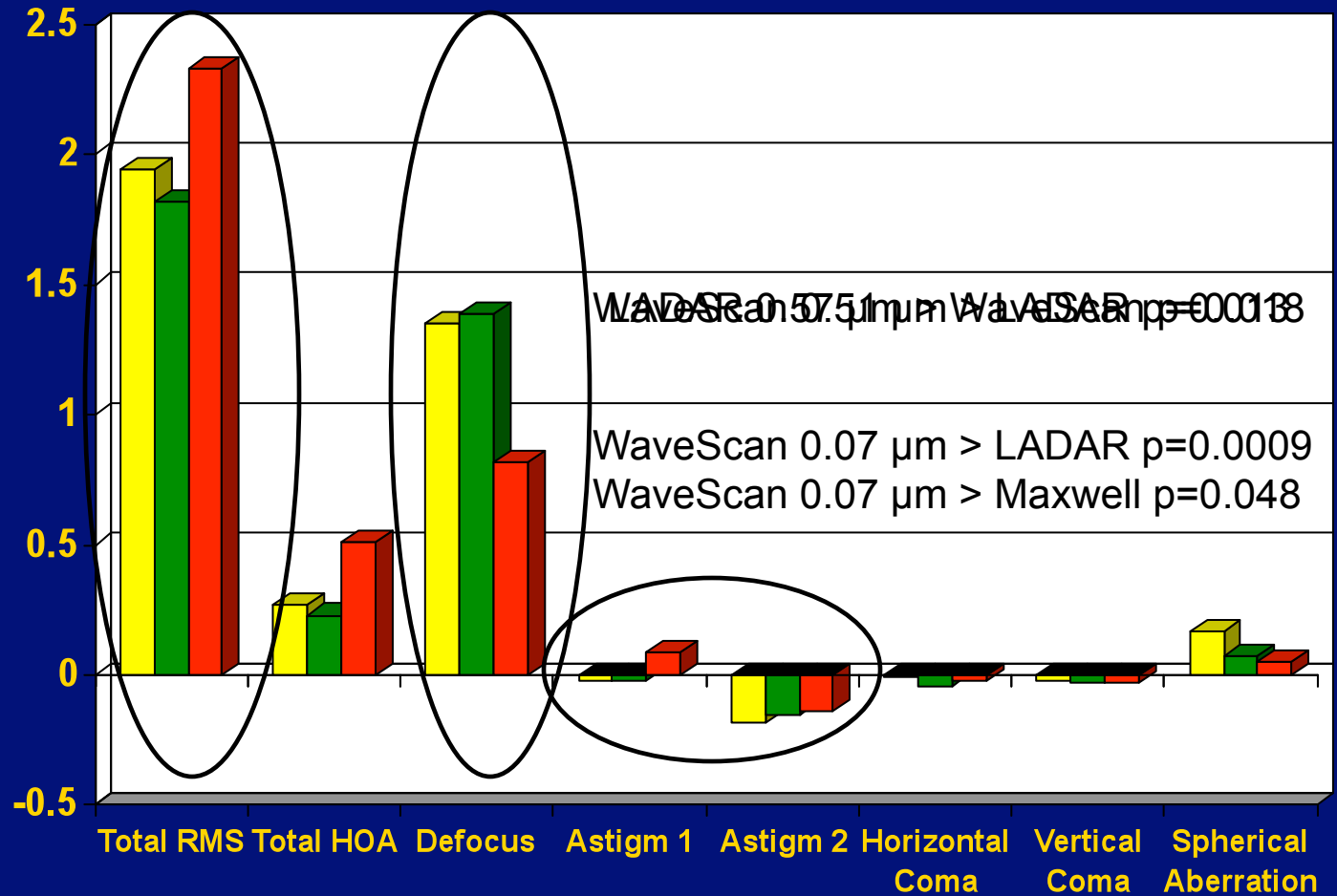


Mean Dilated (6.5 mm) HOA Presbyopes



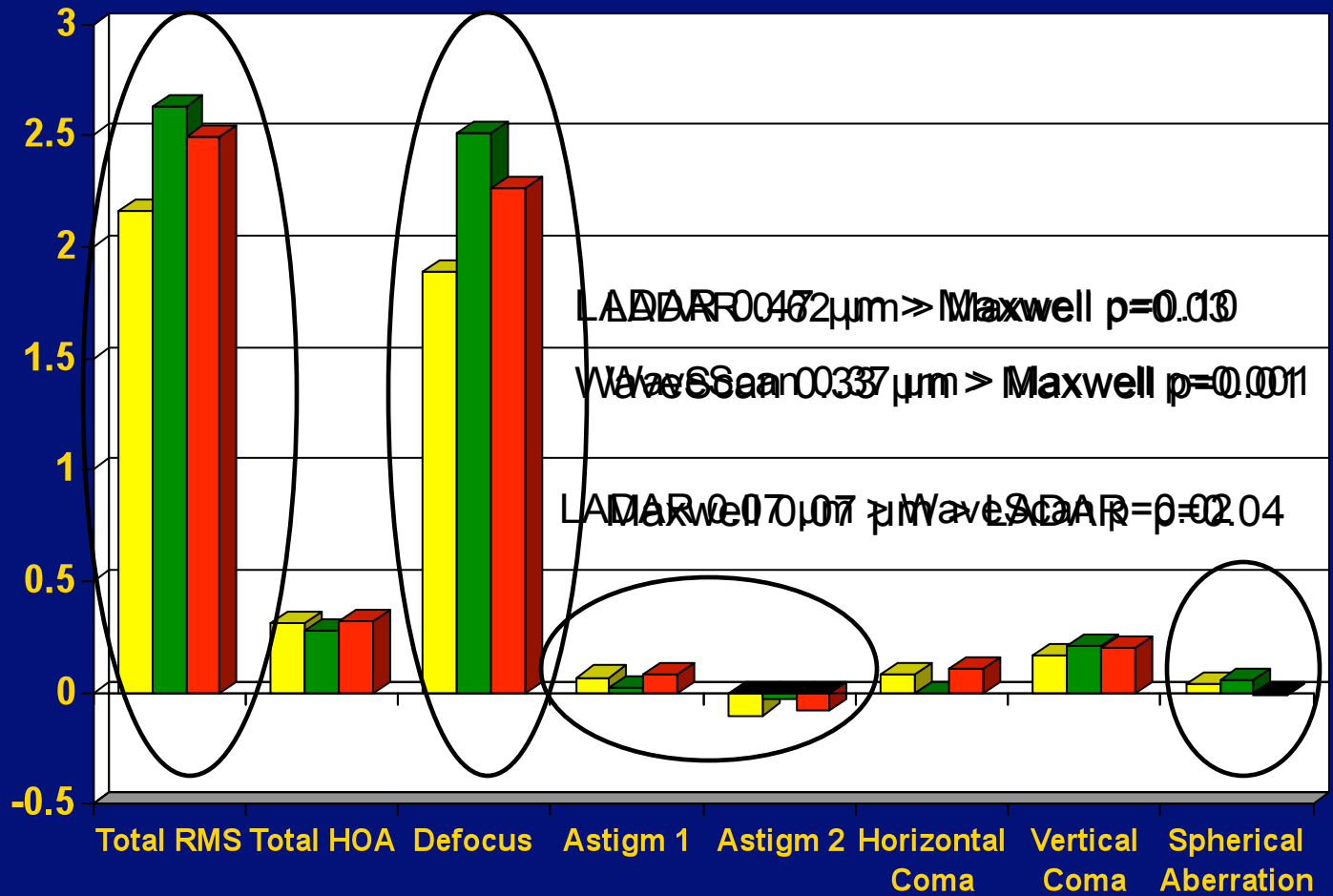


Mean Dilated (5.0 mm) HOA Presbyopes



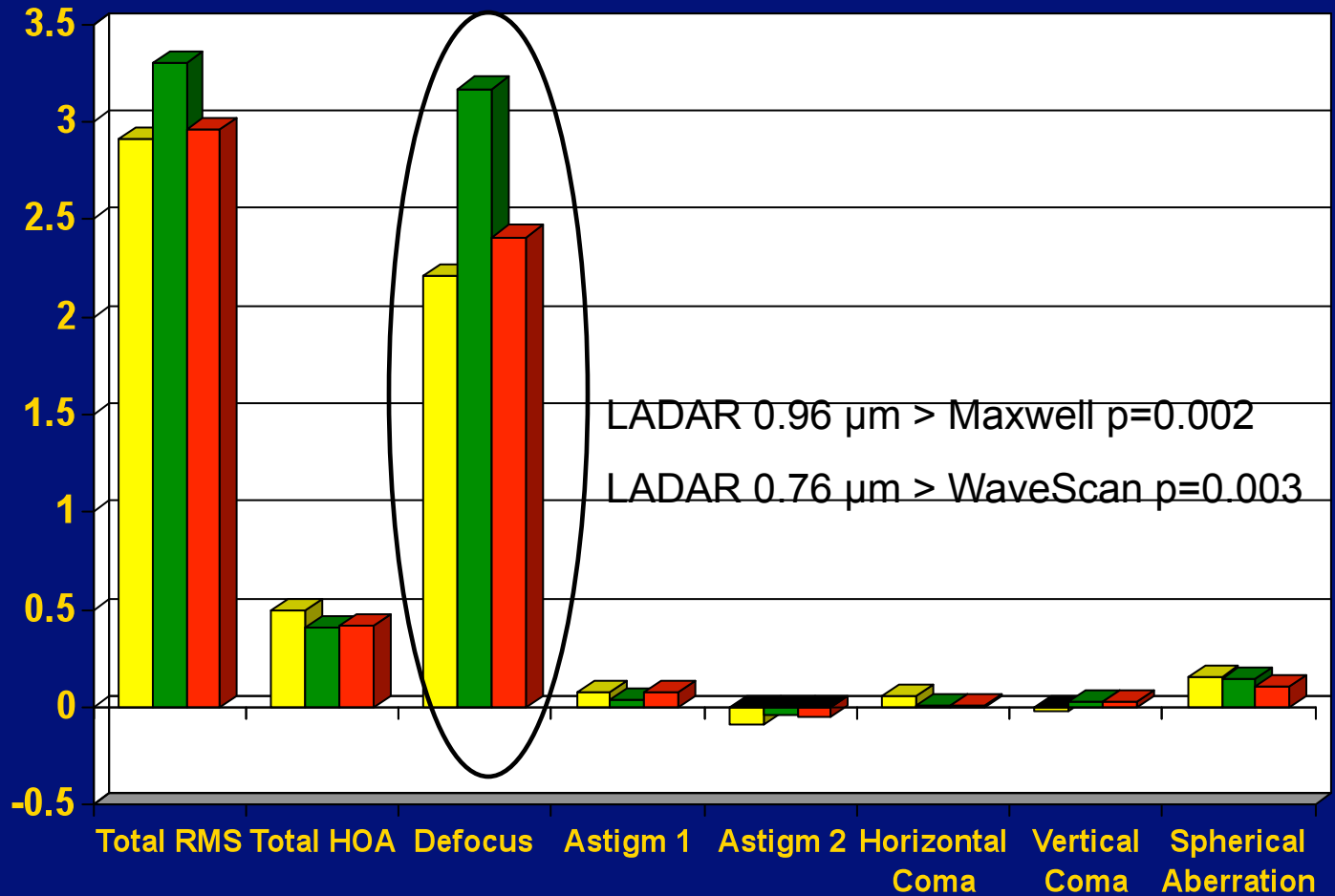


Mean Undiluted HOA Pre-Presbyopes



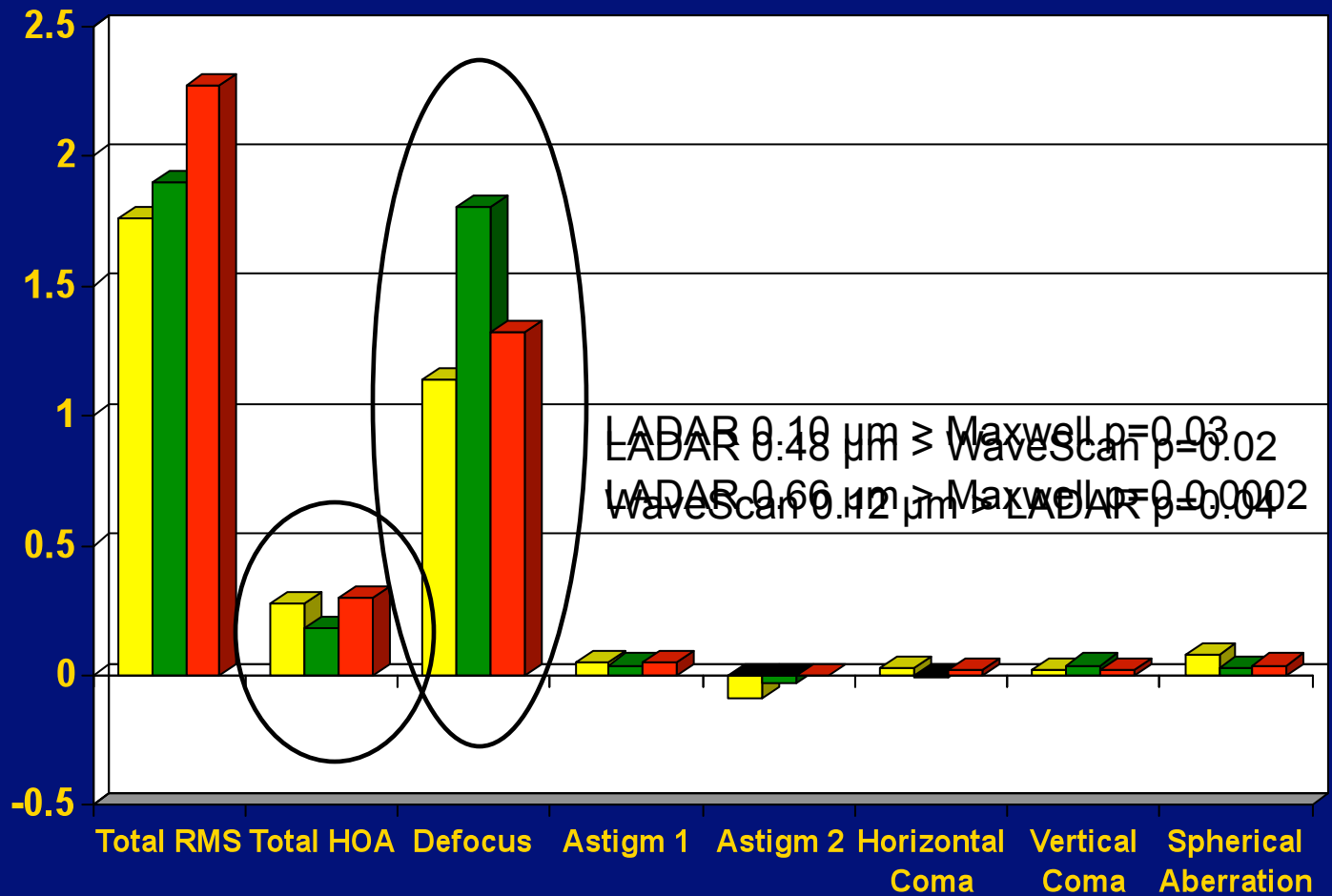


Mean Dilated (6.5 mm) HOA Pre-presbyopes





Mean Dilated (5.0 mm) HOA Pre-presbyopes



Summary

- In comparison with **cycloplegic refraction**, the spherical magnitude of refraction (and magnitude of defocus) tends to be **less** with the **WaveScan** and **more** with the **LADARWave** in both presbyopic and pre-presbyopic eyes.
- The spherical magnitude of refraction (and magnitude of defocus) of the **Maxwell** is **greater** than the **WaveScan** in presbyopes and **less** than the **LADARWave** in pre-presbyopes
- Cylinder and HOA differences are variable.

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Conclusions

- Diagnostic and therapeutic measurements should be performed with similar aberrometers and treatments should be laser platform specific.

Clinical Customized Ablations

CustomCornea (LADARWave)

Must typically use a “+” **offset** to treat **less** than the full Wavefront Sphere for an emmetropic outcome

CustomVue (WaveScan)

Must typically use a “-” **offset** to treat **more** than the full Wavefront Sphere for an emmetropic outcome

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