

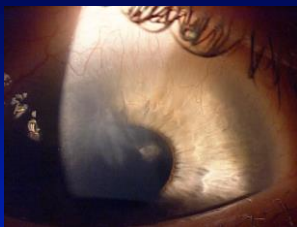
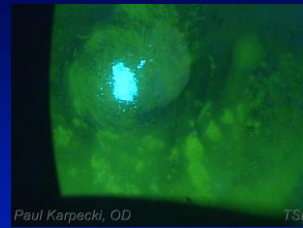
Ride the Wave of Technological Innovations in Eye Care

David I. Geffen, OD, FAAO



David I Geffen, OD, FAAO
Consultant/Advisor/Speaker

- » Accufocus
 - » Alcon
 - » AMO
 - » Annidis
 - » Bausch + Lomb
 - » Bruder Healthcare
 - » EyeBrain
 - » Optovue
 - » Revision Optics
- Shire
 - Tear Lab
 - Tear Science
 - TLC Vision



Stem Cell Technologies

Limbal Stem Cell Deficiency

Sequelae

- Persistent epithelial defects
- Corneal scarring and ulceration
- Conjunctivalization of the cornea
- Severe visual loss
- Chronic pain
- Keratoplasty failure



Limbal Stem Cell Transplantation

Procedures

Donor

Autograft

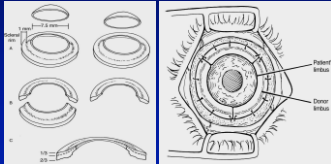
- Conjunctival limbal autograft *fellow eye*

Allograft

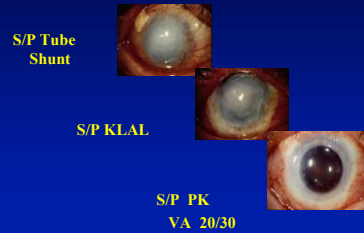
- Living-related conjunctival limbal allograft *relative*
- Keratolimbial allograft *cadaver*

Keratolimbial Allograft

Donor
Recipient

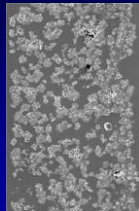


Keratolimbial Allograft

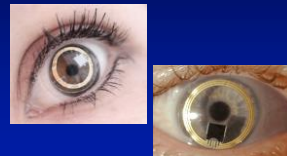


Stem Cell Coated Contact Lenses

- Aniridia patients
- Contact lens overwear?
- Various ocular surface disease issues:
 - Steven's Johnson syndrome
 - Ocular pemphigoid
 - Graft Vs Host
 - Chemical burns



Sensimed Triggerfish lens: Diurnal IOP measurements



Glucose Monitoring Contact Lens



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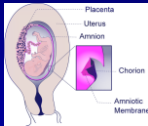
PROKERA®

- Class II medical device comprising of CRYOTEK™ amniotic membrane into a thermoplastic ring set
- Combines the functionality of a symblepharon ring with the biologic actions of CRYOTEK™ amniotic membrane to create a unique treatment option for corneal and limbal wound healing



The Amniotic Membrane

- The amniotic membrane is the innermost lining of the placenta (amnion)
- Amniotic membrane shares the same cell origin as the fetus
 - Stem cell behavior
- Structural similarity to all human tissue
- Avascular like the cornea

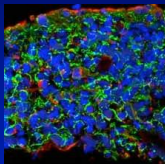


Ocular Surface Disorders

| Diseases with Pre-existing Epithelial Defects <small>(to promote wound healing and prevent complications post-surgery or in options)</small> | Diseases without Epithelial Defects <small>(to prevent further damage and promote regeneration (in non-healing PTK))</small> | Diseases with Unhealthy Epithelium or Basement Membrane <small>(to promote regeneration (in non-healing PTK))</small> |
|--|--|--|
| <ul style="list-style-type: none"> • neurotrophic persistent corneal epithelial defect • post-infectious non-adherent corneal ulcers (e.g. herpes, varicel, and bacteroid) • non-healing epithelial defect after PTK/PTC • acute chemical/thermal burns • acute Stevens-Johnson syndrome/toxic epidermal necrolysis | <ul style="list-style-type: none"> • dry eye syndrome • superficial (granular) keratitis • filamentary keratitis • radiation keratitis, which pattern indicates of limbal stem cell injury • exposure (Stevens) keratopathy | <ul style="list-style-type: none"> • recurrent corneal erosion, EBMD • Salzmann's nodular degeneration • bullous keratopathy during/after PTK • toxic after PTK • partial limbal stem cell deficiency • corneal dystrophy (e.g., Reis-Bückler) |

| Refractive Indications | |
|--|--|
| Before Surgery | After Surgery |
| <ul style="list-style-type: none"> • to treat pre-existing ocular surface disorders and restore corneal integrity before refractive, corneal, or cataract surgery | <ul style="list-style-type: none"> • to enhance healing • to prevent post PTK haze |

RPE Tissue regenerated from Stem Cells



RPE Tissue Regenerated from Pluripotent Skin Stem Cells



Point Spread Function Refracting in PRACTICE

David I. Geffen, OD, FAAO

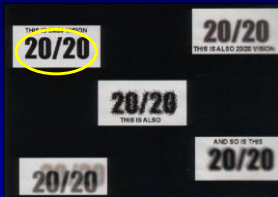


Refraction

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

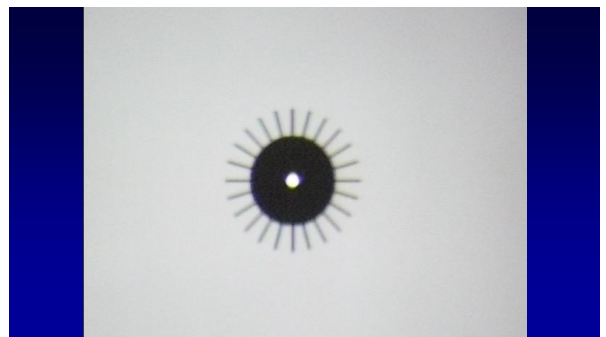
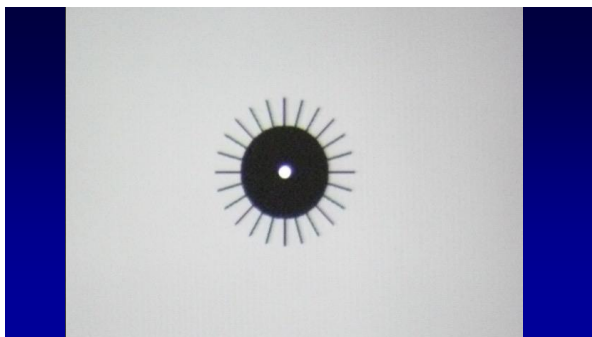
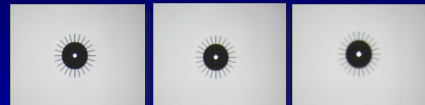


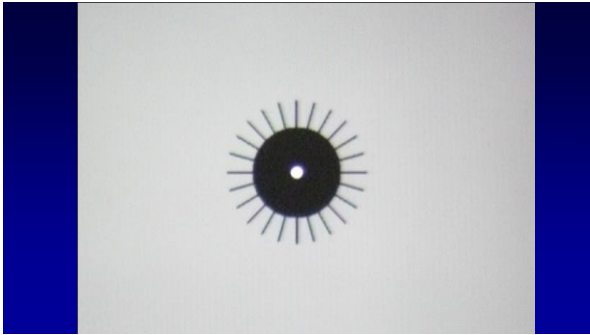
20/20 is not Vision Optimized!



PSF Refraction Is More Sensitive


- Changes in 0.05D are now noticeable





Patient Responses

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



GORDON & WEISS
VISION INSTITUTE

Generates More Accurate Rx

- **Subjective refraction – not auto-refraction**
 - Rx is at equal or higher level of reliability than a phoropter (unlike objective wavefront devices)
- **Point Spread Function technology attains a higher level of sensitivity and accuracy**
 - Patients can discern differences more clearly with PSF than with Snellen letters
- **PSF refines the Rx end point to 0.05D, 5X better than phoropters**
 - Provides highest level of visual acuity and contrast


Maximum Plus Maximum Visual Acuity

- **Prevention of over-minussing due to the true perception of the PSF and the target detail** versus using Snellen optotypes which requires one self to determine their own visual stress point of smaller and darker.
- With the Vmax system if the patient is over-minused, the target simply looks blurry again. This allows for a decrease in the level of patient frustration by having an unambiguous which yields a higher level of clinical confidence. Confidence in the refraction was found to **95% amongst patients achieving identical or better refraction with the device compared to a manual phoropter**

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Preferred by Patients

- PSF Refractor has been clinically proven
- Study with over 900 patients at 7 U.S Study Locations
- Results published at ARVO 2012
- Significantly positive results when patients were asked to choose the PSF Rx versus the phoropter Rx



| Preference | Percentage |
|------------|------------|
| Better | 90% |
| Equal | 5% |
| Worse | 5% |

Point Spread Function Refractor with Wavefront Aberrometer



Hand Held Wavefront Abberometer



SVOne Technology

TECHNOLOGY
Wavefront aberrometry

FIXATION TARGET
Open field, any target

TOTAL REFRACTION TIME
Under 1 minute

DATA ACQUISITION METHOD
Measure and average 5 readings per eye



HD Analyzer



eyeBrain Medical

- » The Problem
 - Small amounts of binocular misalignment, which result in compensatory eye movements, causing excess visual demand.
 - The Vision Council reported that 65% of Americans suffer from symptoms of Computer Vision Syndrome
- » Common Symptoms
 - Digital eye strain
 - Computer Vision Syndrome
 - Headache
 - Visual discomfort
 - Dry eye sensation
 - Fatigue
 - Stiff neck or shoulders

©2014 eye

SightSync (Measurement Instrument)



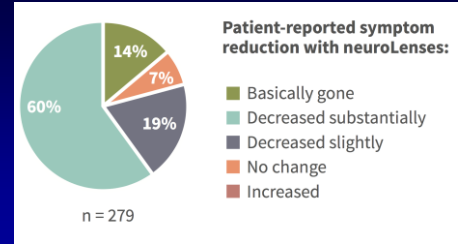
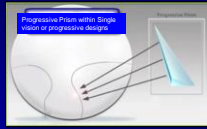
- » Objective, accurate, quick
- » Technician-performed during pre-screening
- » 90-120 seconds

Detects & measures binocular misalignment at distance and near.

| SightSync Output | |
|------------------|-------------|
| Distance: | 2.0 Base In |
| Near: | 2.8 Base In |

The Solution (neuroLens)

- » Synchronizes binocular vision at all distances, eliminating need for compensating eye movements.
- » Progressive prism technology, using measurements from SightSync
- » Built into spectacle lenses with patient's Rx



What current optometric investigators are saying about eyeBrain's SightSync & neuroLens technology:

- » *"The most important breakthrough of my career as an optometrist."*
- » *"One of three WOW factors of my 30 year optometry career – right up there with LASIK and premium cataract surgeries."*
- » *"It's literally rejuvenated my desire to practice optometry and it's driven me to be an even better doctor by having the technology in my practice."*
- » *"I just can't believe how many people come in with these symptoms. I went from thinking I might be able to help 3-5 patients a week with these lenses, but now I'm thinking it's more like 3-5 patients every day!"*

Slide #39

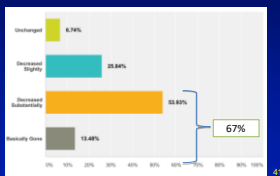
EyeGraine: Subgroup of Chronic Daily Headache

Symptoms

- Primary Symptoms
 - Frequent Headaches
 - 3+ days per week
 - Neck Pain/Stiffness
- Secondary Symptoms
 - Dry eyes
 - Fatigue with near work
 - Photophobia, especially at night
 - headlights



Study Data



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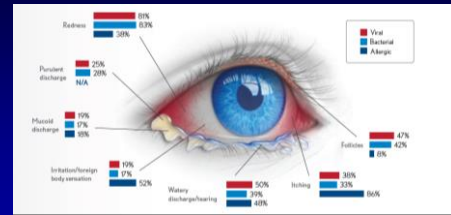
Point-of-Care Diagnostics

RAPID PATHOGEN SCREENER

Ability to screen for viral infections

Can Detect presence of Adenovirus in conjunctiva

Overlapping Signs & Symptoms



CLEARPATH OS-120™



The user interface "Touch Screen" is attachable to the left, right or back of the instrument to accommodate a variety of office space settings.

Cognoptix

- Fluorescent Ligand Scanning (FLS)
- Beta amyloid-specific small molecules is dropped into a patient's eye, which is scanned by the Cognoptix SAPPHERE instrument
- The small molecules are absorbed into the lens and bind to the amyloid aggregates
- The FLS system excites the fluorescent ligands that bind to amyloid

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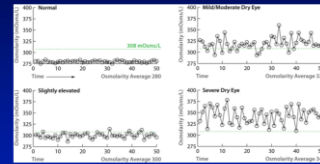
Technology Overview Tear Lab

- 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

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

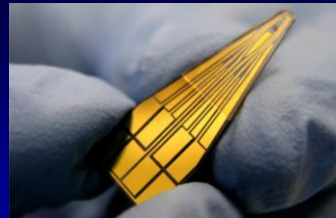
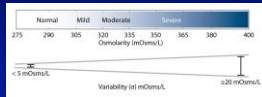
Tear Film Instability Increases With DED Severity



Mathematical model derived from Fig. 3. Hwang & Sweeney, *Am. J. Ophthalmol.* 151:1049-1056, 2013. © 2013. © 2013. © 2013.

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Osmolarity in Diagnosis & Grading of Dry Eye



Osmolarity Disposable Chip

Future of Tear Biomarker Analysis: TearLab Next Generation Platform

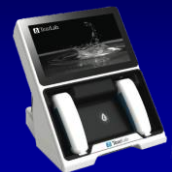
- » Quantitative
- » Ability to measure
 - Osmolarity
 - Inflammation biomarkers
 - Allergy biomarkers
 - Etc.
- » Rapid testing (< 2 minutes)
- » Multiplexed biomarkers
- » EHR Integration
- Clinical Application:
 - Normalization using osmolarity
 - Customized chips with designed sensitivity & specificity



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TearLab Next Generation Platform

- » When?
 - CE Mark by end of 2016
 - 510k submission in early 2017
 - First test will have osmolarity + 1 or 2 additional markers
 - Likely to be focused on inflammation
 - New iterations possible every 6 months



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Presbyopia Correction

- Accommodating IOLs
- Corneal Inlay Technology
- Therapeutic treatment

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Inlay Design



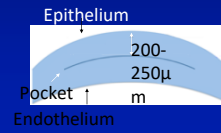
Where the KAMRA® inlay falls within the Patient Spectrum



Surgical Procedure

- Description: A femtosecond laser created pocket in the stroma at a depth of 200-250μm with femtosecond laser spot/line settings of < 6x6 or equivalent is recommended.

Pocket Emmetropic KAMRA (PEK)

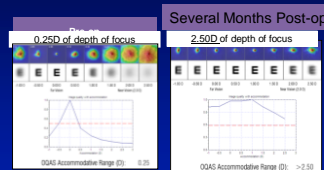


KAMRA Inlay Design

- Inlay improves near vision by extending depth-of-focus
- Central aperture is a hole in the inlay and has no power
- Inlay provides an unobstructed pathway for focused light to reach the retina



Depth of Focus Pre-Op & Post-Op




AcuTarget HD™ Instrument

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Femtophaco makes
 Mediocre surgeons good,
 Good surgeons better,
 Excellent surgeons
 exceptional.

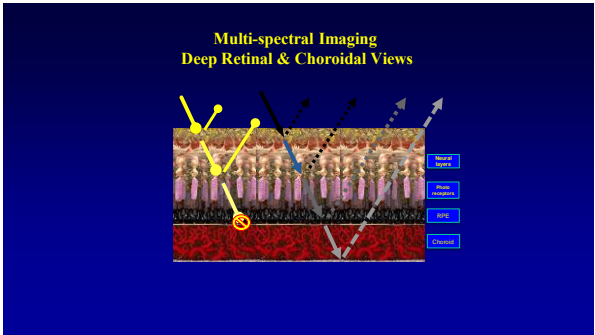
ORA System™: Designed to Optimize Every Cataract Procedure



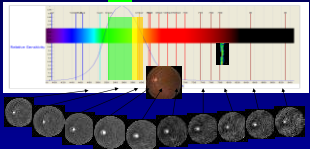
ORA's all new Optiwave™ technology takes intraoperative wavefront aberrometry to a *new level of precision* providing surgeons a *higher level of confidence*.

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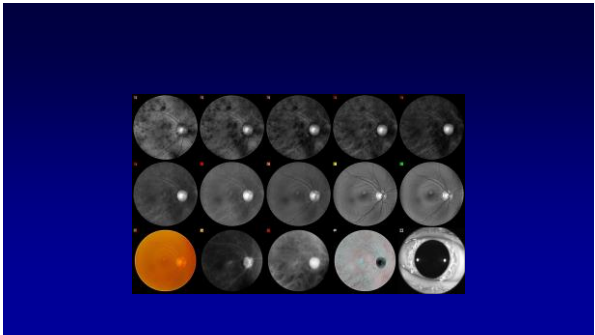
- What is Multi-spectral Imaging?**
- New and unique way to view layers of the retina non-invasively
 - The device uses a series of discrete monochromatic lights to create 12 on face "spectral slices" throughout the entire thickness of the retina
 - Provides clinicians an enhanced view of the entire retina including the deep retinal architecture of the RPE and choroid
 - Allows for *early* detection of retinal pathology
 - Allows you to document, follow, monitor, and treat or refer retinal pathologies with confidence
 - Provides an interface for patient education and loyalty



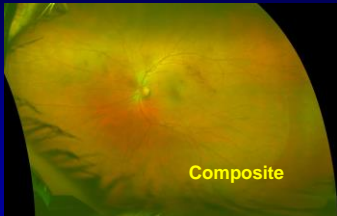
RHA Multi-Spectral Imaging



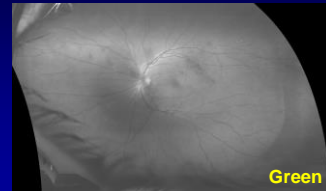
The doctor sees all of these images



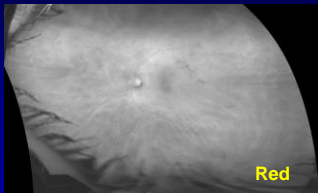
PID 79 - Optos



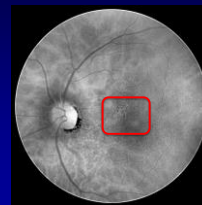
PID 79 - Optos



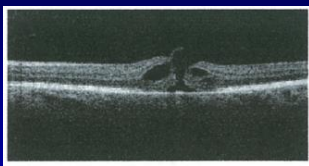
PID 79 - Optos



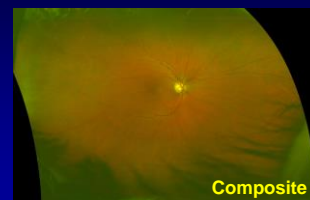
PID 79 - RHA, 662nm



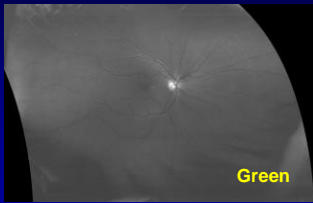
PID 79 - OCT, Macular Hole



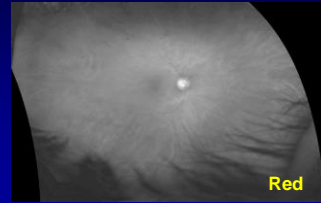
PID 158 - Optos



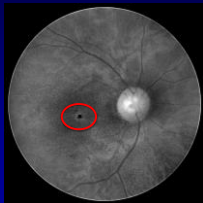
PID 158 - Optos



PID 158 - Optos



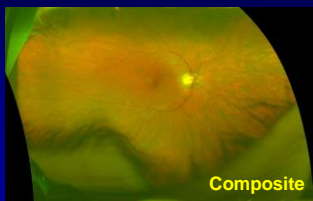
PID 158 - RHA, 702nm



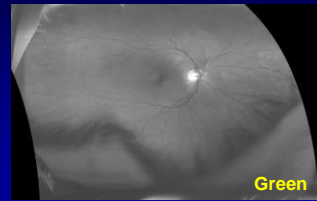
PID 158 - OCT, RPE Disruption



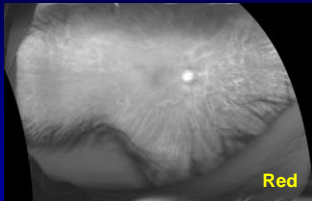
PID 403 - Optos OD



PID 403 - Optos OD



PID 403 – Optos OD



PID 403 – RHA, 662nm



Conclusions

- Many exciting advances in technology
- Important to be aware of the technologies and apply them to help us practice at a higher level and assist patients
- Patients are more educated than in the past and expect to see doctors who know the answers to their eye care questions and can communicate that knowledge