Trends and Technology in Optometry's Future

Course Description

- This course presents developments in science and medicine that will change Optometry.
- Specific topics to be discussed are:
  - The Genomic Revolution, Radio Frequency Therapy, Tissue Engineering and Biomechanics,
  - Anesthetic Alternatives, Angiogenesis Inhibition,
  - Wavefront Technologies and Beyond
  - Phacoemulsification technologies

Commercial Disclosure

- The content of this course was prepared independently by Dr. Talley without input from members of the ophthalmic industry.
- Dr. Talley has no direct financial or proprietary interest in any companies, products or services mentioned in this presentation.

Trends in Optometry's Future

- Continued expansion of Optometrist using medications for the diagnosis and treatment of ocular disease
Trends and Technology in Optometry's Future

Diagnostic Medications?

- Examination Under Sedation (EUS)
- May be used to help calm or relax an adult or child who are nervous or tense
- Allows for a more thorough examination

Wild Child ... Pre Sedation

Wild Child... Post Sedation

- 5 ml given @ 2:00 pm; vital signs normal
- Another 3.75 ml given @ 2:30 pm; vital signs normal

Trends in Optometry’s Future

- Continued expansion of Optometrists using medications for the treatment of ocular disease

Therapeutic Medications?

- 8 YOAAM present with red swollen painful eyelid of two day duration.
- BCVA is 20/20 OD and OS

Which medication can/do you use?

Trends in Optometry’s Future

- Continued expansion of Optometrists using lasers for the diagnosis of ocular disease
Diagnostic Laser?

CPT 92135
- Unilateral
- Billable for Glaucoma, Retinal Abnormalities
- Examples are GDx, HRT, OCT, and RTA
- Requires Interpretation and Report
- Fee: $38.87

Which laser can/do you get paid for?

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Trends in Optometry’s Future

- Continued expansion of Optometrists using lasers for the treatment of ocular disease

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Therapeutic Laser?

- Nd: YAG
- Argon
- Selecta II
- Q Switched 532

Which laser can/do you use?

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Trends in Optometry’s Future

- Continued expansion of Optometrists using lasers for the treatment of refractive disorders

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Refractive Laser?

- 4th Generation Intralase FS Laser
- Flap Creation in 15 seconds

Which laser can/do you use?

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Trends in Optometry’s Future

- Continued expansion of Optometrists using injectable medications for the diagnosis of ocular disease
Trends and Technology in Optometry's Future

Diagnostic Injections?

- Intravenous Bolus Injection Technique

Trends in Optometry's Future

- Continued expansion of Optometrists using injectable medications for the treatment of ocular disease

Therapeutic Injections?

- Infiltrative Intralesional Injection Technique
  Which technique can/do you use?

- Botox injected directly in the affected muscle relieves the muscle spasm
  Which medication can/do you use?
Therapeutic Injections?

Intravitreal Injection Technique

Which technique can/do you use?

Trends in Optometry’s Future

• Continued expansion of Optometrist performing minor surgical procedures of the eye and adnexa

Sx Procedures of the Eyelids

Surgical Procedures of the Eyelids

• Epilation
• Cyst Evacuation
• Papilloma Removal
• Chalazion: Incision & Curettage
• Xanthelasma Excision
• Entropion / Ectropion Repair

Sx Procedures of the Eyelids

• Lance cyst with a 25 gauge needle or Vanese scissors
• Express contents with firm pressure using applicator

Cyst of Moll

Cyst Evacuation Sx Summary

Sx Procedures of the Eyelids

• Anesthetic test
• Reassure patient
• Excise lesion flush
• Control bleeding

Papilloma Excision Sx Case Study

Sx Procedures of the Eyelids

• Score the top of the cyst using a 25 gauge needle or Vanese scissors
• Place two applicators at opposite sides of the base of the lesion and squeeze
Sx Procedures of the Eyelids

Chalazion Incision and Curettage Sx Case Study

Post Anesthetic Prep
Positioning the Clamp

Sx Procedures of the Eyelids

Chalazion Incision and Curettage Sx Case Study

Curettage Vigorously
Granulomatous Material

Sx Procedures of the Eyelids

Chalazion Incision and Curettage Sx Case Study

Cystic Wall Excision
Heomostasis w/ Cautery

Sx Procedures of the Eyelids

Chalazion Incision and Curettage Sx Case Study

Entropion Repair Sx Case Study

• Involutional entropion of the left lower lid resulting in direct apposition of eyelashes to bulbar conjunctiva
• Patient reports significant foreign body sensation

Sx Procedures of the Eyelids

Entropion Repair Sx Case Study

• Using a fine tip “Sharpie Pen” mark location of treatment spots
• Cautery punctures are applied resulting in tissue shrinkage and contraction

Sx Procedures of the Eyelids

Entropion Repair Sx Case Study

• Apply thermo-cauterization perpendicularly to each marked location to a depth of approximately 2-3 mm.
• Patient should always look away from cautery unit
Sx Procedures of the Eyelids

• Immediately assess tissue response to determine if additional application are needed
• If necessary apply additional burns

Immediate Post Op

Hello to HITECH

• Doctors who begin using EHRs by 2011 or 2012 can receive the maximum reward, up to $44,000.00 over five years through the Medicare program
• 75% of Medicare allowed charges up to a capped amount each year
• No incentive, if you wait until 2015

Hello to HITECH

• The EHRs must be “certified” and the doctors must use the EHRs in a “meaningful” way
• Doctors who do not start using EHRs by 2015 will be subject to “payment adjustments”, however the HHS has the authority to make exceptions

Trends in Optometry’s Future

• Continued expansion of Optometrist using Electronic Health Records (EHR) to include Electronic Prescribing (E–Rx) and Physician Quality Reporting Initiative (PQRI)
Technology in Optometry's Future

- Molecular Optometry in the Genomics Revolution to include Gene Chip Technology, Antisense Drugs and Ocular Gene Therapy.

The Genomic Revolution

Molecular Optometry
- Nearly every ocular disease has a genetic component
- The Human Genome Project (HGP) was completed in 2003

The Human Genome Project

- Collaborated study between National Institutes of Health (NIH) and the Department of Energy
- The largest project ever undertaken in biological medical science

Goals of the HGP are to:

1. Map the human genome
2. Sequence all human DNA
3. Explore ethical, legal and social issues
4. Develop comparative genomics
5. Advance functional genomics
6. All of the above
The Genome Revolution

Gene Chips
- Affymetrix has developed tiny chip probes for doing DNA sequence analysis, genotyping, mutation analysis and gene expression studies.

Gene Chips
- The Gene Chip Probe Array contains miniaturized, high-density DNA arrays placed on glass or silicon chips.
- Slightly smaller than a dime.

FACT OR FICTION?
- Gene Chips may be used to diagnose disease, help find the right drug for a specific disease variant, screen large populations for disease patterns and detect susceptibility genes.

The Genomic Revolution

Anti-Sense Drugs
- Traditional drugs target disease-causing proteins.
- Anti-sense drugs inhibit the transcription of messenger RNA making them more specific and selective.

Anti-Sense Drugs
- Potentially, these drugs would be more fast-acting and efficient than conventional medicines with less side effects.
- Also, could allow for increased duration and potency with alternative routes of administration.
Genomic Medicine

- 70 genes, chromosomal regions containing genes (i.e. loci), and alleles that either cause glaucoma or are associated with syndromes encompassing glaucoma have already been identified.

Genomic Medicine

What Now? What Next?
- Which risk alleles contribute to the common forms of glaucoma?
- Do genetic modifiers affect the age of onset and severity of glaucoma?
- Do genetic markers influence the outcome of glaucoma treatments?

Ocular Gene Therapy Here?

Leber’s Congenital Amaurosis (LCA)
- LCA is characterized by a mutation in the RPE65 gene which prohibits the development of the Retinal Pigment Epithelium and inhibits the retina from processing light.
- A three patient gene therapy trial on young adults with LCA was conducted in England.

Ocular Gene Therapy Here?

Leber’s Congenital Amaurosis (LCA)
- Investigators used a viral vector to carry a normal version of the RPE 65 gene which was administered by subretinal injection.
- By two weeks post-op, all three patients reported improved vision in the injected eye (HM to 20/710 and less nystagmus).

Technology in Optometry’s Future

- Radiofrequency Therapy delivered by Optometrists to include Radio Surgery (Electro Surgery), Capacitive Radiofrequency Technology (Thermage) and Conductive Keratoplasty (CK).
Radio Surgery

- Radio Surgery uses high frequent (1.7 to 4 MHz) radio waves for tissue transection.
- High frequent waves cause the water molecules to oscillate vaporizing the intracellular fluid. This forces the membrane of the cell to burst, separating the tissue.

Distinct Waveforms

- **Fully Filtered – Cut...** micro-smooth cutting, negligible lateral heat, minimal cellular destruction, ideal for skin incision and biopsy, best cosmetic results, fastest healing.
- **Fully rectified – Cut / Coagulation...** cutting with hemostasis, ideal for subcutaneous tissue dissection, especially useful in vascular areas.
- **Partially Rectified – Coagulation...** coagulation and shrinkage, ideal for cutting with hemostasis control.
- **Fulguration...** maximum penetration and hemostasis, ideal for intentional tissue destruction.
### Radio Surgery

**Distinct Waveforms**
- Bipolar... pinpoint, micro-coagulation, no tissue adherence to forceps, no charring or tissue necrosis, ideal for coagulation in and around critical anatomy

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### Radio Surgery in Eye Care

- Resection of benign and malignant skin tumors
- Xanthelasma removal
- Blepharoplasty
- Epilation
- Chalazion incision and curettage

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### Radio Surgery in Dermatology

- Rhinophyma Pre and Post Radio Surgery

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### Advantages of Radio Surgery

1. Leading of the instrument without pressure or tensile
2. Coagulation of small vessels during the cutting
3. Minor tissue damage
4. Lower cost price compared to laser technology
5. All of the above

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### Radio Sx Vs. Electro Cautery

- Higher frequency of the radio waves
- Faster disintegration of the tissue
- Less lateral heat propagation
- Less thermal tissue damage
- Faster healing
- Minor scar formation

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### Capacitive Radiofrequency

- A 6 MHz radiofrequency signal used to tighten, contour and rejuvenate facial skin to help naturally restore a more youthful appearance
- This technology tightens existing collagen and stimulate new collagen production
Capacitive Radiofrequency

- Thermal Tip

Conductive Keratoplasty

- The application of radiofrequency (350 kHz) energy that the cornea converts to heat in a controlled fashion
- FDA approved for the reduction of hyperopia (0.75 -3.25D) and the induction of myopia (-1.00 to -2.00D) to improve near vision in presbyopic emmetropes / hyperopes over 40 years of age

Conductive Keratoplasty

- Ring pattern applied in peripheral corneal
- Increase in central corneal curvature

“The Beauty of Thermage”

- Before
- After
- Movie Time

View Point CK System

- Preoperative
- Intraoperative
- Immediate Postoperative
**Post LASIK CK Successful…**

- FDA ongoing clinical trial: CKafterLASIK.com
- Trial sites as follows:
  - Stephen G. Slade, M.D., Houston TX
  - Ralph Chu, M.D., Minneapolis, MN
  - Daniel S. Durrie, M.D., Overland Park, KS
  - Michael Gordon, M.D., San Diego, CA
  - Peter S. Hersh, M.D., Teaneck, NJ

**CK After LASIK Early Results**

- Accuracy and efficiency of CK on post LASIK patients is higher than the original CK approved data
- Binocularly, 100% of patients achieved visual acuity of 20/25 or better at distance and 91% achieve J2 or better at near

**Technology in Optometry’s Future**

- Tissue Engineering and Biomechanics in ocular disease management to include Organ Regeneration and Replacement, Biomechanics, Wound Healing and Tissue Adhesives

**Tissue Engineering & Biomechanics**

- Ocular Regeneration
  - Organ replacement and regeneration
  - Engineered replacement tissue constructs are already in development for a variety of tissues to include: skin, cartilage, nerve, liver, kidney, muscle, heart valves, blood vessels and **cornea**

- Engineered corneas could replace conventional transplants in 10 years
- Advantages include no rejection, no tissue supply problems and no iatrogenic disease transmission
Tissue Engineering & Biomechanics

Ocular Regeneration?
• Immediate applications include toxicity and drug efficacy testing, thus reducing the use of animals

Biomechanics & Wound Healing

• Key to achieving the most from refractive surgery is an understanding of the biomechanics of the refractive procedures in the eye coupled with advances in pharmaceuticals to facilitate wound healing
• Wavefront technology is ahead of the biology

Biomechanics & Wound Healing

• Clear biodendrimer glue (Hyperbranch Medical Technology Inc., Raleigh, N.C.)
• Laser activated and self-gelling polymer
• Design to heal corneal wounds

Biomechanics & Wound Healing

• Can be used to seal a clear corneal cataract incision
• Laser-activated biodendrimer adhesive can be used to seal a LASIK flap

Biomechanics & Wound Healing

“With the imminent burgeoning of phakic and pseudoaccommodative IOL’s, this new glue will offer a safe, effective and innovative alternative to suturing or leaving the corneal wound to self-seal”

Terry Kim, M.D., Associate Professor of Ophthalmology, Duke University Eye Center

Wound Closure w/ Tissue Adhesive

Laceration
Immediate Postop
10 Day Postop

Dermabond
Advantages of Tissue Adhesives

- Incisions can be closed 3 x faster
- Less need for anesthesia
- No stitches to remove
- Seals out most common bacteria
- May shower or bathe
- Disappears naturally as wound heals
- Less need for bandages
- More comfortable than stitches

Disadvantages of Tissue Adhesives

- Wound must have straight edges
- Wound cannot be stretched or pulled
- Wound edges must have good apposition
- Cannot be used on cornea or conjunctival tissue
- Expires faster than sutures
- Expensive... $24 per single use vial

Dermabond Application

- Apply using two thin layers using a light brushing stroke while holding wound together
- Flexible bond in 45 – 60 seconds and full strength in 2½ minutes

Trend or Technology?

All minor surgical procedures of the eye and adnexa can be performed using only topically applied anesthetics

1. Yes
2. No
3. Maybe

Technology in Optometry’s Future

- Anesthetic Alternatives and Drug Delivery Systems to include Cetacaine Spray, Iontophoresis and Lidocaine with liposomes

Anesthetic Alternatives
**Anesthesia Alternatives**

- Superior for anesthesia of the conjunctiva and surgery involving the nasolacrimal duct
- Surgical procedures requiring deeper anesthesia

**Cetacaine Spray**

- Don’t forget to send tissue out to path lab
- Dx: Vercucca / Squamous Papilloma w/ an abundant scale crust

**Papilloma Profile in Pictures**

- 58 YO AA F presents w/ a bump of 3 month duration. No pain, but getting bigger. GEE done by OD partner 1 week prior, completely unremarkable except for refractive error.

**Papilloma Progress in Pictures**

- Don’t forget to administer proparacaine & Celluvisc

**Papilloma Progress in Pictures**

- Remove Lesion
- Cauterize Wound
- Immediate PO

**Topical Cetacaine in Action**
Iontophoresis

• Method of delivering medication to a localized tissue area by applying electrical current to a solution

IOMED Dose Controller

Phoresor II
Auto Model PM850
• Fully Programmable
• Dose range: 0-80mA-minute
• Current range: 0-4.0 mA
• Includes twin lead wires, two 9-volt batteries, carrying case and instruction guide

IOMED Dose Controller

TransQE
• Two Shapes
• Adhesive Foam

IOMED Dose Controller

Optima A
• Buffered Electrodes
• Oval Shape
• Adhesive Foam
• Three Sizes

Electrodes teamed with lidocaine 2% HCL with 1:100,000 epinephrine topical solution

IOMED Dose Controller

• Clinically effective dermal anesthesia up to 10 mm depth in as little as 10 minutes
Entropion Repair: Sx Summary

- Cautery punctures are applied horizontally resulting in tissue shrinkage and contraction
- Puncture sites are approximately 2-3mm deep and apart

Entropion Repair: Step by Step

1. Prepare disposable cautery unit while anesthesia is being administered

Entropion Repair: Movie Magic

- Cautery punctures are applied 2-3 mm from the lid margin spaced horizontally resulting in immediate contraction of the tissue

ELA – Max Topical Anesthetic

- 4% - 40mg lidocaine per g (OTC)
- Uses encapsulated liposomes
- $48.00 per 30g tube
- Use with or without occlusive dressing
Literature Lesson

“ELA – Max topically applied 30 minutes before IV sedation is as effective as injected buffered lidocaine in reducing pain”

1. True
2. False


Technology in Optometry's Future

• Angiogenesis Inhibition with Lucentis and Avastin to treat selective ocular diseases
• Posterior Vitreous Retraction with Vitreosolve to prevent severe Diabetic Retinopathy

Angiogenesis Inhibition

• The process of angiogenesis can be helpful such as in wound healing or harmful as in PDR or AMD
• Vascular Endothelial Growth Factor (VEGF) is a critical mediator in stimulating the formation of new, and “leaky”, blood vessels

Angiogenesis Inhibition

VEGF is implicated in:
• Neovascular AMD (WAMD)
• Diabetic Retinopathy (DR)
• Retinal Vein Occlusion (RVO)
• Retinopathy of Prematurity (ROP)
• Corneal Neovascularization (KNV)
• Iris Neovascularization (INV)
• Neovascular Glaucoma (NVG)

Angiogenesis Inhibition

• Lucentis and Avastin bind to VEGF causing inactivation and the breakdown of angiogenesis
Lucentis Vs. Avastin

- Cancer and ophthalmic drugs have different manufacturing standards.
- Particulate matter must be very low in intravitreal ophthalmic drugs, and Avastin is not manufactured in this manner.
- Keeping Avastin sterile when splitting the quantity for treatment might be a problem because it does not contain preservatives.

Pre-clinical trial toxicity data for Avastin does not exist in retinal therapy.
- The half-life of Avastin clears 100 times slower than Lucentis – at this time, it is unknown if this is harmful.
- Lucentis binds to VEGF more strongly than Avastin – this binding blocks blood vessel growth.

Avastin is a longer molecule that can cause increased inflammation.
- Lucentis is a smaller molecule that can penetrate the retina easier with less inflammation.
- The National Eye Institute has announced a multicenter study that will compare Lucentis to Avastin directly.

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Lucentis Vs. Avastin

Lucentis Avastin

<table>
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<tr>
<th>MCA</th>
<th>MCA*</th>
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<td>$2029.40</td>
<td>N/A</td>
</tr>
<tr>
<td>$169.18</td>
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Total = $2198.58 Total = $169.18

*Cahaba Medicare 2010 will pay only when Macugen or PDT has failed to control wet AMD. Medicare will pay for the injection, but not the medication.

Posterior Vitreous Retraction

- Vitreosolve is injected into the vitreous cavity of the eye liquefying the vitreous gel.
- Prohibits the new vessels produced with proliferative disease to use the firm structure or scaffolding of the vitreous to grow into the retina.
- This process is called Posterior Vitreous Retraction.

Vitreosolve

- Vitreosolve developed by Vitreoretinal Technologies, Inc.
- A potential preventative treatment for Diabetic Retinopathy now in phase 3 FDA clinical trials.
**Vitreosolve**

- Data from those with Posterior Vitreous Retractions suggest subjects were seven times less likely to develop Proliferative Diabetic Retinopathy (PDR)
- Treated patients also reported no symptoms of floaters

**Intravitreal Injection Technique**

- Patient preparation with betadine and lidocaine jelly

**Intravitreal Injection Technique**

- Injection site is placed 3.5 to 4 mm inferior temporal or inferior nasal to the limbus through the sclera into the vitreous behind the lens with a 30 G, 0.5 inch needle

**Intravitreal Injection Technique**

- BIO is performed looking for retina/vitreous hemorrhages and optic nerve perfusion immediately following the procedure

**Post Vitreal Injection Guidelines**

- Cover with topical antibiotics for one week
- One week reevaluation for possible complications
Intravitreal Injection Complications

- Mild and common complications
  - Conjunctival hemorrhage
  - Retinal hemorrhage
  - Vitreous detachment and floaters
  - Pain and irritation
  - Foreign body sensation with increased tearing

Severe but rare complications
- Thromboembolism
- Inflammation and increased intraocular pressure
- CVA
- Endophthalmitis
- Cataract
- Retinal detachment

I would perform Intravitreal Injection for the treatment of ocular disease if properly trained and licensed.
1. Yes
2. No
3. Maybe

EyeGate II Delivery System

- Non-invasive delivery to anterior and posterior chambers of the eye
- Programmable dose control
- Average delivery time is 3 – 5 minutes
- Increased patient safety and potential for lower cost of care
Truth or Dare?

I would perform Transscleral Iontophoresis (EyeGate Delivery System) for the treatment of ocular disease if properly trained and licensed.

1. Yes
2. No
3. Maybe

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TargeGen Eye Drops (TG100801)

• First topically prodrug applied multitargeted VEGF receptor inhibitor
• Under development for the treatment of Age-Related Macular Degeneration (AMD), Diabetic Macular Edema (DME), and Diabetic Retinopathy (DR)

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Truth or Dare?

I would Rx TargeGen Eye Drops (TG100801) for the treatment of ocular disease if properly trained and licensed

1. Yes
2. No
3. Maybe

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Technology in Optometry’s Future

• Wavefront Analysis and Adaptive Optics in Vision Enhancement to include Wavefront guided ablation, Electronic Lens Technology, Wavefront guided IOL design and Bioptics

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Wavefront Technology

Wavefront deformation in the eye

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Is Wavefront-Guided LASIK better than conventional LASIK?

1. Custom LASIK results with fewer higher order aberrations than conventional LASIK
2. Custom LASIK has improved contrast sensitivity and improvement in glare
3. All of the above are true

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Wavefront-Guided Ablation

- Multifocal ablations are an option for correcting presbyopia?
- Algorithms exist and are being refined for the hyperopic and myopic presbyopic population
- This evolving technology is called PresbyLASIK

Intralase FS Laser

- 4th Generation
- Faster and Smarter

New Intralase is Much Faster

[Image showing a comparison of laser flap creation times by generation]

Truth or Dare?

Can the IntraLase femtosecond laser (IntraLase Corp) produce a more accurate flap than a conventional microkeratome?

1. Yes
2. No
3. Maybe

Intralase – Enabled Keratoplasty

Customized Incisions w/ Advanced Edges

- Mushroom
- Top - Hat
- Zig - Zag

- Preserves more host endothelium
- Allows for the transplantation of large endothelial surfaces
- Provides a smooth transition between host & donor tissue

Intralase Enabled Keratoplasty (IEK)

Secure Grafts Requiring Less Suture

- 1 week PO
- 3 month PO
- 6 month PO

IEK incisions create less irritation, form hermetic wound seals, and produce clear corneas
**Reduction of Induced Astigmatism**

- **Zig Zag Incision**
- **IEK 3 month PO**
- **Smooth corneal contour after sx**
- **0.5 diopter of astigmatism**
- **8.0 diopters of astigmatism**

**Intralase Enabled Keratoplasty (IEK)**

- **Design a custom flap matched to the patient’s cornea?**
- **Save more of the anterior stroma and spare more of the mid-periphery?**
- **Reduce dry eye?**
- **Minimize pain and haze?**
- **Enhance reinnervation**
- **Produce topographically and biomechanically stable corneas?**

**Femtosecond’s Future?**

- **Could this technology change the way Optometrist provide eye care?**

**Intralase SBK**

- **Sub-Bowman’s Keratomileusis (SBK) combines the advantages of LASIK and PRK**
- **Uses femtosecond laser to create a smaller and thinner (110 micron) flap**
- **Damages fewer cornea nerve endings which promotes Dry Eye Syndrome**
- **Damages fewer cornea fibers that help the cornea maintain its proper shape**

**Femtosecond’s Future?**

- **Femtosecond Lenticular Extraction (FLEEx)**
- **Femtosecond laser intrastromal orrection of presbyopia (intraCOR)**
- **Femtosecond assisted limbal stem cell harvesting**
- **Femtosecond glaucoma surgery**
- **Femtosecond assisted high resolution tissue imaging**

**Are Microkeratomes Dead?**

- **The Moria One Use-Plus microkeratome with disposable, single-use components is safe, effective and reliable for creating flaps in thin-flap (SBK) LASIK, and it provides excellent outcomes at a lower cost than femtosecond lasers.**
Wavefront-Guided Prescriptions

- **Convention refractions** correct only 2nd order aberrations.
- The Z-View™ Aberrometer (Ophthonix) measures both 2nd order and 3rd-6th order aberrations.

Electronic Lens Technology

- Micro-electronic controls, which are located in the temple of a conventional frame, to automatically adjust add power.

Wavefront-Guided IOL Design

- **AMO Tecnis** lens aims to neutralize the positive spherical aberration of the cornea with negative spherical aberration in the IOL.
- Diffractive optics allows for an even distribution of distant and near images of light with minority interference.

Electronic Lens Technology

- Features a thin layer of liquid crystals sandwiched between two layers of transparent electrodes.
- The crystal molecules rotate in response to a mechanical change in voltage, which alters the index of refraction.
- Under development by Pixel Optics.

Wavefront-Guided IOL Design

- **AMO TECNIS** reduces spherical aberration and improves night driving performance
  - Square edge for uninterrupted contact at the haptic-optic junction
  - Frosted edge designed to minimize unwanted edge glare
**Bioptics: LASIK Plus?**

- Combining IOLs and LASIK or PRK
- Extremely useful in patients with myopia greater than –20D
- Implant IOL followed by wavefront-guided ablation

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**Phakic IOLs: Visian ICL**

- Correction of Myopia (-3 to -15D) OR Reduction of Myopia (-15 to -20D) w/ ≤ 2.5 D of astigmatism
- Adults (21-45 YO) w/ ACD ≥ 3.00mm and a stable MR (≤ 0.5D) for 1 year before implantation

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**Phakic IOLs: Verisyse**

- Correction of Myopia (-5 to -20D) w/ ≤ 2.5 D of astigmatism
- Adults (21-45 YO) w/ ACD ≥ 3.20mm and a stable MR (≤ 0.5D) for 6 months before implantation

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**Corneal Inlays**

- The ACI 7000 (AcuFocus) is a nanotechnology corneal inlay (3.8mm diameter) that is inserted under a LASIK flap in the center of the visual axis of the non-dominant eye to help improve reading ability in presbyopes
- It increases depth of focus through 1.6mm central opening

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**ACI 7000 (AcuFocus)**

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**Curious Corneal Inlays?**

- Revision Optic’s Presbylens is a plus lens to correct for presbyopia
- Biovision’s Invue is a refractive microlens inlay with an optical layout similar to the ReSTOR IOL
Technology in Optometry’s Future

- Multifocal Mania, Accommodative IOL’s, Light Adjusting Lens’s (LAL) with Digital Light Density Devices (DLDD) and Vortex Emulsification

Multifocal Mania

- Alcon AcrySof ReStor is a pseudoaccommodative, apodized diffractive lens
- Deliver better near visual acuity with a small pupil and better distance acuity with a large pupil

What is Apodization?

- Apodization is the gradual reduction or blending of diffractive step heights.
- This unique technology optimally distributes the appropriate amount of light to near and distant focal points

AcrySof® IQ ReSTOR® IOL

Apodized Diffractive
- The apodized diffractive optics are found within the central 3.6 mm optic zone of the lens.
- This area comprises 12 concentric steps of gradually decreasing (1.3-0.2 microns) step heights that allocate energy based on lighting conditions and activity, creating a full range of quality vision – near to distant.

AcrySof® IQ ReSTOR® IOL

Refractive
- The refractive region of the optic surrounds the apodized diffractive region.
- This area directs light to a distance focal point for larger pupil diameter, and is dedicated to distance vision.

AcrySof® IQ ReSTOR® IOL

- The AcrySof® IQ ReSTOR® IOL +3.0 D (SN6AD1) incorporates a +3.0 diopter correction at the lenticular plane (approximately +2.5 D at the spectacle plane), for improved intermediate vision over the original AcrySof® IQ ReSTOR® IOL +4.0 D (SN6AD3), with similar near and distance visual acuity.
Multifocal Mania

- AMO ReZoom is a three-piece, acrylic implant with a refractive, distance-dominant, multifocal optic (6mm)
- Delivers better intermediate focus than the original AcrySof® IQ ReSTOR® IOL +4.0 D (SN6AD3), but less effective at near

AMO ReZoom IOL

- Low light/distance-dominant zone
- Bright light/distance-dominant zone
- Correction Zones
- Large, distance-dominant area
- Near-dominant zone

TECNIS® Multifocal IOL

- AMO TECNIS Multifocal is an Aspheric, Acrylic IOL

TECNIS® Multifocal IOL

- ReSTOR clone … or new improved ReZoom?

Mixing Multi & Monofocal IOLs?

- Combining AMO's Tecnis (near vision emphasis) with the ReZoom (intermediate vision emphasis)
- New AcrySof IQ ReStor to enhance intermediate vision in one eye and the original version of the ReSTOR to provide stronger near vision in the other eye.

Accomodative IOL's

- Crystalens™ Model AT-45 Lens (Bausch & Lomb), silicone
  - A hinge at the junction of the modified plate haptic / squared-edge biconvex optic allows for forward movement during ciliary muscle contraction
  - 1.75 - 2.25 D of accommodation
Crystalens HD

- The Crystalens HD demonstrated an increased depth of focus as compared to the previous AT-50
- UCVA Distance: 20/32 (87%)
  UCVA Intermed: 20/20 (80%)
  UCVA Near: J1 (55%) & J2 (80%)

Crystalens AO

- The latest generation Crystalens AO becomes available during the first quarter of 2010 and is the first aberration-free accommodating intraocular lens with aspheric optics
- It is designed to improve retinal image quality without compromising depth of field and therefore provides greater quality of distance and intermediate vision.

Current Crystalenses

- Available Powers
  11 to 15 in 0.5 steps (also available in step 0°)
  15 to 19 in 0.5 steps

- Product Specifications:
  DIAMETER: 6.0 mm
  SHAPE: Spheric
  MATERIAL: PMMA
  ACRYLIC BULK (5 mm):
  EQUATORIAL RADIUS: 1.427
  MILLER CURVATURE: 1.50
  EQUATORIAL CURVATURE: 1.50

- Available Lenses: 22 steps (11 to 15.25 D = 12.0 mm

Truth or Dare?

Sometime in the next five years “you’ll see a rebound away from multifocal lenses toward accommodating”...

1. Yes
2. No
3. Maybe

Truth or Dare?

In 10 years, “there won’t be any multifocal lenses on the market, only monofocal and accommodating”...

1. Yes
2. No
3. Maybe

Future Factoid?

- Sometime in the next five years “you’ll see a rebound away from multifocal lenses toward accommodating”...
- In 10 years, “there won’t be any multifocal lenses on the market, only monofocal and accommodating”.

Richard L. Lindstrom, M.D., Eye World, August 2007
Visiogen Synchrony

**Dual-Optic Accommodating IOL’s**

- Dual optic lenses have a plus-powered optic connected by flexible haptics to a slightly posterior placed negative powered optic
- On accommodation, the distance between the lenses expands resulting in a more plus powered lens

The Nulens

**Deformable Accommodating IOL’s**

- Accommodates by forcing soft IOL material through a thick aperture that has been modeled after penguin eyes
- There are two materials in the lens with different refractive indexes
- Accommodative amplitudes are 6 – 8 diopters

Visiogen Synchrony

**Light Adjustable Lens (LAL)**

- 1st IOL that can be precisely and non-invasively adjusted after the eye is healed
- The lens material is photosensitive designed to respond to a low-intensity beam of light

Calhoun Vision’s Light Adjustable Lens (LAL)

- Carl Zeiss Meditec manufactures the DLDD which is a slit lamp-delivered device that enable the laser light to be delivered in a digital manner in less than 2 minutes
- Wavefront guided data can be dialed into the DLDD allowing for correction of residual astigmatism, myopia or hyperopia

Real Results?
Calhoun Vision’s Light Adjustable Lens (LAL)

- The next generation LAL will put the UV enhanced layer to block ambient UV light on the posterior surface of the IOL.

Photochromic IOL’s

Medennium plans to introduce a one-piece, aspheric version of the Aurium photochromic intraocular lens to Europe in late 2009, at which time it will seek FDA clearance for U.S. clinical trials.

Vortex Emulsification

Avantix by Bausch and Lomb
- A 1-2 mm incision is made in the lens capsule with a probe
- A propeller type of impeller creates a vortex which actually spins the cataractous material and evacuates it simultaneously.

News Flash!

Atlantic Technology Ventures, Inc. and MIT are working on a patented polymer gel technology (Injectable Lens Substitute) to use with the Avantix.

Thank You!

Questions… E-mail Dave westtennesseeeye@bellsouth.net.