NEW TECHNOLOGIES IN GLAUCOMA MANAGEMENT: WHAT TO BUY, HOW TO MAKE IT WORK IN YOUR PRACTICE

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Cirrus™ HD-OCT
Certainty in Seconds. Certainty for Years. ™

Cirrus software version 6.0
Speaker Slide Set
CIR.3992 Rev B
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Glaucma - RNFL Thickness Analysis

OPTIC DISC CUBE SCAN
The 6mm x 6mm cube is captured with 200 A-scans per B-scan, 200 B-scans.

CALCULATION CIRCLE
AutoCenter™ function automatically centers the 1.73mm radius peripapillary calculation circle around the disc for precise placement and repeatable registration. The placement of the circle is not operator dependent. Accuracy, registration and reproducibility are assured.

Ganglion Cell Analysis

• Measures thickness for the sum of the ganglion cell layer and inner plexiform layer (GCL + IPL) using data from the Macular 200 x 200 or 512 x 128 cube scan patterns.

RNFL distribution in the macula depends on individual anatomy, while the GCL+IPL appears regular and elliptical for most normals. Thus, deviations from normal are more easily appreciated in the thickness map by the practitioner, and arcuate defects seen in the deviation map may be less likely to be due to anatomical variations.

Ganglion Cell Analysis

The analysis contains:
• Data for both eyes (OU)
• Thickness Map - shows thickness measurements of the GCL + IPL in the 6mm x 6mm cube and contains an elliptical annulus centered about the fovea.
• Deviation Maps - shows a comparison of GCL + IPL thickness to normative data.
• Thickness table - shows average and minimum thickness within the elliptical annulus.
• Sector maps - divides the elliptical annulus of the Thickness Map into 6 regions: 3 equally sized sectors in the superior region and 3 equally sized sectors in the inferior region. Values are compared to normative data.
• Horizontal and Vertical B-scans.
Ganglion Cell Analysis

Updated Guided Progression Analysis (GPA™)
Optic Nerve Head information now included
- Average Cup-to-Disc Ratio plotted on graph with rate of change information.
- RNFL/ONH Summary includes item “Average Cup-to-Disc Progression”.
- Printout includes an optional second page with table of values, including Rim Area, Disc Area, Average & Vertical Cup-to-Disc Ratio and Cup Volume. Each cell of the table can be color coded if change is detected.
- Miscellaneous updates to the report design.

RAPDX: UNDERSTANDING THE OPTIC NERVE IN GLAUCOMA

RAPDx Expanded Pupil Diagnostics
- Automated pupillography
- Designed to detect a relative afferent pupillary defect (RAPD)
- Assessment of differential amplitudes and latencies
- Objective test of visual pathway function
- Test time is 1 to 5 minutes

Relative Afferent Pupillary Defect
- Relative afferent pupillary defect (RAPD) is an asymmetry in the pupillary light response
- Detection of RAPD is performed by alternately illuminating each eye while comparing the velocity and amplitude of the pupillary responses
- Neutral density filters in 0.3 logarithmic unit steps aid in the detection and quantification of RAPD
- The size of the RAPD can be quantified by the density of the neutral density filter required to balance the response of each eye

Eye Diseases that may lead to a RAPD

- **Glaucoma**: Even though glaucoma affects both eyes, if the disease is more severe in one eye, a RAPD may be detected.
- **Retinal Disease**: Diabetic retinopathy, arterial occlusions, sickle-cell retinopathy, and retinal detachments may produce a RAPD.
- **Optic Nerve Disease**: Disorders such as optic neuritis are a common cause of RAPD.
- **Neurological Disease**: Lesions of the midbrain, compressive lesions.

**Clinical Benefits of RAPDx Testing**

- RAPDx technology represents a paradigm shift in pupil testing.
- Remarkable sensitivity for detecting glaucoma:
  - Sensitivity = 81%
  - Specificity = 90%
- By comparison, IOP has a 65% sensitivity for detecting glaucoma.
- RAPDx results correlate with VF and RNFL tests.

**Case Report**

59-year-old black female with an eleven year history of glaucoma.

Cup-to-disc ratio = .65/.70
Cup-to-disc ratio = .75/.80

**Optical Coherence Tomography**

- Severe fallout of the retinal nerve fiber layer in the left eye.
- Abnormal TSNIT curve profile analysis.
- Abnormal sector plot analysis.
- Abnormal symmetry.
- OCT test results are consistent with glaucoma.

**Visual Field Examination**

Mild, isolated paracentral scotoma
Superior arcuate scotoma, inferior scotomas.

**RAPDx Pupillary Testing – Amplitude**
RAPDx Pupillary Testing – Latency

Goldmann Appplanation

- The Gold standard in IOP measurement for 50 years
- Goldmann & Schmidt: when tonometer head is 3.06 mm in diameter and there is a normal central corneal thickness of 500 microns – surface tension = corneal rigidity
- CCT is relatively constant in the absence of corneal disease


OHTN and CCT

  - 48 OHTN subjects - 592 +/- 39
  - 63 patients with POAG 536 +/- 34
  - 106 normal subjects 545 +/- 33
- Relationship between corneal thickness and measured intraocular pressure in a general ophthalmology clinic. Ophthalmology. 1993 Nov;100(11):2043-60
  - 232 OHTN subjects – 579.5
  - 335 patients with POAG 550.1
  - 235 normal subjects 545 +/- 33
  - 52 Normal-tension glaucoma 514

Central Corneal Thickness in the Ocular Hypertension Treatment Study (OHTS)

- Analysis of 350 eyes of 190 patients with POAG during initial visit to specialist.
  - In multivariate analysis, lower CCT was significantly associated with worsened AGIS score, worsened mean deviation of visual field, and increased vertical and horizontal cup-disc ratios.

CCT as a risk factor in patients with glaucoma

- Analysis of 350 eyes of 190 patients with POAG during initial visit to specialist.
  - In multivariate analysis, lower CCT was significantly associated with worsened AGIS score, worsened mean deviation of visual field, and increased vertical and horizontal cup-disc ratios.

Reichert 7C8

- IOPcc: IOP compensated for corneal effects, including corneal hysteresis, a measure of viscoelasticity of the cornea (elasticity)
- IOPg: Goldmann equivalent IOP
ORA Signal Analysis

The ORA optical system records 400 data samples of reflected IR light intensity during the rapid (30 ms) in/out corneal deformation.

The optical signal (red curve) is a “dynamic map” of the cornea during the rapid in/out deformation.

The signal provides additional information about corneal biomechanical properties, revealing “signature” characteristics of the eye being measured.
**Corneal Hysteresis**

*Corneal Hysteresis*

Identified by David Luce, Ph.D., Corneal Hysteresis is the difference in the inward and outward pressure values obtained during the dynamic bi-directional applanation process employed in the Ocular Response Analyzer, as a result of viscous damping in the cornea.

\[ CH: P_1 - P_2 \]

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**Corneal Resistance Factor**

An indicator of the overall "resistance" of the cornea, including both the viscous and elastic properties. It is significantly correlated with Central Corneal Thickness (CCT) and GAT, as one might expect, but not with IOPCC.

\[-CRF = P_1 - (0.7*P_2)\]

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**Corneal-Compensated IOP (IOPcc)**

- An Intraocular Pressure measurement that is less affected by corneal properties than other methods of tonometry, such as Goldmann (GAT). IOPcc has essentially zero correlation with CCT in normal eyes and stays relatively constant post-LASIK.

\[-IOPcc = P_2 - (0.43*P_1)\]

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**Frequency Distribution: CCT**

Data courtesy New England College of Optometry

Lower Corneal Hysteresis is Associated With More Rapid Glaucomatous Visual Field Progression

Carlos Gustavo V. De Moraes, MD,*+ Victoria Hill, BS,*+ Cobro Tillo, MD,*+
Jeffrey M. Liebmann, MD,+‡ and Robert Ritch, MD,*

- 153 glaucomatous eyes, with >8 visual fields, followed for >5 years
- Progressing eyes (n=25) had lower CCT (525 μ vs 542 μ, P=0.04) and lower CH (7.5 mmHg vs 9.0 mmHg), P<0.01) compared with nonprogressing eyes.
- By multivariate analysis, peak intraocular pressure (OR=1.13, P<0.01), age (OR=1.57, P=0.03), and CH (OR=1.55, P<0.01) were significant predictors of progression.

Technologies in the Diagnosis and Management of Glaucoma

Doppler Optical Coherence Tomography


VEP in Glaucoma

Technologies in the Diagnosis and Management of Glaucoma

Pattern Electroretinogram / Visual Evoked Potential


Technologies in the Diagnosis and Management of Glaucoma

Asymptomatic Symptomatic

Healthy VF Glaucoma


Technologies in the Diagnosis and Management of Glaucoma

Asymptomatic Symptomatic

Healthy VF Glaucoma

Non documented functional damage Documented functional damage

Healthy VF Glaucoma

OCT PERG/VEP

Non documented structural damage Documented structural damage


Technologies in the Diagnosis and Management of Glaucoma

Normal IOP


Techonologies in the Diagnosis and Management of Glaucoma

OHT


Technologies in the Diagnosis and Management of Glaucoma

Glaucoma


Technologies in the Diagnosis and Management of Glaucoma

EYE

LGN

CORTEX

Ganglion Cell


QUANTEL MEDICAL

Linear UBM

ClearScan™ and Clinical Applications

Ultrasound Biomicroscopy (UBM) of the eye
Visante™ OCT Anterior Segment Imaging and Biometry

Problems with traditional Gel & Shell examination method
- Worry about probe tip hitting the cornea
- Probe sterility issues
- Methodology concerns
  - Patient must recline
  - Gel often required
  - Shell must be inserted under the lids and (uncomfortable)
  - Likelihood of corneal abrasions from shell as posterior structures are examined

Methodology
- Fill bag ¾ with tap water
- Add water slowly to minimize air bubbles
- LIN50 - USE DISTILLED WATER

Methodology (Preferred)
Patient can be examined sitting (ocular structures & dynamics same when viewed with slit lamp)

Clinical Applications
Glaucoma

Glaucoma (lights off exam)
Phakomorphic Bulky ciliary body in phakomorphic angle closure

Convex iris in pupil block

Pupil Block before and after YAG laser

Plateau iris

Cyst
Drug Eluting Contacts

- Harvard Medical Center Researchers
- Recipients of MIT innovators in Life Sciences competition
- Daniel Kohane, MD, PhD (anesthesiology)
- Coating Polyactic co-glycolic acid (PLGA) is coated with films containing Polyhydroxy-methacrylate by UV polymerization
- Research is being funded by:
  - National Institute of Medical Studies
  - National Eye Institute
  - Boston KPro foundation
- Duration can be as long as 300 days
- Limitation will be the duration of CL wear

Punctal Plugs with Latanoprost Core

- QLT, Inc
- 44-g Latanaprost Punctal Plug Delivery System
- Phase II
- Data:
  - Mean change from baseline -3.5 mmHg
  - 36% showed reduction of ≥ 5 mmHg
  - Overall goal of 90% retention/ Initial 75%
  - Second generation plug 90%
  - Goal of therapy 90 days of Tx

Tracking the Elusive Diurnal!

- Sensimed: Swiss medical device company. Jean Marc Wismer CEO
- Device is called Triggerefish
- Tracks fluid pressure in the eye and beams data to palm size recorder.
- Uses a circular antenna taped around the eye and connected to a battery powered portable recorder.
- This transmits radio frequency energy to an ultra thin gold ring in the CL. This powers a chip embedded in the lens.
- Additionally on the lens in an ultra thin platinum ring that stretches in response in variation in eye shape secondary to pressure.
- Available in Europe. Primary trial at University Hospitals of Geneva