Refractive Shift (Coupling) with Standard and Wavefront LASIK

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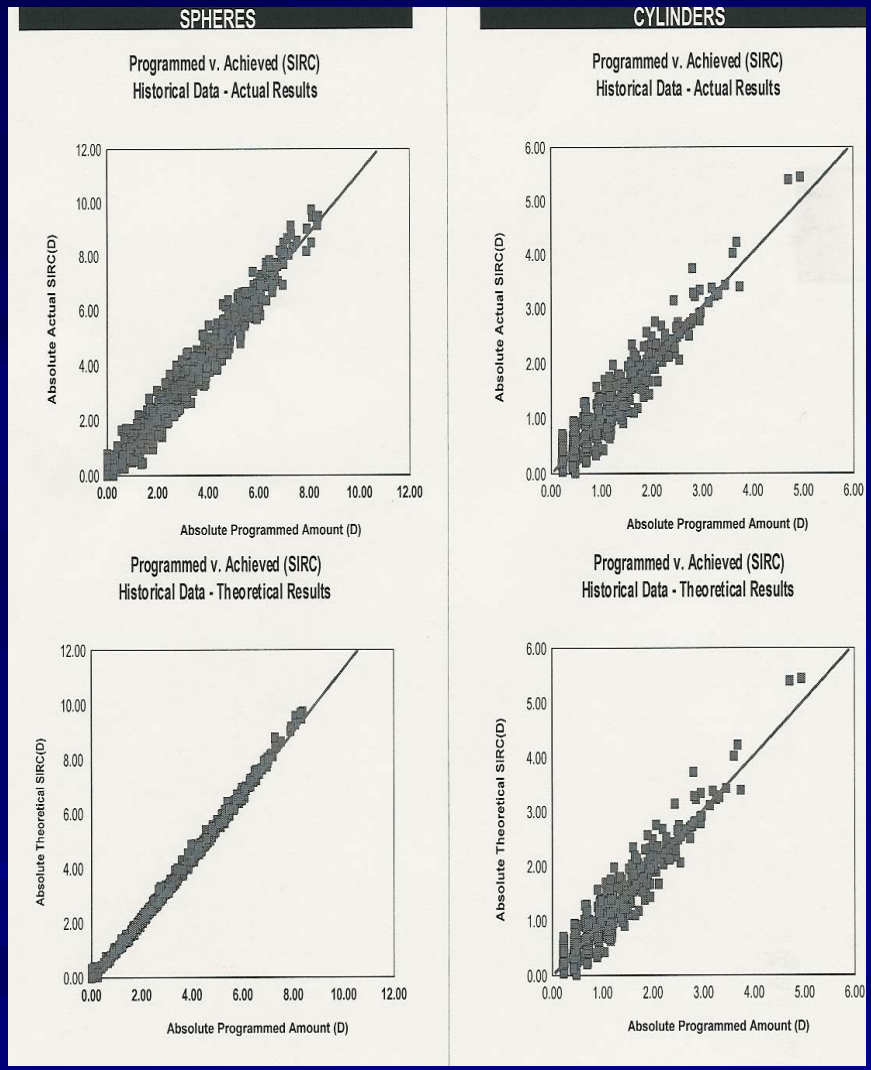
Refractive Surgical Consultant ™

uses surgeon outcomes to calculate laser nomograms



	Actual Results	Theoretical
Number Eyes	1,081	1,081
Average	0.29	0.29
Standard Deviation	0.41	0.26
Minimum	-0.99	-0.27
Maximum	1.88	1.52
+/- 0.50 D (N / %)	780 / 1,081 (72.2%)	882 / 1,081 (82.0%)
+/- 1.00 D (N / %)	1,019 / 1,081 (94.3%)	1,059 / 1,081 (98.0%)
> +/- 1.00 D (N / %)	62 / 1,081 (6.0%)	22 / 1,081 (2.0%)

	Actual Results	Theoretical
Number Eyes	860	860
Average	0.01	0.01
Standard Deviation	0.20	0.06
Minimum	-0.61	-0.10
Maximum	0.93	0.50
+/- 0.50 D (N / %)	836 / 860 (97.2%)	860 / 860 (100.0%)
+/- 1.00 D (N / %)	860 / 860 (100.0%)	860 / 860 (100.0%)
> +/- 1.00 D (N / %)	0 / 860 (0.0%)	0 / 860 (0.0%)

Developed by Dr Jack Holladay and Dr Guy Kezirian

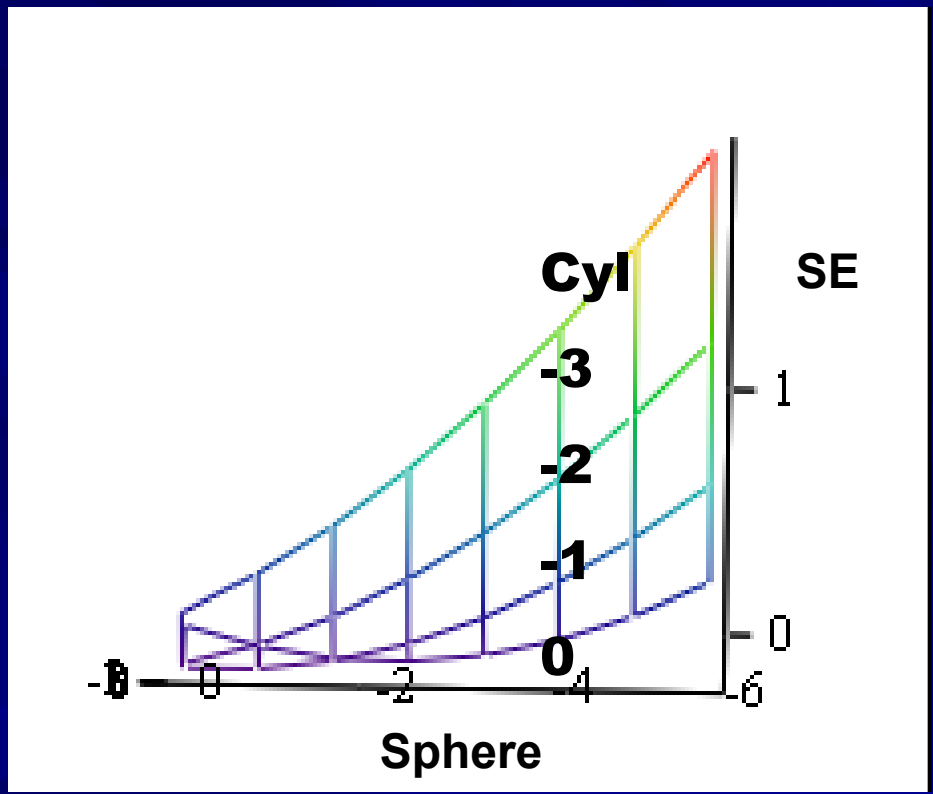
Refractive Surgical Consultant ™ Results

Laser	Sphere (s) nomogram	Cyl (c) nomogram	# Eyes s/c	R^2 s SE	R^2 c SE
Visx Blend	$1.21s + 0.04s^2 + 0.04sc$	$0.06s + 0.01s^2 + 1.18c + 0.03c^2 + 0.05sc$	216 199	0.97 0.45	0.97 0.30
Visx Custom	$1.49\ s + 0.07s^2 + 0.08sc$	$1.07c + 0.07c^2$	128 128	0.97 0.45	0.97 0.28
B&L Zyoptix	$1.09s + 0.02s^2 + 0.31c + 0.11c^2 + 0.07sc$	$0.05s + 0.01s^2 + 0.96c - 0.03c^2 + 0.05sc$	439 439	0.95 0.31	0.96 0.18
Visx Fourier	$1.02\ s + 0.29c + 0.07c^2 + 0.06sc$	$0.09s + 0.02s^2 + 0.80c - 0.07c$	371 369	0.97 0.39	0.97 0.23

Zyoptix

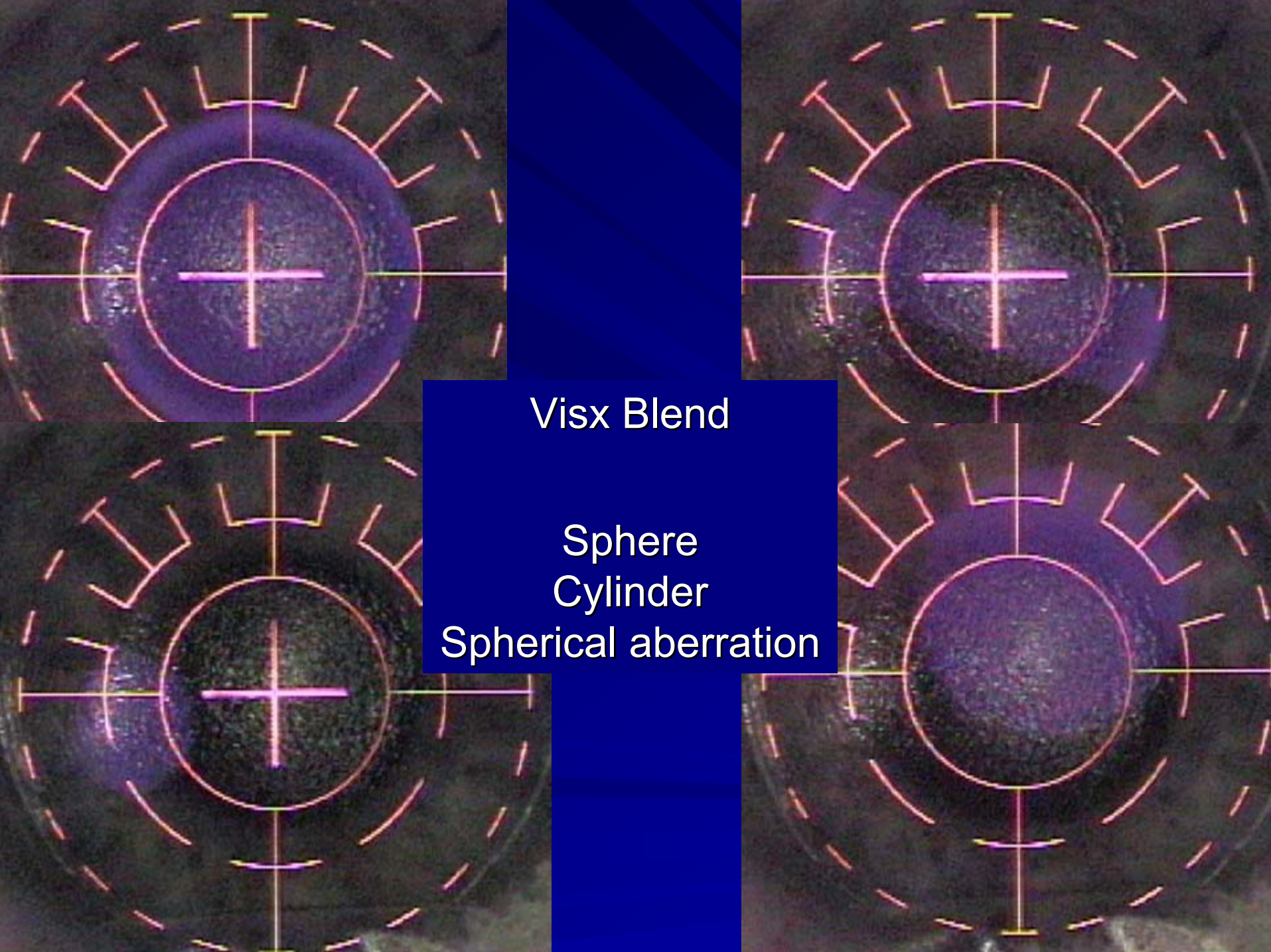
Ablation pattern is difficult to analyze, but treatment times of high cylinder and/or high sphere are very long

Zyoptix: Predicted power in Spherical Equivalent (SE)



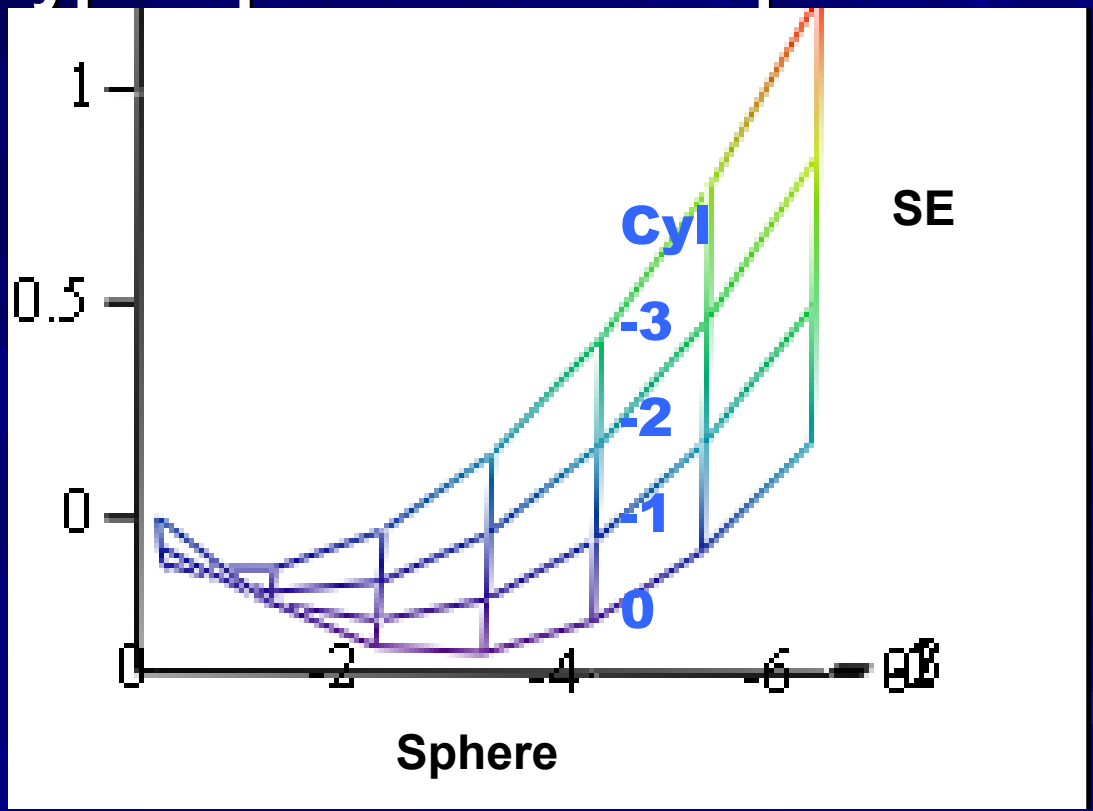
3D side view with cylinder in the z axis

1.09s + 0.02s2 +0.31c +0.11c2 +0.07sc +1/2 cyl adjustment


Visx Blend
Sphere
Cylinder
Spherical aberration

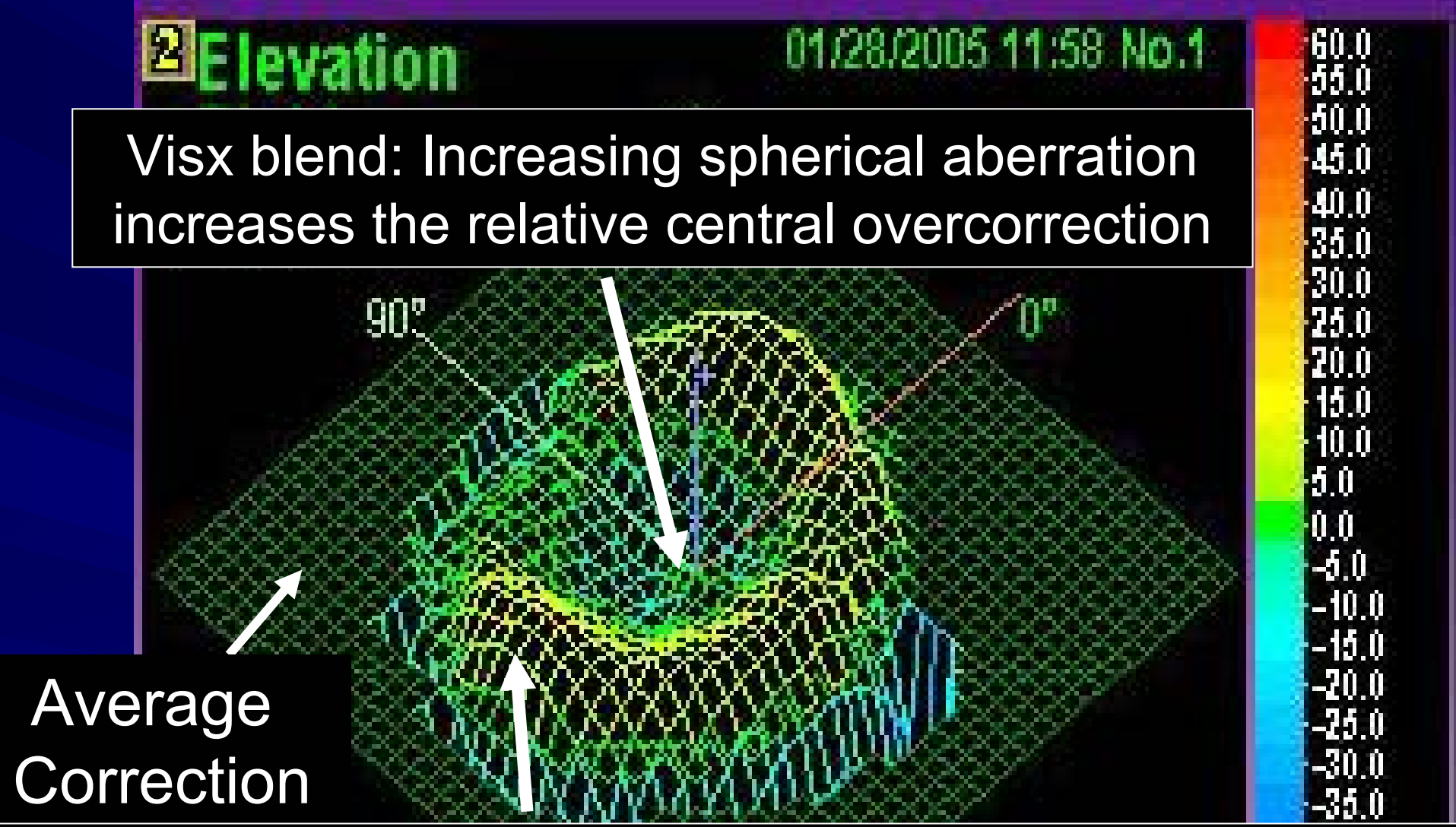
Predicted Spherical Equivalent with Visx Blend

Increasing hyperopic shift with sphere and cylinder



s = 1.21s +0.04s2 +0.04sc

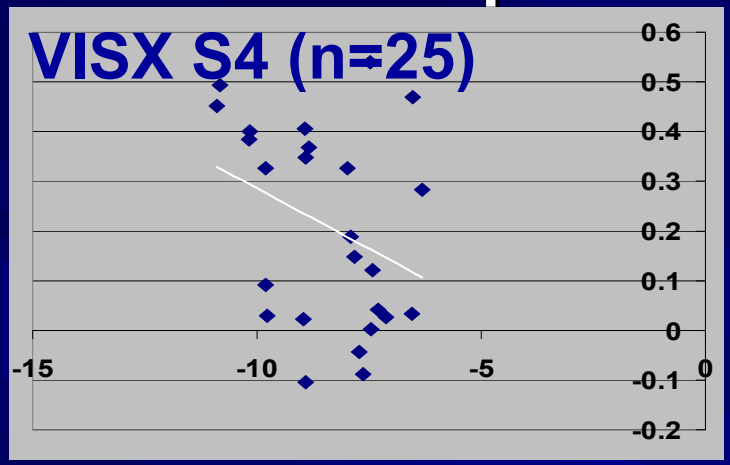
(+½ cyl adjustment)

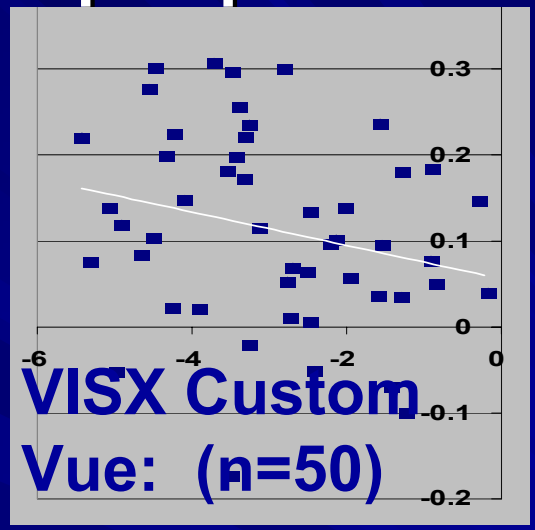


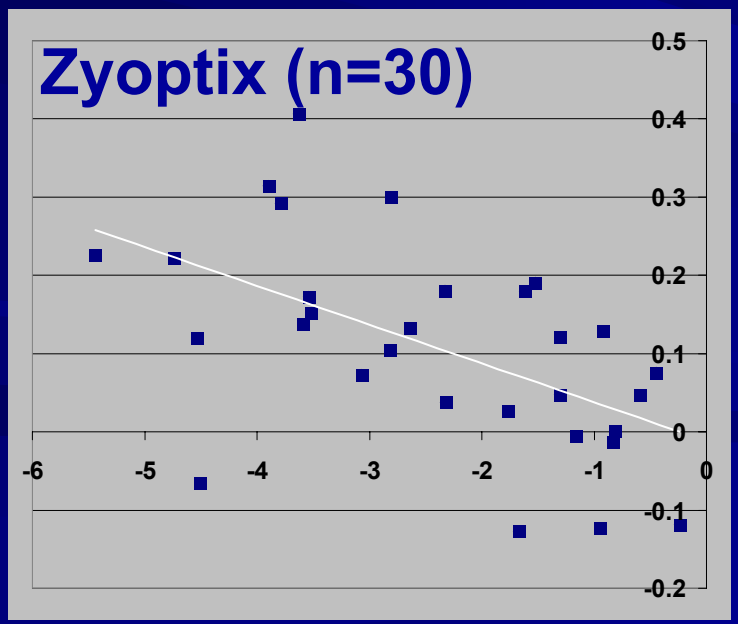
Spherical aberration and atoricity increases with increasing sphere and cylinder ablation

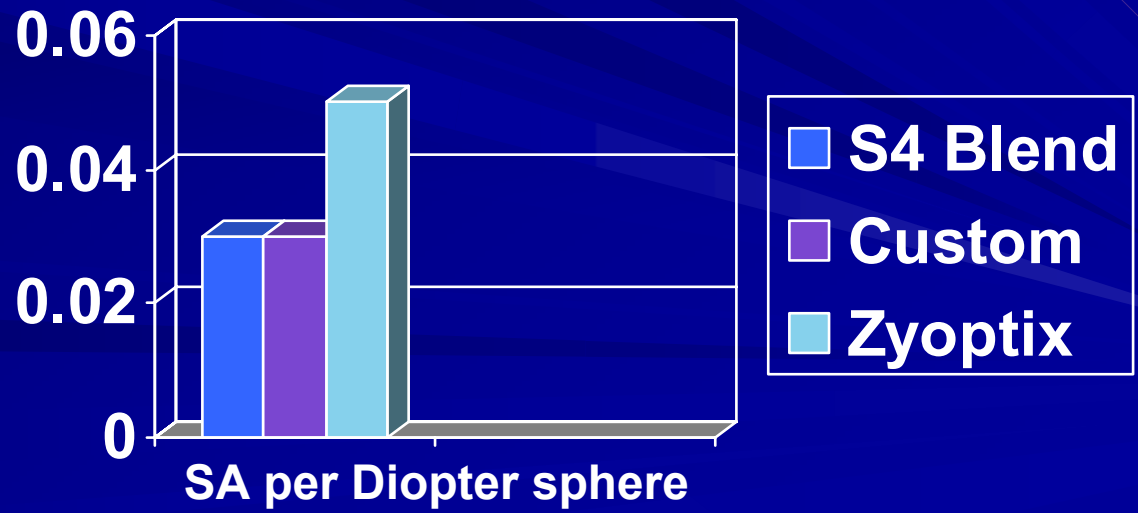
Increases as Sphere Squared with spherical system

Post –op Spherical aberration (SA) compared to pre-op sphere



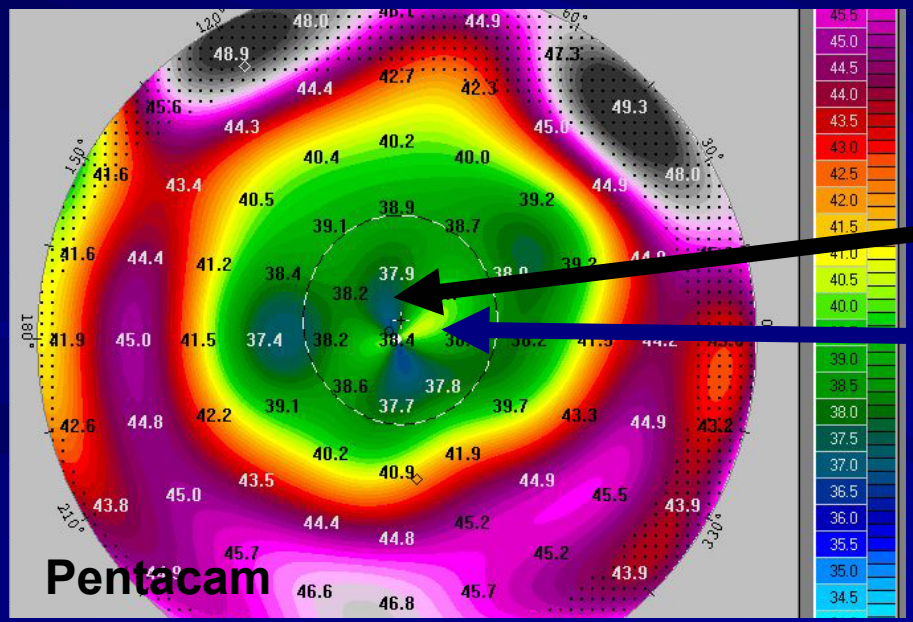


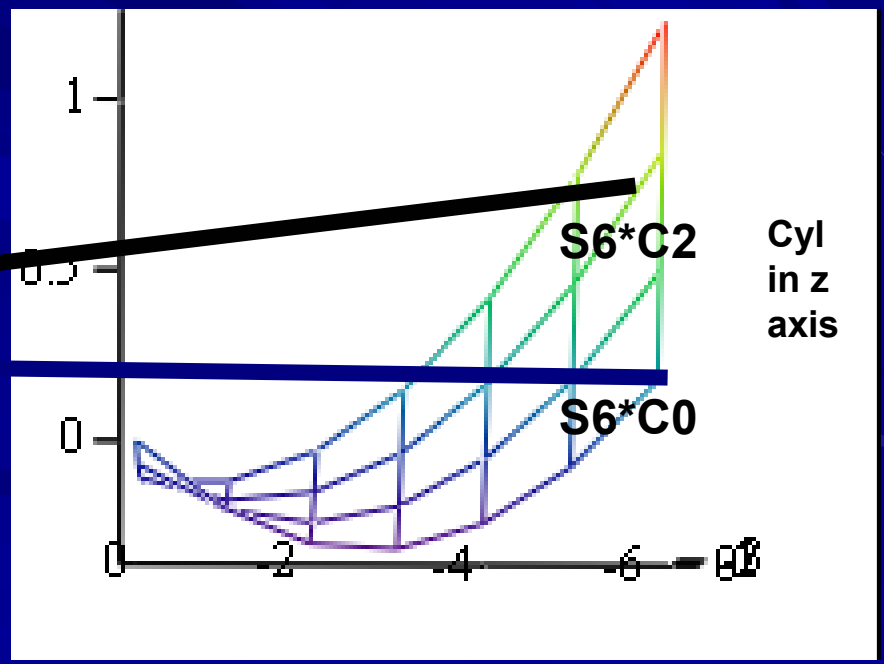


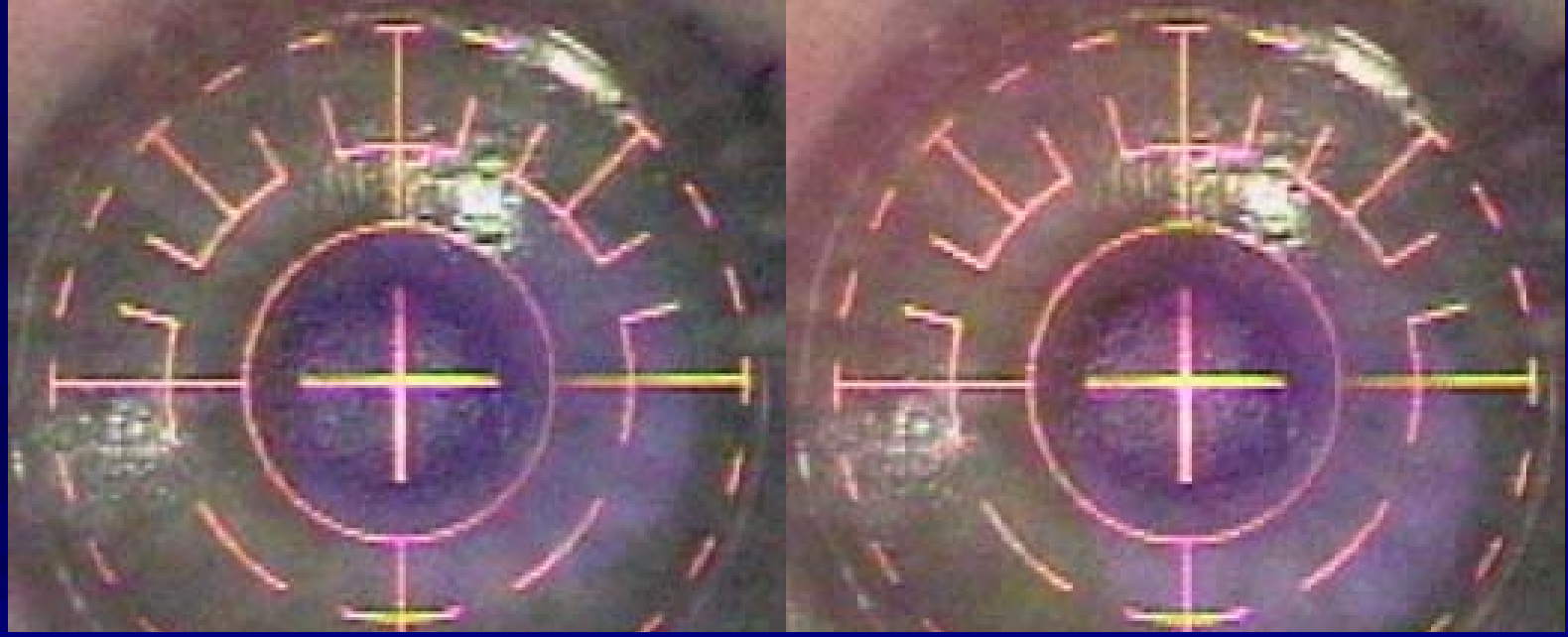


The curves generated using the nomogram approximate the surface contour difference from an ideal ablation .

Visx blend with the rule: The long axis, corresponding to the SC0 curve has slight under-correction centrally and moderate peripheral under-treatment. The short axis, corresponding to the s62 curve has significant over-treatment both mid-peripheral and peripherally

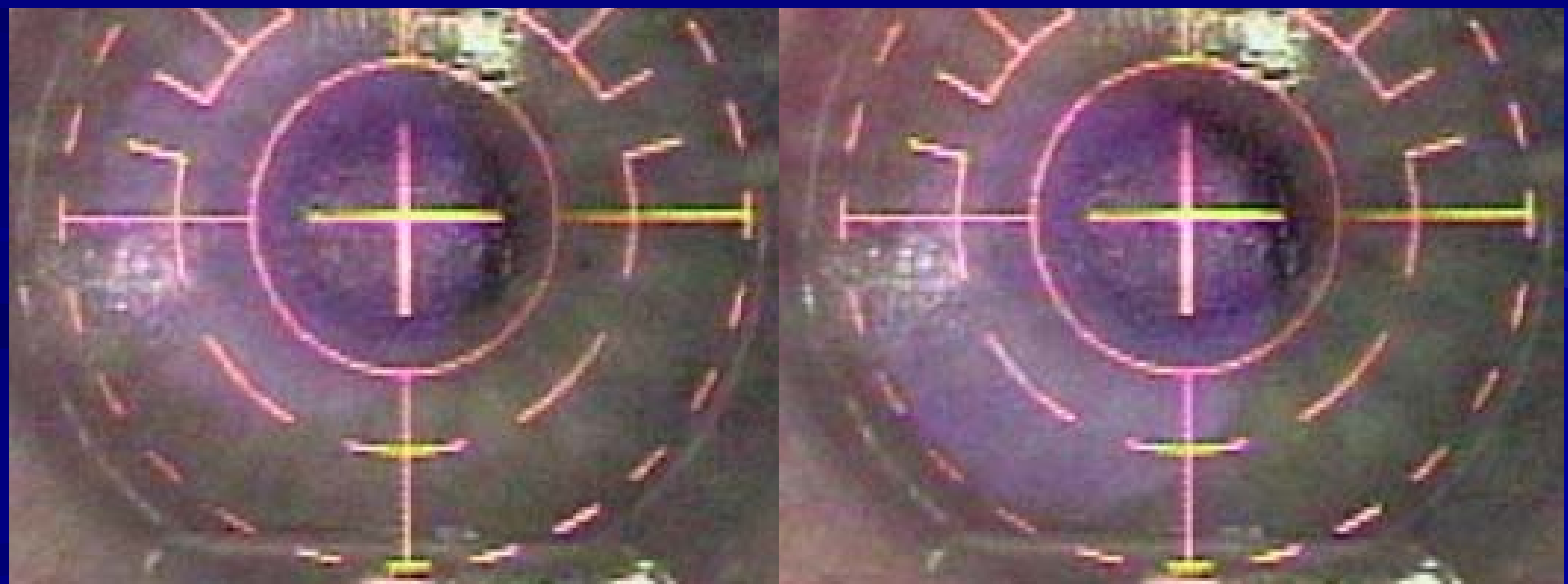






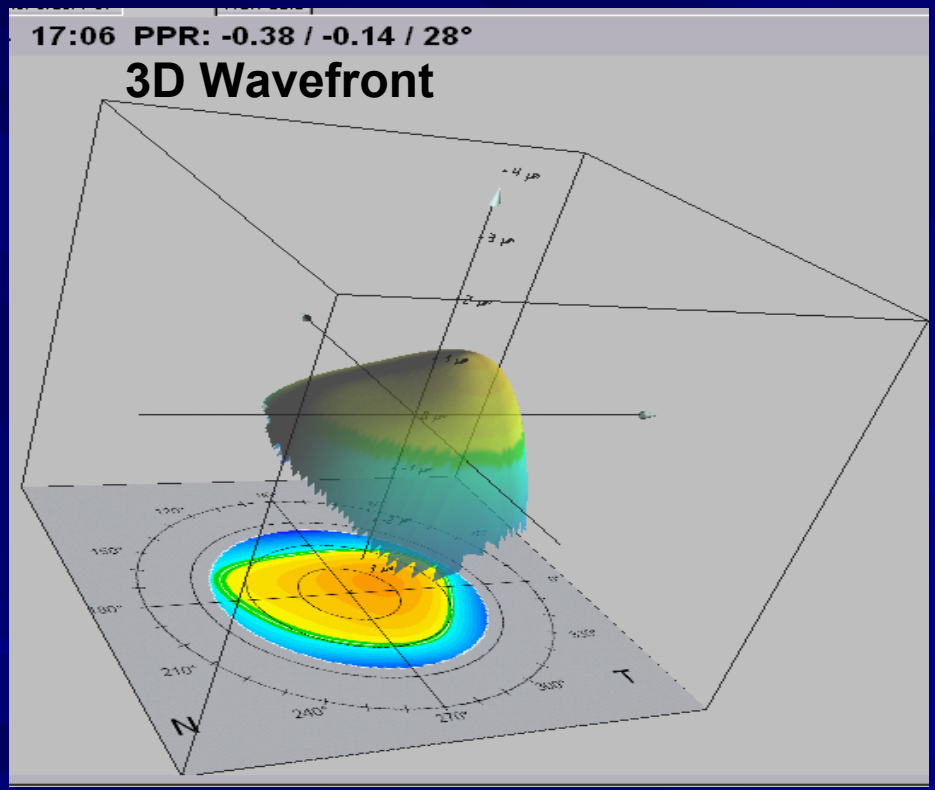
Visx Wavefront :

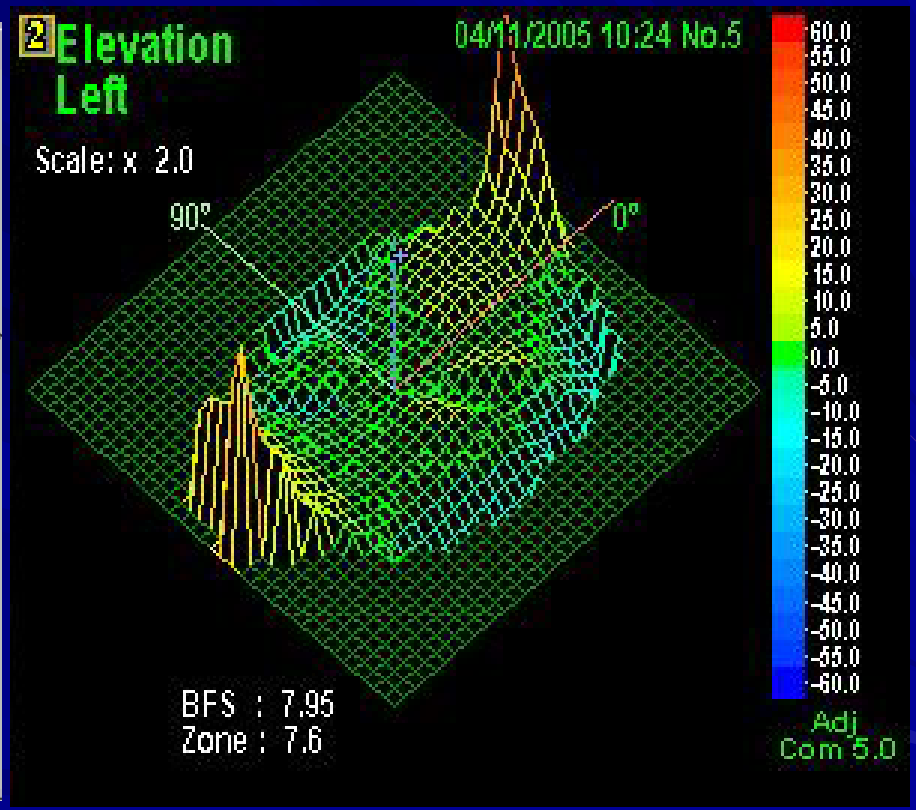
Note how sequential laser spot rotate around the central axis



Custom Vue

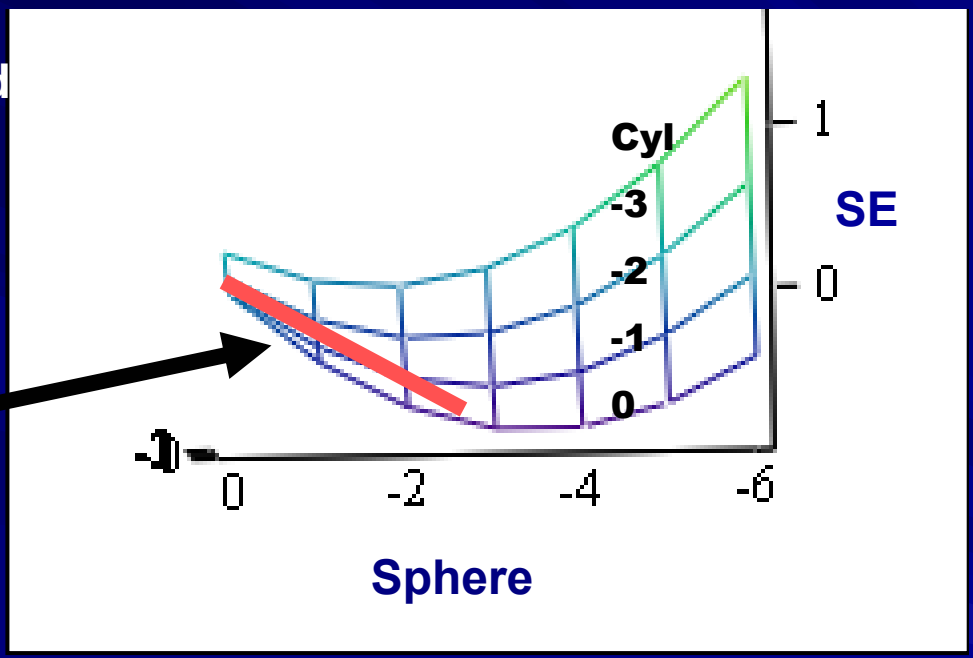
Note that mid-peripheral overcorrection creates mild negative spherical aberration





Custom Vue Predicted outcomes (SE)

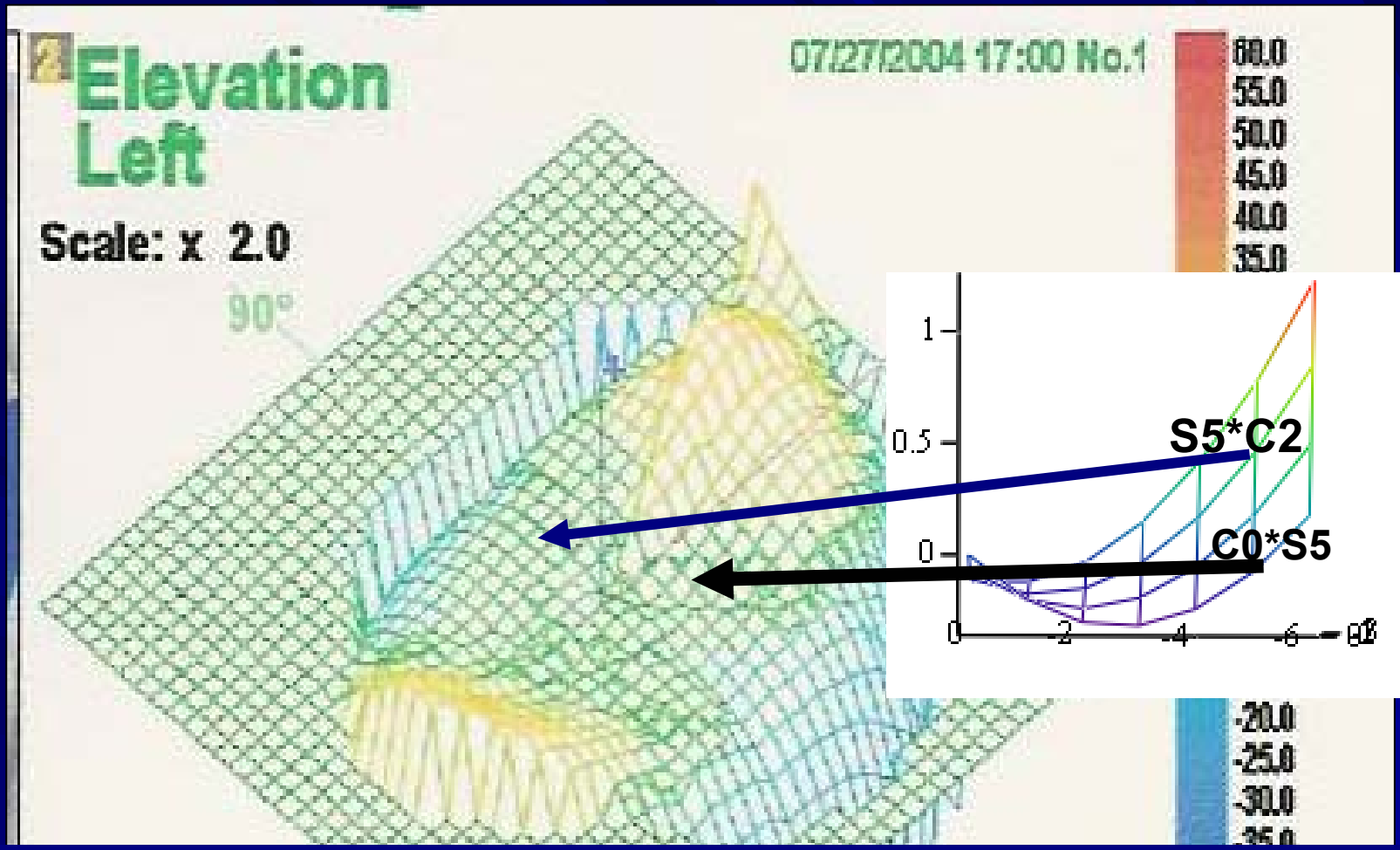
Low cylinder and sphere ablation have mid-peripheral under-correction and prolate cornea



Side view with the cylinder in z axis

1.49 s + 0.07s2 +0.08sc

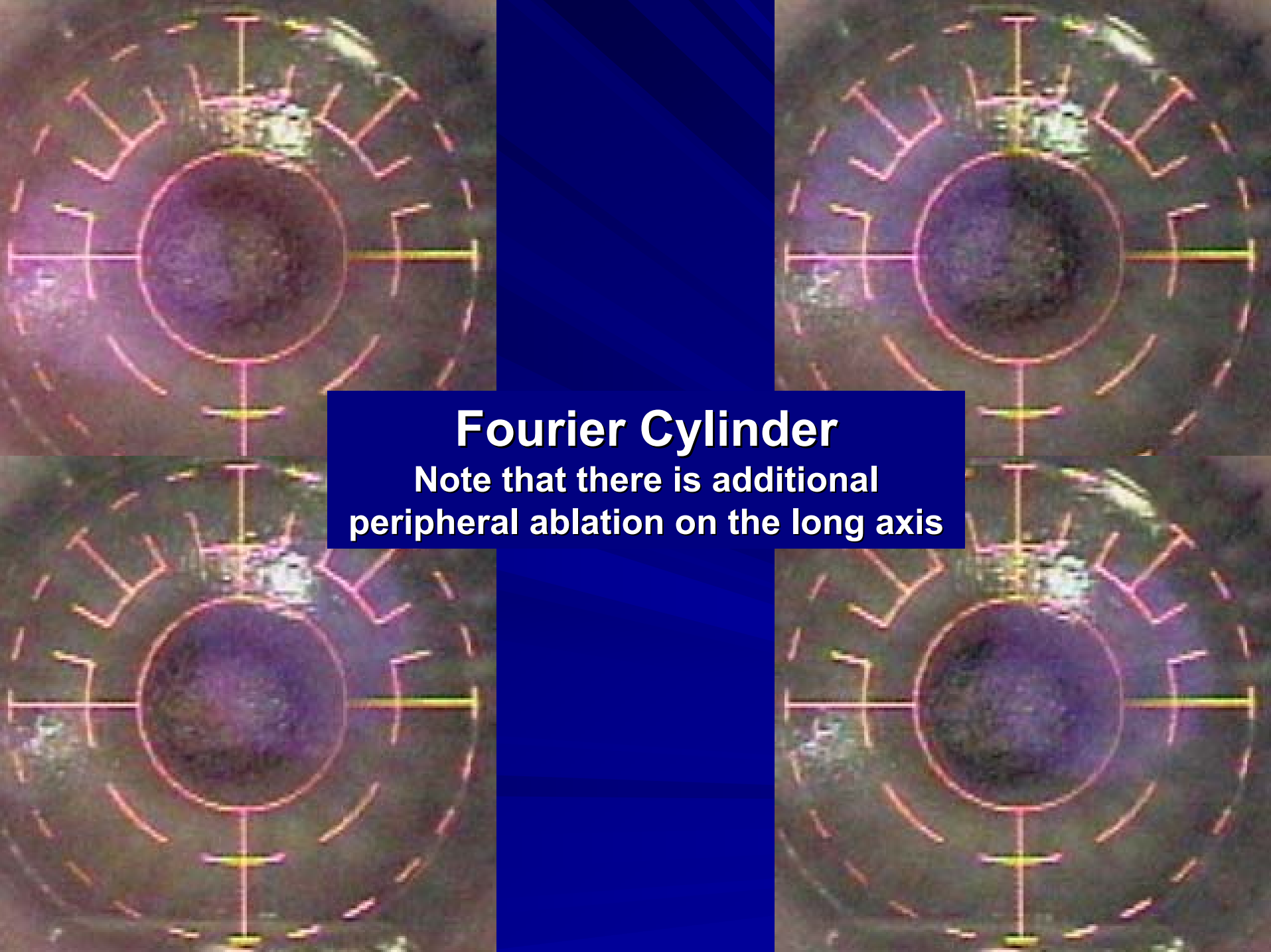
+1/2 cyl adjustment



Custom Vue,cylinder with the rule:

Over-correction in the mid-periphery of the long axis S5*C0

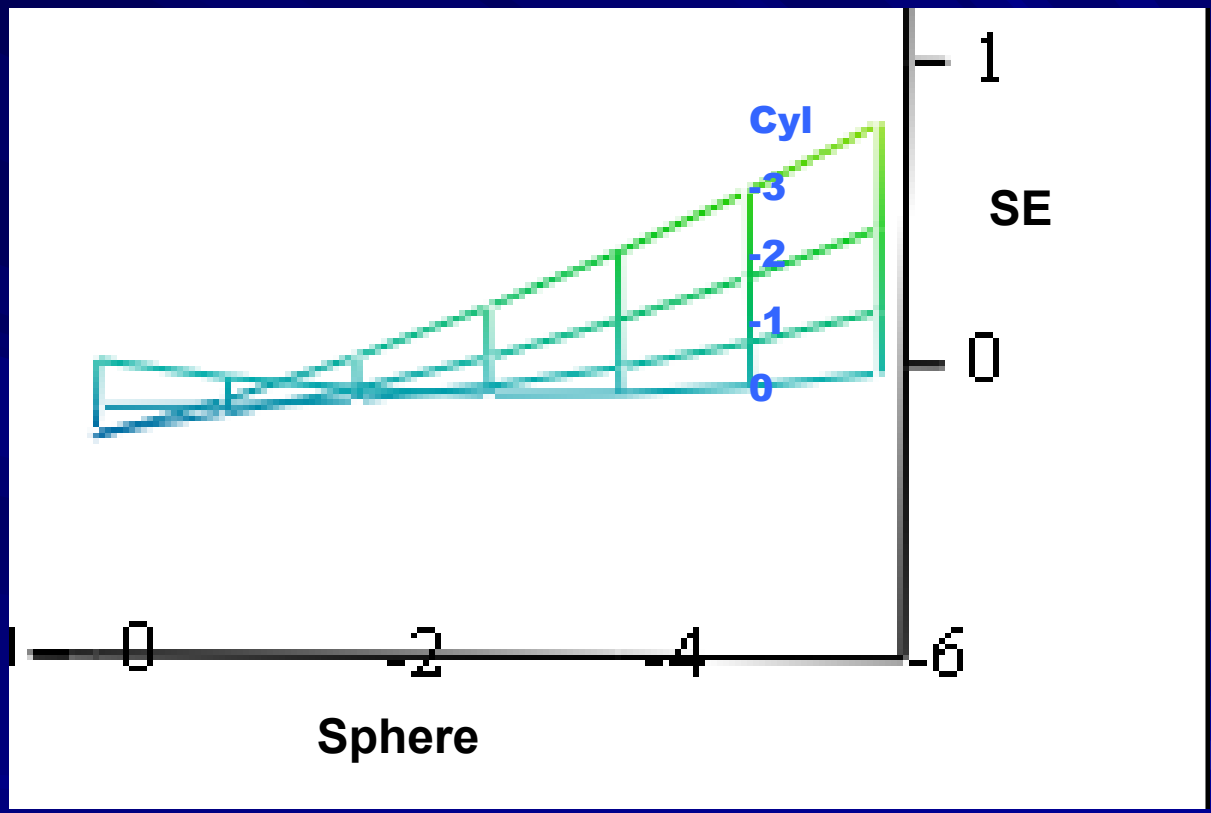
Under-correction in the short axis S5*C2



Fourier Cylinder

Note that there is additional peripheral ablation on the long axis

Predicted results (SE) Visx Fourier



Cyl in z axis

1.02 s + 0.29c +0.07c^2+0.06sc + ½ cyl nomogram

Summary

- The sphere squared (S^2) coefficient is related to spherical aberration
- Sphere times cylinder (S*C) coefficient is related to atoricity
- Coupling is induced by the relative mismatch of the central, mid-peripheral and peripheral ablation, especially when significant cylinder is present.
- Improved ablation profiles reduce clinical coupling and require less nomogram adjustment