State of the Art Cataract Surgery

This isn’t your Father’s Oldsmobile
For my eye, I would want:

A) Laser Assisted Cataract Surgery
B) Manual Cataract Surgery

How do I vote?

- Open the SECO 2016 Mobile App
- Choose Agenda
- Find this course
- Click on the polling question at the bottom of the screen

OR

- Follow Texting instructions on the results screen
- You will receive a reply with the answer options
“I’m all for progress....
It’s change I don’t like”

-Mark Twain
Is my cataract ripe?
Cataract Surgery is Rehabilitative Surgery
Cataract Surgery

is not just

Rehabilitative Surgery
Cataract Surgery is Refractive Surgery
Healthy Eye

IOL Calculations

Aberrometry

Biometry

Femto Technology

Safety

IOL Positioning

Enhancement

Reproducibility

Visual Goals
Healthy Eye

IOL Calculations

Aberrometry

Visual Goals

Biometry

Femto

Reproducibility

Enhancement

Safety

IOL Positioning

IOL Technology
BAD IDEA
Some Things Are Just A Bad Idea!!!
Intraoperative IOL Positioning

Initial IOL Position

Final IOL Position

Image Courtesy: Daniel Chang MD
Is Femto Helpful?

Standard  Complex  ReLACS
How Does Femto Help?

• Decreased Ultrasound Energy (30%)
• Reproducibility
  – Rhexis
  – Incisions
  – Astigmatic Keratotomies
  – Effective Lens Position?
  – Refractive Outcomes?
2 Min Surgeon Time
### Table 4. Published Rates of Major Complications Reported with Cataract Surgery

<table>
<thead>
<tr>
<th>Authors</th>
<th>Study Design and Population</th>
<th>Surgery</th>
<th>AC Tear (%)</th>
<th>PC Tear without Vitreous Loss (%)</th>
<th>PC Tear with Vitreous Loss (%)</th>
<th>Posterior Lens Dislocation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gimbel et al 2001</td>
<td>Retrospective (n = 18 470)</td>
<td>MCS</td>
<td>—</td>
<td>0.24</td>
<td>0.20</td>
<td>0</td>
</tr>
<tr>
<td>Tan et al 2002</td>
<td>Retrospective (n = 2538)</td>
<td>MCS</td>
<td>—</td>
<td>—</td>
<td>0.45</td>
<td>3.6</td>
</tr>
<tr>
<td>Androudi et al 2004</td>
<td>Retrospective (n = 543)</td>
<td>MCS</td>
<td>—</td>
<td>3.50</td>
<td>3.6</td>
<td>4.05</td>
</tr>
<tr>
<td>Muhtaseb et al 2004</td>
<td>Prospective (n = 1441)</td>
<td>MCS</td>
<td>2.8</td>
<td>—</td>
<td>7.55</td>
<td>1.7</td>
</tr>
<tr>
<td>Hyams et al 2005</td>
<td>Retrospective (n = 1501)</td>
<td>MCS</td>
<td>—</td>
<td>0.99</td>
<td>2.2</td>
<td>1.93</td>
</tr>
<tr>
<td>Misra et al 2005</td>
<td>Prospective (n = 1883)</td>
<td>MCS</td>
<td>—</td>
<td>0.16</td>
<td>0.53</td>
<td>0.11</td>
</tr>
<tr>
<td>Ang et al 2006</td>
<td>Retrospective (n = 2727)</td>
<td>MCS</td>
<td>—</td>
<td>5.1</td>
<td>0.69</td>
<td>—</td>
</tr>
<tr>
<td>Chan et al 2006</td>
<td>Retrospective (n = 8230)</td>
<td>MCS</td>
<td>—</td>
<td>0.79</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Marques et al 2006</td>
<td>Retrospective (n = 2646)</td>
<td>MCS</td>
<td>—</td>
<td>4.05</td>
<td>6.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Unal et al 2006</td>
<td>Prospective comparative (n = 296)</td>
<td>MCS</td>
<td>—</td>
<td>10.4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Olali et al 2007</td>
<td>Interventional case series (n = 358)</td>
<td>MCS</td>
<td>—</td>
<td>5.6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Zaidi et al 2007</td>
<td>Prospective and retrospective (n = 1000)</td>
<td>MCS</td>
<td>—</td>
<td>0.4</td>
<td>1.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Mearza et al 2009</td>
<td>Retrospective (n = 1614)</td>
<td>MCS</td>
<td>—</td>
<td>—</td>
<td>1.5</td>
<td>2.66</td>
</tr>
<tr>
<td>Agrawal et al 2009</td>
<td>Prospective (n = 2984)</td>
<td>MCS</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Narendran et al 2009</td>
<td>Retrospective (n = 55 567)</td>
<td>MCS</td>
<td>—</td>
<td>1.92</td>
<td>—</td>
<td>0.18</td>
</tr>
<tr>
<td>Greenberg et al 2011</td>
<td>Retrospective (n = 45 082)</td>
<td>MCS</td>
<td>—</td>
<td>3.5</td>
<td>—</td>
<td>0.12</td>
</tr>
<tr>
<td>Clark et al 2011</td>
<td>Population-based study (n = 129 982)</td>
<td>MCS</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Lundstrom et al 2011</td>
<td>Retrospective (n = 602 553)</td>
<td>MCS</td>
<td>—</td>
<td>2.09</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Bali et al 2012</td>
<td>Prospective (n = 200)</td>
<td>LCS</td>
<td>4</td>
<td>0.5</td>
<td>3.5</td>
<td>2</td>
</tr>
<tr>
<td>Roberts et al 2012 (Current study)</td>
<td>Prospective (n = 1300)</td>
<td>LCS</td>
<td>0.32</td>
<td>0.08</td>
<td>0.23</td>
<td>0</td>
</tr>
</tbody>
</table>

AC = anterior capsule; LCS = laser cataract surgery; MCS = manual cataract surgery; PC = posterior capsule.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of Eyes</th>
<th>Laser Platform Used</th>
<th>Findings</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central corneal thickness/ endothelial cell loss</td>
<td>76</td>
<td>LenSX® Laser</td>
<td>Central corneal thickness was significantly higher in the phaco group than in the FLACS group (607±91 μm versus 580±42 μm) on day 1, but there was no significant difference at 1 week and 1 month. Volume stress index at day 1 was significantly lower in the FLACS group than in the phaco group (p&lt;0.05) but did not differ significantly at 1 month.</td>
<td>42</td>
</tr>
<tr>
<td>Central corneal thickness</td>
<td>146</td>
<td>Catalys®</td>
<td>Mean relative change in corneal thickness from the preoperative values was −0.0±1.9 % at 1 day, 2.8±1.8 % at 1 week, and 3.3±1.7 % at 3 months in the study group and −0.9±2.3 %, 2.4±1.5 %, and 3.2±1.4 %, respectively, in the manual group. Mean ECL was 7.9±7.8 % SD 1 week postoperatively and 8.1±8.1 % 3 months postoperatively in the study group and 12.1±7.3 % and 13.7±8.4 %, respectively, in the control group.</td>
<td>34</td>
</tr>
<tr>
<td>Anterior chamber inflammation</td>
<td>176</td>
<td>Catalys®</td>
<td>Postoperative aqueous flare was significantly greater in the manual cataract surgery group versus FLACS at 1 day (p=0.0089) and at 4 weeks (p=0.003).</td>
<td>45</td>
</tr>
<tr>
<td>Parameter</td>
<td>Number of Eyes</td>
<td>Laser Platform Used</td>
<td>Findings</td>
<td>Reference</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>----------------</td>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Capsulotomy strength</td>
<td>10</td>
<td>Victus®</td>
<td>Observed mean rupture force (i.e., maximum amount of force measured immediately before tissue rupture) was 113 mN ± 12 SD in FLACS and 73±22 mN in the manual procedure (p&lt;0.05). The stretching ratios were 1.60±0.10 (femtosecond) and 1.35±0.04 (manual) (p&lt;0.05)</td>
<td>10</td>
</tr>
<tr>
<td>Capsulotomy precision</td>
<td>20</td>
<td>LenSX® Laser (pre SoftFit™)</td>
<td>Vertical diameter of manual was statistically significantly higher in the first week and month. Horizontal IOL decentration was statistically significantly higher in the manual group over 1 year. There was a significant difference in dichotomized horizontal decentration values at 0.4 mm with chi-square test after 1 week and 1 year (p=0.035 and p=0.016, respectively)</td>
<td>22</td>
</tr>
<tr>
<td>Capsulotomy precision</td>
<td>45</td>
<td>LenSX® Laser (pre SoftFit™)</td>
<td>Horizontal and vertical tilt were significantly lower in the FLACS group compared with manual (p=0.007 and p&lt;0.001, respectively) Lenses implanted after manual procedures showed greater horizontal and total decentration (p=0.034 and p=0.022, respectively)</td>
<td>27</td>
</tr>
<tr>
<td>Capsulotomy precision</td>
<td>99</td>
<td>LenSX® Laser (pre SoftFit™)</td>
<td>The FLACS group had significantly lower values of intraocular vertical tilt (-0.05±0.36 versus 0.27±0.57) and coma (-0.003±0.11 versus 0.1±0.15), and significantly higher Strehl ratios (0.02±0.02 versus 0.01±0.01) and MTF values at all measured cycles per degree compared with the manual group</td>
<td>28</td>
</tr>
<tr>
<td>Capsulotomy precision</td>
<td>17</td>
<td>LenSX® Laser (pre SoftFit™)</td>
<td>Vertical and horizontal tilt were significantly higher in the 6.0 mm group than in the 5.5 mm group (p=0.014 and p=0.015, respectively)</td>
<td>32</td>
</tr>
<tr>
<td>Capsulotomy precision and strength</td>
<td>39</td>
<td>Catalys®</td>
<td>Deviation from intended diameter of the resected capsule disk was 29±26 μm and 337±258 μm for the FLACS and manual groups, respectively. Mean deviation from circularity was 6 % and 20 %, respectively. Capsulotomy center was within 77±47 μm of the intended position. Capsulotomy strength (porcine subgroup) decreased with increasing pulse energy: 152±21 mN for 3 μJ, 121±16 mN for 6 μJ, and 113±23 mN for 10 μJ</td>
<td>11</td>
</tr>
<tr>
<td>Capsulotomy precision</td>
<td>111</td>
<td>LenSX® Laser (pre SoftFit™)</td>
<td>Circularity values were significantly better in the FLACS group (p=0.032) Incomplete overlap of capsulotomies in 28 % of eyes in the manual group and 11 % in the FLACS group (p=0.033)</td>
<td>21</td>
</tr>
<tr>
<td>Capsulorhexis geometry and strength</td>
<td>60</td>
<td>LENSAR®</td>
<td>Capsulorhexes obtained with FLACS at all energy settings were perfectly circular with negligible deformation. The manual group showed a significantly higher thickness of the capsulorhexis edge than the other groups (p&lt;0.001) There was also a statistically significant correlation between the degree of irregularity and increasing energy (p&lt;0.001)</td>
<td>25</td>
</tr>
<tr>
<td>Anterior capsule integrity</td>
<td>1626</td>
<td>Catalys®</td>
<td>There was a significantly increased rate of anterior capsule tears in the FLACS group (1.87 %) compared with the manual group (0.12 %; p=0.0002)</td>
<td>18</td>
</tr>
<tr>
<td>Parameter</td>
<td>Number of Eyes</td>
<td>Laser Platform Used</td>
<td>Findings</td>
<td>Reference</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>EPT</td>
<td>119</td>
<td>Victus*</td>
<td>Mean EPT was significantly lower in the laser group than in the manual group (5.2±5.7 versus 7.7±6.0 seconds) (p=0.025). There was a significant difference in the mean phaco energy between the two groups (13.8±10.3 % in laser group; 20.3±8.1 % in manual group) (p&lt;0.001)</td>
<td></td>
</tr>
<tr>
<td>Phacoemulsification time</td>
<td>24</td>
<td>LenSx® Laser (pre SoftFit℠)</td>
<td>Compared with control porcine eyes, FLACS resulted in a 43 % reduction in phacoemulsification power and a 51 % decrease in phacoemulsification time</td>
<td>2</td>
</tr>
<tr>
<td>EPT</td>
<td>109</td>
<td>Catalys®</td>
<td>In the FLACS group, the mean laser treatment time was 54.9 seconds and the EPT was 0.16±0.21 seconds compared with 4.07±3.14 seconds in the standard group</td>
<td>37</td>
</tr>
<tr>
<td>EPT</td>
<td>212</td>
<td>Catalys®</td>
<td>Mean EPT was reduced by 83.6 % in the femtosecond pretreatment group (p&lt;0.0001) compared with controls, with 30 % having zero EPT (p&lt;0.0001)</td>
<td>36</td>
</tr>
</tbody>
</table>
Results – Actual Versus Predicted ELP

- **LenSx Group (n=22)**
  - 71% of the variable’s variance result for the LenSx group Vs. only 29% for the manual group.
  - Better ELP predictability

- **Manual Group (n=26)**
  - R² = 0.2877

- **Graphs**
  - Actual ELP vs. Predicted ELP for each group.
  - The LenSx group shows a higher R² value compared to the manual group.
  - The trend lines illustrate the correlation between actual and predicted ELP.
Results – Multi-Center Study

• Prospective, Non-Randomized, Multi-Site Study
• Single Lens Type (Acrysof Platform - SN60WF)
• 83 Eyes (Laser Capsulotomy = 39 Manual Capsulotomy = 44)
  • Kerry Solomon, M.D., Robert Cionni, M.D.
• 1 Month Postop: Accuracy to Target & Visual Acuity

<table>
<thead>
<tr>
<th>1M UCVA</th>
<th>LenSx (n=39)</th>
<th>Manual (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/20 or Better</td>
<td>51%</td>
<td>32%</td>
</tr>
<tr>
<td>20/25 or Better</td>
<td>64% (59% more)</td>
<td>43%</td>
</tr>
<tr>
<td>20/40 or Better</td>
<td>95% (80% more)</td>
<td>75% Less</td>
</tr>
<tr>
<td>20/50 or Worse</td>
<td>75% Less</td>
<td>20%</td>
</tr>
</tbody>
</table>

Accuracy to Target: 51% for LenSx vs. 32% for Manual, difference of 19% more

Visual Acuity: 95% for LenSx vs. 75% Less for Manual, difference of 20%
Large ESCRIS Study

Showed no difference between Phaco & Femto

However

Recent ISRS paper argues otherwise
• >4000 Cases
• Statistically More anterior tears in Laser Group (1.84% vs 0.22%)
• Low Posterior Tear rate in both groups
T-LACS
Therapeutic Laser-Assisted Cataract Surgery

• 24 eyes with complex cataracts including capsular scars, phacodonesis, and white cataracts.
• 4 patients had posterior capsule tears during
• 79% of patients achieved a BCVA of 20/40 or better.
TLACS

54 YO Female
VA – HM
Traumatic Dislocated Cataract since Age 9
TLACS

12 YO Male
VA – HM
Traumatic Cataract from stick injury 2 weeks prior
Anterior Capsular Tear Extending to the Equator
Significant Anterior Lens Assymetry
By adjusting gates we were able to complete capsulotomy

Notice Cortical Material protruding through anterior capsule rupture
The Anterior Tear caused by trauma did not extend posteriorly and IOL goes bag
Is T-LACS helpful

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Catalys*</td>
<td>Victus 1*</td>
<td>Victus 2*</td>
</tr>
</tbody>
</table>

*Trademarks are properties of their respective owners
Is Femto Meaningful?

Standard: Not Yet
Complex: Yes
ReLACS: Probably
Audience Response Question

IF I had 2D of Astigmatism and Cataracts I would want:
A) Toric IOL
B) Toric Accommodating IOL
C) Toric Multifocal IOL
D) Multifocal or Accommodating with LASIK
E) Standard IOL and Glasses
Residual Astigmatism

POM #1 SN6AT9 Toric IOL @ 110°

$V_{sc} \quad 20/60$

MRX $-1.00 + 1.75 \times 150 \quad 20/25$
More than 1/3 of the population has >1 D of astigmatism.

Perceived acceptable degrees of postoperative rotational error before visual quality and visual acuity are significantly affected:

- $\geq 10^\circ$: 32%
- $5^\circ$ to $9^\circ$: 50%
- $< 5^\circ$: 18%
Many people came to help us clean the place after the party.

He could see a bird outside if he looked through his window.
Residual Astigmatism

POM #1 SN6AT9 Toric IOL  @ 110°

V_{asc}  20/60

MRX – -1.00 + 1.75  x 150  20/25
Causes of Residual Astigmatism

Wrong Location
- Poor Measurements
- Poor Calculations
- Surprising SIA
- Posterior Ks
- IOL Rotated
- Poor IOL Placement

Wrong Lens
- Poor Measurements
- Poor Calculations
- Surprising SIA
- Posterior Ks

Wrong Eye
- Ocular Surface Disease
- ABMD
- Irregular Astigmatism

Treat Disease
Causes of residual refractive astigmatism

Actual Axis of IOL (measured)

Ideal Axis of IOL (determined by astigmatismfix.com)

Intended Axis of IOL (from calculations)

Rotation: difference from intended
Causes of Residual Astigmatism

Change in Ideal Axis
- 76%

IOL Rotation
- 78%

Neither
- 6%
Prior MRX: -1.00 + 1.75 x 150

Predicted MRX: -0.29 + 0.32 x 150

Final Refraction: -0.25 + 0.25 x 155

www.astigmatismfix.com
Mark Current and Ideal Axis
How Intended Axis = Ideal Axis?

Pre-operative

• K’s
  – Manual
  – Biometry
  – Topography

Intraoperative

• Alignment Systems
  – Pre-op Images linked to Microscope Display
    • Callisto, Verion,
    • TrueVision, Streamline

• Aberrometry
  – ORA
  – Holos
Verion Video
Why trust Aberrometry?

- Surgically Induced Astigmatism
- Posterior Corneal Curvature
- The Data
When to Trust Aberrometry

Routine Cases

% of Patients within .50D

- Literature**: 60%
- ORA w VerifEye: 84%
- ATIOls: 86%

When to Trust Aberrometry

Post-Refractive

Mean Absolute Error

Why to Trust Aberrometry

Astigmatism

It's better to measure than estimate

~15% of patients don't have ATR on the posterior cornea

When to Trust Aberrometry

Astigmatism

More than 0.5D of Residual Astigmatism

- With ORA: 10.8%
- Conventiona Approach: 23.4%
When to Question Aberrometry

Post-RK
High Hyperopia
Highly Irregular Corneas
Pseudophakic Readings (Sphere and Cylinder)

* Or if you enter incorrect biometric data
Take Home Point #1

You Can’t Fix Presbyopia Until you Fix Astigmatism
Take Home Point #2

Presbyopia solutions are better than ever!
Audience Response Question

What would you suggest?

A) Monofocal Distance  
B) Monovision  
C) Multifocal  
D) Accomodating

Wants Spectacle Independence

64 YO F  
20/25 OU BAT 20/40  
Prior PRK 6 years ago
Audience Response Question

What would you suggest?
A) Monfocal Distance
B) Monovision
C) Multifocal
D) Accomodating

Wants Spectacle Independence
64 YO F
20/25 OU BAT 20/40
Prior PRK 6 years ago
OD
Symfony
+1.75 EDOF
20/20
J2

OS
ZLBOO
+3.25
20/20⁻¹
J1
Goal
- Desires all focal points
- Mild compromise of quality
- OK needing good light
- OK with possible halos

Eye Characteristics
- Astigmatism <0.75D
- Pristine macula
- Treat Dryness Pre-op
- Low HOA’s
- Similar 3 and 5mm MRX
- Angle Kappa < 0.4mm

Restor 4.0, 3.0, 2.5 +Toric
Goal
– Desires distance and near
– OK with possible halos

Eye Characteristics
– Astigmatism <0.75D
– Pristine macula
– Treat Dryness Pre-op
– Low HOA’s
– Similar 3 and 5mm MRX
– Angle Kappa < 0.5mm
– High Myopes, Young

Tecnis Multifocal +4.0, +3.25, +2.75 +1.75 (Symfony) + Toric
Patient Characteristics
- Desires distance and intermediate (or near with Mini-Mono)
- No Halos
- Readers for fine print

Eye Characteristics
- Astigmatism <1.0D
- Treat Dryness Pre-op
- Stable Zonules

Crystalens & Trulingn
Tecnis Monofocal

Tecnis Multifocal

Tecnis Symfony EDOF
Take Home Point #3

Understand the Technology
#1. Nail the Spherical Equivalent
#2. Nail the Astigmatism
#3. Nail the Presbyopia
An eraser doesn’t remove ink
Other Piece of the Puzzle
The Problem

PLEASE
ASK CASHIER
IN FRONT
FOR TOILET
PAPER.

THANK YOU.
Take Home Point #4

Think Ahead and Don’t Go Down a Road You Can’t Retreat From
Healthy Eye

IOL Calculations

Aberrometry

Safety

Reproducibility

Visual Goals

Enhancement

IOL Positioning

IOL Technology

Biometry

Femto
Max Planck

“a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die and a new generation grows up that is familiar with it.”
MIGS & Emerging Technologies

Predicting the Future is Easy......Being Right is Hard

John Berdahl
68 yo Patient, with Cat and Mild POAG on 1 med:

A) Cataract Surgery Alone
B) Cataract plus iStent
C) Cataract plus ECP
D) Cataract plus other glaucoma procedure

How do I vote?

- Open the SECO 2016 Mobile App
- Choose Agenda
- Find this course
- Click on the polling question at the bottom of the screen

OR

- Follow Texting instructions on the results screen
- You will receive a reply with the answer options
What is MIGS?

• Ab-interno Microincision
• Minimal Trauma
• Efficacy
• Safety
• Rapid Recovery
Do we need something better?
Patterns of Glaucoma Medication Adherence over Four Years of Follow-Up

Paula Anne Newman-Casey, MD, MS,1,2 Taylor Blachley, MS,1 Paul P. Lee, MD, JD,1,2 Michele Heisler, MD, MPA,2,3 Karen B. Farris, PhD,4 Joshua D. Stein, MD, MS1,2

Purpose: To assess longer-term patterns of glaucoma medication adherence and identify whether patterns established during the first year of medication use persist during 3 subsequent years of follow-up.

Design: Retrospective, longitudinal cohort analysis.

Participants: Beneficiaries aged ≥40 years who were enrolled in a United States (US)-managed care plan for ≥7 years between 2001 and 2012 and newly diagnosed and treated for open-angle glaucoma.

Methods: For each enrollee, we quantified medication adherence using the medication possession ratio. Group-based trajectory modeling (GBTM) was applied to identify patterns of adherence for 1 and 4 years of follow-up. The percent of beneficiaries who remained in the same trajectory group in the 1- and 4-year models was tabulated to evaluate group stability. Factors impacting adherence at 1 and 4 years were identified using regression analyses.

Main Outcome Measures: Patterns of glaucoma medication adherence.

Results: Of the 1234 eligible beneficiaries, GBTM identified 5 distinct glaucoma medication adherence patterns in both the 1-year and 4-year follow-up periods. These groups were as follows: (1) never adherent after their index prescription fill (7.5% and 15.6% of persons in the 1- and 4-year models, respectively); (2) persistently very poor adherence (14.9% and 23.4% of persons in the 1- and 4-year models, respectively); (3) declining adherence (9.5% and 9.1% of persons in the 1- and 4-year models, respectively); (4) persistently moderate adherence (48.1% and 37.0% of persons in the 1- and 4-year models, respectively); and (5) persistently good adherence (20.0% and 15.0% of persons in the 1- and 4-year models, respectively). More than 90% of beneficiaries in the 4 groups with the worst and best adherence patterns (groups 1, 2, 3, 5) maintained their patterns from their first year throughout their 4 years of follow-up. Those with persistently moderate adherence (group 4), the largest group, were most likely to change groups from 1 to 4 years of follow-up. Persons with the best adherence over 4 years were more likely to be white, to be older, to earn $60 000/year, and to have more eye care visits (P < 0.05 for all comparisons). Those with a higher initial copayment cost had lower adherence rates (β = −0.06/dollar, P = 0.03).

Conclusions: For most patients who were newly prescribed glaucoma medications, adherence patterns observed in the first year of treatment reflect adherence patterns over the subsequent 3 years. Investing resources in both identifying and helping patients with suboptimal adherence patterns over the first year may have a large impact on longer-term adherence. Ophthalmology 2015;122:2010-2021 © 2015 by the American Academy of Ophthalmology.
## High Annual Drug Costs for Patients

<table>
<thead>
<tr>
<th>Drug</th>
<th>Cost per Year per Eye</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alphagan</td>
<td>$977.07</td>
</tr>
<tr>
<td>Xalatan</td>
<td>$797.60</td>
</tr>
<tr>
<td>Lumigan RC</td>
<td>$764.60</td>
</tr>
<tr>
<td>Azopt</td>
<td>$715.86</td>
</tr>
<tr>
<td>Travatan Z</td>
<td>$703.35</td>
</tr>
<tr>
<td>Combigan</td>
<td>$684.45</td>
</tr>
<tr>
<td>Betoptic S</td>
<td>$628.35</td>
</tr>
<tr>
<td>Cosopt</td>
<td>$513.70</td>
</tr>
<tr>
<td>Trusopt</td>
<td>$419.93</td>
</tr>
<tr>
<td></td>
<td>Tube</td>
</tr>
<tr>
<td>----------------------</td>
<td>------</td>
</tr>
<tr>
<td>IOP</td>
<td>14.4</td>
</tr>
<tr>
<td># of Meds</td>
<td>1.4</td>
</tr>
<tr>
<td>Failure Rate</td>
<td>30%</td>
</tr>
<tr>
<td>Complications Post-op</td>
<td>39%</td>
</tr>
<tr>
<td>Complications Surgical</td>
<td>22%</td>
</tr>
<tr>
<td>Reoperation</td>
<td>9%</td>
</tr>
</tbody>
</table>
## MIGS

<table>
<thead>
<tr>
<th>Device</th>
<th>Company</th>
<th>Site</th>
<th>Availability</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>iStent</td>
<td>Glaukos</td>
<td>Trabecular Meshwork</td>
<td>Yes</td>
<td>PMA</td>
</tr>
<tr>
<td>KDB</td>
<td>New World Medical</td>
<td>Trabecular Meshwork</td>
<td>Yes</td>
<td>Class 1</td>
</tr>
<tr>
<td>Aquesys</td>
<td>Aquesys</td>
<td>Sub-Conjuntival</td>
<td>Trials</td>
<td>510K</td>
</tr>
<tr>
<td>Hydrus</td>
<td>Ivantis</td>
<td>Trabecular Meshwork</td>
<td>Trials</td>
<td>PMA</td>
</tr>
<tr>
<td>Cypass</td>
<td>Alcon</td>
<td>SupraChoroidal</td>
<td>Trials</td>
<td>PMA</td>
</tr>
<tr>
<td>iStent inject</td>
<td>Glaukos</td>
<td>Trabecular Meshwork</td>
<td>Trials</td>
<td>PMA</td>
</tr>
<tr>
<td>iStent supra</td>
<td>Glaukos</td>
<td>SupraChoroidal</td>
<td>Trials</td>
<td>PMA</td>
</tr>
</tbody>
</table>
Trabecular Meshwork
IOP & Meds in Pseudophakia

Consistent Cohort Data (6-month post-op, n=13)
Significant IOP reduction (mean) - 3.31 mmHg (p>0.05)
Significant med # reduction (mean) - 0.77 (p>0.05)

<table>
<thead>
<tr>
<th>Time Period</th>
<th>IOP (mmHg)</th>
<th>Glaucoma Meds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop (n=27)</td>
<td>20.26</td>
<td>2.11</td>
</tr>
<tr>
<td>1 Day (n=27)</td>
<td>17.56</td>
<td>1.37</td>
</tr>
<tr>
<td>1 Week (n=25)</td>
<td>19.12</td>
<td>1.76</td>
</tr>
<tr>
<td>1 Month (n=25)</td>
<td>18.42</td>
<td>1.62</td>
</tr>
<tr>
<td>3 Month (n=21)</td>
<td>19.62</td>
<td>1.48</td>
</tr>
<tr>
<td>6 Month (n=13)</td>
<td>16.08</td>
<td>1.31</td>
</tr>
</tbody>
</table>
Multiple iStents vs Phaco Alone
Avg 2.7 stents

275% increase in Facility of Outflow


Early Data shows 77% reach unmedicated IOP <18
Hydrus
Hydrus
Trabectome
Trabectome removal of meshwork

cells visible on outer wall of Schlemm's canal

(human autopsy eye; Courtesy of Doug Johnson)
KDB – Kahook Dual Blade
Suprachoroidal Space
Suprachoroidal Space
Subconjunctival Space
Aquesys
Aquasys
Not MIGS
Not MIGS

- ECP???
- Canaloplasty
- Trabeculectomy
- Tube Shunts
- InnFocus
ECP Treatment of Ciliary Body
ICE PROCEDURE
(ISTENT+CATARACT EXTRACTION+ENDOCYCLOPHOTOCOAGULATION)

TITLE TEXT HERE
Glaucoma treatment will improve dramatically over the next 10 years.
The Future
Oculeve
IOLs

Light Adjustable Lens
-Dan Schwartz

Omega Lens
-Gary Wortz

Harmoni Modular Lens
-Malik Kahook
Drug Delivery

Inserts

Punctal Delivery

Intraocular Delivery
If you ask me anything I don’t know...
...I’m not going to answer

-Yogi Berra