Corneal Compensation of Presbyopia

INSTRUCTIONAL COURSE

COURSE DIRECTOR:
Jorge L. Alió, Spain

COURSE PARTICIPANTS:
Dan Reinstein, UK
Ioannis Pallikaris, Greece
Günther Grabner, Austria
Julian Stevens, UK
Mike Holzer, Germany

ESCRS, VIENNA, 2011

The optical system of the human eye

The optical system of the human eye

NORMAL CORNEA DEPTH OF FOCUS

DOF=0.75 D

Course schedule

Introduction: Is corneal accommodation possible?
Jorge Alió

Femtosecond presbyopic correction:
Mike Holzer

Refractive inlays:
Flexivue Presbylens:
Ioannis Pallikaris

The Presbylens (Revision Optics):
Julian Stevens

Pinhole inlays: Fundamentals of pinhole inlays. The Kamra Acufocus:
Günter Grabner

Excimer laser Presbylasik techniques:
Peripheral Presbylasik techniques:
Daniel Reinstein

Central Presbylasik techniques:
Jorge Alió

Panel discussion:

CORNEAL ACCOMODATION

How does the cornea focus at different distances

1. MULTIFOCALITY

2. DEPTH OF FIELD

FACTORS THAT INFLUENCE NORMAL CORNEAL ACCOMMODATION

• Myopic Astigmatism

• Irregular Cornea: Keratoconus

• Manipulated corneas: Spherical & Coma aberration
**CORNEAL ACCOMODATION**

How does the cornea focus at different distances?

1. MULTIFOCALITY
2. DEPTH OF FIELD

**METHODS TO INDUCE CORNEAL ACCOMMODATION**

- **CORNEAL LASER SURGERY:**
  - Excimer Laser Multifocal Cornea (PresbyLasik techniques):
    - Intrastromal Femtosecond multifocality
- **CORNEAL INLAYS:**
  - Refractive Inlays
  - Pinhole Inlays

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**EXCIMER LASER SURGERY:**

**MODERN PRESBYLASIK**

1. CENTER FOR NEAR: Central hyperpositive multifocal area (Central Presbylasik).
2. CENTER FOR FAR: Peripheral multifocal area (Peripheral Presbylasik).

**MODERN REQUIREMENTS FOR PRESBYLASIK TECHNIQUES**

- Bilateral
- Should not decrease vision for far
- Should improve functional vision to adequate levels
- Should not induce collateral negative symptoms
- Should be stable
- Minimally invasive

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**CENTRAL PRESBYLASIK**

**CENTER FOR NEAR MIGHT BE BETTER...**

- Synergistic with convergence myosis
- Synergistic with the line of sight
- Minimal tissue ablation added to the correction of the main defect
- Minimal neuroadaptation, immediate outcome
- Focus dominance FAR/NEAR depending on pupil size
- Minimal induction of HOA / minimal or no degradation of the quality of the retinal image
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</tr>
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<td>0.5</td>
<td>0.0390</td>
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<td>8%</td>
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<td>0.1700</td>
<td>15%</td>
</tr>
<tr>
<td>2</td>
<td>0.2500</td>
<td>25%</td>
</tr>
<tr>
<td>2.5</td>
<td>0.3050</td>
<td>30%</td>
</tr>
<tr>
<td>3</td>
<td>0.3600</td>
<td>36%</td>
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<tr>
<td>3.5</td>
<td>0.3900</td>
<td>39%</td>
</tr>
<tr>
<td>4</td>
<td>0.4000</td>
<td>40%</td>
</tr>
<tr>
<td>4.5</td>
<td>0.4000</td>
<td>40%</td>
</tr>
<tr>
<td>5</td>
<td>0.3900</td>
<td>39%</td>
</tr>
</tbody>
</table>

**EQUIVALENCE BETWEEN CORNEA AND IOL OPTICAL POWER FOR A...**

**PERIPHERAL PRESBYLASIK**

- Based on the induction of high levels of negative asphericity at the mid — peripheral cornea
- The induction of high levels of negative spherical aberration increases dept of field
- Requires a period of neuroadaptation

**PERIPHERAL PRESBYLASIK**

Visx Aspheric Presby Ablation

**CENTRAL Vs PERIPHERAL PRESBYLASIK**

Differences in tissue removal:

- **HYPEROP +3 (+2 near ADD)**
  - CENTRAL: 4 micron more
  - PERIPHERAL: 150 micron for -0.5 asphericity

- **MYOP -3 (+2 near ADD)**
  - CENTRAL: 4 micron
  - PERIPHERAL: 200 micron for -0.25 asphericity, > 270 micron for -0.5 asphericity

**CENTRAL PresbyLasik**

PresbyMax®
PERIPHERAL PRESBYLASIK
Aspheric Visx Treatment

CustomVue

CustomVue + Presby

+2.00 +0.50 x 125

Presbyopia Ablation

PresbyLasik Meta-analysis
(only bilateral procedures)

Number of studies:
Peripheral: 9
Central: 4

Years:
2004 to 2009

Number of eyes included:
Peripheral: 1072
Central: 140

Level of evidence:
Peripheral: 1.66
Central: 2

PresbyLASIK – Main Reports

investigator
Ali
Jackson
Jung
Williams

Laser
H. Eye Tech
AMO/VISX
AMO/VISX (software)

N=eyes/patients
50/25 LASIK
56/28 LASIK
54/27 LASIK (25) PRK (29)
60/30 PRK

Age
58 (51–68)
56 (45–65)
53 (45–63)
52 (46–61)

Mean SE
+1.69 ±0.63 D
+1.92 ±0.56 D
+1.16 ±0.82 D
+1.46 ±0.55 D
+0.16 ±0.60 D

Follow-up (mths)
66
66
66
66

Binocular UCDVA
20/25 or better
88%
100%
93% (monocular)
86%

Binocular UCNVA J3
or better
91%
100%
64%
97%

Mean Post-op SE
0.34 ±0.55 D
+0.07 ±0.48 D
+0.33 ±0.45 D
+0.16 ±0.60 D

Simultaneous 20/25 & J3
100%
64% --

Lines Lost Dist & Near
14%, 2 lines dist
14%, for near
16%, 2 lines dist
8.3%, near
4%, 2 lines dist
0%, near
0%, 2 lines dist
0%, near

Contrast Acuity
Decreased
Not Significant
Decreased
Not Significant

Satisfaction Dist & Near
High, 72% no glasses
High, 49% no glasses
High, 79% satisfied

Retreatments
12%
0%
0%
0%


Last 5 years reports
(only binocular procedures)

Definition of success:
• Far: ≥0.8 (20/25)
• Near: ≥J3

<table>
<thead>
<tr>
<th>Type of presbylasik</th>
<th>MONOCULAR</th>
<th>BINOCULAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENTRAL No. Eyes</td>
<td>706 (94.1%)</td>
<td>705 (93.9%)</td>
</tr>
<tr>
<td>PERIPHERAL No. Eyes</td>
<td>88 (97.1%)</td>
<td>70 (99%)</td>
</tr>
<tr>
<td>CENTRAL No. Patients</td>
<td>264 (100%)</td>
<td>277 (100%)</td>
</tr>
<tr>
<td>PERIPHERAL No. Patients</td>
<td>--</td>
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</tr>
</tbody>
</table>

UCVA
DISTANCE ≥0.8 (20/25)

UCVA NEAR ≥ J3
90% (100%)

* COMMENT: Peripheral presbylasik requires a longer follow-up to achieve success.

FEMTOSECONDS MULTIFOCAL CORNEA SURGERY
(Intracore®)

INTRACOR presbyopia mechanism

IOP
CENTER FOR NEAR CORNEAL LASER PROCEDURES

- Both PresbyMax and Intracore work improving near vision related to pupil size
- Both, confirmed by optical analysis by simulated RayTrace on real case data
- To add central corneal power should have equivalent effects to multifocal pupil dependent IOLs
- Still, these techniques require to pass the test of time to confirm stability of the outcomes

CORNEAL INLAYS

- REFRACTIVE:
- PINHOLE:

FLEXIVUE® Optical Design

- Inlay steepens central cornea
  - Dilated pupil allows for distance image focus
  - Pupil constriction during accommodative response increases near power to create pseudo-accommodation

FLEXIVUE SLIT LAMP APPEARANCE
CORNEA INLAYS

- **PINHOLE EFFECT**
  - Random hole pattern
  - Pores are 5 to 11 microns diameter
  - Solid ID and OD edge

**Presbyopic Near Vision with a Pinhole Inlay**
- Near Object
- Lens Cannot Accommodate
- Focus Behind Retina
- Smaller Blur Circle
- Less Blurred Image

**Depth of Field with Kamra**
- Distance Vision is Clear
- Near Vision is Clear
- Intermediate Vision is Clear

**Kamra Slit Lamp appearance**

**CONCLUSIONS**
- Corneal compensation of presbyopia can be accomplished through different mechanisms and surgical techniques
- Such methods are feasible and successful
- They will have probably different indications depending on patient’s profile and corneal anatomy
- They may offer a more attractive option than CLT (Cristaline Lens Mutilation and substitution by an IOL) as they are less invasive and, in some cases, reversible
Pinhole Inlays
Fundamentals, Results, Complications and Outlook of the AcuFocus™ Kamra Inlay

G. Grabner and co-workers

Pinhole Inlays
Fundamentals, Results, Complications and Outlook of the AcuFocus™ Kamra Inlay

Universitätsaugenklinik Salzburg
AcuFocus™ ACI-7000 Corneal Inlay

• Designed to improve near and intermediate vision in presbyopia
• Polyvinylidene fluoride
• 1600 random nutritional holes (25µm Ø)

Central aperture: 1.6 mm
Overall diameter: 3.8 mm
10 microns thin

Blocks unfocused light
Allows focused light into the eye

Near Vision
Same principle used in camera lenses to increase range of vision

Normal
Presbyopia
With ACI
Increasing Depth of Field!

Surgical Procedure

• Non-dominant Eye
• Topical anesthesia
• Flap created (Intralase, 170 µm depth)
• ACI-7000 insertion and centration
• Closing of flap
• < 30 minutes - start to finish

Study Design / Salzburg Group

As part of a prospective nonrandomized Multicenter FDA Study - European Sites

Inclusion criteria
• Natural presbyopic emmetropes
• Age between 45 - 55 years
• Refractive myopia of ≤ 0.25 sph
• Refracting astigmatism ≤ 1.00 sph or ≤ 2.5 sph
• K-values ≤ 41.00D and ≤ 47.00D
• UNVA ≥ 20/100 and ≤ 20/60
• BCVA 20/20 in both eyes

Exclusion criteria
• Prior eye surgery
• Any other eye disease
• Cycloplegic Refraction > ± 0.5 sph

RE
45 year old presbyope
NON-implanted eye

OQAS Accommodative Range (D): 0.25
49 year old presbyope

**Uncorrected Visual Acuity Results (mean)**

### Salzburg Results

| Test Type               | Months | n=32 | 1Mo | n=32 | 3Mo | n=32 | 6Mo | n=32 | 9 Mo | n=32 | 12Mo | n=32 | 24Mo | n=32 | 30Mo | n=31 | 36Mo | n=32 |
|-------------------------|--------|------|-----|------|-----|------|-----|------|------|------|------|------|------|------|------|------|------|
| **Near (IE)**           |        |      |     |      |     |      |     |      |      |      |      |      |      |      |      |      |      |
| FDA: 75%                | J-7    | J-8  | +3.6| +4.4 | +4.3| +4.7 | +4.4| +4.4 | +4.4 | +4.4 | +4.4 | +4.4 | +4.4 | +4.4 | +4.4 | +4.4 | +4.4 |
| **Intermediate (IE)**   |        |      |     |      |     |      |     |      |      |      |      |      |      |      |      |      |      |
| Letter size seen at 80 cm testing distance |        |      |     |      |     |      |     |      |      |      |      |      |      |      |      |      |      |
| **Distance (IE)**       |        |      |     |      |     |      |     |      |      |      |      |      |      |      |      |      |      |      |
| FDA: 75%                | 20/16  | 20/25| +1.4| +1.8 | +1.7| +1.7 | +1.6| +1.8 | +2.3 | +2.3 | +2.3 | +2.3 | +2.3 | +2.3 | +2.3 | +2.3 | +2.3 |

### Uncorrected Near VA (Implanted Eye)

- FDA: 75% ≥ J5
- J1 or better
- J3 or better
- J5 or better

### Uncorrected Intermediate VA (IE)

- 20/20 or better
- 20/25 or better
- 20/32 or better
- 20/40 or better

### Uncorrected Distance VA (IE)

- 20/20 or better
- 20/25 or better
- 20/32 or better
- 20/40 or better

### Uncorrected Distance & Near VA

- 20/20
Complications

0.5 mm recentration after 7 months

2 cases with decentered inlays

11 cases with epithelial ingrowth and repeated flap lift

Low decrease UDVA, low increase in UNVA & UIVA 6 months after implantation

Solution for optimising centration

Line-of-sight (LOS) - Device

The KAMRA AcuTarget

Future?

- is here!

In-Situ Centration Guidance

For the AcuFocus Corneal Inlay (ACI)

AcuFocus™ ACI 7000 - Conclusions

- Effective
- Extraocular and minimally invasive
- Stable and well tolerated
  - potentially reversible
- Allows for complete ocular exam / Tx postop.
- Great potential
  - post-LASIK presbyopia
  - pseudophakia
4 years post fs-LASIK
IFS > 220 μ

Excellent option for presbyopia!
Laser Blended Vision with MEL80

Dan Z Reinstein MD MA(Cantab) FRCSC FRCOphth1,2,3,4

1. London Vision Clinic, London, UK
2. St. Thomas’ Hospital - Kings College, London, UK
3. Weill Medical College of Cornell University, New York, USA
4. Centre Hospitalier National d’Ophtalmologie, (Pr. Laroche), Paris, France

This indication for use is not cleared by the FDA for distribution in the United States

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dzr@londonvisionclinic.com

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The author (DZ Reinstein) is a consultant for Carl Zeiss Meditec AG (Jena, Germany)

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Laser Blended Vision: 8-in-1 Mechanism

1. Monovision principle
2. Depth of field to reduce anisometropia
3. Spherical aberration control
   (DOF without decrease quality of vision)
4. Vertex centration of spherical aberration
   (OSA coma, on-axis symmetry of image blur)
5. Retinal image processing (edge detection)
6. Neural summation
7. Blur adaptation
8. Neural suppression

Influence of Spherical Aberration on Depth of Field

Slides courtesy Hartmut Vogelsang, PhD
Laser Blended Vision: 8-in-1 Mechanism

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How much spherical aberration?

<table>
<thead>
<tr>
<th>Spherical Aberration</th>
<th>Control</th>
<th>WFG Repair</th>
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<td>Low</td>
<td></td>
<td></td>
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<tr>
<td>High</td>
<td></td>
<td></td>
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<tr>
<td>High Pre SA</td>
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</table>

- Tolerable level ~0.56 µm @ 6mm

Depth of Field by SA: Myopia

Depth of Field by SA: Hyperopia

Depth of Field by SA: Emmetropia

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If we can increase depth of field fully by spherical aberration, brain can create sharp perception at all distances.
**Simulation for -1.50 D defocus**
-1.50 D @ 7 mm

- Reduce pupil size to 4 mm
- Add spherical aberration

With spherical aberration and @ 4 mm

Central neural processing

**Presbyopia: Ideal Solution**
- Far Distance
- Distance
- Intermediate
- Near

- Right Eye
- Left Eye

- 3.00 D
- 3.00 D

**Current Possible Depth of Field Increase**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Right Eye</th>
<th>Left Eye</th>
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</thead>
<tbody>
<tr>
<td>Far</td>
<td>1.50 D</td>
<td>1.50 D</td>
</tr>
<tr>
<td>Intermediate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near</td>
<td></td>
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</tbody>
</table>

**Loss of contrast**

**Laser Blended Vision: 8-in-1 Mechanism**

1. Monovision principle
2. Depth of field to reduce anisometropia
3. Spherical aberration control
   - [DOF without decrease quality of vision]
4. Vertex centration of spherical aberration
   - [OSA coma, on-axis symmetry of image blur]
5. Retinal image processing
   - [edge detection]
6. Neural summation
7. Blur adaptation
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**Laser Blended Vision – Micro-Monovision**

<table>
<thead>
<tr>
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<th>Dominant Eye</th>
<th>Non-Dominant Eye</th>
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<tbody>
<tr>
<td>Far</td>
<td>1.50 D</td>
<td>1.50 D</td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near</td>
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**Contact Lens Monovision**

<table>
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<th>Distance</th>
<th>Dominant Eye</th>
<th>Non-Dominant Eye</th>
</tr>
</thead>
<tbody>
<tr>
<td>Far</td>
<td>1.50 D</td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near</td>
<td></td>
<td>1.50 D</td>
</tr>
</tbody>
</table>
Correcting Presbyopia: Contact Lens Monovision

Dominant eye: mainly corrected for distance

Non-dominant eye: mainly corrected for near

Brain merges two images to see near and far without glasses

Patients Tolerate

Dominant eye: mainly corrected for distance

Non-dominant eye: mainly corrected for near

Brain merges two images to see near and far without glasses

Patients Tolerate

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Reinstein DZ et al. LASIK for Hyperopic Astigmatism and Presbyopia Using Micro-monovision with the Carl Zeiss Meditec MEL80. JRS. 2009;25(1):87-93

Binocular Vision: Neural Summation

Distance UCVA After All Treatments

Binocular 13% 53% 96% 98% 100% 100% 100%

Distance Eyes 9% 45% 92% 98% 99% 100% 100%

Near Eyes 1% 3% 15% 24% 36% 45% 80%

Cumulative Percentage Eyes

Near 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Distance UCVA After All Treatments

Binocular 13% 53% 96% 98% 100% 100% 100%

Distance Eyes 9% 45% 92% 98% 99% 100% 100%

Near Eyes 1% 3% 15% 24% 36% 45% 80%

Cumulative Percentage Eyes

Near 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Blur Adaptation

Wore glasses except for VA measurement

No change in Rx

No glasses throughout

Wore glasses throughout
**Laser Blended Vision: 8-in-1 Mechanism**

1. Monovision principle
2. Depth of field to reduce anisometropia
3. Spherical aberration control (DOF without decrease quality of vision)
4. Vertex centration of spherical aberration (OSA coma, on-axis symmetry of image blur)
5. Retinal image processing [edge detection]
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**Ocular Rivalry and Blur Suppression vs Multifocal**

- Neuronal gates instantaneously select the better image, or elements of each, to obtain the best image for the task at hand

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**Brain adaptation**

- Multi-focality
- Binocular Fusion

---

**Problem With Multi-focality**

- Multi-focal IOLs
- PROBLEM: Two Images

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**Laser Blended Vision: 8-in-1 Mechanism**

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**Centration: Visual Axis vs Entrance Pupil**

- Phoroptor Manifest Refraction
- No Angle Kappa
- Large Angle Kappa
- Excimer Laser Ablation
**Centration: Visual axis vs Pupil centre**

- **Higher order wavefront map**
- **Objective Point Spread Function**
- **Subjective Point Spread Function**

Subjective PSF correlates with vertex PSF, NOT pupil PSF

**Laser Blended Vision: 8-in-1 Mechanism**

1. Monovision principle
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   - (DOF without decrease quality of vision)
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**Outcomes**

**Measurement of Effective Depth of Field**

Example: Emmetropic Patient

**Laser BV Emmetropic LASIK – 56 yo Female**

<table>
<thead>
<tr>
<th>56 yo</th>
<th>OD</th>
<th>OS</th>
<th>Binocular</th>
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</thead>
<tbody>
<tr>
<td>Pre</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Manifest</td>
<td>+0.75 -0.75 x 158</td>
<td>+0.50 -0.75 x 170</td>
<td></td>
</tr>
<tr>
<td>BSCVA</td>
<td>20/16</td>
<td>20/16</td>
<td></td>
</tr>
<tr>
<td>1 Yr Post Op</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UCVA</td>
<td>20/16</td>
<td>20/32</td>
<td>20/16 &amp; J2</td>
</tr>
<tr>
<td>Manifest</td>
<td>+0.25 sph</td>
<td>-1.00 -0.50 x 20</td>
<td></td>
</tr>
<tr>
<td>BSCVA</td>
<td>20/16</td>
<td>20/16</td>
<td></td>
</tr>
</tbody>
</table>

**Expected Distance UCVA**

- **Near eye Rx:** -1.00 -0.50 x 20
  - SEQ -1.25 D  → UCVA 20/63

**Expected Distance UCVA**

- **Near eye Rx:** -1.00 -0.50 x 20
  - SEQ -1.25 D  → UCVA 20/63
  - Actual UCVA 20/32  → -0.50 D
**Expected Near Addition – 56 yo Female**

- Near eye Rx: -1.00 -0.50 x 20
  - SEQ -1.25 D → UCVA 20/83
  - Actual UCVA 20/32 → -0.50 D

**Depth of Field – 56 yo Female**

- Near eye Rx: -1.00 -0.50 x 20
  - SEQ -1.25 D → UCVA 20/83
  - Actual UCVA 20/32 → -0.50 D

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**Outcomes of Non-linear Aspheric Presbyopic Micro-monovision LASIK for Myopia, Hyperopia, and Emmetropia**

- **Myopia**
  - SEQ: -3.58 ± 1.80 D (up to -8.50 D)
  - Cylinder: -0.83 ± 0.64 D (up to -2.50 D)
  - Age: median 49 yrs (43 to 63 yrs)

- **Hyperopia**
  - SEQ: +2.58 ± 1.17 D (up to +5.75 D)
  - Cylinder: -0.49 ± 0.50 D (up to -3.25 D)
  - Age: median 56 yrs (44 to 66 yrs)

- **Emmetropia**
  - SEQ: +0.35 ± 0.35 D (up to +0.75 D)
  - Cylinder: -0.39 ± 0.30 D (up to -1.00 D)
  - Age: median 54 yrs (43 to 71 yrs)

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**Routine LASIK Procedure**

- **Hansatome 160**
- **CRS-Master** custom programming (Non-linear aspheric ablation profile)
- MEL80 excimer laser
- Micro-monovision:
  - Dominant: “plano” [plano to -0.75]
  - Non-dominant: “-1.50 D” [-0.75 to -2.25]
- >90% follow up at 1 year
- Results presented including enhancements

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**Laser Blended Vision: Results**

- **Myopia**: 20/20 & J5
- **Hyperopia**: 20/20 & J5
- **Emmetropia**: 20/20 & J5

- **Myopia**: 98.5%
- **Hyperopia**: 94.5%
- **Emmetropia**: 97.7%
**Blended Vision: Safety**

Range: -8.50 D – plano – +5.75 D

<table>
<thead>
<tr>
<th>Lines Change in BSCVA</th>
<th>Percentage Eyes</th>
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<tbody>
<tr>
<td>Loss 2 or More</td>
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<tr>
<td>Gain 2 or More</td>
<td>1%</td>
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<tr>
<td>No Change</td>
<td>62%</td>
</tr>
<tr>
<td>Loss 1 or Gain 1</td>
<td>22%</td>
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</tbody>
</table>

| Myopia                | 0.0% 8% 55% 36% 1% |
| Hypertropia           | 0.0% 17% 62% 19% 2% |
| Emmetropia            | 0.0% 13% 64% 22% 1% |

**Laser Blended Vision: Contrast Sensitivity**

Statistically significant improvement (p<0.05)

**Stereo Acuity: Patients & Methods**

- 22 myopes, 38 hyperopes, 16 emmetropes
- Stereo acuity measurements (4-dot test)
  - Pre-op: near-corrected
  - Post-op: near-corrected
  - Post-op: uncorrected
- Analysis
  - Safety: post-op near corrected – pre-op near corrected
  - Efficacy: post-op uncorrected – pre-op near corrected

**Stereo Acuity: Safety**

- All eyes retained BCSA of 100 arcsec or better post-operatively
- No statistically significant difference between pre-op best-corrected stereoacuity and post-op best-corrected stereoacuity (p=0.185)

**Stereo Acuity: Efficacy**

- All eyes retained UCSA of 400 arcsec or better post-operatively
Non-linear Aspheric Micro-Monovision:

Summary

- Non-linear aspheric micro-monovision
  - Correction of pure presbyopia (distance normal)
  - Wide range of refractive error: +5.00 to -9.00
  - Simultaneous accurate correction of cylinder
  - Easily enhanced in future if required
  - Centration on visual axis
  - Minimal compromise to contrast sensitivity and night vision disturbances
  - Tolerated by >95% of patients
  - Functional stereo acuity maintained
  - Performed as bilateral simultaneous 10 minute procedure with fast recovery

Laser Blended Vision with MEL80

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2. St. Thomas' Hospital - King's College, London, UK
3. Weill Medical College of Cornell University, New York, USA
4. Centre Hospitalier National d'Ophthalmologie, (Pr. Laroche), Paris, France

This indication for use is not cleared by the FDA for distribution in the United States

Thank You
Intracorneal Inlays for Presbyopia

- The Lens is implanted into the corneal stroma of the non-dominant eye, inside a pocket created using femtosecond laser.

**Figure 1:** The Flexivue Microlens™ is a transparent, hydrophilic disc with 3 mm diameter and approximately 15 μm edge thickness. The central 1.8 mm diameter of the disc is plano and the peripheral zone has an add power. The base power available range from +1.25 D to +3.50 D in 0.25 D increments. At the center of the disc there is a hole of 0.5mm diameter that permits the transfer of oxygen and nutrients of the cornea through the lens.

### Refractive Power:
- +1.25D to +3.50D
- No Refractive Power

**Figure 2:** During far vision the rays pass through the central zone of the implant (blue line) and through the free peripheral corneal tissue (interrupted blue line) without the lens add refractive effect and will be sharply focused on the retina, whereas the rays which pass through the refractive peripheral zone (red line) will be focused in front of the retina.

**Figure 3:** During near vision the rays pass through the central zone of the Lens (blue line) will be out of focus behind the retina and the rays passing through the peripheral clear cornea will be blocked by the pupil (interrupted blue lines). The rays passing through the peripheral refractive zone (red lines) will be focus on the retina.

### Femtosecond-assisted Corneal Pocket

#### Femto parameters:
- iPockets software
  - Depth: 280-300
  - Diameter: 4 mm
  - Bed energy: 0.60-0.70
  - Spot-Line Sep: 2-2 (or 3-3)
  - Side cut energy: 1.6-1.7
  - Side cut angle: 160
- Deactivate pocket
- Suction-applanation

### The Four Principal Phases

1. Create the corneal pocket
2. Mark the center of the visual axes
3. Implant the Lens
4. Check the position of the Lens

### Uncorrected Near Visual Acuity in the Operated Eye IV-31

- Pre-Op
- 1 Day
- 1 Week
- 1 Month
- 3 Months
- 6 Months

<table>
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<th>40%</th>
<th>60%</th>
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