

Slide 1



Slide 2



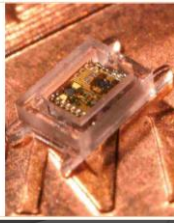
Slide 3



Slide 4

1.5 mm³ IOP Monitor

- Continuous IOP monitoring
- Wireless communication
- Energy-autonomy
 - Solar cell
 - Wireless transceiver
 - Cap to digital converter
 - Processor and memory
 - Power delivery
- Thin-film Li battery
- MEMS capacitive sensor
- Biocompatible housing



Slide 5

Another IOP Sensing Contact Lens



These contact lenses with a pattern of conductive silver wires could be used to measure pressure inside the eye and study glaucoma. University of California

Slide 6

Contact lenses to detect blood sugar changes




Developed by biochemical engineering professor Jin Zhang at the University of Western Ontario in Hamilton, the new technology benefits from hydrogel contact lenses made from extremely small nano-particles. The nano-particles used in these lenses react with glucose molecules found in tears, causing a chemical reaction and subsequently changes in their color

Slide 7

Photochromic contact lenses

- Nano sized tunnels that can fill with dye
- Faster response than photochromic spectacles

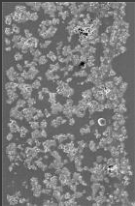


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Slide 8

Drug dispensing contact lenses


- Ciprofloxacin release via a bandage contact lens
- Month or longer drug delivery for other medications



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Slide 9

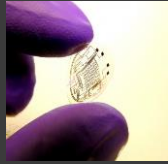
Microsoft and UW



Microsoft and the University of Washington are developing an electronic contact lens that can non-invasively monitor and wirelessly report blood sugar levels.

Slide 10

Virtual and Augmented Reality Contact Lenses



Researchers at the University of Washington are incorporating micro-circuitry for augmented reality applications. Diffraction is expected to limit the scope of the application.

Slide 11

Pain: Media Bottleneck

Screen too small for rich content

Narrow Field of View

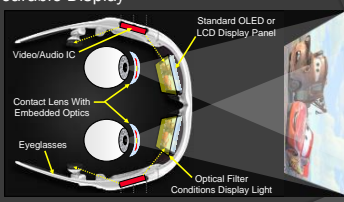
Unattractive Styling

Excessive Bulk



Slide 12

Solution: Contact Lens Enabled Wearable Display



Slide 13

Innova Inc. iOptik™ Contact Lens

Outer lens sharpens view of normal surroundings (50% of population need corrective lenses)

Center lens streams HD/3D Digital Media from eyewear flat-panels or projectors



Contact Lens

Outer Filter

Center Filter & Display Lens

Slide 14


VMAX IN PRACTICE
David I. Geffen, OD, FAAO



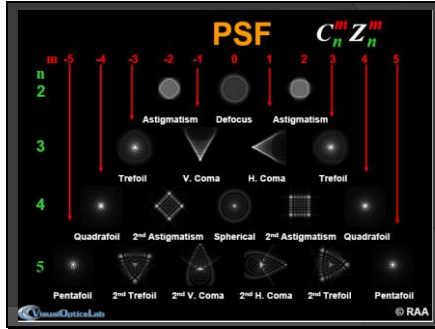
Slide 15

Refraction

- Over 100 years the same method
- Confusing for the patient
- Inaccurate
- Low Tech



Slide 16



Slide 17

PSF Refraction Is More Sensitive

- Changes in 0.05D are now noticeable

The slide shows three PSF patterns side-by-side, illustrating how small changes in refraction affect the PSF. The patterns are circular with a central spot and surrounding rings, showing increasing complexity and size as the refractive error increases.

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Vmax


- Ease of use
- Ease of patient understanding
- Extreme Accuracy
- High Tech

The slide features a photograph of the Vmax device, a small, white, handheld instrument used for vision testing. The logo "GORDON & WEISS VISION INSTITUTE" is visible at the bottom right of the slide.

Slide 19

Practice Benefits

- High Tech Look and Feel
- Get out of the Dark Ages
- Patients hate "Which is Better, One or Two"
- Greater Reliability



Slide 20

Results

Multi-Center Study of 900 Patients Over 8 Months
90% patients prefer PSF refraction to phoropter refraction



| Refraction Type | Percentage |
|-----------------------------|------------|
| Prefer PSF Refraction | 90% |
| Neutral | 7% |
| Prefer Phoropter Refraction | 3% |



vision perfected



Slide 21

Patient Responses

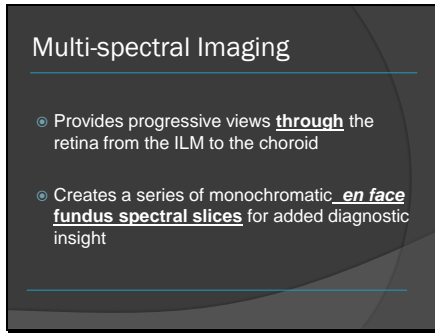
- Easier to tell the difference
- High tech
- Less strain
- Feels more accurate



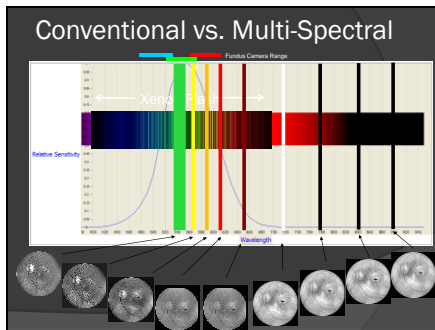
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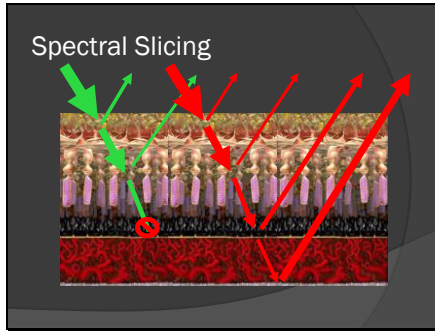
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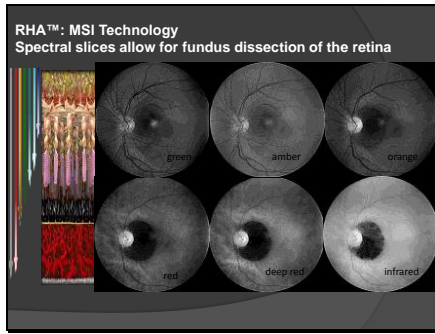
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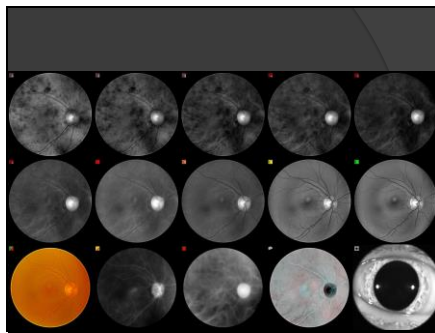
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Slide 26



Slide 27

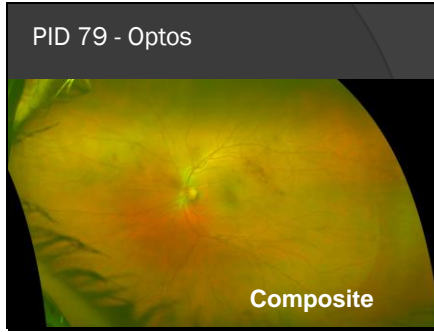


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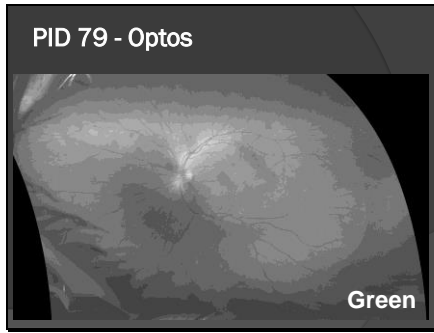
RHA™: MSI enables a spectral dissection for localization and interpretation of retinal pathologies

| Monochromatic Light Sources | Examples of Structures Best Viewed with MSI |
|--|--|
| Greens Superficial Structures Highlighted | Epiretinal membranes, tractional forces, cysts, folds |
| Yellows Ambers Reds Mid Retinal Structures Highlighted | Retinal vasculature, haemorrhages, neovascular membranes, drusen, exudates |
| Deep Reds Infrareds Deep Retinal Structures Highlighted | RPE architecture, pigmentary anomalies, nevi, melanomas |

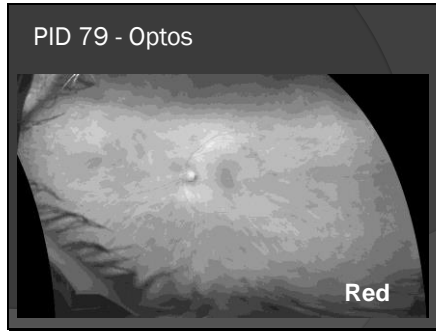
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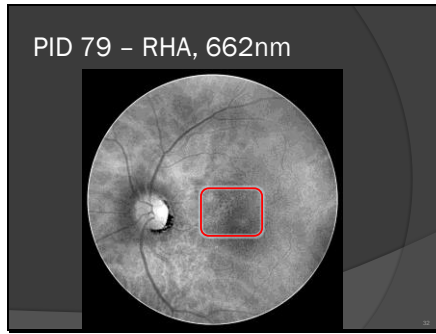
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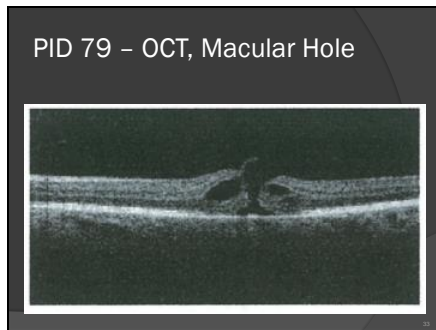
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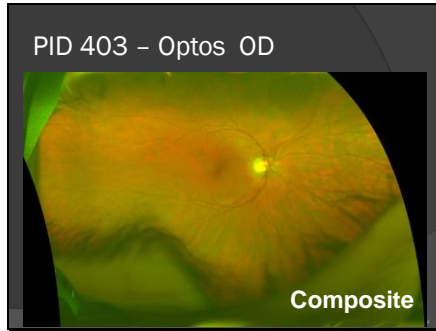
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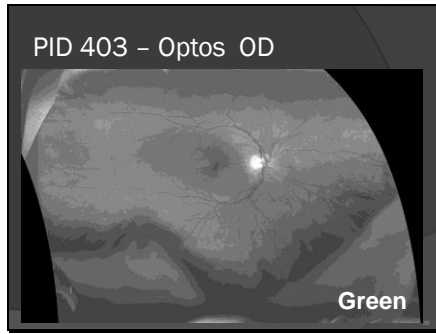
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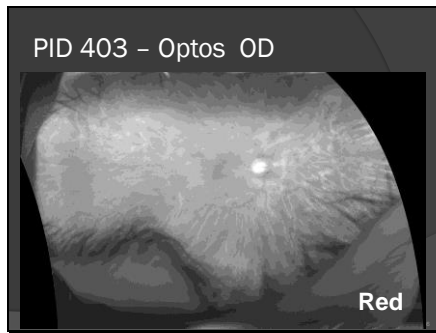
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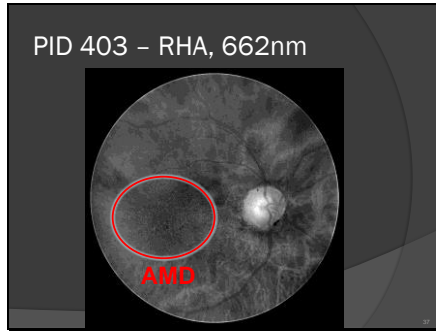
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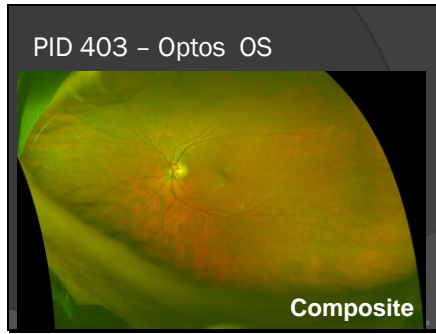
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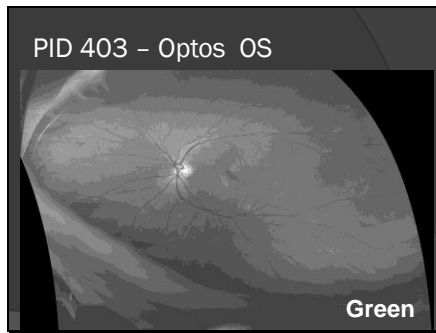
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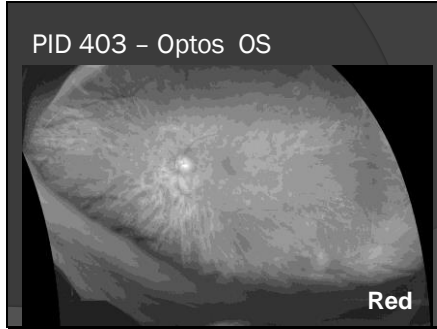
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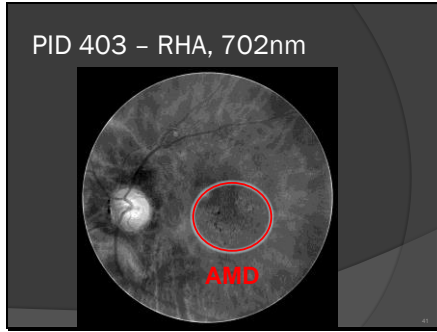
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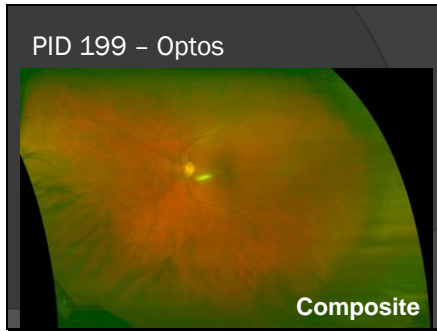
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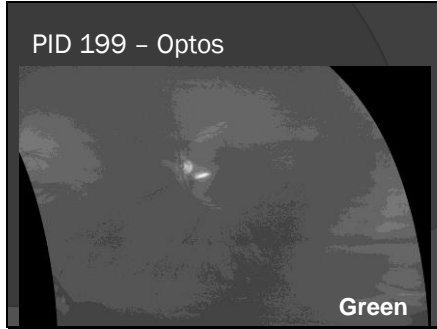
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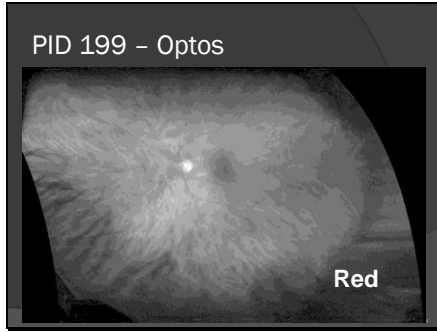
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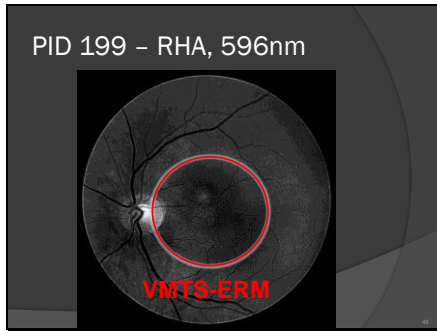
Slide 43



Slide 44



Slide 45



Slide 46

Return on Investment

- To date, 18% of my patients screened on the RHA have had suspect areas of interest to pursue further. This has drastically increased the utility of my OCT and I am now selling 4 times more nutraceuticals.

Dr.
David Geffen

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Slide 48

Technology Overview

- Revolutionary tear collection
 - Non-invasive
 - Gives access to untrained users (CLIA waiver)
 - Integrates into technician workflow
- Novel lab-on-a-chip
 - Less than 50 nL required
- Platform for rapid electrochemical biomarker assays
 - Sample-to-Answer in less than 30 seconds

Slide 49

Tears as an *in vitro* Diagnostic Platform

- Tears are an ideal matrix for non-invasive testing
 - Derived from blood
 - Largely acellular
- Tears known to have thousands of proteins & genes
 - Potential for many ophthalmic & non-ophthalmic markers
- Biomarker normalization using osmolarity
 - Fundamentally corrects for tear film instabilities
 - More accurate reporting of proteins, genes, metabolites
 - Combines multiple markers & payments on a single chip

Slide 50

Tear Hyperosmolarity- the Central Mechanism Causing Ocular Surface Inflammation, Cell Damage and Symptoms in Dry Eye Disease

DEWS Report, 2007

Tear hyperosmolarity stimulates a cascade of inflammatory events

- Inflammatory tear cytokines and MMPs
- Apoptotic cell death
- Reduced and altered tear mucins
- Reduced lubrication
- Up-regulation of HLA-DR expression on surface cells
- Disruption of epithelial junctions
- Intra-cytoplasmic changes in surface cells

OSMolarity tracks severity of disease linearly and tracks response to therapy and is tightly linked to tear film instability

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Using Tear Osmolarity in the Diagnosis of Dry Eye Disease

- If one or both eyes ≥ 308 mOsm/L or larger than a 9 mOsm/L difference between eyes
- Normal subjects have a tight band of variability
- Patients with mild/moderate DED show variability
 - Variability is the hallmark of this stage in which compensatory mechanisms are still operative in response to environmental stress
 - Variability confirms rather than confounds the DED diagnosis
 - Am J Ophthalmol 2011 May
- Patients with moderate to severe DED have tear osmolarity which varies between eyes and over time but generally remains elevated within the abnormal range

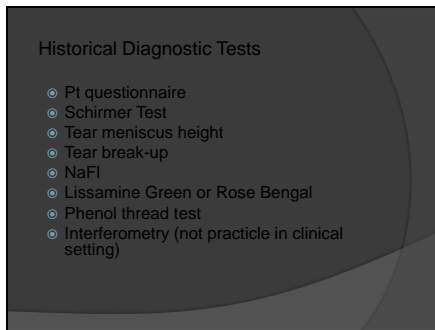
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Slide 53



Slide 54



Slide 55

Osmolarity in the Diagnosis of Dry Eye Disease

| Clinical Test | PPV |
|-----------------|-----|
| Osmolarity | 87% |
| Schirmers | 31% |
| TBUT | 25% |
| Staining | 31% |
| Meniscus Height | 33% |

- Osmolarity is the "gold standard" test for Dry Eye Disease
 - 45 years peer reviewed research
 - Osmolarity has been added to definition of Dry Eye
 - Global marker of Dry Eye, indicating a concentrated tear film

Source: Ocular Surface, October 2007, Vol 5, No. 3, & Thompson A. et al. Ocular Surface 2007

Slide 56

Diagnose & Classify Patients Quickly

1. Determine disease severity

2. Classify disease

| Aqueous Tear Deficiency | Mild Dry Eye | Moderate Dry Eye | Severe Dry Eye |
|--|--|--|----------------|
| Additional Signs: Evidence of inflammation | | | |
| Suggested Mechanism of Action: Tear Replacement | Suggested Mechanism of Action: Tear Replacement, Osmoprotectants | Suggested Mechanism of Action: Anti-inflammatory, Secretagogues, Punctal Plug | |
| Mebomian Gland Disease / Blepharitis | | | |
| Additional Signs: Evidence of inflammation, poor wiperability of lipids | | | |
| Suggested Mechanism of Action: Lubrication, Lipid Replacement, Lid hygiene | Suggested Mechanism of Action: Lipid Replacement, Lid hygiene | Suggested Mechanism of Action: Lipophilic Antibiotics, Antiseptics, Supplementations | |
| Corneal Roughness / Tear Instability | | | |
| Additional Signs: Evidence of corneal or conjunctival staining, low tear film breakup time | | | |
| Suggested Mechanism of Action: Lubrication | Suggested Mechanism of Action: Lubrication, Neuroregeneration | Suggested Mechanism of Action: Lubrication Modulator | |

Slide 57

ORA System™: Designed to Optimize Every Cataract Procedure

ORA's all new Optiwave™ technology takes intraoperative wavefront aberrometry to a *new level of precision* providing surgeons a *higher level of confidence*.


ORA (Optiwave Refractive Analysis)

Copyright © 2011, Wavefront Sciences

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ORA System™ (Optiwave™ Refractive Analysis)


- Provides intra-operative refractive information
- Attaches to most surgical microscopes for on-demand intraoperative measurements of sphere, cylinder and axis
- Enables real-time surgical course correction
- "Get it right – right on the table" the first time
- Every ORA system connects live to WaveTec servers to capture every procedure and push software upgrades



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ORA System™ Helps Surgeons Optimize Outcomes for ALL Cataract Patients

- IOL power calculations using aphakic refraction
 - Guides IOL selection
 - Post-refractive IOL power calculations
 - Standard monofocal and aspheric IOLs
 - Presbyopic IOLs
 - Toric IOLs (SE power)
 - Guides toric IOL cases
 - Cylinder power & axis
 - Guides LRI cases
 - Whether done in the phakic, aphakic, and/or pseudophakic mode

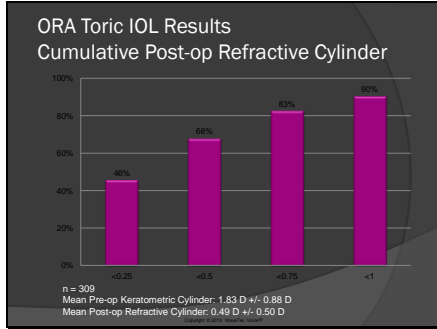


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Sample ORA Screen Shots



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Slide 62

Today's Modern Cataract Surgery

Is it really refractive?

Only **50%** of cataract patients get within 0.50 D of attempted correction*

* Randomized average of published studies with refractive targeting between 80% and 90%

Slide 63

ORA System™

Enables Refractive Outcomes

While **Over 80%** of ORA patients get within 0.50 D of attempted correction

* Randomized average of published studies with refractive targeting between 80% and 90%

Slide 64

What to Expect After Surgery – Day One

The vast majority of patients will be seen by the surgeon at day one, but if not:

- Look for a quiet anterior chamber
- Continue prescribed therapy (e.g., antibiotics, steroids, NSAIDs)
- Check ocular surface


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LASER REFRACTIVE CATARACT SURGERY

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Traditional Cataract Surgery

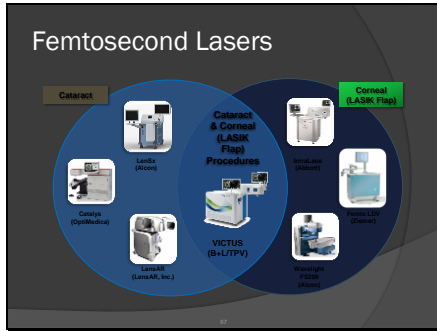
- Capsulotomy size directly related to Effective Lens Position^{1,2}
- Corneal incisions are manually executed and imprecise
- High level of phaco power can be associated with post-op complications
- Cataract surgery complications are 10x that of LASIK^{3,4}



| Common | Incidence | Vision Threatening | Incidence |
|-----------------------------------|-----------|------------------------------------|-----------|
| Posterior Capsular Opacification | 10-30% | Retinal Detachment | 0.6-1.7% |
| Cystoid Macular Edema (transient) | 2-10% | Cystoid Macular Edema (persistent) | 1-2% |
| Vitreous Loss | 1-5% | IOL Malposition | 0.3% |
| Corneal Endothelial Cell Loss | 4-10% | Need for Corneal Transplant | 0.3% |
| | | Endophthalmitis | 0.1% |

1. Nishii, B. Sources of error in intraocular lens power calculation. J Cataract Refract Surg 2008 Mar;34(3):388-76.
2. Cheng, Q. Editorial C. The relationship between capsulotomy size and anterior chamber depth location. Ophthalmic Surg Lasers 1999 Mar;28(3):188-93.
3. Reavey, et al. OJOP 2008 Oct;32(10):1681-4.
4. Park, et al. Ophthalmic Surg Lasers Imaging 2010 Mar-Apr;41(2):236-41.

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Slide 68



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Catalys – engineered for laser cataract surgery

Catalys was designed for laser cataract surgery
- not a modification of existing femtosecond technology
- 25% smaller footprint than competing systems

Precision that changes everything

Every other laser performing cataract surgery was originally designed for something else

Slide 70

The LenSx® Laser

The LenSx® Laser

A dynamic platform technology that will:

- Deliver true refractive cataract surgery with the precision of a femtosecond laser
- Establish Laser Refractive Cataract Surgery - a viable new premium category
- Rapidly advance the evolution of true image-guided intraocular surgery
- Advance the development of a more digitized, predictable approach to lens replacement surgery



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Laser Refractive Cataract Surgery

Goal is to Improve Every Procedure, Technology and Surgeon

| Key Step | Current Surgery | Impact | Safety Impact |
|--------------------|------------------------------|--|---|
| Corneal Incision | Not Optimized | Induced Cylinder | Infection |
| Capsulorhexis | Variable Sized, Not Centered | Variable IOL Position & Effective Lens Power | Capsular Tears, Posterior Capsule Opacification |
| Lens Fragmentation | Excessive Ultrasound Power | Delayed Visual Recovery | Loss of Endothelial Cells, Capsule Rupture |

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LenSx® Laser Integrated OCT

Image-guided Laser Refractive Cataract Surgery

- Intuitive touch screen Graphic User Interface
 - for easy customization of all surgical parameters
- Real-time video imaging for 3D visualization
 - guides the surgeon while docking
 - for optimal surgeon control
- True image-guided surgical planning
 - enables the surgeon to precisely program size, shape, location of each incision

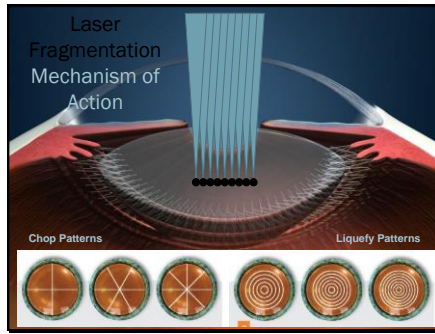
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Traditional Lens Fragmentation

- Initial phaco technique divides the nucleus into quadrants (Divide and Conquer)
 - Endothelium effects
- Variations on this technique were developed to reduce phaco power
 - Chop, Quick Chop, Stop and Chop, Flip, etc.
- Difficult to perform
- Lens density dependent

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Laser Fragmentation Mechanism of Action



The diagram illustrates the laser fragmentation mechanism of action. It shows a cross-section of an eye with a laser beam directed at the lens nucleus. Below the main diagram, there are two rows of circular patterns: "Chop Patterns" and "Liquify Patterns". The "Chop Patterns" row shows six circular diagrams with radial lines, representing different chop techniques. The "Liquify Patterns" row shows six circular diagrams with concentric rings, representing different liquify techniques.

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Manual Clear Corneal Incisions

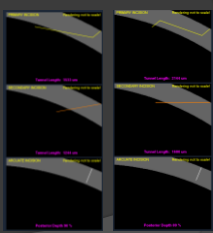
- Wound architecture limited by hand-held instruments, manual incisions
 - imprecise tunnel length and geometry
- Frequently require stromal hydration to seal
- Can result in cascading intraoperative difficulties
 - fluid control, anterior chamber maintenance
- Recent literature suggests an increased incidence of post-op infection¹
- Incisions may be unstable at low IOPs²

¹ Nisan M, Behrens A, Newsome RL, Nishi MY, Sandi G, Sweel FM, McDonnell PJ. Acute endothelialitis following cataract surgery: a systematic review of the literature. *Arch Ophthalmol*. 2008 May;126(5):613-20.
² Behrens A, Stark WJ, Proctor KA, McDonnell PJ. Dynamics of small-incision clear cornea wounds after phacoemulsification surgery using optical coherence tomography in the early postoperative period. *J Refract Surg*. 2008 Jan;24(1):46-9.

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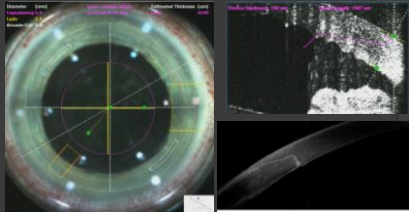
Incision Configurations Single or Multiplane

- ⦿ Computerized programming of incision patterns
- ⦿ Customizable geometry
 - Angle
 - Depth
 - Width



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LenSx[®] Laser Corneal Incisions



Customized wound architecture and placement Self-sealing incisions

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Arcuate Incisions

Traditional, Handheld Diamond Knife

- ⦿ Manually executed by "tracing" corneal marks
- ⦿ Inconsistent depth control
- ⦿ Unpredictable effect due to imprecise wound architecture and depth
- ⦿ No image-guided surgical planning or visualization

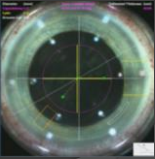


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LenSx® Laser Arcuate Incisions

Image-guided surgical planning with 3D visualization


- Real time corneal thickness
- Computer programmed incisions
 - % depth
 - incision length and position
 - 3D visualization of incision placement
- Predictable incision width, tunnel length
- Titrateable incisions
 - adjustable during surgical procedure
 - adjustable post-op at slit lamp



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Laser Arcuate Incision

- Square edge
- Uniform depth (no ripple)
- Precise, reproducible
 - Arc shape
 - Arc length
 - Diameter



Slide 81

Ideal Capsulorhexis

- Reproducible size, shape and well-centered

Current Manual Capsulorhexis

| Too large | Too small | Irregular shape | Off center |
|------------------------|--------------------------|------------------|--------------------------|
| No capsule-IOL overlap | Phimosis | IOL tilt | IOL decentration |
| IOL tilt | Difficult phaco maneuver | IOL decentration | Edge catches visual axis |

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LenSx® Laser Capsulorhexis

- Reproducible, Precise Circular Shape and Diameter Capsulotomy
- Enables Image-Guided Centration of Capsulotomy

A photograph of the LenSx Laser Capsulorhexis machine, which is a blue and white medical device with a monitor and a control panel.

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Effective Lens Position (ELPo)

- Assumed value, from empirical data (A constant and surgeon factor)
- A significant source of IOL power error,(Norby, 2008) key to post surgery refraction (Hill, 2009)
- Size of capsulorhexis effects ELPo (Cekic, 1999)

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Patient Expectation

LenSx® Laser technology provides the patient:

- Perceived benefits of a laser procedure
 - Computer controlled precision
 - Procedural predictability
- A comprehensive, advanced technology approach to lens replacement surgery
- A truly premium, value-added surgical experience

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Practice Performance

LenSx® Laser technology provides the surgeon:

- Known benefits of femtosecond technology
 - Improved accuracy of all incisions
 - Predictability at every step
- True image-guided Intraocular surgery
 - Opportunity to create optimal wound architecture
 - Precise capsulotomy design for every IOL
- A strong value proposition
 - A message that easily resonates with patients and staff

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Standard-Of-Care Technology

Light Adjustable Intraocular Lens (LA®)
Developed by Colhouin Vision, Inc.



- Photosensitive Silicone Material
- Precise, Non-Invasive Post Operative Adjustments
- >2 Diopter Correction for Myopia, Hyperopia, or Astigmatism
- Non-Toxic, Biocompatible
- Foldable


Slide 87

Why the Light Adjustable Lens?

- Predictable correction of residual refractive error *after* lens implantation for optimal distance vision
 - Spherical and cylindrical errors up to 2D
- Customized presbyopia solutions for near and intermediate vision
 - Adjustable Monovision
 - Customized Near Add
 - Asphericity Control

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Light Adjustable Lens



- Foldable 3-piece silicone IOL
- Blue PMMA modified-C haptics
- 6.0 mm biconvex optic
- Overall length 13.0 mm
- Manufactured in range from 10.0 D to 30.0 D
 - (+17.0 D to +25.0 D in 0.5 D steps)

+21.0 dpt, +1.0 -1.0/90°



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Mechanism of Power Adjustment

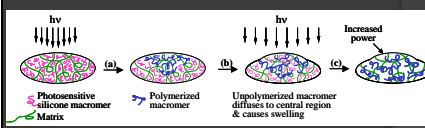
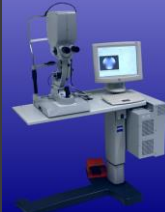




Diagram illustrating the mechanism of power adjustment in a light-adjustable lens. It shows three stages: (a) initial state with photosensitive silicone macromer and matrix; (b) polymerized macromer; (c) unpolymerized macromer diffusing to the central region, causing swelling and increasing power.

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Light Delivery Device Customized Treatment

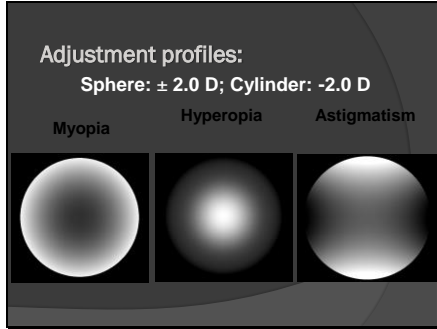


- Standard slit-lamp footprint
- Unlimited flexibility for lens modification
- The heart is the digital mirror device (DMD), which allows customized generation of spatial irradiance profiles

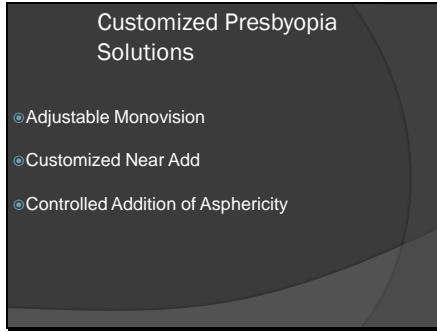


14 μm

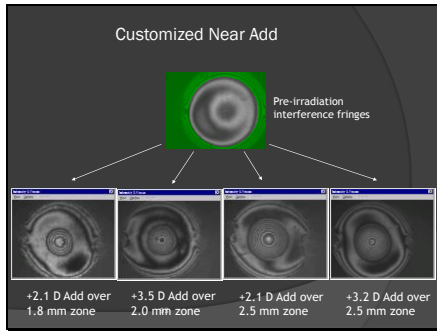
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Control of Asphericity

Induction of positive or negative spherical aberration to increase depth of focus

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CONCLUSION
The Calhoun Vision Light Adjustable Lens
Predictably achieves excellent distance acuity

A variety of options to customize near and intermediate uncorrected acuity

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THANK YOU
