New Ideas in Glaucoma Management

John A. McGreal Jr., O.D.
Missouri Eye Associates
McGreal Educational Institute

Glaucoma Evaluation is Transforming

In the past, detection & management relied on functional assessment
- Visual fields (white-on-white)
  - Insensitive for detecting early POAG
  - High degree of variability

Recently, structural change over time longitudinal studies have validated the role of structural imaging
- Are structural defects with normal functional tests false positives or POAG?
**Glaucoma Suspect**

- **CPT / ICD**
  - 99214 / Glaucoma Suspect (365.01) = $80.00
  - 92020 / (365.01) = $25.00
  - 76514 / (365.01) = $15.00
  - 92250 / (365.01) = $70.00
  - 92083 / (365.01) = $70.00
- **CPT / ICD**
  - 99213 or 92012 / (365.01) = $50.00 or $63.00
  - 92235-RT, 92235-LT / (365.01) = $90.00
  - Total $400.00 or $413.00
- **Rx:** Initiate or continue treatment or observe
- **Use V58.69 in addition to ICD code when changing medications in a glaucoma patient**

**Gonioscopy 92020**

- **Bilateral**
- **Requires documentation**
  - describe visible angle structures
- **No limitations to diagnostic groups in most states**
- **Fee** $25.71-

**Digital Gonioscopy 92020**

- **SL-OCT (Heidelberg)**
  - Integrated Slit lamp & digital gonioscopy system
  - Haag-Streit BD 900 slit lamp, OCT scanning unit
  - High resolution grey scale or false color reports
  - Fast, easy, non-contact OCT at any position
  - Stores data
  - Measures angle, angle opening distance, angle recess area, trabecular iris contact length, trabecular iris space area
  - Measures pachymetry and biometry

**SL-OCT™ Hardware Features**

- **Non-contact**
- **Fast and easy to use**
- **Simultaneous**
  - optical and OCT exam
- **Color or gray-scale images**
Limitations of Manual Gonioscopy

- Patient discomfort – full globe contact
- Time consuming
- Subjective
- Requires considerable skill and experience

Statement of Assoc. of International Glaucoma Societies (AIGS) 3rd Global Consensus Meeting, May 2006

Pachymetry 76514

- Bilateral
- Measurement of central corneal thickness (CCT) proven by Ocular Hypertension Treatment Study (OHTS) to be standard of care in diagnosis and management of glaucoma, glaucoma suspect and ocular hypertension
- Also billable for keratoconus, corneal transplants, cataracts with corneal dystrophies, guttata, edema
- Requires Interpretation & Report
- Fee $11.92

CCT Assessment

- Has become standard
- Equipment widely available
  - DGH was used in OHTS
  - Low cost
- Consider potential effect of LASIK on IOP findings
- Also billable for non-glaucoma ICD-9 codes
  - Corneal edema, keratoconus

Reichert IOPac

- Portable, battery op.
- Stores up to 1000 pats.
- USB and infrared interface
- Download to PC and printer
- Detachable probe
  - Easily replaced if necessary
- Download PDR into Palm
**Pachymetry**
- IOP correction by correlation to corneal thickness is NOT POSSIBLE!
  - A linear relationship does not exist!
  - Careful examination of regression analysis (scatter graph of IOP relative to CCT) demonstrates huge bandwidth
- Adjusting IOP by CCT instills a degree of accuracy into an inaccurate measurement
- It is possible to adjust the IOP in the WRONG direction
- Barbados study of black patients shows no correlation of CCT/IOP
- “Trying to be more precise than this is not supported by the data and may be harmful to patient care” Jamie Brandt, MD Dir Glauc Sre, UCD / OHTS investigator

**PASCAL at work:**
- Slit lamp mounted
- Technique similar to GAT but…
  - Constant light pressure
  - No fluorescein
  - Self-calibrating
  - Battery operated

**Pascal DCT**
- Measures
  - Ocular Pulse Amplitude
  - (OPA)
  - IOP
  - Quality (Q)
  - Heart Pulse (H)
- Stores data

**The PASCAL SensorTip**
- Contour-matched concave tip surface (7mm)
  - Accurate for corneal radius 5.5-9.2mm and CCT 300-700
- built-in pressure sensor (1.2mm)
- transparent tip permits view of cornea interface for centering and control
Comparison of DCT With the GAT

- Univ. Of Zurich
- 228 eyes measure with DCT and GAT
- Compared IOP measurements
- Looked at effects of:
  - CCT
  - Corneal curvature
  - Astigmatism
  - AC Depth
  - Axial length
- Intra-observer and Inter-observer variability

DCT vs. GAT

- DCT median difference: DCT +1.7mm higher than GAT
- GAT: Affected by CCT, curvature, astigmatism, AC depth and axial length
- DCT: NO EFFECT with any parameters

DCT vs. GAT

- Intra-observer variability
  - GAT 1.1mm
  - DCT 0.65mm
- Inter-observer variability
  - GAT 1.28mm
  - DCT 0.44mm

IOP Measurements Using DCT After LASIK

- “Corneal ablation of 90.0+/−49.18microns reduced IOP as measured by GAT by 3.0+/−mm. ..no significant change in IOP was recorded by DCT(-0.2MM)”

Kaufman et. al. IOVS 2004; 45:3118-3121

Biomechanical Properties in Tonometry

- Flatter corneas = lower IOP
- Thinner corneas = Lower IOP
- Softer corneas = lower IOP
- Stiffer IOP = higher IOP
- How accurate is Goldmann in thick, soft cornea?
- How accurate is Goldmann in thin, stiff cornea?
- Pascal DCT removes biomechanical properties from measurements
- Cannot correct IOP using thickness alone!
  - Linear correction factors of GAT will not accurately correct IOP

DCT in Ectatic Corneas

- Study of 53 eyes at Will’s by Ozbek & Cohen
- Included eyes with keratoconus, Pellucid Marginal Degeneration and penetrating keratoplasty
  - Topography = 54.7 X 43.6
  - CCT = 482
  - DCT = 16.1 / GAT = 14.3 / TP = 13.8
- DCT were not different between PMD, KC, PK
- DCT were not affected by corneal steepening

Conclusions

- “IOP measurements by DCT are highly concordant with IOP readings obtained by GAT but do not vary in CCT and have a lower intra- and inter-observer variability. DCT seems to be an appropriate method of tonometry for routine clinical use”

James Brandt, MD
Director Glaucoma Services
UC Davis

“Assuming that CCT can be used as a correction factor for GAT is a misinterpretation of the results of OHTS… that couldn’t be further from the truth. Adjusting IOP based on CCT is attempting to instill a degree of precision into a flawed measurement. You may actually correct in the wrong direction. The issues related to the most accurate tonometry need to include the material properties of the cornea”
Ocular Pulse Amplitude (OPA)
- Amplitude and shape of OPA are easily observed with DCT
- OPA is a function of
  - Vascular geometry & flexibility
  - Ocular rigidity
  - Systemic blood pressure
- Can be used to assess ocular perfusion
- Data now suggests a correlation between OPA & Ocular rigidity…and hence between OPA & risk of glaucoma progression
  - A. Harris, PhD (Indiana University)

Latino Eye Study
- How often is GAT significantly low?
- Median difference between DCT & GAT studied
  - >4.5mmHg = 10.6%
  - >5.5mmHg = 4.4%
  - >6.5mmHg = 2.5%
- Increased IOP still most common factor in optometric practice converting normals to glaucoma suspects

IOP Measurements By DCT After LASIK
- “Corneal ablation of 90.0 +/- 49.18u reduced IOP as measured by GAT by 3.0mm...no significant change in IOP was recorded by DCT (-0.2MM)”
- Clinically validated by manometric studies of true intracameral pressure
- LASIK case volume in US is 7,401,400
  - GAT DOES NOT WORK!


Case of “I Have A Peculiar Nerve”
- 45yowm CC: “OD wants R/O Papilledema”, Indistinct optic discs, IOP 20-25 range, pach 637
- PH: Hodgkin’s disease, R hip replacement, 3 vessel CABG, HTN, Hyperlipidemia
- FH: + POAG paternal aunt
- Meds: Darvocet,Amitryptilline, nitrate, isosorbide, norvasc,toprol, plavix, lipitor, ASA
- VA 20/20 OU PERRL-APD
- IOP: 26/23 Pach: 639
- SLE: NI OU Fundus : As shown
What is the diagnosis?

- 1. Normal optic nerves
- 2. Papilledema
- 3. Optic nerve drusen
- 4. Ocular histoplasmosis
- 5. Choroidal nevus

What tests are indicated?

- 1. VF / Pach / SCODI / Stereo disc photos
- 2. MRI
- 3. MRI / VF
- 4. Histoplasmosis titres
- 5. IVFA / VF

Case of “I Have A Peculiar Nerve”

- 45yowm  CC: “OD wants R/O Papilledema”
- **DCT OD: 24.9 / OPA 4.4 / Q3**
- **DCT OS: 23.1 / OPA 3.8 / Q3**
- SLE: Nl OU  Fundus : As prev
- VF OD: Superior and inferior nasal defects
- VF OS: minor changes
- SCODI: Confirms disc elevation limited to disc itself

Visual Field 9208x

- Bilateral
- Requires Interpretation
  - separate report form
  - narrative in body of medical record, on date of service
- Fee $43.88- (-81) $57.37+ (-82) $65.92- (-83)
**Oculus Easy Field Perimeter**
- Screening AND Threshold fields
- Color LCD-Display
- Fixation monitoring – CCD camera
- Stores up to 40,000 exams
- Built-in printer

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**FDT Perimetry Abnormalities as Predictors of Glaucomatous VF Loss**
- 105 eyes of 105 glaucoma suspects
  - IOP 23mm+ or disc damage on photos
  - SAP VF normal
- Baseline FDT obtained
- Mean follow-up 41 months

Medeiros FA, et al AJO 137:863-871, 2004

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**FDT as Predictor of VF Loss**
- 16% (17 pats.) converted on SAP VF
- In pats. with abnl. FDT at baseline:
  - Probability of developing abnl. SAP: 30%
- Pats. With NL FDT at baseline:
  - Probability of developing abnl. SAP: 4%

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**FDT as Predictor of VF Loss**
- Location of the FDT and SAP defects corresponded in 14 of 17 patients
- FDT defects in 59% of the converters occurred as much as 4 years before SAP
  - Mean: 21 months
However…..

- Only 59% of SAP defects were previously identified by abnl. FDT
- 24% had SAP defects BEFORE FDT
- 18% of converters NEVER developed FDT defect
- 24% of normal SAP’s showed abnl. FDT but never developed abnl. SAP
  - False positives?

Other Important VF Studies

- Paczka (2001) - found FDT better overall performance in detecting damage than RNFL photographs
- Kondo (1998), Wu (2001) - In patients with SAP VFDs restricted to 1 hemifield, FDT has shown to be able to detect functional losses in the other hemifield

Other Important VF Studies

- Kim (2007/AAO) – when SAP is normal, some patients with VFD detected by FDT showed decreased NFL thickness (OCT)
  - Provide evidence that coincident FDT & OCT abnormalities may be an early sign of glaucoma

Visual Field Testing for Specific Functions

- Short wavelength autoperimetry (SWAP)
  - Bistratified ganglion cell (9%) short-wavelength cones
- Frequency doubling technology (FDT)
  - Magnocellular ganglion cells
- Motion automated perimetry (MAP)
  - Magnocellular ganglion cells (3%)
- High pass resolution perimetry (HPRP)
  - Parvocellular ganglion cells
**Visual Field Testing for Specific Functions**

- **Standard Autoperimetry (SAP)**
  - Achromatic perimetry
  - Non-specific for ganglion cell type
  - Appreciable portion of nerve fibers lost before defect measured

- **Short wavelength autoperimetry (SWAP)**
  - 440nm, 1.6 degree target @ 200ms yellow background
  - More sensitive by 3-5 years to early loss
  - Disadvantages – time consuming, variable, not bright enough to threshold in advanced POAG

- **Frequency doubling technology (FDT)**
  - 0.25 cycle/sec sinusoidal grating with 25Hz counterphase flicker
  - View grating at low spatial frequency and high temporal rate
  - Percept is double frequency illusion attributable to subset of magnocellular ganglion cells
  - Portable, fast, reproducible

- **Motion automated perimetry (MAP)**
  - Tests Magnocellular ganglion cells (3%)
  - Present random dot kinematogram with coherent motion on uniform grey background in 14 locations
  - Computer controlled stimulus (1024x768), 30 degree field, 7 frames in rapid succession (420ms), 20 dots/frame, in circular 7.3 degree angle, moving at 8 degree/sec
  - Superior to SAP in early detection, but time consuming and high variability

- **High pass resolution perimetry (HPRP)**
  - Parvocellular ganglion cells system detection
  - Test presents spatially filtered rings, 50 test locations in 30 degree field, 14 different ring sizes used @ 165 ms
  - 6 minutes, easy
  - Very useful in following progression
  - Lacks standardization
A Comparison of Humphrey SITA-Standard Perimetry With Both Screening Oculus Easyfield Perimetry And With Screening FDT

- Dept. of Oph., Johns Hopkins University

Objective

- To determine the sensitivity and specificity of the screening modes of the Oculus Easyfield Perimeter and Frequency Doubling Testing when compared with SITA standard threshold perimetry.

Methods

- One hundred one subjects had the following perimetric testing: Frequency Doubling Technology (screening mode), Oculus Easyfield Perimetry (suprathreshold mode), and Zeiss Humphrey SITA Standard C-24-2 threshold perimetry.

Results

- The sensitivity and specificity of detecting any glaucomatous visual field defect using an abnormal Glaucoma Hemifield Testing criterion was 76% and 89% for the FDT and 86% and 98% of the Oculus Perimeter, respectively.
Conclusions

- Both smaller screening perimeters were relatively quick. Although the Oculus was just 30 seconds slower than the FDT, its increased sensitivity and specificity could be much more cost effective in the treatment of glaucoma.

Octopus 301 Perimeter

- Motorized auto eye tracking
- 100% fixation control
- Blazing fast speed
- Ergonomic design patient friendly
- Blue yellow testing in 3 min/eye
- Critical fusion testing
- One min screen
- Three min full threshold
- PeriTrend Analysis
- LAN ethernet
- 800.787.5426
- www.haag-streit.com

Current Perimeters are Highly Variable

- After one abnormal visual field test:
  - 86% of patients test within normal limits on next exam

- After two consecutive abnormal test results:
  - 66% of patient test within normal limits on next exam

Heidelberg Edge Perimeter

- New “Flicker Defined Form” Stimulus
- Overcomes limitations in Frequency Doubling Technology
- True targeting of M-cell visual pathway
- Less test-retest variability
- Direct link to HRT optic disc assessment
Flicker Defined Form (FDF) Targets M-cells

- The magnocellular (M-cell) pathway is one of the three main neural pathways from the retina to the primary visual cortex
- M-cells may be the first to sustain damage in glaucoma
- There are fewer M-cells so selective testing can find defects to all cells earlier
- FDF selectively targets the M-cells which are sensitive to high frequency and high contrast stimuli

How is Flicker Defined Form (FDF) Different?

- Frequency Doubling Technology is not as selective at stimulating the M-cell pathway as previously thought
- Standard Automated Perimetry stimulates all retinal cells (broadband stimulus)
- FDF is more selective and targets the M-cell pathway
- FDF studies show less test-retest variability

HEP: The New Perimeter for Glaucoma Management

- New FDF stimulus for early signs of glaucoma
- Less test-retest variability for improved diagnosis
- Structure-Function Map for combined assessment
- Network-ready
- Test types:
  - Contrast sensitivity
  - Letter tests
  - Driving test

Closing Statements

- Advances in perimetry are continuing
  - Faster third generation algorithms reduce test time by 50%
- Customization for specific needs
  - Early detection / established glaucoma / screening
- Early VF loss is often selective, with specific types of axons disturbed
  - SWAP allows early recognition, HPRP follows progression
- SAP perimetry will continue to be preferred for established glaucoma with VFDs
  - Considerably improved methods of computer-assisted interpretations of serial VFs
- Screening methods will sacrifice sensitivity for specificity and ease of use to detect the half of glaucoma patients who have undiagnosed disease
  - Deployed in non-professional environments
Closing Statements

- Perimetry is a robust method of examination, a cornerstone of glaucoma management and will remain so.
- It will become more user and patient friendly.
- VF testing is easy to administer (technician).
- VF instruments are not expensive.
- VF testing can still be performed in cataract patients.
- Computer-assisted analysis (ie Glaucoma Hemifield Test) performs as well as trained observers and are extremely specific.

Closing Statements

- Standard SAP testing is not optimal.
- Combination testing of 2 or more modalities improves detection.
- Glaucomatous optic atrophy may precede currently measurable functional loss in some.
- Functional loss with specific tests may precede detection of glaucoma disc changes on stereo photograph review.
- Most sensitive test may be different for each stage of the disease.

Fundus Photography 92250

- Bilateral.
- Not Bundled.
- Stereo disc photography.
- Requires Interpretation.
- Fee $73.67+.

Fundus Retinal Photos ROI

- Synemed (Canon).
- Cost $24,500.00.
- Lease $543.90.
- Breakeven 2 photos / wk.
- 6 MP digital non-mydriatic.
- 10 images / wk – lease = $22,273.20 annual revenue.
Scanning Computerized Ophthalmic Diagnostic Imaging 92135

- Unilateral
- Applies to glaucoma and retinal evaluations
  - Retinal Thickness Analyzer (RTA)
  - Heidelberg Retinal Topography (HRT3)
  - Humphrey Optical Coherence Tomography (OCT)
  - Laser Diagnostic Technology (GDX VCC)
- Requires Interpretation & report
- Fee $45.59-

Scanning Laser Covered Diagnosis List

- 362.85 retinal nerve fiber bundle defects 377.00-377.04
- 364.22 glaucomatocyclitic crisis Papilledema
- 364.53 pigmented iris degeneration
- 364.73 goniosynechiae
- 364.74 pupillary membranes
- 364.77 recession of the angle
- 365.00-365.9 glaucoma
- 368.40-368.45 visual field defects
- 377.9 unspecified disorder of optic nerve or pathways

Scanning Laser 92135

- Moderate Damage - payable once or twice per year, not with a field
  - Visual field examples
    - moderate reduction in retinal sensitivity
    - temporal wedge
  - Optic Nerve examples
    - enlarged cup with sloped or pale rim
    - focal notch
    - rim/disc >.1 but <.2
    - prominent lamina cribrosa

- Advanced Damage - rarely payable, fields more valuable
  - Visual field examples
    - loss of central vision
    - temporal island remains
    - severe reduction in retinal sensitivity
    - absolute defects to within 3 degrees of fixation
  - Optic Nerve examples
    - rim destroyed
    - rim/disc ratio<.1
**GDx VCC**
- Image acquisition in less than 1 second
- Uses internal fixation device
- Compact, table-top design
- Portable
- Easiest to use
- Comfortable, objective test for patients
- Easy interpretation

**What’s NEW in the HRT3**
- OHTS Ancillary Study Results
- GPS Glaucoma Probability Score
- Enhanced Glaucoma Analysis
- Enhanced Progression Software
- Portable Design
- More operator friendly
- Choose from four packages

**Top 5 Stereometric Parameters**
- Rim Area
- Rim Volume
- Cup Shape Measure
- Height Variation Contour
- Mean RNFL Thickness

**DIAGNOSE: CUP, RIM & RNFL**
- Optic disc size measure and “small”, “average” and “large”
- Parameters adjusted for disc size
- Largest normative database
- Ethnic-selectable
- OU asymmetry
- RNFL normative data
- Quality Indicator
- Conclusion: Complete Assessment
Monitor Change Over Time
- Baseline compared to follow-up images
  - Absolute change calculated
- Progression Change Probability Analysis
  - Pixel by pixel comparison
  - Independent of reference plane
  - No contour line is needed
- Progression Trend Report
  - Normalized stereometric parameters graphically displayed

How Predictive is the HRT?
- Moorfields Regression Analysis – measures rim area & adjusts for disc size
- 40% of patients flagged at baseline as “outside of normal limits” by Moorfields Temporal Superior sector analysis developed glaucoma.
- 26% of patients flagged at baseline as “outside normal limits” by Moorfields Global analysis developed glaucoma.
- 90% of those with normal HRTs did not develop glaucomatous damage over the next 5 years

Glaucoma Probability Score (GPS)
- What if we could take the world’s leading glaucoma experts and use their combined knowledge to help you diagnose your patients?
- The Glaucoma Probability Score takes the first step in this direction by applying machine learning to glaucoma diagnostics.

GPS Advanced Artificial Intelligence
"Find a bug in a program, and fix it, and the program will work today. Show the program how to find and fix a bug, and the program will work forever."

- Oliver G. Selfridge, in AI’s Greatest Trends and Controversies
**Glaucoma Probability Score**

- A new approach to optic disc analysis
- 6 years in development
- Applies the latest in artificial intelligence to glaucoma diagnostics – “Relevance Vector Machine”
- Produces an understandable indicator - probability of disease
- Eliminates the need for contour lines or reference planes

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**GPS How It Works**

- Uses same HRT scan as in the past
- Performs 3-dimensional shape analysis
- Relevance Vector Machine is “trained” to look for glaucoma
- Measures 5 key parameters
- 3 parameters represent cup shape and 2 represent RNFL

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**Case of the “Ocular migraine?”**

- Age: 43yowm CC: “Flashes of light”
- HPI: 20mins / OU / once / 3L soda/Day / -HA, nausea, vomiting / overweight
- Meds: synthroid    Allergy: none
- BVA: OU 20/20    Pupils: PERRL-APD    EOM: full
  EXT: NL, CA auscultation NL
- Pach: 528/532    SLE: NI OU    IOP 24/24,17/17
- VF: normal    Optic N: OD 0.80 OS 0.65
- OcHx: Mother & brother susp ONH & NI VFs

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**3-D Thickness Map**

- Thickness Map with adjustable opacity
- Can be rotated to change perspective
- Floor shows reflectance image to help orient user
Support Literature

- Heidelberg Engineering website: www.heidelbergengineering.com
  - Complete list of published articles on all products
  - Abstracts of published articles
  - Condensed summary of the supporting literature for main topics of interest
  - Downloadable tutorials for all HE products

Optical Coherence Tomography OCT

Optical: Light-based
Coherence: property of light waves in which the oscillations maintain a fixed relationship to each other
Tomography: Cross-sectional imagery

How OCT works

- Similar to ultrasound but uses light instead of sound to image tissue
- Beam of light is directed into tissue and reflections coming from different layers of the tissue are received by a detector

Stratus OCT Software

- Macula Thickness Analysis
- RNFL Analysis
- ONH Analysis
RNFL analysis

- Circular scanning around ONH at a radius of 1.73mm
- Scan begins temporally
- Three scans are acquired and data is averaged

Optic nerve head analysis

- Radial scanning across optic nerve head
- Six 4mm scans are taken

Optic Nerve Head Parameters

- Volumetric Information
  - Volume of Cup
- Dimensional Information
  - Disk Area
  - Cup Area
  - Rim Area
- Cup Disk Ratios
  - Horizontal
  - Vertical
  - Average

Optical Genetics

- Researchers have identified genes for OAG
  - TIGR/Myocilin = juvenile OAG
  - OPTN (optineurin) = Primary OAG (NTG)
    - Optineurin may provide neuroprotection to optic N
  - CYP1B1 = Congenital glaucoma
- Genetic testing will allow clinicians to determine if Pt is predisposed to or affected with specific type of glaucoma, even before symptoms appear
- OcuGene (InSite Vision/Alimeda) – simple, in office test, 99% accurate detection of TIGR (trabecular meshwork inducible glucocorticoid response gene)
  - Positives may be treated more aggressively, earlier
### Blood Flow Analysis

- Paradigm/Dicon
- TonoPlus Tonograph
  - Pulsatile Ocular blood flow analysis
  - Identifies ocular ischemic syndromes
  - Reimbursable procedure
  - Small laptop size

### Low Tension Glaucoma

- Compromised ocular blood flow
- 50% have a cause / find it / fix it
  - Past hx transfusions, bleed, hypovolemic
  - Medications: B-blockers, digoxin, digitalis
  - MRI: orbits & brain
  - R/O all cardiovascular causes of LTG
    - CBC/anemias, CA doppler, TEE, sleep studies, coagulaopathies (PTT), overly fit (low BP)
- Treatment
  - Decrease IOP, avoid B blockers, start with PG, bromonidine, CAIs last resort
  - Ginko biloba 60mg/D: inc fluidity without affecting platelet aggregation

### Surgical Glaucoma Therapy

- Argon Laser Trabeculoplasty (ALT, LTP)
- Selective Laser Trabeculoplasty (SLT)
  - Q switched Nd:YAG selectively targets pigmented trabecular cells (increasing activity?)
  - Increases immune system by increasing monocytes & macrophages in TM
  - Selective because it does not cause appreciable damage to TM
  - 50 confluent applications to 180 degrees @0.06mJ
    - No blanching or bubble phase needed
  - Addresses greatest roadblock = compliance with medical therapy

- Trabeculectomy
- Trabeculectomy with surgical adjuncts
  - 5 FU (lower risk eyes)
  - Mitomycin-C (MMC) – higher risk eyes
- Indications
  - Maximum tolerated medical therapy
  - Progression of disease
  - Unable to instill medications
  - Secondary glaucomas (Neovascular glaucoma)
- Consideration
  - Age, HTN, DM, Anticoagulants, Preop IOP, previous vitrectomy
  - Degree of visual impairment,
  - Lens status
  - Comorbidities
**Surgical Glaucoma Therapy**

- **Future directions**
  - Newer antifibrinolytics
    - CAT-12, a monoclonal antibody to TGF-B2
  - Photodynamic therapy
  - Novel drug delivery systems
    - Collagen implants, bioerodable polymers, liposomes & microspheres
  - Glaucoma drainage implants instead of filtering surgery
    - Shunts aqueous from AC tube through an episcleral plate
  - Ocular genetics
    - Discover genes, gene therapy, primary prevention of glaucoma may become a reality

**Glaucoma Pipeline**

- Extracellular Matrix metalloproteinases
- Oral neuroprotectants - Memantine (Narmeda)
- Sustained release formulations
- Anecortave acetate (Retaane/Alcon) – ARVO 2006
  - Originally studied for ARMD
  - Steroid that actually LOWERS IOP
  - No cataract formation
  - 25% decrease in IOP at six months after 1 juxtascleral injection

Thank you

McGreal Educational Institute

Missouri Eye Associates

*Excellence in Optometric Education*