European Society of Cataract and Refractive Surgery

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MiCO, Milano Congressi

Course IC 32

“Presbyopia Correcting IOL Implantation: Choosing The Proper lens For Each Patient”

Senior Instructor:
Matteo Piovella MD

Instructor:
Claudio Carbonara MD
Jack T Holladay MD
Michael C Knorz MD MSEE FACS
Richard L Lindstrom MD
Scipione Rossi MD
Roberto Zaldivar MD

Sunday, September 09, 2012
08.00 AM- 10.00 AM
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“Lens Surgery in Patients at Risk for Narrow-Angle Glaucoma: Three Years Follow Up”

Matteo Piovella MD, Barbara Kusa MD, Fabrizio I Camesasca MD

Clinical Advantages of Preoperative Anterior Segment OCT Technology.

Definition of:
- AC depth
- Cristalline lens vaulting (lens grows 20µ/y.)
- Angle opening
- Improved surgical planning
  - Identification of adequate viscoelastics (Double filling Healon V & Discovisc)
- Improved control of capsulorhexis
- Better identification and selection of surgical pts

OCT Technology Widened Indications for Clear Lens Extraction

In Patients at risk for glaucoma, removal of cristalline lens implies:
- Reduced need for iridectomy.
- Reduced need for topical glaucoma therapy.
- Reduced social cost of glaucoma.
- Reduced number of challenging cataract cases.

A New Class of Difficult and Challenging Cataract Cases.

- Low Anterior Chamber & Narrow Angle.
- Refractive Lens Exchange.
- Multifocal IOLs.

Purpose:
To evaluate anterior segment parameters within clear lens/mild cataract extraction should be suggested by surgeons as prevention of glaucoma complications.

Materials and Methods:
- We studied with Visante OCT (Carl Zeiss Meditech AG, Jena, Germany) the anterior segment of 74 eyes before and after natural lens removal.
- Mean age : 69.61 ± 10.29 years.
- Mean preoperative BSCVA : 0.68 ± 0.25
- Mean preoperative IOP : 15.79 ± 5.18 mmHg.
- Mean preoperative AC Depth : 2.18 ± 0.18 mm
- Mean preoperative Angle Width : 12.84° ± 5.79°.
Anterior Chamber Depth & Narrow Angle

Hyperopic Patient (+5 sf)
54 y.o
angle: 2 degree
normal IOP

Low Anterior Chamber & Narrow Angle
OVD’s Technique

Double Filling (Healon V and Discovisc)
Goal:
Safer Capsulorhexis Management.

Anterior Chamber Depth Variation
Preop 1.52 mm Vs Postop 3.66 mm
Preop.: Angle opening 13.8° ACD 1.52 mm
1 week after lens removal:
Angle opening:
39.1°
AC Depth:
3.66 mm

The Three “A”

Inclusion Criteria

AGE : over 50 y.o.
ACD : ≤ 2.4 mm
ANGLE : ≤ 15 degrees

Anterior Chamber Depth increased
of 70.50%

Anterior Chamber Depth Variation

Angle Opening Variation
Cataract Patient 70 y.o. male Preop vs. Postop

2 years postoperatively
Anterior Chamber Depth increased
of 70.50%
Given the insidiousness of glaucoma and the increased life expectancy of the population, prevention of glaucomatous damage is of the foremost importance.

The AC OCT provides previously unseen images of the anterior segment, with immediate visualization of its structures and almost instantaneous diagnostic opportunities. Presently, the indications for cataract surgery in eyes with very shallow ACD and narrow angle are being reconsidered on the basis of the new images provided by AC OCT as well as on the increasingly limited invasiveness of cataract and lens surgery. Our studies indicate that it is possible to determine these three parameters:

The Three “A”

Age: over 50 y.o. - ACD: ≤ 2.4 mm - Angle Width ≤ 15°
Multifocal IOLs and % Light Distribution
(Refractive MIOL Technology)

All multifocal IOLs provide adequate performance for Far and Near distances at nominal 3 mm pupil and differences can be shown towards the limits of the pupil range: 2 mm and 5 mm.

Three Years Monocular Near Vision Visual Acuity
35 Eyes – Preliminary Results

MEAN ETDRS
MEAN JAEGER
UCNVA 35.61 3.7

Introducing Multifocal IOLs in Your Practice:
What is Different? What is Wrong?

- Refractive Cataract Surgery
- Patients Selection
- More Technologies
  OCT/Pupillometry/Aberrometry
- More Timing Consuming
- Personal Experience Up to 200 Cases pre and post op
- Dominant Eye Concept
- Monofocal IOLs Effective – 5th Generations

• First Diffractive and Most Sold MIOL was the Weakest
• First Accomodative IOLs Didn't Work Well
• USA/Europe Differences Due to Health Care Systems
• Wrong Eye Doctors Informations/Formations
• No Enought Eye Doctor Motivations
• No Enought Changes in Patients Management
• Only 6% Premium Lens Market
• The Premium Lens High Cost is Not the Main Problem
“Advanced cataract surgery with multifocal IOL implantation: four years follow-up”
*Matteo Piovella MD*

### Effect of Contrast Reduction

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Normal</td>
</tr>
<tr>
<td>Moderate</td>
<td>Reduced</td>
</tr>
<tr>
<td>Severe</td>
<td>Blurred</td>
</tr>
</tbody>
</table>

### More Popular Multifocal IOLs Weak Points

- Contrast Sensitivity Penalization
- Small Refractive Errors (0.50 Diopters Astigmatism) Are Co-Responsible of 50% Patients Complaints
- Diffraction Technology: Rings Creates Diffractions
- Halos and Ghost Images Difficult to Manage in Suspicious Patients
- Poor Intermediate Distance Vision

**Perfect Target is Plano Postop Results**

### Multifocal IOLs and % Light Distribution (Refractive MIOL Technology)

<table>
<thead>
<tr>
<th>Zone</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near</td>
<td>20%</td>
</tr>
<tr>
<td>Intermediate</td>
<td>60%</td>
</tr>
<tr>
<td>Far</td>
<td>20%</td>
</tr>
</tbody>
</table>

### ReZoom™ MIOL (AMO)

- Distant-dominant central zone for vision in bright-light conditions when the pupil is constrained
- Five concentric refractive zones create true multifocal vision
- Zones proportioned to provide a full range of quality vision in varying light conditions
- Usage of 100% of available light
- Aspheric transition between zones provides balanced intermediate vision

### TECNIS® Diffractive MIOL ZMA00 (AMO)

- Hydrophobic acrylic material, 3-Piece Design
- Full diffractive posterior surface for pupil-independent performance at all light conditions
- Prolate aspheric anterior surface to compensate spherical aberrations and improve contrast sensitivity
- Light distribution 50/50
- Optical power add +4.0 D to optimize acuity at reading distance of 33 cm

### Advantages

- Diffractive Optics allow for Distance and Near vision for full range of pupil size
- Nearly 90% of patients are able to function comfortably without glasses at all distances at one year
- 92.1% of patients simultaneously reach 20/25 or better distance AND 20/32 or better near vision at one year (with distance correction in place)

### Disadvantages

- Substantial near add at large pupils may contribute to halo
- 16% of light is outside focusable range of vision
- May have limited provision for intermediate vision, however...
Tecnis® MIOL Uncorrected Near Vision Visual Acuity
Monocular vs Binocular

<table>
<thead>
<tr>
<th></th>
<th>1 year p.o.</th>
<th>2 years p.o.</th>
<th>3 years p.o.</th>
<th>4 years p.o.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monocular</td>
<td>&quot;VI A Jaeger&quot;</td>
<td>3.41 ± 0.66</td>
<td>2.75 ± 0.46</td>
<td>2.17 ± 0.72</td>
</tr>
<tr>
<td>Binocular</td>
<td>1.95 ± 0.51</td>
<td>1.95 ± 0.51</td>
<td>1.43 ± 0.51</td>
<td></td>
</tr>
</tbody>
</table>

Contrast Sensitivity and Control Values

Control values for C5 are derived from Hochberger paper

- 15-14 healthy phakic subjects for the following age groups:
  - <30; 30-38; 40-49; 50-58; 60-68; 70+50
- Functional image Analyzer OPTEC 6500
- Daytime (56 od/m²), Nighttime (3 oz/m²) and Nighttime with Glare
- Monocular testing
- Paper demonstrated strong age dependence of C5 with age

RaZoom™ MIOL Contrast Sensitivity (Max 5.2 mm pupil size PS)
Daytime, night time and night time with glare

Tecnis® MIOL contrast sensitivity
Daytime, night time and night time with glare

MIOL YAG LASER CAPSULOTOMY:
136 EYES

YAG LASER TREATMENTS
104 Implants Mix and Match:
- 13.6% (14 eyes) RaZoom (5 six months, 4 one year, 5 two years)
- 11.5% (12 eyes) Tecnis (1 one month, 2 six months, 5 one year, 4 two years)
- 32 Bilateral Tecnis Implant
- 54.4% (17 eyes) Tecnis (4 six months, 3 one year, 10 two years)

CustomMatch
Nine Pearls for Patient Satisfaction
1. Don’t assure 100% spectacle independence and counsel patient on near reading learning curve.
2. Identification of the dominant eye
3. Two biometry exams: IOLMaster and A scan
4. Pupil diameter in mesopic conditions: 6.2 mm max for refractive implant (i.e., RaZoom)
5. Start implanting a refractive implant (TECNIS®) in the nondominant eye
6. Fellow eye surgery within a week
7. Refractive goal: plano is the key point for successful outcomes
8. Early YAG laser capsulotomy to achieve better contrast sensitivity
9. Spectacle correction of residual refractive errors (within 0.75 D) can significantly reduce or eliminate glare and halos in specific situations: i.e., night driving
“Multifocal Progressive Diffractive Lens: Two Years Follow Up”  
Matteo Piovella MD, Barbara Kusa MD, Antonio Mocellin MD

PURPOSE: OptiVis™ represents a new concept in multifocal IOL optics combining benefits of both diffractive bifocal and progressive refractive designs providing near, far, and intermediate vision in one IOL. We present the optical theory of OptiVis™ and one year clinical outcomes of 79 implants (40 bilateral implantation).

METHODS: OptiVis™ is implanted bilaterally through a 2.8/3.0 mm incision following cataract removal. Follow-up examinations occur at 1 days, 1 week, 1 month, 3 months, 6 months, one year and two years. Follow-up evaluations include uncorrected (UCVA) and best corrected visual acuity (BCVA) for distance and distance-corrected near and intermediate visual acuity. Photopic and mesopic lighting are used during visual acuity testing as appropriate. Patient satisfaction surveys are administered to assess functional visual performance, spectacle independence, and unwanted visual images.

RESULTS: Through-focus response (TFR) curves for OptiVis™ from optical bench testing show a broad distance focus peak relative to other diffractive multifocal IOLs predicting greater depth of focus into the intermediate range and more forgiving distance power calculations and near focus peak similar to simple diffractive bifocal IOLs. Mean age was 70.73 ± 6.25 yrs. At two years, distance UCVA was 27.23 /20 (0.86) and BCVA 23.08/20 (0.93) with -0.25 ± 0.66 SE. Uncorrected binocular vision was 31.20/20 at 40 cm, and 41.37/20 at 70 cm. Clinical results demonstrate good patient satisfaction, good distance and near vision, and functional intermediate vision.

CONCLUSIONS: OptiVis™ is an advanced generation multifocal IOL combining apodized diffractive and progressive refractive optics for near, distance, and intermediate vision. OptiVis™ is to be indicated for bilateral implantation. Clinical outcomes indicate that this is an effective new multifocal design.
Second Generation Multifocal Diffractive IOL
What is the Difference?
- OptiVis Central Area is 2.1 sq. mm.
- ReStor and Acri.Lisa Central Area is 1.3 sq. mm.
- ReStor and Acri.Lisa Central Areas is the First Diffractive Groove that works together with the other diffraction grooves
- OptiVis Central Area acts as a stand alone refractive zone of Progressive power range which complements the lens diffraction grooves to provide Intermediate foci
- Other differences - optimized Apodization to reduce light outside the range of vision and improved Aspherization to minimize effect of lens tilt and decentration

Refractive Progressive / Diffractive OptiVis MIOL
(Aaren Scientific)

- Refractive-Diffractive posterior surface design with 2.8 D Effective Add power
- Refractive central 1.5 Ø zone of Progressive power range for Distance-Intermediate foci
- Diffractive Bifocal for Distant and Near foci within 1.5-3.8 Ø zone. Apodized to reduce halo
- Bi-sign Aspheric base surface of diffractive zone and lens periphery to improve image contrast at Distance even with lens tilt and decentration

Advantages and % Light Distribution
OptiVis MIOL (Aaren Scientific)

<table>
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<tr>
<th>% Light Distribution</th>
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<tr>
<td>Near</td>
</tr>
<tr>
<td>2 mm Pupil</td>
</tr>
<tr>
<td>5 mm Pupil</td>
</tr>
</tbody>
</table>

Materials and Methods
OptiVis™ implanted in 79 eyes of 40 patients (38 Bilateral implantation)
Mean age: 70.37 ± 6.25 years.
Follow-up: 2 year (13 eyes)
Follow-up: 748.25 ± 54.12 days
• Uncorrected VA (UCVA), Near (UCNVA) and Distance (DCNVA)
• Best corrected distance VA (BCDVA) Distance
• Intermediate VA, uncorrected (UNIVA) and distance corrected
• Near VA

Manifest Refraction: Spherical Equivalent
79 Eyes

Outcome for targeted refraction

Two years Binocular Near* Vision Visual Acuity
40 Patients – 79 Eyes

<table>
<thead>
<tr>
<th>MEAN ETDRS 20/30</th>
<th>MEAN JAEGER</th>
<th>BEST VISION MEAN DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCNVA PHOTOPIC</td>
<td>34.13</td>
<td>3</td>
</tr>
<tr>
<td>DCNVA PHOTOPIC</td>
<td>31.88</td>
<td>3</td>
</tr>
</tbody>
</table>

Two years Binocular Intermediate* Vision at 70 cm
40 Patients – 79 Eyes

<table>
<thead>
<tr>
<th>MEAN ETDRS 20/30</th>
<th>MEAN JAEGER</th>
<th>DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNCORRECTED INTERMEDIATE VISION</td>
<td>38.22</td>
<td>4</td>
</tr>
<tr>
<td>DISTANCE CORRECTED INTERMEDIATE VISION</td>
<td>38.22</td>
<td>4</td>
</tr>
</tbody>
</table>

* Used same ETDRS Logarithmic Visual Acuity Chart "2"
New multifocal IOLs generation represents a new concept in multifocal IOL optics, combining benefits of both diffractive bifocal and progressive refractive designs by providing near, far, and intermediate vision in a single IOL.
**Improvement Strategies:**
- Biometry, Topography
- Power Calcs to Ret
- Surprises

**The Promise of No Glasses or Contact Lenses!**

**Requirements**
- Accurate Biometry – IOL Master
- Accurate K’s - Repeatable
- 4th Generation Formula (WTW)
- Personalized Lens Constant
- Eliminate Corneal Astigmatism

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- Accurate Biometry – IOL Master
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IOL CALCS in Keratoconus

- Corneal is Bifocal
- Patient does not look through cone for distance (may use at 10 cm as magnifier)
- Look at Power Distribution
- Use Paracentral Power (65% Mean Power)

Accuracy of EKR

<table>
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<tr>
<th>Prior</th>
<th>STD 4.5</th>
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<tr>
<td>Sx</td>
<td>(D)</td>
</tr>
<tr>
<td>LASIK</td>
<td>0.56</td>
</tr>
<tr>
<td>RK</td>
<td>0.94</td>
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Keratoconus Calculation #2

Dear Dr. Holladay,

> Will you please review this case and give me some insight. A KC with lasik patient underwent EROS/OK, the diopter targeted -4.50, so as to not make him astigmatic. I used the Pentacam 3D Keratoconus EKR and the Holladay II formula. The patient came out: PL 0.75x 125 = 1.80 D UCVA = 20/20. Patient is very happy, but, was an unintended outcome. How does one measure the central corneal power in an astigmatic patient? Can you determine the cause of this outcome? It appears that the keratome must be farther than what the instrument measured. Is that a correct assumption? The suggested IOL power was 28.80D, for a target of -4.00 D. When I click the Keratoconus box (after the fact) for the same target, the suggested IOL power was 27.50 D. What should I have done differently?

> Please advise! THANK YOU 1000x

Tomme
**Keratoconus Calculation #2**
- Used \( K_m = 39.60 \) D => Plano, but targeted for -4.00 D
- Should have used 65% Mean
  - 37.7 D => +2.00 D
  - If had \( K_KC \) => +0.50 D
  (not \( K_KC \) will use steeper \( K \) to size eye)

**Requirements**
- Accurate Biometry – IOL Master
- Accurate K's- Repeatable
- 4th Generation Formula (WTW)
- Personalized Lens Constant
- Eliminate Corneal Astigmatism

**Vergence Formula**
\[
IOL = \frac{1336}{AL - ELP} - \frac{1336}{1000 + K(\text{Post} \, R)} - \frac{1336}{1000} \cdot \left( \frac{D_{PostR}}{V} \right)
\]

**CONCLUSION: 9 EYES**

<table>
<thead>
<tr>
<th>Anterior Segment Size</th>
<th>Megalocornea + axial hyperopia (80%)</th>
<th>Megalocornea (6%)</th>
<th>Large Eye Buphthalmos Megalocornea + axial myopia (10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>(6%)</td>
<td>(2%)</td>
<td>(2%)</td>
</tr>
<tr>
<td>Normal</td>
<td>axial hyperopia (80%)</td>
<td>normal (96%)</td>
<td>axial myopia (90%)</td>
</tr>
<tr>
<td>Small</td>
<td>Small eye Narrowfield (20%)</td>
<td>Microconea (2%)</td>
<td>Microconea + axial myopia (0%)</td>
</tr>
<tr>
<td>Short</td>
<td>Normal</td>
<td>Short</td>
<td>Long</td>
</tr>
</tbody>
</table>

**Measurements taken for Predictors of ELP**
- Axial Length
- Average K (Pre Ref)
- Horizontal WTW
- ACD
- LT
- Pre-op Refraction
- Age
FORMULA PERFORMANCE

Requirements

- Accurate Biometry – IOL Master
- Accurate K’s- Repeatable
- 4th Generation Formula (WTW)
- Personalized Lens Constant
- Eliminate Corneal Astigmatism

Personalized Lens Constant

- Never use Manufacturer’s Constant except to start
- 20 to 40 cases and continue
- Factors
  - IOL Style
  - Lens placement
  - Post op medications
  - Biometer, keratometer, ...
“Toric Multifocal IOLs or Bioptics?”
Michael Knorz MD
My Treatment Choices

- LASIK
  - Very effective, treats corneal plane
  - Additional procedure
  - Dry eye
- Toric IOL
  - Effective, but treats at IOL plane
  - One procedure only required!

My Current MIOL Approach

- ReStor SN6AD1 in both eyes!
  - Good distance, all patients can read, intermediate okay, few halos at night
- Not for everybody, patient selection is important!

Patient Selection MIOL

- Multifocal IOLS are a compromise for those who do not like glasses!
- I tell patients that they will have halos at night
  - halos will get less obvious with time, but some will remain
  - halos are “the price to pay” to achieve spectacle independence

The Ideal MIOL Patient

- Presbyopic hyperopes!
- Emetropia must be achieved postoperatively!
  - Correct astigmatism!

How do I Treat Astigmatism?

- <1.5 D
  - Laser refractive cataract surgery with arcuate incisions + ReSTOR
- 1.5 D or more:
  - Toric ReSTOR
Clinical Studies

Binocular Visual Acuity outcomes with apodized diffractive multifocal toric intraocular lenses

Knorz MC, Rincon JL, Suarez E, et al

ReSTOR Toric - Study Design

- To evaluate near, intermediate, and distance visual acuity of cataract subjects with preoperative normal astigmatism after bilateral implantation of REsTOR multifocal toric intraocular lenses (IMLs).
- 40 subjects at 4 clinical sites
  - Average age: 61.0 ± 7.0 yrs
  - 67.1% female
- 3-month results presented
  - Uncorrected Visual acuity at distance, Intermediate and near
  - Best Corrected Visual acuity at distance, Intermediate and near
- SAS version 9.2 used for data analysis

Uncorrected Visual Acuity

Difficulty at Distance without Glasses

- Significant reduction in difficulty with distance vision
**Difficulty at Intermediate without Correction**

Significant reduction in difficulty with intermediate vision

<table>
<thead>
<tr>
<th>Mean VISA Score</th>
<th>Pre Op (n=44)</th>
<th>Month 1 (n=44)</th>
<th>Month 6 (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty</td>
<td>4.5</td>
<td>1.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

**Difficulty at Near without Correction**

Significant reduction in difficulty with near vision

<table>
<thead>
<tr>
<th>Mean VISA Score</th>
<th>Pre Op (n=44)</th>
<th>Month 1 (n=44)</th>
<th>Month 6 (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty</td>
<td>4.5</td>
<td>1.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

**Spectacle Wear**

<table>
<thead>
<tr>
<th>Glasses required</th>
<th>Pre Op (n=44)</th>
<th>Month 1 (n=44)</th>
<th>Month 6 (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td>57.20%</td>
<td>2.60%</td>
<td>0.30%</td>
</tr>
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</table>

**Quality of Vision**

<table>
<thead>
<tr>
<th>Score</th>
<th>Pre Op (n=44)</th>
<th>Month 1 (n=44)</th>
<th>Month 6 (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

**Visual Disturbances**

<table>
<thead>
<tr>
<th>Disturbances</th>
<th>Pre Op (n=44)</th>
<th>Month 1 (n=44)</th>
<th>Month 6 (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No disturbance</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Conclusions**

- Bioptics optically better, but additional surgery (LASIK) required (dry eye!)
- Toric multifocal IOLs provide a one-step option to correct astigmatism
- Perfect solution as multifocal IOLs require precise correction of astigmatism
Can I mix different Multifocal IOLs or Multifocal with Monofocal IOLs?

Richard L Lindstrom MD

Curbside Consultation in Cataract Surgery
Submitted by Richard L. Lindstrom, M.D.
Founder: Minnesota Eye Consultants, P.A.
Adjunct Professor Emeritus: University of Minnesota
Department of Ophthalmology

Q. Can I mix different multifocal IOLs or multifocal with monofocal IOLs?
Multifocal intraocular lenses and accommodating intraocular lenses can be paired with a normal crystalline lens in the opposite eye, a monofocal implant in the opposite eye or a different multifocal or accommodating lens in the opposite eye. Combining complementary intraocular lenses provides for many patients a superior outcome to that achieved utilizing the same implant in both eyes. The concept of using different optical systems in each of a patient’s two eyes which are complimentary is not new. The most common example of this, familiar to all ophthalmologists, is monovision where one eye is set for distance and the other for near. If the difference between the two eyes is greater than 1.50 diopters I call that monovision and if it is less than 1.5 diopters I call it blended vision. In blended vision some stereopsis and fusion is retained and a relative amblyopia for distance is less likely. In the case of multifocal and accommodating lenses there are at least 10 potential options which can be utilized. An accommodating lens can be implanted into one eye with a normal crystalline lens in the opposite eye. A multifocal lens can be implanted into one eye with a normal crystalline lens in the other eye. Bilateral accommodating intraocular lenses can be utilized with a symmetrical refractive outcome target. Bilateral accommodating intraocular lens can be utilized with a blended vision outcome (targeting for example -0.25 diopters in one eye and -1.00 diopters in the alternate eye.) Bilateral multifocal implants with the same optical configuration can be implanted in both eyes with a symmetrical refractive outcome target. Bilateral multifocal implants with the same optical configuration can be utilized with a blended vision outcome (targeting for example plano in one eye and -0.50 diopter in the alternate eye). An accommodating intraocular lens can be implanted in one eye and a monofocal implant in the opposite eye. A multifocal intraocular lens can be implanted in one eye and the monofocal lens in the opposite eye. An accommodating intraocular lens can be implanted in one eye and a multifocal lens in the opposite eye. Complimentary multifocal intraocular lenses can be implanted in the alternate eyes. For example a zonal aspheric intraocular multifocal intraocular lens (ReZoom) in one eye and an epodized defractive/refractive multifocal intraocular lens in the opposite eye (ReStor). This has become known as “mix and match” of presbyopia correcting intraocular lenses. To best use complimentary intraocular lenses it is important for the ophthalmologist to understand the strengths and weaknesses of each intraocular lens. The standard monofocal intraocular lens is the best economic value. It gives excellent distance, fair intermediate and poor near vision. For example 20/20+, J4, J7 at the three distances. The pseudo-accommodative amplitude is approximately 2 diopters which means it has about 1 diopter of pseudo-accommodative amplitude to the minus side. This means that if the patient is targeted for a -1.50 refractive outcome they will be able to read as though they had a +2.00 to +2.50 reader. The lens has positive spherical aberration of approximately +0.10 microns, somewhat dependent on optic power and optic design. This type of spherical aberration is best in patients who have negative spherical aberrations in the cornea such as those post-hyperopic LASIK, with keratoconus or a cornea with naturally occurring negative spherical aberration (10-20%). Second, we have aspheric monofocal intraocular lenses including those with no spherical aberration (B & L Advanced Optic) and those with negative spherical aberration (AMO Tecnis, Alcon IQ). The intraocular lens with no spherical aberration is most forgiving of decentration and tilt, and might be selected in patients where decentration might occur such as in pseudexfoliation, a capsular tear or where an ideal capsulorhexis is not available. The implants with negative spherical aberration give better quality of vision, especially mesopic vision in the patient with a typical cornea with positive spherical aberration. They also provide superior performance in the patient that has undergone myopic refractive surgery. The accommodating intraocular lens as designed by Eyeonics and called the CrystaLens gives excellent distance and intermediate vision. Typically one can
achieve 20/20+ and J1 at distance and intermediate respectively. It provides good near acuity with a typical outcome being J3 or better. This lens has the least night vision symptoms, the least loss of contrast sensitivity and the least color distortion of all presbyopia correcting intraocular lenses. It is also pupil size independent in its optical function. It is excellent for blended vision. The zonal aspheric multifocal intraocular lens manufactured by AMO and called the ReZoom provides good distance acuity, good intermediate acuity, and good near acuity. Typical outcomes are 20/20 distance, J2 intermediate and J2 at near. There are some night vision symptoms, some loss of contrast sensitivity and some color distortion. This lens is pupil size dependent. The aspheric diffractive multifocal intraocular lens (AMO Tecnis Diffractive Multifocal Intraocular Lens) provides good distance acuity, fair intermediate and excellent near acuity. Typical outcomes to be expected are 20/20- at distance, J4 at intermediate and J1 at near. It also has the potential for night vision symptoms, decreased contrast sensitivity and some color distortion. The decreased contrast sensitivity usually associated with a multifocal implant is reduced by the aspheric nature of the optic. This lens is not pupil size dependent. The epodized diffractive/refractive multifocal intraocular lens (Alcon ReStor) provides good distance acuity, fair intermediate and excellent near. Distance acuity might be expected to be 20/20- intermediate J4 and near J1. This lens also potentially generates night vision symptoms, decreased contrast sensitivity and color distortion. It is also pupil size dependent as the lens becomes more distance dominant as the pupil dilates. The author and other members of his practice (Minnesota Eye Consultants, P.A.) have utilized all of the above combinations of implants with good success. Multifocal intraocular lenses have been used in a mix and match approach for approximately 20 years, beginning in 1985. Our experience has been that almost all patients adapt well over time to the use of complimentary optics in their alternate eyes. Neuroadaptation is a concept that is receiving increased attention as ophthalmologists use more and more optical systems dissimilar to the natural crystalline lens. It appears that there is an early and late neuroadaptation. Approximately 80 percent of patients seem to adapt easily to complimentary optics whereas 20 percent may struggle for a few months to a year or more. Late neuroadaptation appears to occur at near 100 percent and the author’s personal experience is that there are no patients in his practice with over 2 years follow-up with dissimilar optics who have not adapted well to their optical system. Select recent clinical series of mix and match with some multifocal and accommodating intraocular lenses provide insight into the outcomes that might be obtained. Leonardo Akaishi, MD and Pedro Paulo Fabri, from Sao Paulo, Brazil have performed a comparative series of ReZoom/ReZoom, ReStor/ReStor, ReZoom/ReStor and Tecnis Diffractive/ReZoom. Their outcomes are summarized in Table 1. The best outcomes were obtained with ReZoom/Restor and ReZoom/Tecnis Diffractive Intraocular Lens combinations.

<table>
<thead>
<tr>
<th></th>
<th>ReZoom/ReZoom (N=100)</th>
<th>ReStor/ReStor (N=100)</th>
<th>ReZoom/ReStor (N=88)</th>
<th>ReZoom/Tecnis Diffractive (N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral uncorrected distance</td>
<td>20/20</td>
<td>20/25</td>
<td>20/20</td>
<td>20/20</td>
</tr>
<tr>
<td>Bilateral uncorrected intermediate</td>
<td>J2.15</td>
<td>J3.85</td>
<td>J2.30</td>
<td>J2.10</td>
</tr>
<tr>
<td>Bilateral uncorrected near</td>
<td>J2.30</td>
<td>J1.40</td>
<td>J1.50</td>
<td>J1.10</td>
</tr>
<tr>
<td>Average reading speed (words per minute)</td>
<td>125</td>
<td>165</td>
<td>155</td>
<td>185</td>
</tr>
<tr>
<td>Spectacle independence</td>
<td>75%</td>
<td>89%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Halos/glare</td>
<td>2+</td>
<td>1+</td>
<td>1+</td>
<td>1-</td>
</tr>
<tr>
<td>MTF</td>
<td>0.20</td>
<td>0.12</td>
<td>0.18</td>
<td>0.38</td>
</tr>
</tbody>
</table>
Rick Milne, MD from Columbia, South Carolina has also performed a comparative series looking at patient satisfaction, spectacle independence and daytime and nighttime halo. His outcomes are summarized in Table 2. Again, the ReZoom/ReStor outcomes generated higher patient satisfaction than the ReStor/ReStor outcomes in this series.

<table>
<thead>
<tr>
<th></th>
<th>ReStor/ReStor (N=30+)</th>
<th>ReZoom/ReStor (N=30+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfied/Very Satisfied</td>
<td>83%</td>
<td>96%</td>
</tr>
<tr>
<td>Neutral Dissatisfied</td>
<td>0</td>
<td>4%</td>
</tr>
<tr>
<td>Very Dissatisfied</td>
<td>17%</td>
<td>0%</td>
</tr>
<tr>
<td>Would have procedure again,</td>
<td>70%</td>
<td>97%</td>
</tr>
<tr>
<td>recommend to family &amp; friends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete spectacle independence</td>
<td>65%</td>
<td>94%</td>
</tr>
<tr>
<td>Daytime halo</td>
<td>43%</td>
<td>18%</td>
</tr>
<tr>
<td>Nighttime halo</td>
<td>86%</td>
<td>71%</td>
</tr>
<tr>
<td>Requesting explants</td>
<td>6%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Frank A. Bucci, Jr. MD from Wilkes-Barre, Pennsylvania has also completed a series comparing ReStor/ReStor to ReZoom/ReZoom. His outcomes are summarized in Table 3. Of note, is that his intermediate vision outcomes are significantly better with ReZoom/ReStor than with ReStor/ReStor and that his patient satisfaction is also higher.

<table>
<thead>
<tr>
<th></th>
<th>ReStor/ReStor (N=55+)</th>
<th>ReZoom/ReStor (N=39+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral uncorrected distance</td>
<td>20/25</td>
<td>20/25</td>
</tr>
<tr>
<td>(P=NS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilateral uncorrected intermediate</td>
<td>J3.81</td>
<td>J2.39</td>
</tr>
<tr>
<td>(P.001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilateral uncorrected near</td>
<td>J1.00</td>
<td>J1.04</td>
</tr>
<tr>
<td>(P=NS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unhappy with intermediate</td>
<td>32%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Finally, Trevor Woodhams, MD from Atlanta, Georgia has a series of patients with Crystalens/ReStor use in alternate eyes. Again, he found excellent distance, intermediate and near vision with high patient satisfaction.

<table>
<thead>
<tr>
<th></th>
<th>Crystalens/ReStor (N=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral uncorrected distance</td>
<td>20/25</td>
</tr>
<tr>
<td>Bilateral uncorrected intermediate</td>
<td>J1.3</td>
</tr>
<tr>
<td>Bilateral uncorrected near</td>
<td>J1.3</td>
</tr>
</tbody>
</table>

In summary, the human visual system can neuroadapt to dissimilar optics in alternate eyes. Patients should be given at least one year to neuroadapt to their new optical system before explant/exchange is considered. Multifocal or accommodating intraocular lenses can be used successfully with a monofocal intraocular lens in the opposite eye. Multifocal or accommodating intraocular lenses can also be used successfully with a natural crystalline lens in the opposite eye. Of great importance is the observation that complimentary multifocal and accommodating intraocular lenses may provide superior outcomes for many patients than symmetrical implantation of the same intraocular lens in both eyes, especially at intermediate distance. Further clinical study is ongoing but the current evidence supports the use of complimentary presbyopia correcting intraocular lenses in the alternate eyes of select patients.
“Dual-Optic Accommodating IOL results: effective near vision with no contrast sensitivity penalization”
Matteo Piovella MD & Barbara Kusa MD

<table>
<thead>
<tr>
<th>Synchrony Dual-Optic IOL</th>
<th>Synchrony Preloaded Injector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What is the Synchrony AIOL?</strong></td>
<td></td>
</tr>
<tr>
<td>- Single-piece, dual-optic silicone IOL</td>
<td></td>
</tr>
<tr>
<td>- Three-dimensional lens designed to fill the capsular bag</td>
<td></td>
</tr>
<tr>
<td>- 0.5 mm high plus anterior optic (+0.2D)</td>
<td></td>
</tr>
<tr>
<td>- 6.0 mm variable negative posterior optic</td>
<td></td>
</tr>
<tr>
<td>- Optics conformed by spring haptics</td>
<td></td>
</tr>
<tr>
<td>- Size 9.5 mm x 9.8 mm</td>
<td></td>
</tr>
<tr>
<td>- Single-use, disposable</td>
<td></td>
</tr>
<tr>
<td>- Easy to use</td>
<td></td>
</tr>
<tr>
<td>- Controlled release</td>
<td></td>
</tr>
<tr>
<td>- Consistent delivery</td>
<td></td>
</tr>
<tr>
<td>- Current incision size 5.75 mm</td>
<td></td>
</tr>
</tbody>
</table>

**Aqueous Channels**
- Support the anterior bag while providing fluid channels
- Facilitate fluid egress
- Encapsulate capsule preventing capsule - IOL sealing and nesting

**Posterior Wings**
- Insure proper posterior position
- Compensate for capsular bag size variations
- Prevent deconcentration

**Spacers**
- Provide consistent separation distance at emmetropia
- Prevent lens adhesion

**Spring Haptics**
- Bias the system open
- Provide consistent separation force
- Optimized movement
Symphony AIOL

At distance the 2 optics are chosen together providing monovision.

When the ciliary body contracts, reducing capsular bag and zonular tension, the anterior lens moves forwards, changing the eye’s focus to near & intermediate.

Symphony Implantation Technique

- Insert injector tip to CCC edge
- Release 1st optic
- Open capsular bag by pushing leading optic against the posterior capsule
- Deliver 2nd optic into capsular bag

Symphony IOL - Objective Accommodation

Dynamic accommodative responses from one eye of one patient are shown below. This case was chosen because high quality images were obtained during complete accommodative cycles in this eye. The left figure shows that this subject achieved different levels of accommodation during a 5-minute session. Although not the highest level of accommodation available to this subject the video on the right side (red inset) depicts a complete accommodative cycle.

Capsularhexis and Symphony Implantation

Must be...
- Round
- Centered
- Symmetric
- Intact
- Free of notches
- Approx. 4.5 - 5.0 mm

Next Generation Symphony Accommodating IOL

- The next generation Symphony Accommodating IOL is designed to provide enhanced near vision without compromising quality of vision.
- Central blended astigmatic zone designed to extend depth of focus.
- Latest innovation advancing the Symphony platform.
- The lens is CE Mark approved and will be available next year.

Symphony Dual Optics AIOL - One Year Clinical Results

32 eyes of 16 patients

Mean Age 71.46 ± 7.54
Mean Preoperative BCVA 0.66± 0.33
Mean Time Follow Up Days 38± 42.22
Mean Preoperative Sphere Equivalent 0.88 ± 1.47
Inclusion Size : 3.75 mm using calibrated metal knife
Accommodating IOL: Best

- No Contrast Sensitivity Penetration
- No Patient Complained of Severe/Very Severe Halos or Glare
- Future AMD: No Future Visual Penetration due to IOLs Technology
- Best Choice for Suspicious Patient, with Possible High Sensitivity to Glare and Halos, but Highly Demanding for New Technology IOLs
- Provide Intermediate Vision Effective for Computer Distance

Quality of Vision - Halos

No Synchrony patient complained of severely/very severe halos or glare
(Fisher's Exact, p < 0.001)

Quality of Vision
Contrast Sensitivity and Control Values

Control values for CS are derived from Heidener paper
G. Heidenberg et al. - Measuring contrast sensitivity in normal subjects with OPTikon 6500:

- 10-14 healthy phakic subjects for the following age groups:
  - 20: 30-40-50-60-70-80-90
  - Functional Image Analyzer OPTikon 6500
  - Daytime (20 odm), Nighttime (3 odm) and Nighttime with Glare (2 odm)
  - Monocular testing
  - Paper demonstrated strong age dependence of CS with age

Multifocal IOLs Contrast Sensitivity

Contrast Sensitivity

Daytime, Nighttime and Nighttime with glare

Contrast Sensitivity in mesopic & photopic conditions

Dual-Optic Accommodating IOL: Possible Weak Points

- New Surgical Technique
- Incision Size 3.2 mm
- Perfect Surgery Required to Implant Synchrony IOL
- Postop Temporary Induced Myopia (At Least Two Months)
- Temporary Glasses Prescription to Drive Car
- Slight Difficulties in reading J 2
- Near Vision Prescriptions 11 of to read 16/20 Characters

28
“New methods for Astigmatism Control in surgeries with Premium IOLs”

Roberto Zaldivar MD

With the advent of the new toric PHAKIC AND PSEUDOPHAKIC MULTIFOCAL intraocular lenses the accuracy in the calculation of the lens POWER and the ADECUATE alignment OF THE IOL’S AXIS, are becoming increasingly important KEY FACTORS IN ORDER TO determine the success or failure of THE surgical OUTCOMES.

WHEN USING A diffractive multifocal OPTICAL system, ANY LOW TO MODERATE spherical or cylindrical error CAN CAUSE a drastic drop in the PATIENT’S POSTOPERATIVE VISUAL ACUITY AND CONTRAST SENSITIVITY, as well as THEIR MTF IN THEIR optical quality ASSESMENT.

DURING THE COURSE, WE WILL DEMONSTRATE HOW refinements of THE PAST AND CURRENT FORMULAS for calculating TORIC IOL POWER, AND THE DEVELOPMENT OF NEW ALIGNMENT TECHNIQUES HAVE A DIRECT IMPACT ON THE POSTOPERATIVE REFRACTIVE OUTCOMES.
MATTEO PIOVELLA MD
C. M. A.
Centro Microchirurgia Ambulatoriale
Via Donizetti, 24 - 20052
Monza- Italy
Ph.: +39 039389498
Fax:+39 0392300964
e-mail: piovella@piovella.com

CLAUDIO CARBONARA MD
Studio Carbonara
Via Vessella, 7 00199
Rome, Italy
Ph.: +39 0686200243
e-mail: studio.carbonara@gmail.com

JACK T HOLLADAY MD MSEE FACS
5108 Braeburn DR,
BALLAIRE TX 77401-4902
Ph.: (713) 668 7337
Fax: (713)669 9153
e-mail: holladay@docholladay.com

MICHAEL C KNORZ MD
FreeVis LASIK Center,
Klinikum Mannheim,
Mannheim 68135
Germany
Ph.: 49-621-383-2242
Fax: 49-621-383-1984
e-mail: knorz@eyes.de

RICHARD L LINDSTROM MD
Minnesota Eye Consultants,PA
Ste 200 9801 Dupont Ave S
Bloomington MN 55431-3200
Ph.: 952-567-6051
Fax: 952-567-6182
e-mail: rllindstrom@mneye.com

SCIPIONE ROSSI MD
Ospedale San Carlo
Via Aurelia 55 Roma
Ph. +39 06 39706242
e-mail:s.rossi@idi.it

ROBERTO ZALDIVAR MD
Inst. Zaldivar
Av Emilio Civit 685 Mendoza,
MZA 5500 Argentina
Ph.: 54 261 4419-999
Fax: 54 261 4380-350
e-mail: zaldivar@zaldivar.com