

# **Improved astigmatism outcomes for VISX CustomVue™ with Maximized optical zone and blend size**

**Mark E Johnston MD FRCSC**

Nebraska Laser Eye Associates, Omaha, NE

[www.nebraskaeye.com](http://www.nebraskaeye.com)

**[www.markjohnstonlasik.com](http://www.markjohnstonlasik.com)**

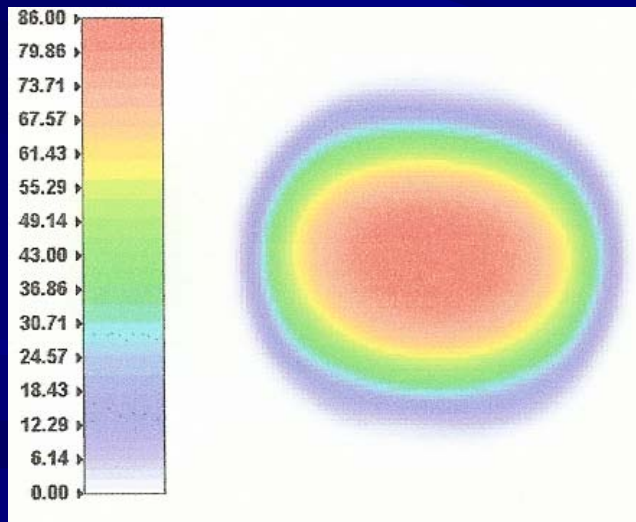
In 2005 & 2006 we noted that  
VISX Wavefront treatment of myopic astigmatism  
resulted in significant overcorrection

**-2.63 -2.53 x 175**

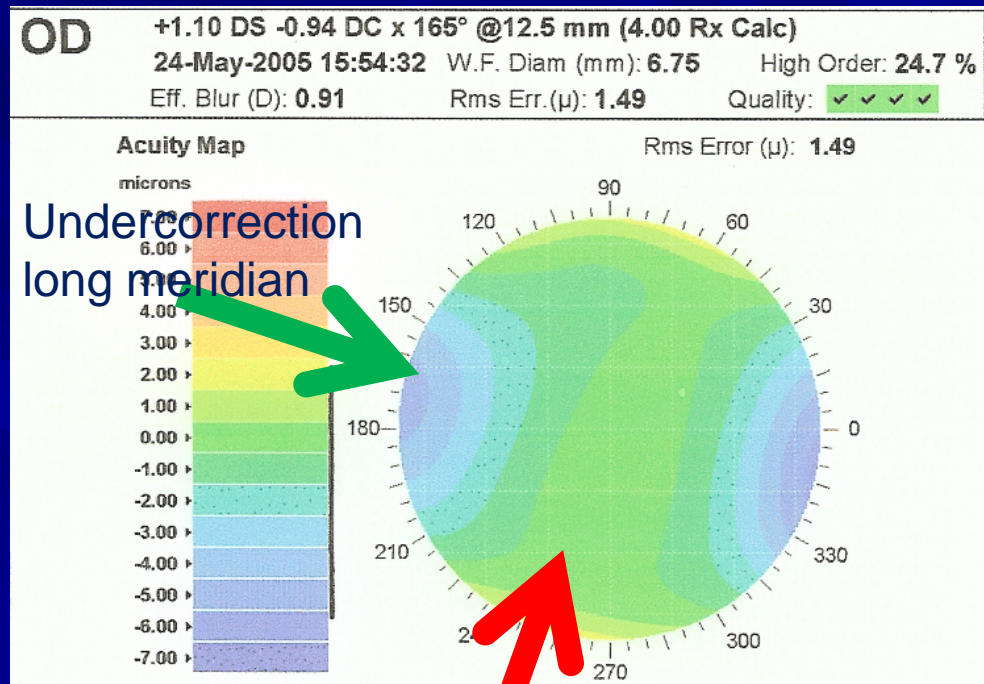
Treatment Type: <b>LASIK</b>	Correction Type: <b>CustomVue</b>	Nomogram Change: <b>+10%</b>
Physician Adjustments - SPH (D): <b>-0.20</b>	CYL (D): <b>+0.00</b>	Axis(°): <b>VTX(mm): 0.00</b>
Total Correction - SPH (D): <b>-2.63</b>	CYL (D): <b>-2.53</b>	Axis(°): <b>175</b> VTX(mm): <b>0.00</b>

<b>Treatment Parameters</b>	<b>Distribution of VSS Pulse Diameters</b>
Optical Zone (mm): <b>6.00 x 6.67</b>	
Ablation Zone (mm): <b>8.00</b>	



**+1.10 – 0.94 x 165**

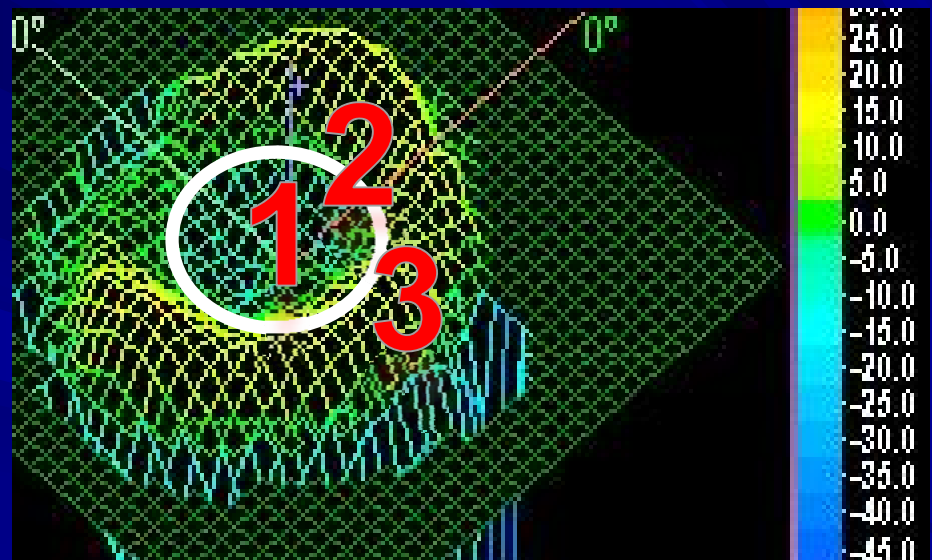


Overcorrection  
short meridian

■ \*Previous studies have shown that increasing the depth of spherical and cylinder laser ablation results in an exponential :

1. Increase in overcorrection
2. Decrease in effective optical zone,
3. Increase in induced spherical and toric aberrations

Theoretically, we would expect the same effects with any decrease in the width of ablation.



Effective Optical Zone (EOZ) is the area within one diopter of central power



Assuming that increasing the width of the ablation would result in less overcorrection, beginning in July 2006, all eyes with more than 1.5 Diopters of astigmatism were treated with:  
a blend zone adjusted to the Maximal **9.0 mm**  
thereby maximizing the optical zone to **6.00 by 7.00 mm**

Treatment Type: **LASIK**      Correction Type: **CustomVue**      Nomogram Change: **+10%**  
Physician Adjustments - SPH (D): **+0.00**    CYL (D): **+0.00**    Axis(°):      VTX(mm): **0.00**  
Total Correction - SPH (D): **-0.80**    CYL (D): **-1.92**    Axis(°): **98**      VTX(mm): **0.00**

**Treatment Parameters**

Optical Zone (mm): **6.00 x 7.00**

Blend Zone (mm): **9.00**

Max. Ablation Depth (μ): **41.3**

No. of Tissue Pulses: **366**

Treatment Time (sec): **19**

**Surgical Parameters**

Flap Diameter (mm): **9.50**

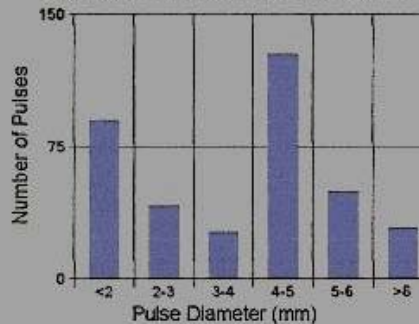
Flap Thickness (μ): **140**

Residual Bed Depth (μ): **331**

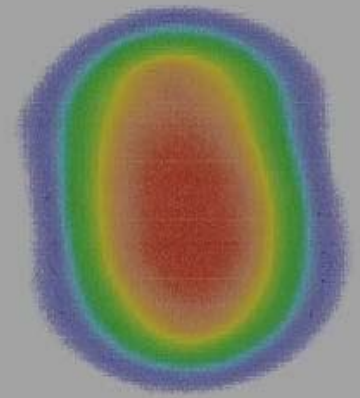
**Additional Information**

The Manifest and WaveScan refractions do not match

**Distribution of VSS Pulse Diameters**



**Ablation Depth (microns)**



VISX CustomVue™ was used to perform excimer laser ablations on patients with one to six diopters spherical equivalent using either the standard 8.0 mm blend zone (Standard) or maximal 9.0 mm blend zone (Maximized)

# Method

- Refractive outcomes were analyzed using a commercial outcome software program, the Refractive Surgery Consultant™ (RSC), which provides a best fit regression nomogram equation for both sphere(S) and cylinder(C).

The screenshot displays the 'The Refractive Surgery Consultant (TM) Lite' software interface, specifically the 'Treatment Profile and Nomogram Report' for a patient named 'Fouad Omaha'. The report is divided into several sections:

- Treatment Profile Metrics:**

Date Created	10/16/2004
Created By	James Eye Clinic Omaha Administrator
Primary or Secondary	Primary
Procedure to Date	4/5/05
Procedure Date	10/16/2004 Rev 10/16/2007
Sphere/Cylinder/Axis	0/14/00
Eyes with Postop > 20 Days	2/33
- More Treatment Profile Metrics:**

Laser	Max Frontier
Laser Software	Frontier
Hinge Location	All Locations
Treatment Plan	Monovision
- More Treatment Profile Metrics:**

How to Plot	Plot
Optical Zone Size	All Diameters
Keratoma / Cornea	All Keratomas
Keratoma Plot	All Plots
User Default	NA
- Pre-Op Nomogram Metrics:**

Nomogram Type	Optical H-R
Date Processed	10/16/2007
# Profiles Sharing Nomogram	2
Number of Eyes Evaluated	775
Number of Eyes Evaluated	27
Number of Eyes Used to Create	775
Surgical Dates	10/16/2004 Rev 10/16/2007
Mean / SD Follow Up (Days)	106.0 +/- 65.0
Follow Up Range (Days)	30 to 330
Nomogram R Squared Statistic	0.960
Standard Error of Regression	0.38
- Post-Op Nomogram Metrics:**

Nomogram Type	Optical H-R
Date Processed	10/16/2007
# Profiles Sharing Nomogram	2
Number of Eyes Evaluated	775
Number of Eyes Evaluated	26
Number of Eyes Used to Create	749
Surgical Dates	10/16/2004 Rev 10/16/2007
Mean / SD Follow Up (Days)	106.0 +/- 64.8
Follow Up Range (Days)	30 to 330
Nomogram R Squared Statistic	0.970
Standard Error of Regression	0.23
- Variables:**

Variable	Coeff	Mean	SD	Min	Max	P
Sphere K - Flat K	0.06	1.07	0.75	0.00	6.15	<0.005
Sph Tet Amount (D)	1.07	-2.79	1.47	-6.82	0.42	<0.005
Sph Tet Net Squared	0.02	1.99	3.12	0.00	47.42	<0.005
Cyl Tet Amount (D)	0.28	-0.81	0.62	-2.21	0.59	<0.005
Cyl Tet Net Squared	0.12	1.04	1.55	0.00	10.32	<0.005
Sph Tet X Cyl Tet	0.05	2.23	2.31	-0.34	10.19	<0.005
Ready of Age Squared	-0.20	0.00	0.00	0.00	0.00	<0.005
- Regression Equations:**

<b>Sphere Programmed Amount =</b>	$1.07 \times \text{Sphere Correction} + 0.02 \times \text{Sphere Correction Squared} + 0.20 \times \text{Cylinder Correction} + 0.02 \times \text{Cylinder Correction Squared} + 0.05 \times \text{Sphere} \times \text{Cylinder Correction} + 0.06 \times (\text{Sphere K} - \text{Flat K}) + -0.20 \times \text{Age}$
<b>Cylinder Programmed Amount =</b>	$0.28 \times \text{Sphere Correction} + 0.02 \times \text{Sphere Correction Squared} + 0.02 \times \text{Cylinder Correction} + 0.12 \times \text{Cylinder Correction Squared} + 0.05 \times \text{Sphere} \times \text{Cylinder Correction} + 0.28 \times (\text{Sphere K} - \text{Flat K}) + -0.20 \times \text{Age}$

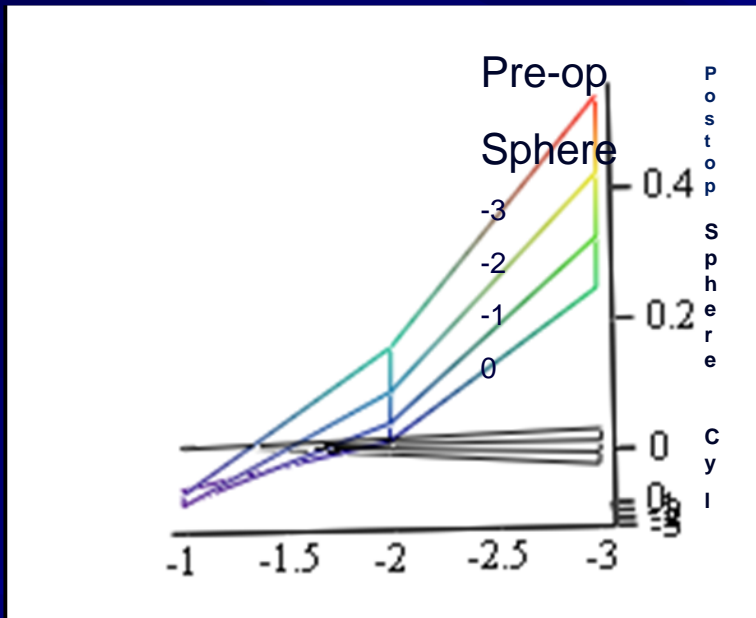
Program developed by Dr Jack Holladay and Dr Guy Kezirian

# RSC Nomogram Results:

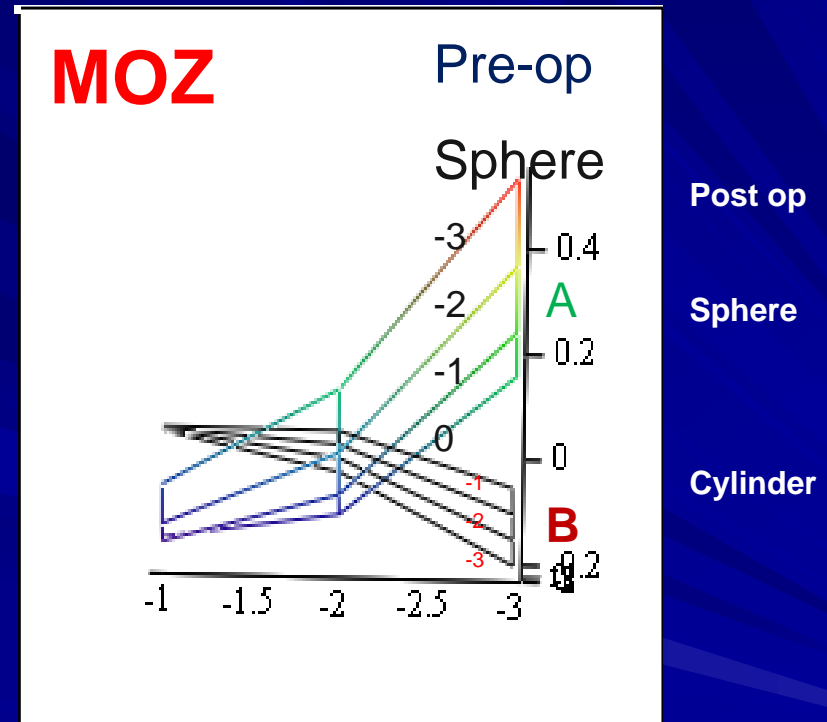
## Normal vs. maximized optical zone (MOZ)

Best fit regression RSC for Standard (1044 eyes) is  
 $S=1.07s +0.01s^2 +0.17c +0.08c^2 +0.05sc$  ( $r^2$  0.97)  
 $C=1.02c +0.01sc$  ( $r^2$  0.85).

### Standard WF



Pre-op cylinder

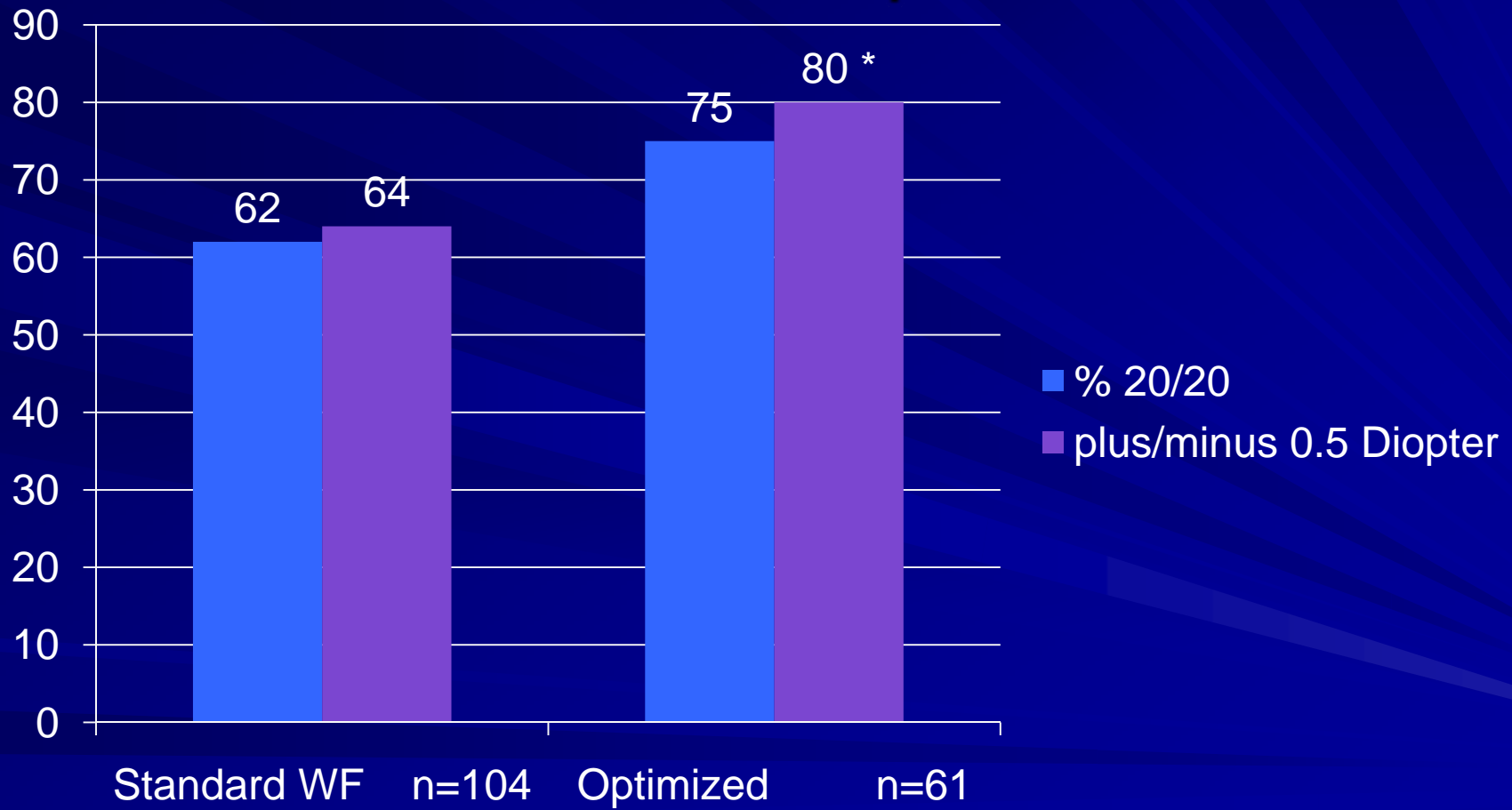


**A:** Less induced plus sphere  
**B:** Under-correction of cylinder  
 • Normalized spherical equivalent

July 2006 n=1044

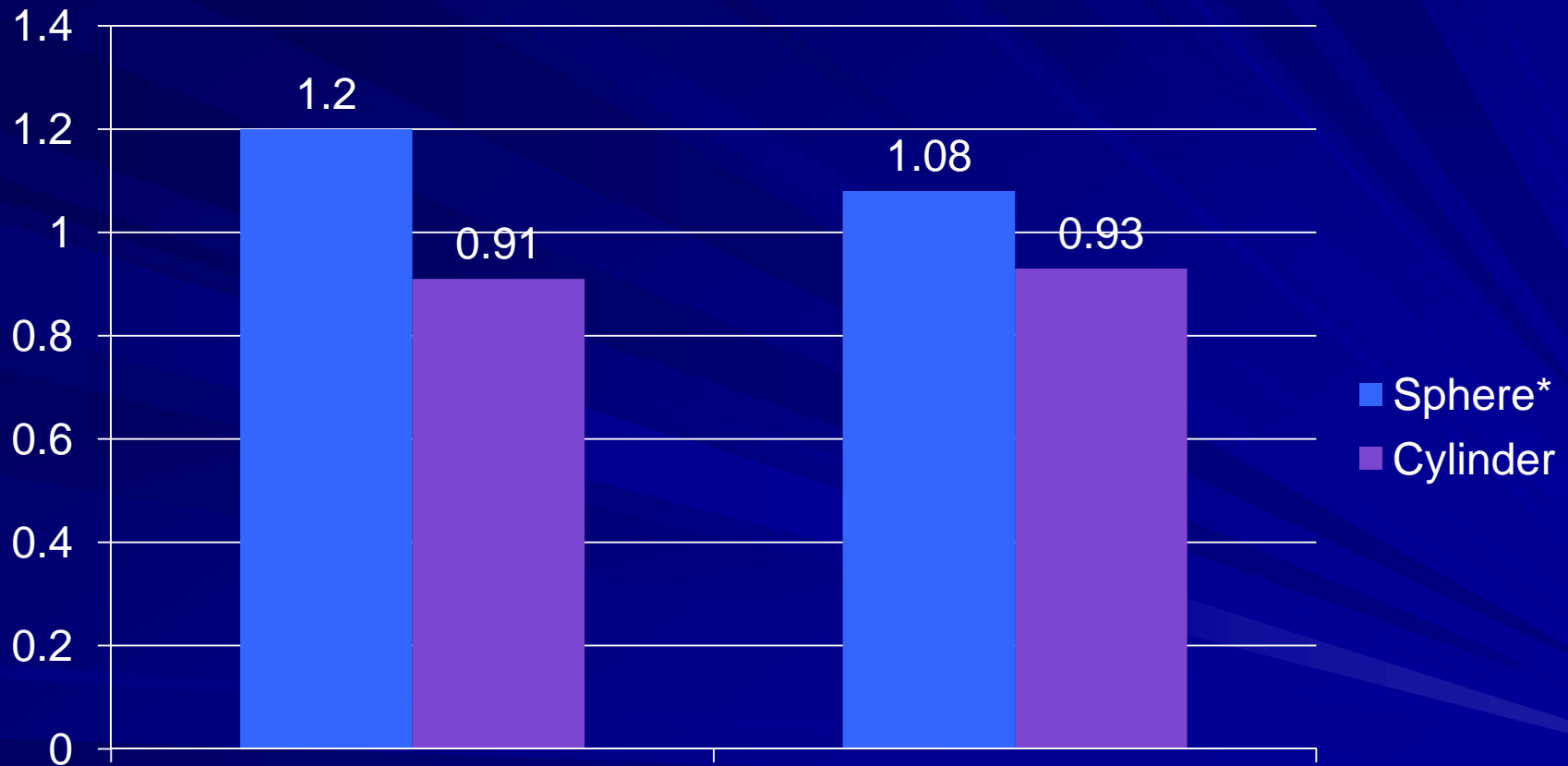
March 2007 n=753

# When pre-op Cylinder is over 2.00 Diopters, better visual and optical results were noted with Maximized Optical Zone



\*Statistically significant  $p=0.0001$

With Cylinder greater than 2.00 D,  
the achieved versus attempted ratio for sphere  
and cylinder was normalized for Maximized OZ



Standard WF

N=104,  $r^2$  0.982/0.966, ssd=0.49

Maximized

N=61,  $r^2$  sc 0.977/0.976, ssd=0.42

\*Statistically significant ( $p=0.0003$ )

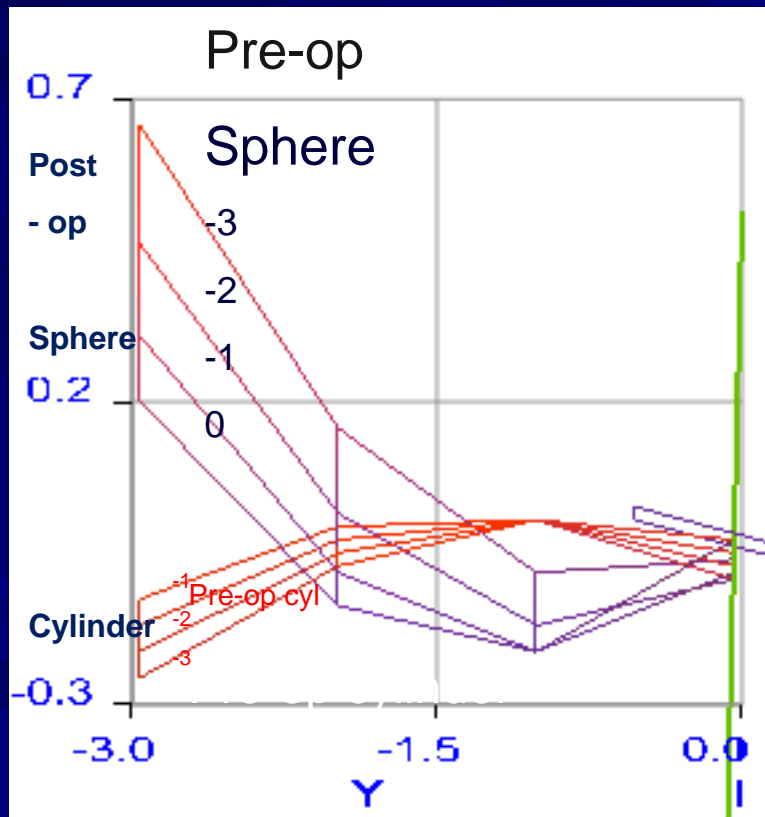
No statistically significant difference was noted between Standard and Maximized for Low Cylinder



# Current (2008) VISX Myopic Wavefront nomogram using maximized optical zone

( Some of the improvement noted may be related to an averaging effect from including high myopia wavefront cases)

**March 2007**



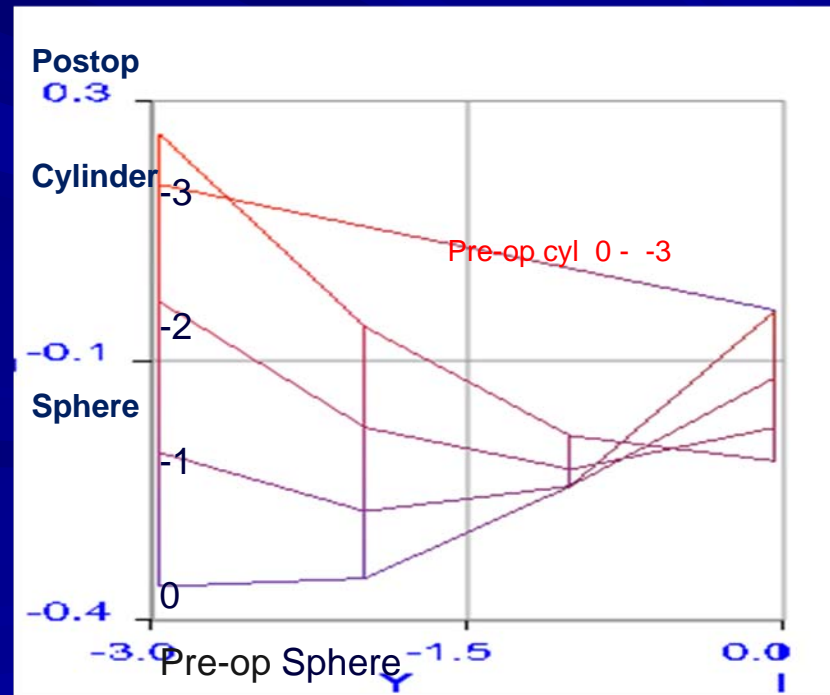
**March 2008**

$$S=1.09s+0.01s^2=0.26c+0.05c^2+0.08sc$$

$$(r^2=0.95, se=0.37, n=666)$$

$$c=0.95c$$

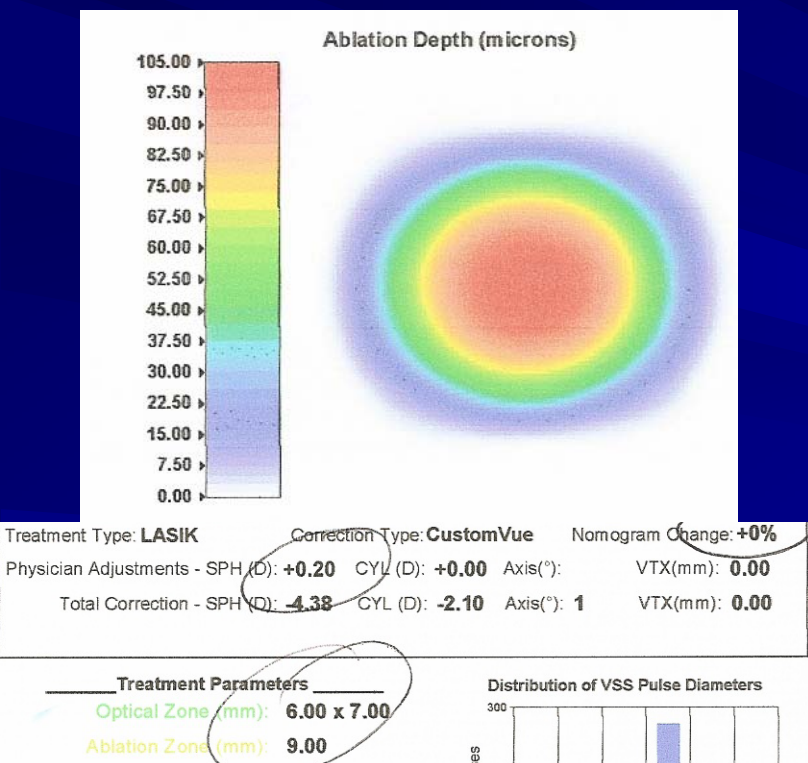
$$(r^2=0.97, se=0.21, n=666)$$



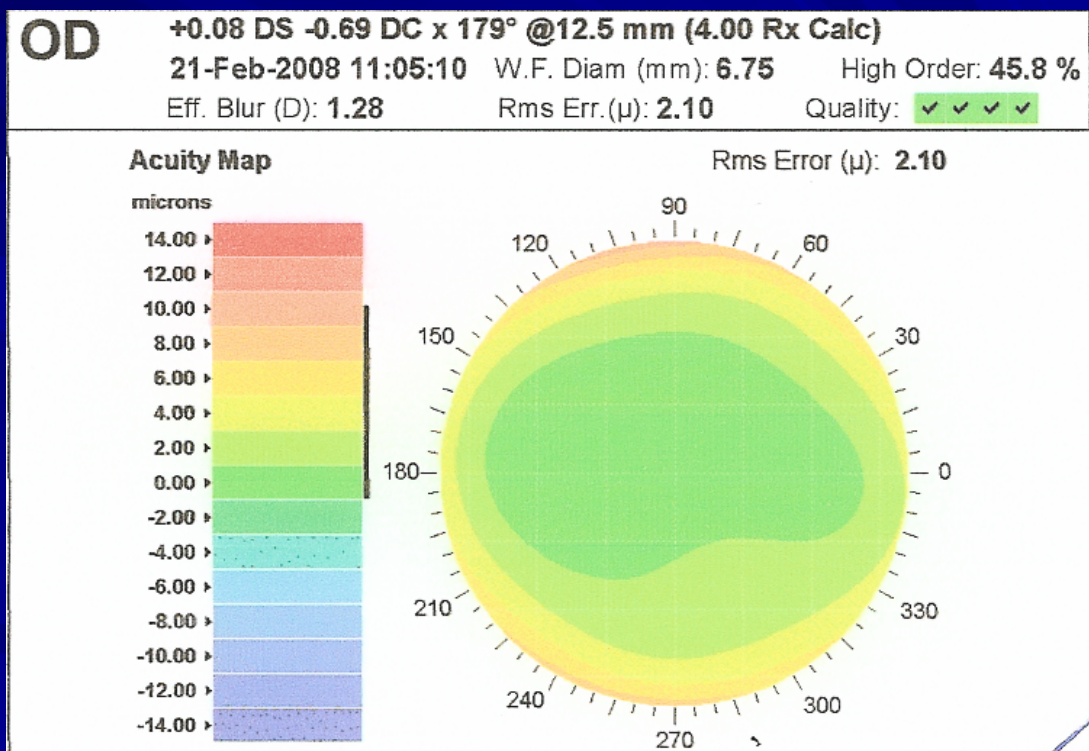
# Conclusion

For patients with Cylinder over 2 Diopters,  
Maximized Optical Zone:

- requires less nomogram adjustment
- provides superior clinical outcomes



**-4.38 -2.10 x 1**



**+0.08 - 0.69 x 179**