

# **Optical Connection, Inc. and Ophthonix, Inc.**

**Partners in the delivery of non-  
surgical vision optimization**

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

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

The human eye has optical imperfections that can not be measured by conventional means, and are not correctable with today's lenses

- Current examination technology leaves up to 20% of refractive error unmeasured
- To optimize vision, we need to correct 100% of refractive error, including higher order aberrations

# Wavefront Technology

- Thorough analysis of the optics of the visual system – from cornea to retina.
- Low order aberrations of sphere and cylinder
- Unique combination of low and high order aberrations in each individual
- The goal: to produce an individually customized refractive correction

# Optical Aberrations

- Low order aberrations
  - Tilt (prism)
  - Defocus (sphere)
  - Astigmatism (cylinder)
- High order aberrations
  - Spherical
  - Coma
  - Trefoil
  - Secondary Astigmatism

# High order aberrations

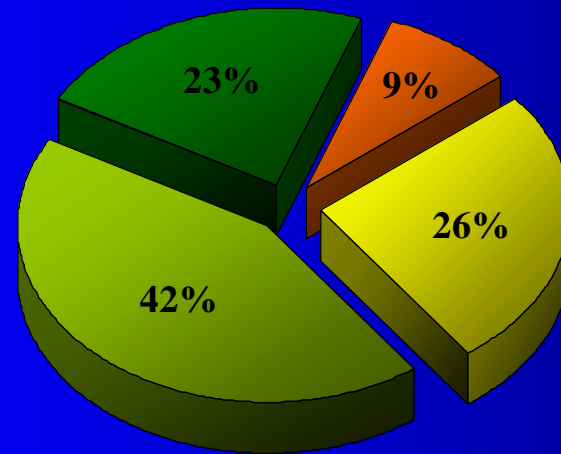
- Irregular astigmatism: A complex shape that, due to its asymmetry, cannot be measured using conventional refractive methods
- The only option for correcting “irregular astigmatism” has been an RGP

# Refractive correction

- Today we correct a rotationally asymmetric eye with a perfectly symmetric contact or spectacle lens
- Result: Up to 20% of refractive error may be left uncorrected

# Subjects With High-Order Aberrations

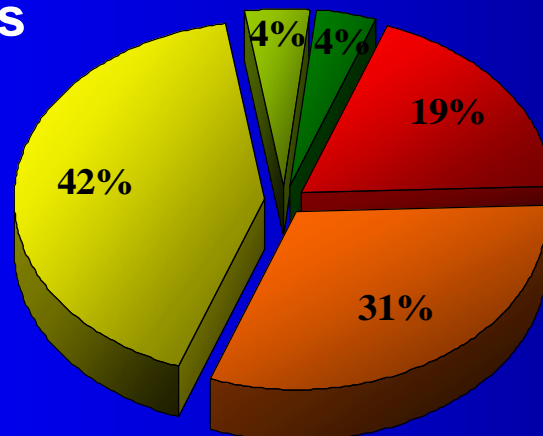
Emmetropes: N = 47 eyes



Amount of high-order aberrations

- >0.3 microns
- 0.2 - 0.3 microns
- 0.1 - 0.2 microns
- <0.1 microns

Myopes: N = 26 eyes



Amount of high-order aberrations

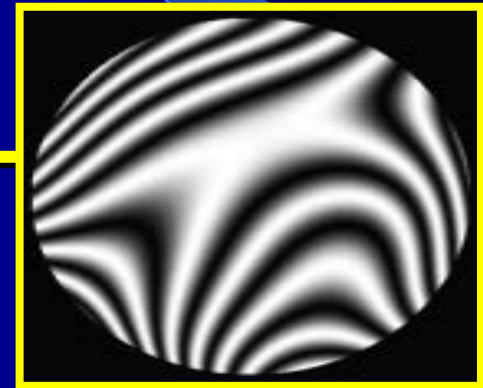
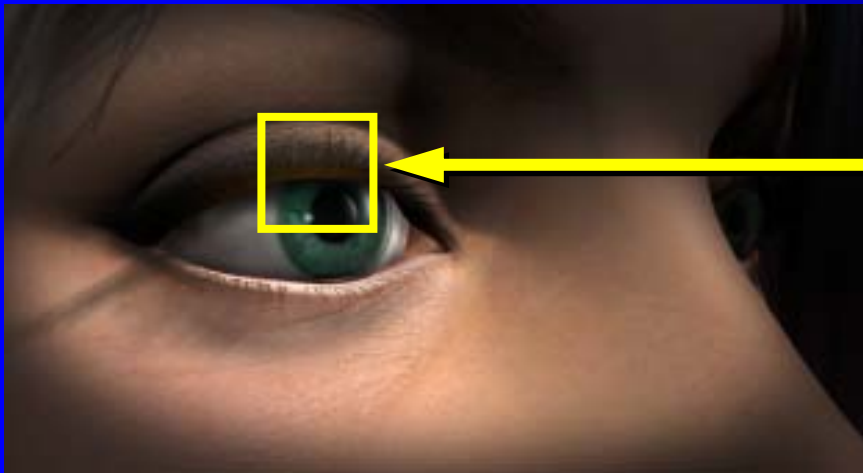
- 0.5-1.0 microns
- 0.3-0.5 microns
- 0.2 - 0.3 microns
- 0.1 - 0.2 microns
- <0.1 microns

# Signs of non-optimized (normal) vision

- Double images
- Low contrast, lack of crispness
- Reduced color sensitivity
- Glare sensitivity
- Night driving problems
- “Halos,” “star burst patterns,” “comet’s tails” around lights at night
- Compromised far and near vision



# Human Eye...An Imperfect Instrument



**Many localized aberrations**  
**“Optical fingerprint”**

# The Wavefront Solution

- A more precise, objective vision examination
  - The Ophthonix Z-View™ Aberrometer
- A fundamentally new form of refractive correction:
  - The individually customized iZon™ and iZon by Definition™ Contact Lens
    - Wavefront-guided
    - Fully customized
    - Fully optimized

# Vision Examination

Today



Subjective, manual,  
discrete steps, 15  
minutes

Ophthonix Z-View™



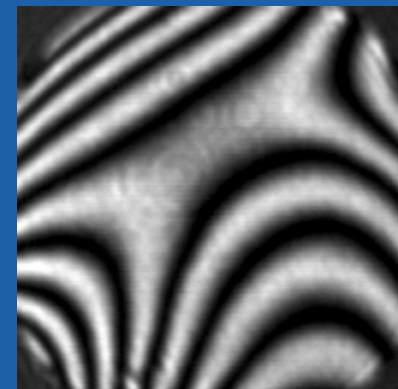
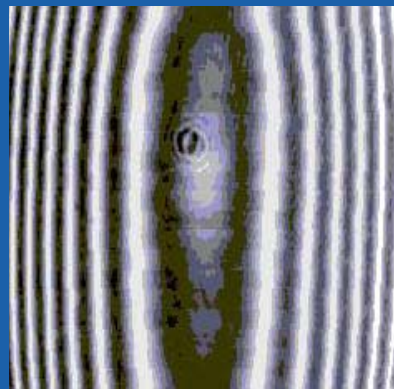
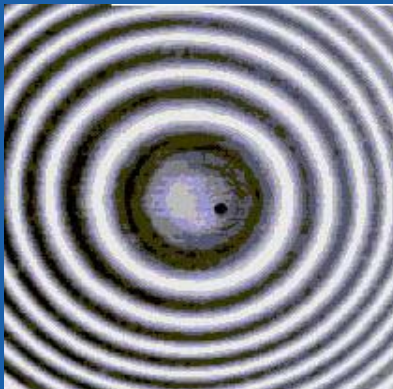
Objective, accurate results.  
Measures low and high  
order aberrations in one  
minute

The Z-View aberrometer creates a customized match for the “optical fingerprint” of the eye

**Result: 100% Refractive Error Measured**

**Current Lenses**

**Ophthonix iZon™ Lens**



**Sphere**

**Cylinder**

**Perfect Match**

# Z-View™ Aberrometer Features



- Proprietary wavefront technology
- 11,300 points over 6mm pupil
- Pupil diameter measurement
- Pupillary distance measurement
- Designed for ease of use
- Binocular viewing
- Through-the-lens
- Internal fixation
- Internal reading target
- High correlation with manifest refraction ( $R^2=0.988$ )
- Efficient (Less than one minute)



# iZon™ by Definition™ Wavefront-guided contact lens

A new category of contact lens  
correction

# iZon™ by Definition™

- New contact lens that can be individualized to nanometer level of optical path difference (OPD)
- Can correct sphere and cylinder to 0.01D
- Is customized to individual on-eye lens movement and centration characteristics
- Corrects low and high order aberrations and distortions, including those aberrations induced by the lens itself

# The ultimate custom contact lens

- Each eye is individually measured
- Each lens is individually designed and manufactured
- Each prescription is treated the same: sphere, toric, keratoconus, post-LASIK



# The ultimate custom contact lens

- WaveTouch<sup>tm</sup> manufacturing assures absolute reproducibility
- Manufacturing process allows great flexibility in polymer selection and lens fit characteristics

# On-eye lens stability requirement

The background is a solid dark blue. A thin, light blue curved line starts from the left edge and curves downwards towards the bottom center. A larger, semi-transparent blue shape, resembling a quarter-circle or a large arc, is positioned in the lower right quadrant, overlapping the dark blue background.

# Simulated Optical Performance of Custom Wavefront Soft Contact Lenses for Keratoconus

Opt. Vis. Sci., Vol. 80, No. 9, September, 2003.  
de Brabander, Chateau, Marin, Lopez-Gil,  
van der Worp, Benito

# On-eye lens stability

- Translation (movement and centration) should not exceed 0.5mm
- Rotation should not exceed +/- 10 deg
- Any of today's **soft torics** meet these criteria

de Brabander, et. al.

# Soft lenses will work?!

A wavefront contact lens must be well centered, stable and provide little movement. Soft lenses meet those criteria.

# The Wavefront Process

A decorative graphic consisting of a blue wave-like shape that starts from the left edge and curves downwards and to the right, ending at the bottom right corner. The wave is composed of several overlapping, semi-transparent blue layers, creating a sense of depth and movement.

# Wavefront Process

Step 1

Wavefront  
Data  
Acquisition

Wavefront  
over refraction  
through trial  
lens

Step 2

Wavefront  
Contact  
Lens  
Production

Conversion of  
wavefront data  
into production  
code

Step 3

Wavefront  
Contact  
Lens  
Delivery

Direct delivery  
of custom lens  
– no inventory  
required

*WavefrontProcess*<sup>TM</sup> Pat. Pending (Serial#60/407,316)

# Step 1: Wavefront Data Acquisition

A “predicate” trial lens is placed on the eye; wavefront analysis is performed through the predicate lens.



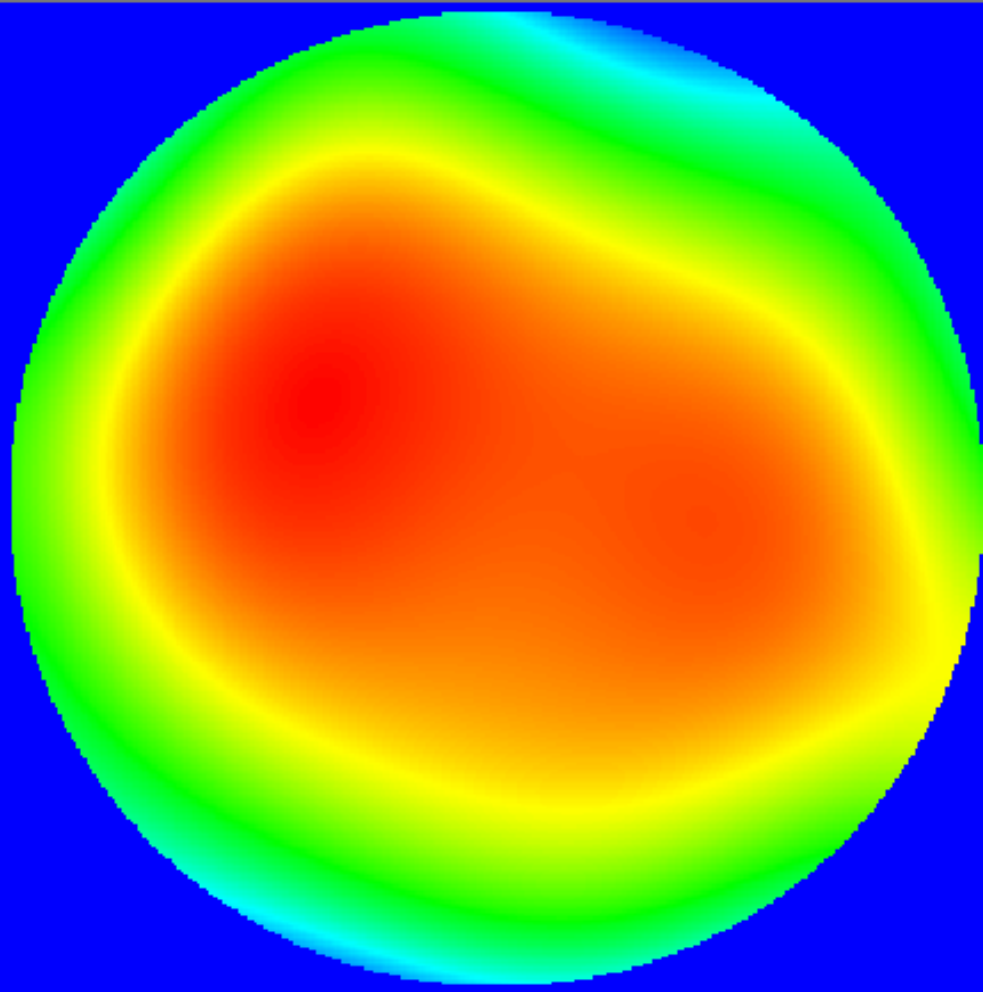
Predicate Lens with  
Alignment Markings

Wavefront Over Refraction US Patent 6,086,204



4.93  $\mu\text{m}$

0.00  $\mu\text{m}$



Z VIEW™

O.D.



-0.87

Sphere

-1.25

Cylinder

160

Axis

6.13

Pupil Size

Good Measurement! Press Rx to view / print.





Z VIEW™

O.S.

Sphere

0.62

Cylinder

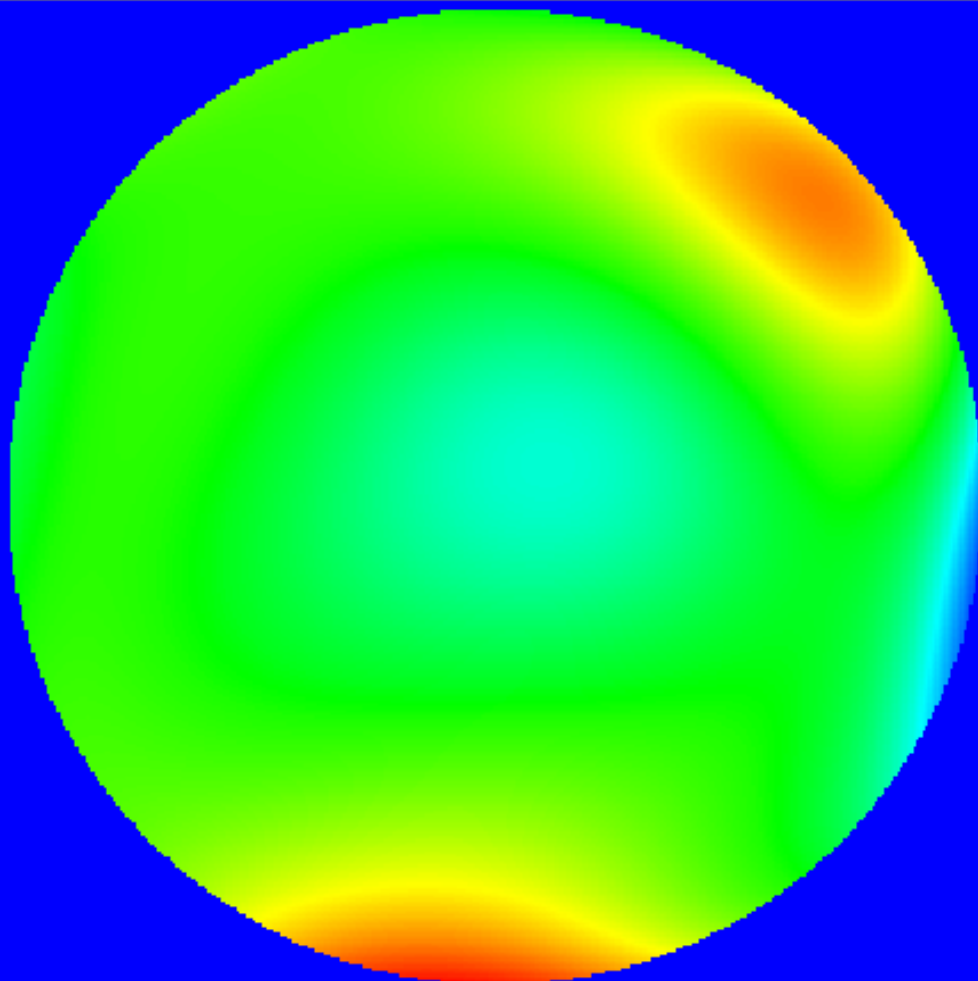
-0.62

Axis

78

Pupil Size

5.14

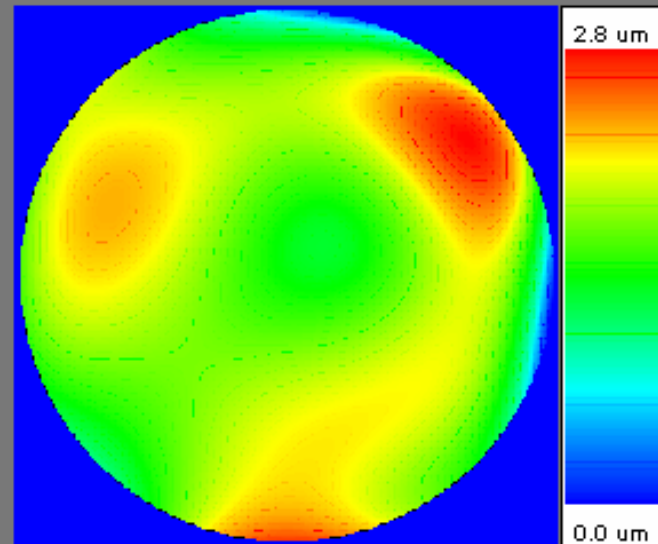
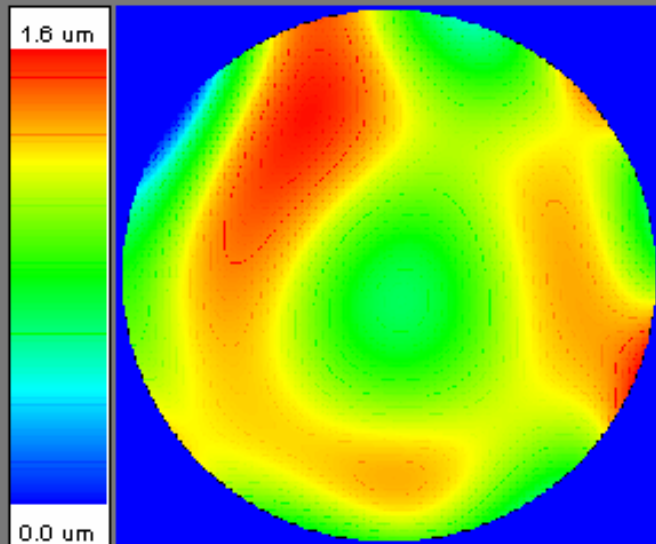


4.45  $\mu\text{m}$

0.00  $\mu\text{m}$

Good Measurement, press advance to next eye button.





	O.D.		O.S.	
	ZView Rx	Refraction	ZView Rx	Refraction
Sphere	-0.87 D		0.62 D	
Cylinder	-1.25 D		-0.62 D	
Axis	160 Deg		78 Deg	
Pupil Dia., Zernike Dia.	6.1 mm, 4.0 mm		5.1 mm, 4.0 mm	
Total High-Order	0.41 D		0.62 D	
Trefoil	0.14 D		0.42 D	
Coma	0.15 D		0.05 D	
Spherical Aberration	0.25 D		0.35 D	
Pupil Distance	35.3 mm		32.8 mm	



Standard Lens Correction

(O.S.)

Z-Lens Correction



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20 / 48

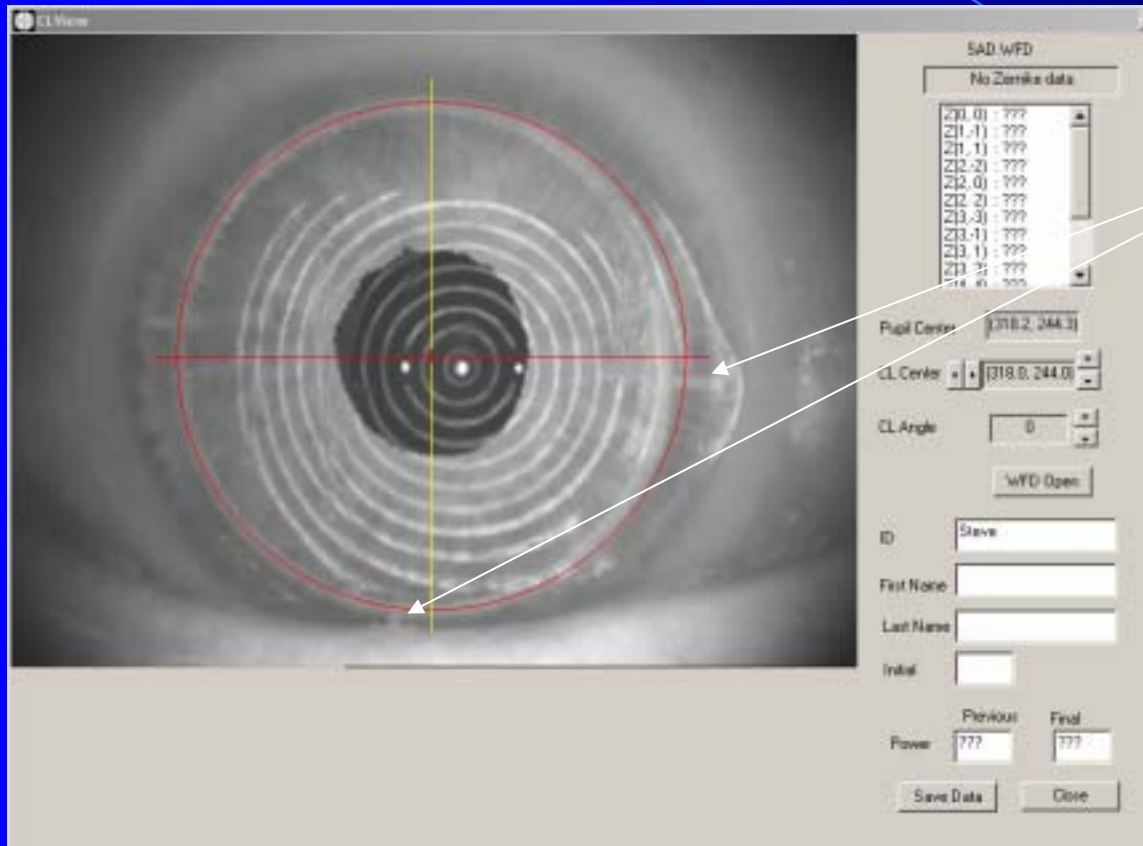
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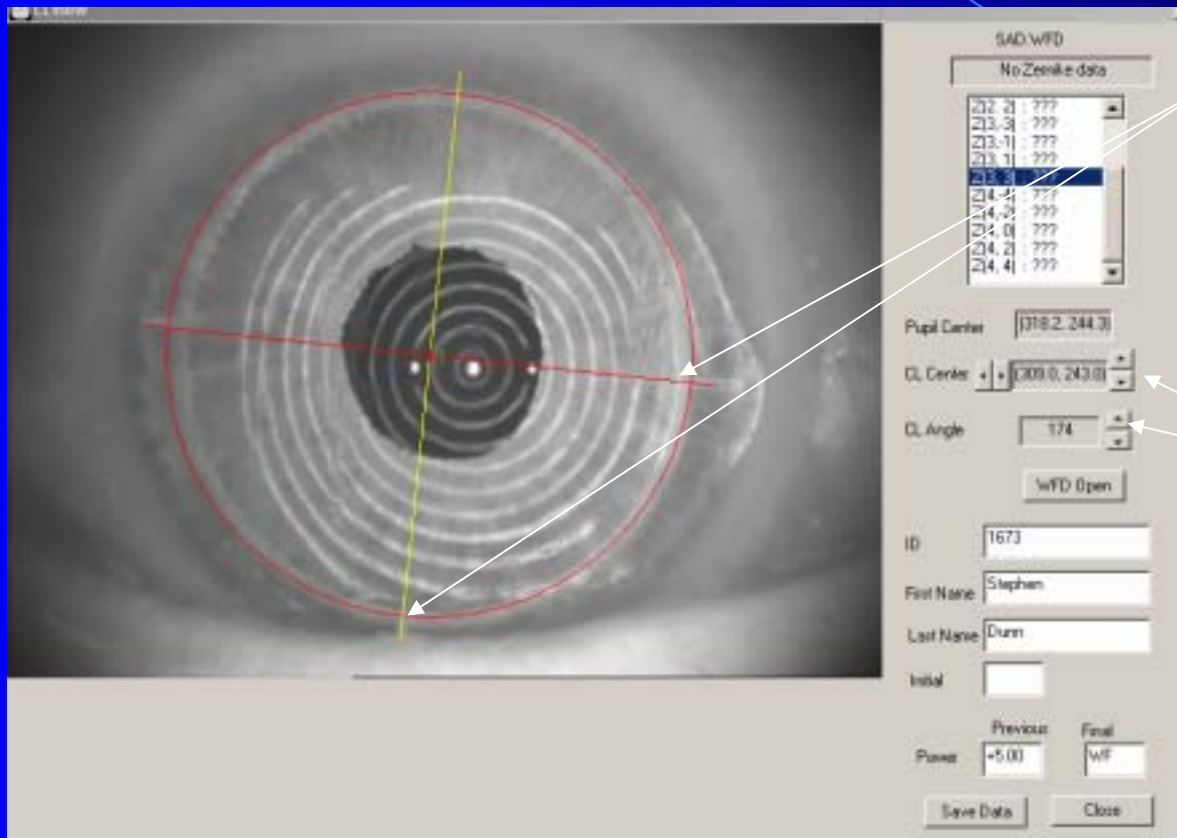
# Wavefront Data Acquisition ~ continue



Alignment  
Markings

View of an eye with a predicate lens on

# Wavefront Data Acquisition ~continue



Alignment of the axis and CL center with the markings

The lens position data acquired





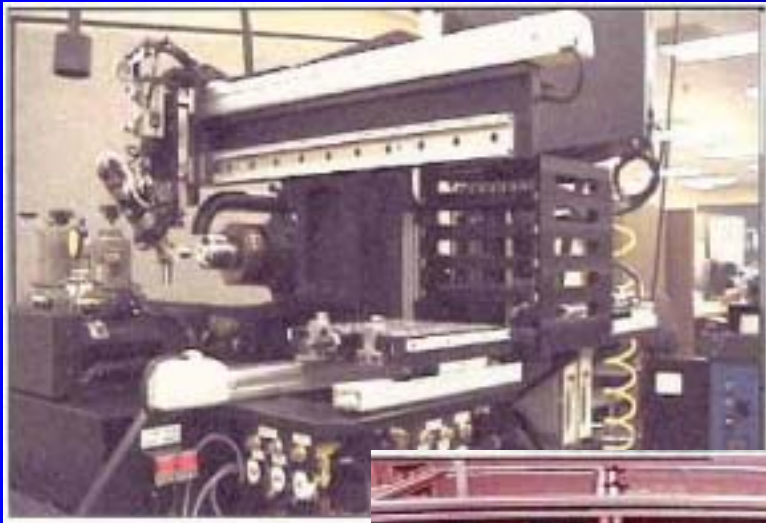




# Wavefront Contact Lens Production

~continue

Semi-mold  
production



The WaveTouch Process is performed on a blank identical to the predicate lens

# Step 3: Wavefront Contact Lens Delivery

Custom Wavefront Contact Lenses are shipped to the ECP

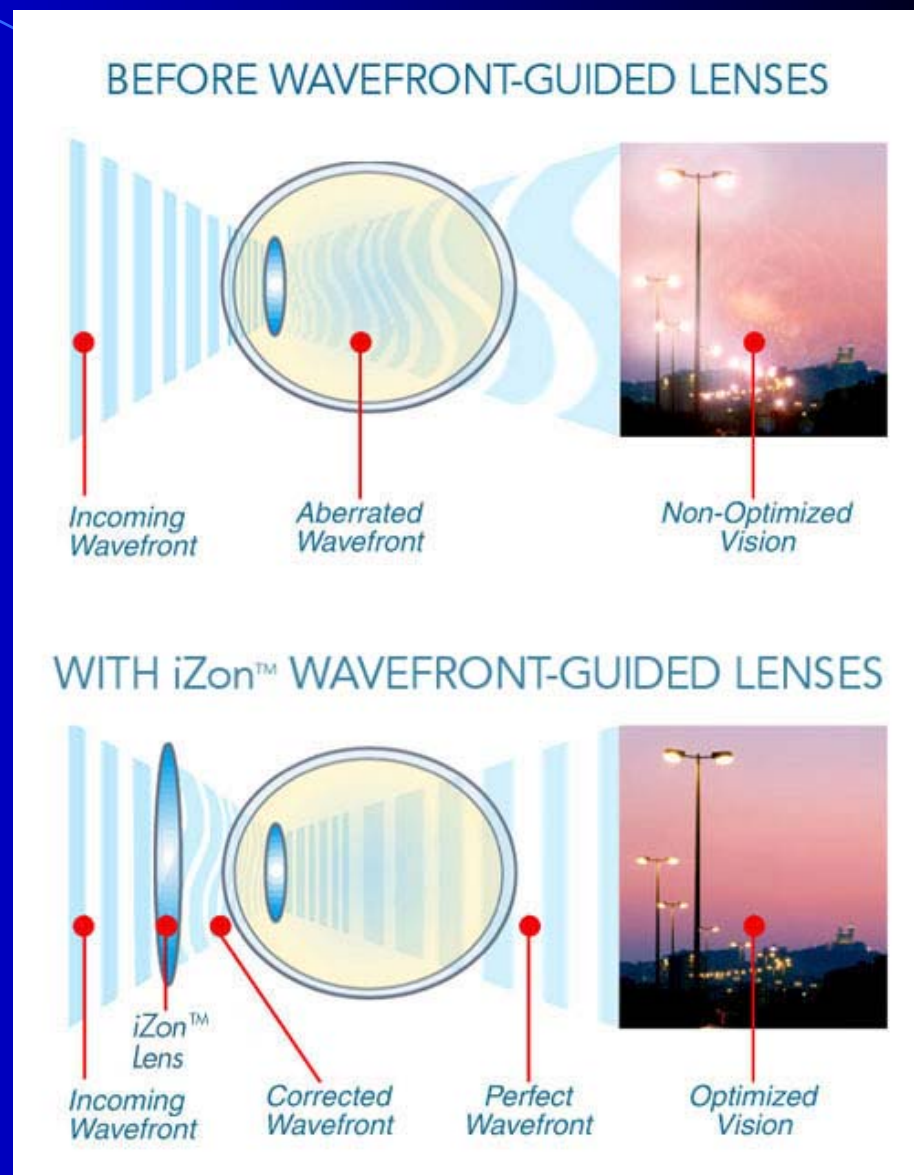
Fitting confirmation and payment

Annual supply shipped directly to the patient

\* Direct delivery of custom lens eliminates lens inventory at ECPs

# Patient Benefits From iZon™ by Definition Lenses

- Fully optimized, high definition vision
- Provides refractive correction near the physiological limits of the human eye – 20/10 or better
- Significantly improved
  - visual acuity
  - low contrast visual acuity
  - contrast sensitivity
  - night vision, reduced glare



# Target patient population?

- Regular Astigmatism
- Irregular astigmatism
- Surgical corneal irregularities (PK)
- Keratoconus

# iZon™ Lens Product Family

- Continuous stream of product innovation
  - Premium iZon™ Wavefront-Guided Single Vision Spectacles (Q4 '04)
  - iZon™ by Definition Wavefront-Guided Contact Lenses by Definition™ (Q1 '05)
  - iZon™ Wavefront-Guided Progressive Addition Lens (Q4 '05)



Thank you...

