# Correction of Pseudophakic Presbyopia with Multifocal IOLs

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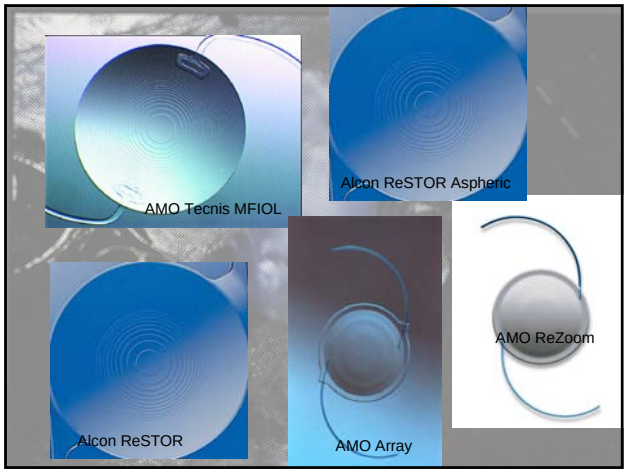


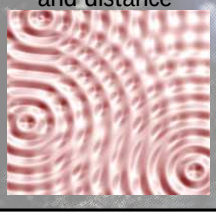

## Multifocal Lenses

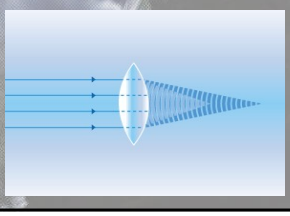
### Basic Designs

- Diffractive-only bifocal
- Refractive- bifocal and multifocal

## Diffractive Optics

- Huygens-Fresnel Principal
- The bending of light around steps or corners
- Light waves bend at grooves in lens
- Bent light undergoes constructive or destructive interference to form two foci, near and distance





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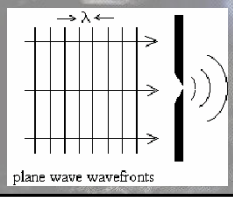


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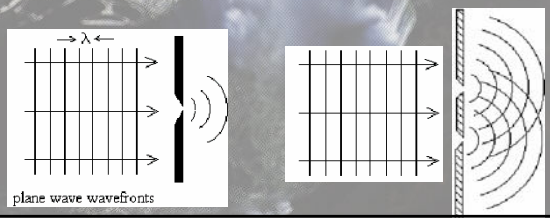
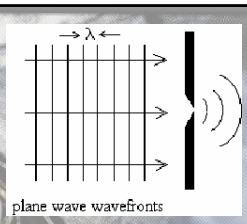
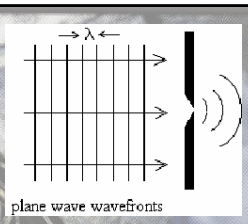



## Diffraction

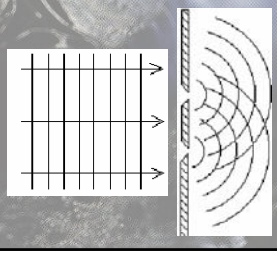



**Single slit: diffraction**

## Diffraction



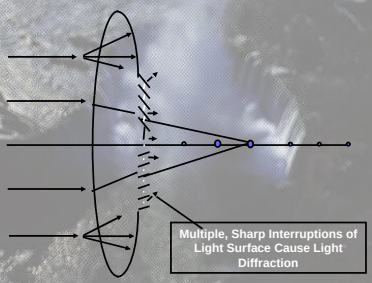

**Single slit: diffraction**



**Double slit: diffraction and interference**

## Diffractive Bifocal Design

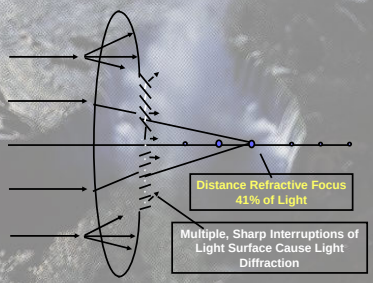
Diffractive Design




Light waves bend at grooves in lens

## Diffractive Bifocal Design

Diffractive Design

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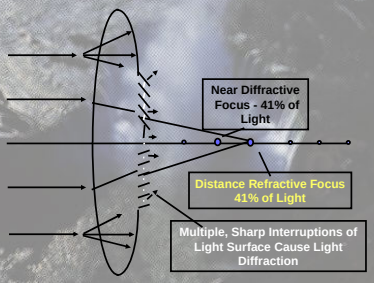
## Diffractive Bifocal Design

Diffractive Design

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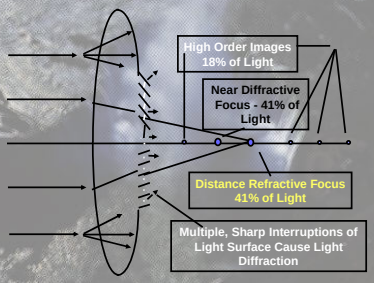
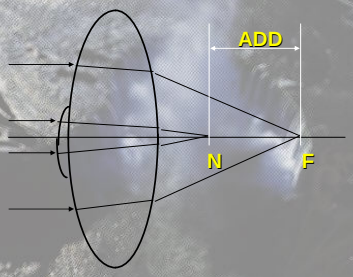
## Diffractive Bifocal Design

Diffractive Design




Light waves bend at grooves in lens

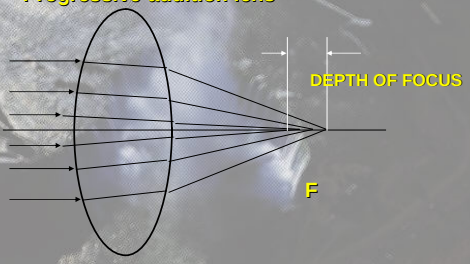
## Refractive Bifocal Lens




A refractive bifocal IOL has concentric rings which produce distance and near foci

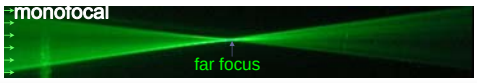
## Refractive Multifocal Lens

Progressive-addition lens



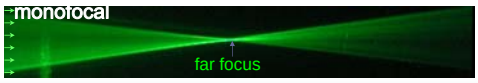

Progressive-addition IOL incorporates a range of foci from near to distance

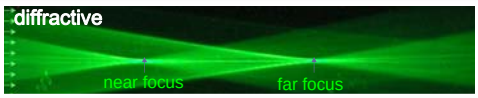
## Optical Principles of IOLs




Terwee, ESCRS 2004

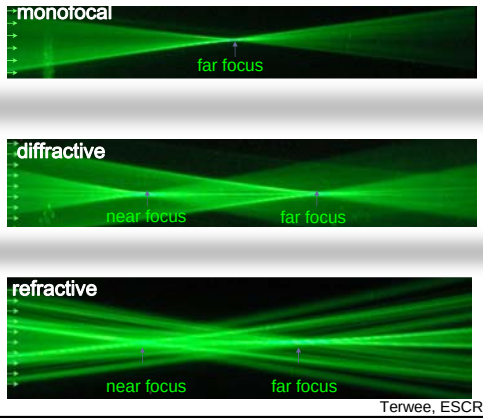
## Optical Principles of IOLs



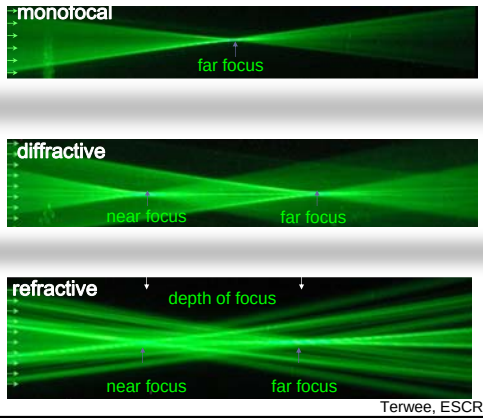

Terwee, ESCRS 2004

## Optical Principles of IOLs




Terwee, ESCRS 2004

## Optical Principles of IOLs

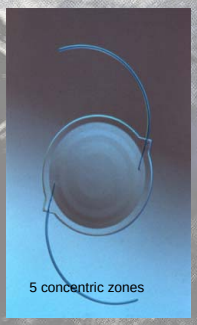


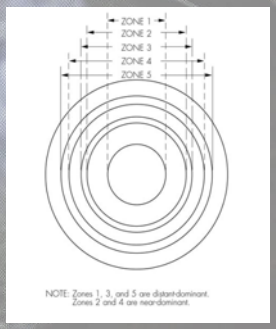

Terwee, ESCRS 2004

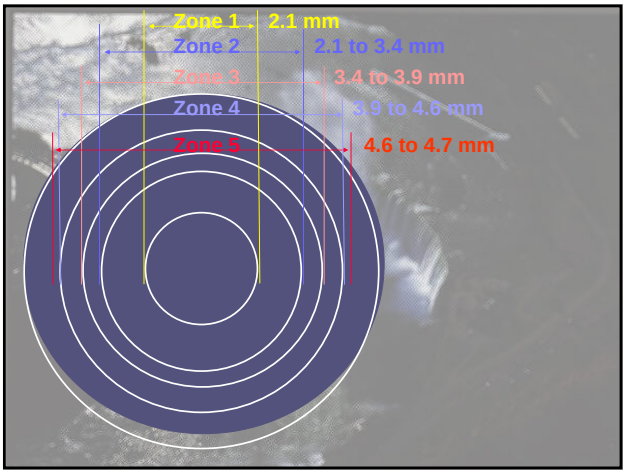
## Refractive Multifocal Lenses- AMO Array

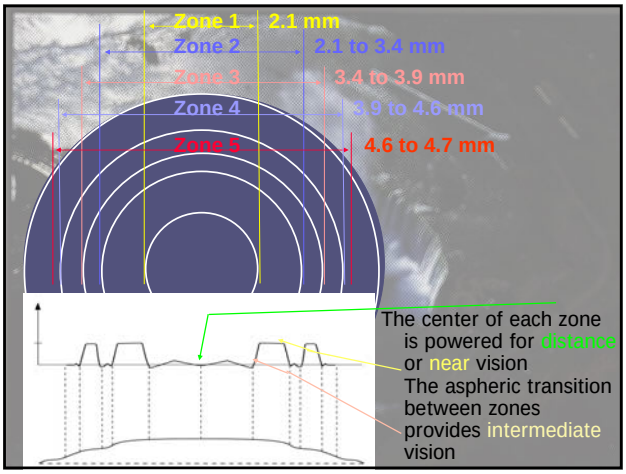
## The AMO® Array®

Foldable Silicone Multifocal IOL Model SA40N™

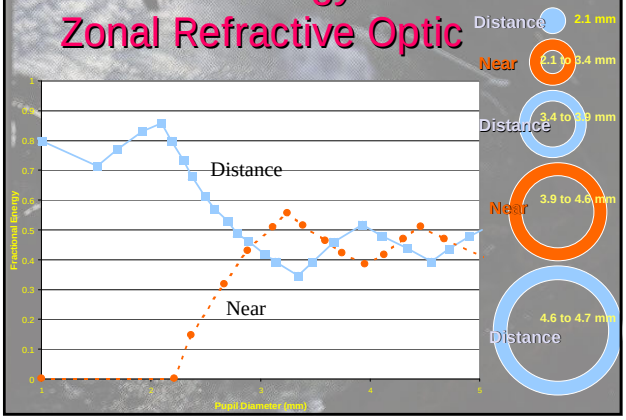


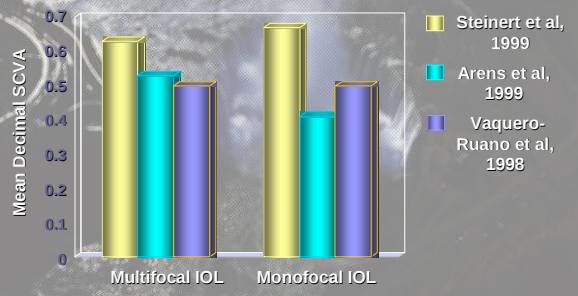



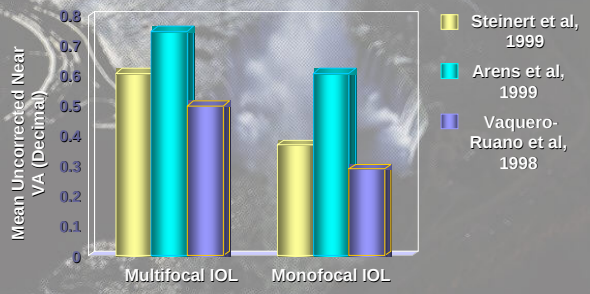
## Theoretical Energy Balance Zonal Refractive Optic




## AMO Array- Distance Vision Similar to Monofocal IOL

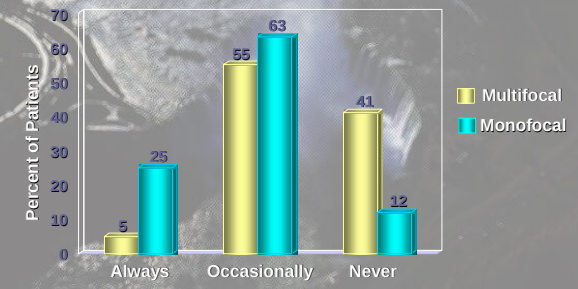



## AMO Array- Near Vision Superior to Monofocal IOL




## AMO Array- Decreased Need for Spectacles

***Significantly more multifocal than monofocal IOL patients never wore glasses (P<.001)****




Javitt J, et al, *J Cataract Refract Surg*, 2000

## AMO®Array® - 75% pts with bilateral Array had UCDVA 20/40 or better and UCNVA J3 or better

## Comparative Nighttime Images

(5 mm Aperture, IOL in Wet Cell)

Monofocal


AMO Array

## Comparative Nighttime Images
(5 mm Aperture, IOL in Wet Cell)

Monofocal

AMO Array

## Refractive Multifocal Lenses- AMO ReZoom

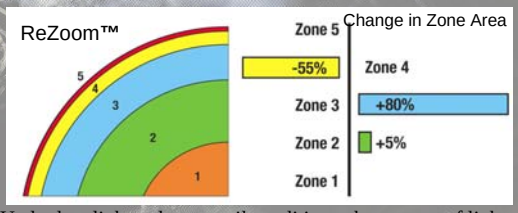
## AMO ReZoom™ Specifications

- Hydrophobic acrylic material
- Three-piece design
- PMMA capsule fit haptics
- 6.0 mm optic, 13 mm OL
- +6.00 to +30.00
- 3.5 dioptres of reading power
- Features Balanced View Optics
- OptiEdge™ triple edge PC IOL design

## ReZoom™ Zones


- Zone 1, 3, and 5 are distance vision dominant
- Zones 2 and 4 are near vision dominant
- Provides good near, intermediate and distance vision

## ReZoom™ Zones vs. Array™ Zones



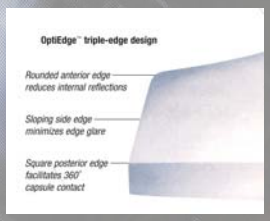

- Under low light or large pupil conditions, the amount of light that goes to the near foci is reduced and redistributed to distance; thus reducing the out of focus light on the retina
- Less out of focus light on the retina leads to less halos and glare

## AMO ReZoom™

- less glare and halo compared to AMO Array Rau, ASCRS 2005

## OptiEdge™ Triple Edge Design

- Patented design minimizes PCO
- Lowest reported incidence of visual aberrations compared with those associated with double-square edge barrier designs




## ReZoom™ Canadian Multicentre Trial

16 surgeons across Canada

R. Baldassare MD, FRCS(C)
R. Braga-Mele MD, FRCS(C)
L. Corriveau MD, FRCS(C)
S. Fanous MD, FRCS(C)
M. Laflamme MD, FRCS(C)
F. Law MD, FRCS(C)
D. Nixon MD, FRCS(C)
M. Pop, MD, FRCS(C)
G. Beiko BM, BCh, FRCS(C)
L. Brierley MD, FRCS(C)
P. Faber MD, FRCS(C)
J. Gohill MD, FRCS(C)
S. Lahoud MD, FRCS(C)
B. Nicholls MD, FRCS(C)
C.Perreault MD, FRCS(C)
T. Rabinovitch MD, FRCS(C)

## ReZoom™ Multicentre Trial - Evaluation Parameters

- Goal to enroll 100-150 patients to be bilaterally implanted with the ReZoom Multifocal IOL
- Method:
  - Pre and post-op patient qualitative questionnaires on freedom from glasses at different distances
  - Pre and post op patient questionnaire to evaluate Halos and Glare before and after surgery, and potential neuro adaption between 6 week and 6 month follow-up visits
  - Pre and post-op surgeon qualitative and quantitative questionnaires on refraction and uncorrected visual acuity for Far, Near, and Intermediate distance

## Patient Selection Criteria

- Cataract
- Hyperopic
- Presbyopic
- Astigmatism that can be corrected
- High myopes (surgeon preference)

## Patient Exclusion Criteria

- Significant dry eye
- Corneal scarring
- Mild to moderate myopia
- Pupil size <2.5 mm
- Monofocal implant in first eye
- Uncorrected post-op astigmatism >0.5 D
- Unstable capsular support

## Target Emmetropia

- Post-op refraction was targeted at emmetropia to + 0.50 D
- Aim for patient to be plano to slightly hyperopic to provide good distance vision for driving

## Preliminary results:

- # of surgeons participating in the trial: 16
- # of patients having completed pre-op questionnaire: 159
- # of patients having completed 6 week post-op follow-up: 106
- # of patients having completed 6 month post-op follow-up: 98

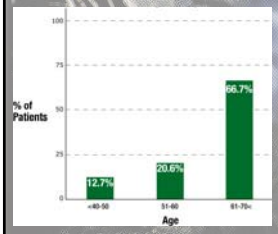
## Excluded Patients

| | |
|---|---|
| Received non-ReZoom lens in 2nd eye | 22 |
| ReZoom not implanted | 7 |
| Lost to follow-up | 6 |
| Surgery cancelled | 2 |
| Unilateral ReZoom | 2 |
| No information | 13 |
| | 53 |

## Patient distribution by age

**6-WEEK FU** **6-MONTH FU**

Population: 106 patients

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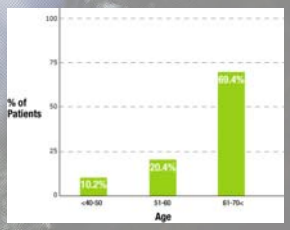
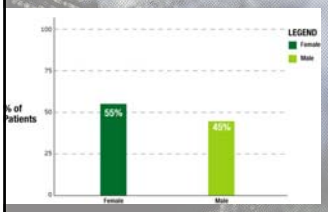
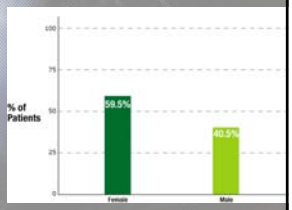



## Patient distribution by gender

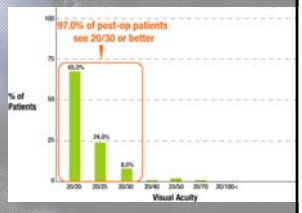
**6-WEEK FU** **6-MONTH FU**



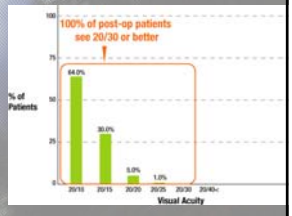

## Pre and post-op uncorrected distance visual acuity

**6-WEEK FU VS. PRE-OP** **6-MONTH FU**


## Pre and post-op uncorrected intermediate visual acuity

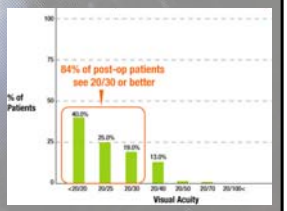
**6-WEEK F.U. VS PRE-OP** **6-MONTH FU**

## Pre and post-op uncorrected near visual acuity

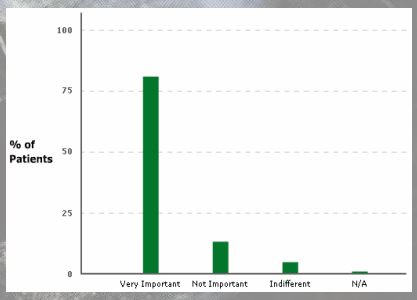
**6-WEEK FU VS PRE-OP**


**6-MONTH FU**




## Spectacle independence of patients

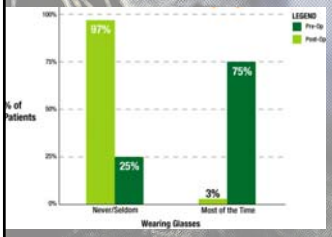
Pre-op patient responses on
Importance of NOT wearing glasses




## Spectacle independence for distance vision

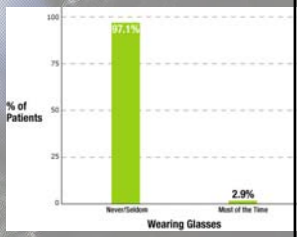
**6-WEEK FU VS. PRE-OP**

97% of patients never or seldom wear glasses for distance vision




**6-MONTH FU**

97.1% of patients never or seldom wear glasses for distance vision



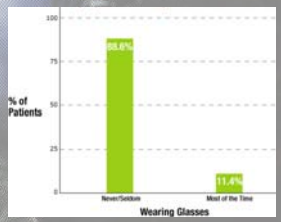

## Spectacle independence for intermediate vision

**6-WEEK FU VS. PRE-OP**

87% of patients never or seldom wear glasses for intermediate vision


**6-MONTH FU**

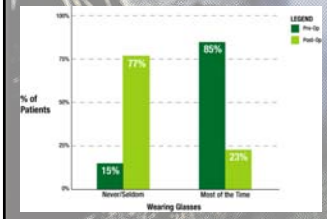
88.6% of patients never or seldom wear glasses for intermediate vision




## Spectacle independence for near vision

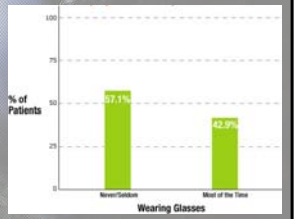
**6-WEEK FU VS. PRE-OP**

77% of patients never or seldom wear glasses for near vision




**6-MONTH FU**

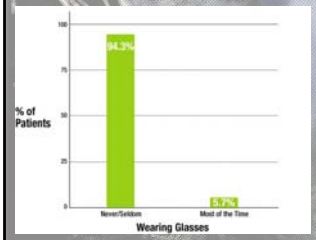
57.1% of patients never or seldom wear glasses for near vision




## Overall spectacle Independence with ReZoom™

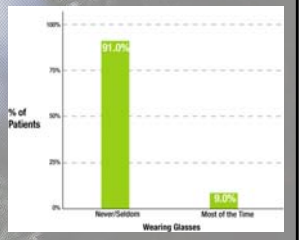
**6-WEEK FU**

94.3% of patients never or seldom wear vision correction glasses




**6-MONTH FU**

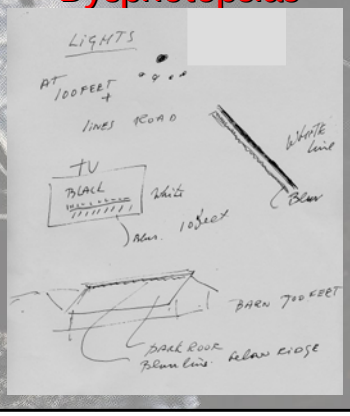
91.0% of patients never or seldom wear vision correction glasses



# Spectacle independence vs age

| Age Group | Q5 Patients Wearing Glasses | Patient Totals | Patient % per Age Group | | Surgeon Data % at 20/30 or Better |
|---|---|---|---|---|---|
| 41-45 | Never | 3 | 100% | | 100% |
| | | | | | |
| 46-50 | Most of the time | 1 | 14.29% | | 86% |
| | Seldom | 1 | 14.29% | | |
| | Never | 5 | 71.43% | 86% | |
| | | | | | |
| 51-60 | Most of the time | 6 | 30.00% | | 90% |
| | Seldom | 5 | 25.00% | | |
| | Never | 9 | 45.00% | 70% | |
| | | | | | |
| 61-65 | Most of the time | 9 | 50.00% | | 72% |
| | Seldom | 7 | 38.89% | | |
| | Never | 2 | 11.11% | 50% | |
| | | | | | |
| 66-70 | Most of the time | 8 | 34.78% | | 96% |
| | Seldom | 9 | 39.13% | | |
| | Never | 6 | 26.09% | 65% | |
| | | | | | |
| >70 | Most of the time | 13 | 48.15% | | 74% |
| | Seldom | 9 | 33.33% | | |
| | Never | 5 | 18.52% | 52% | |

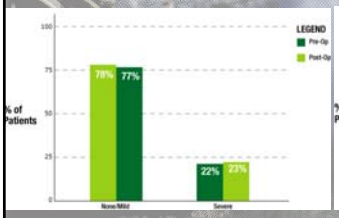
# Dysphotopsias




# Bother from halos

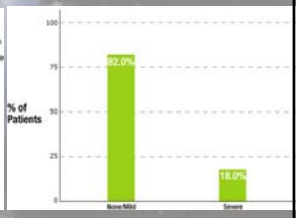
**6-WEEK FU VS. PRE-OP**

77% of patients have none to mild bother from halos



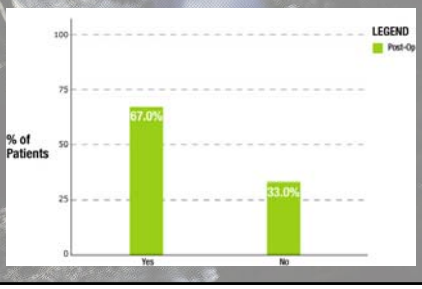

**6-MONTH FU**

82.0% of patients have none to mild bother from halos




# Improvement with Halos Since Right After Surgery

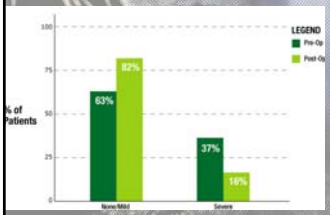
67.0% of patients have reported improvement with halos between the 6-week and 6-month follow-ups




# Bother from glare

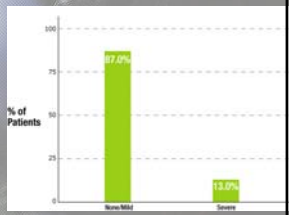
**6-WEEK FU VS. PRE-OP**

82% of patients have none to mild bother from glare



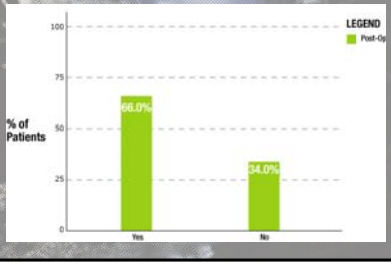

**6-MONTH FU**

87.0% of patients have none to mild bother from glare




# Improvement with Glare Since Right After Surgery

66.0% of patients have reported improvement with glare between the 6-week and 6-month follow-ups



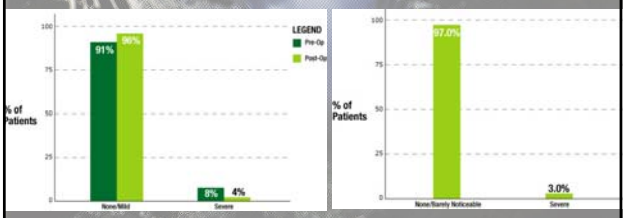
## Bother from Ghosts/Double Vision - 6 Month Follow Up

**6-WEEK FU VS. PRE-OP**

96% of patients have none to mild bother from ghosts/double vision

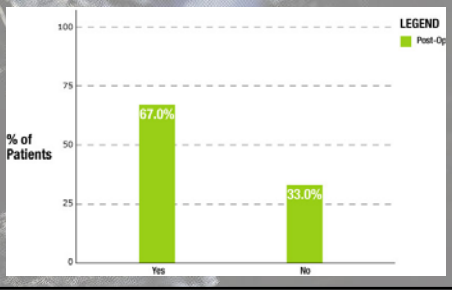
**6-MONTH FU**

97.0% of patients have none to mild bother from ghosts/double vision




## Improvement with Ghosts/Double Vision Since Right After Surgery

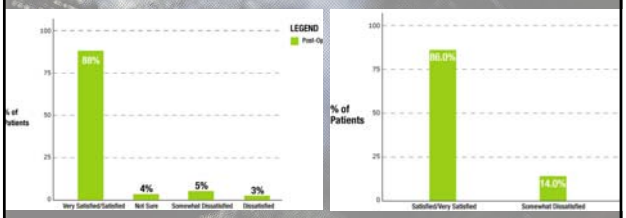
67.0% of patients have reported improvement with ghosts/double vision between 6-week and 6-month follow-ups



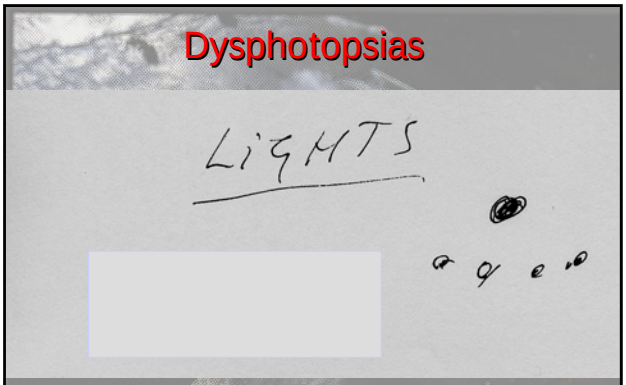

## Patient satisfaction with ReZoom™ after bilateral implantation

**6-WEEK FU**

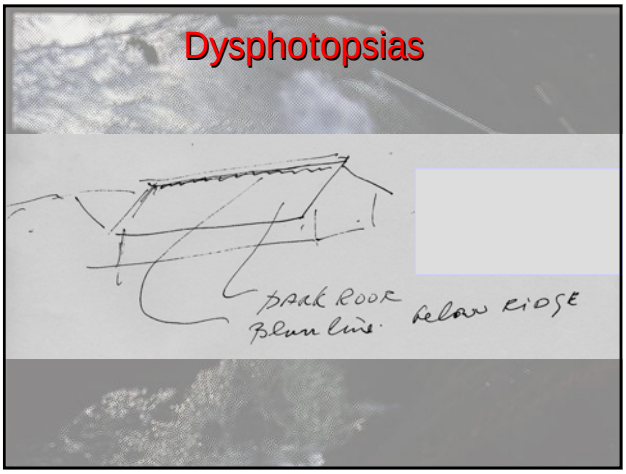
**6-MONTH FU**



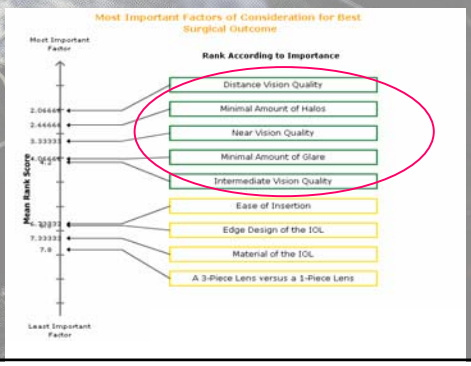

## Dysphotopsias



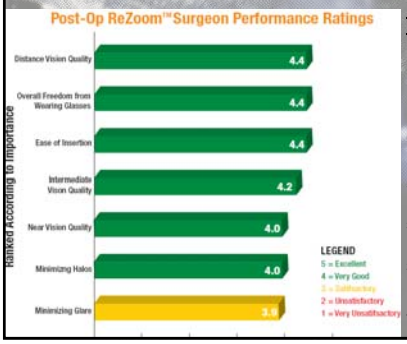

## Dysphotopsias




## Surgeon factors of importance in selecting a Multifocal IOL



## Post-operative surgeon evaluation of ReZoom™ performance




**Pre-op factors of importance**

1st criterion of importance

6th criterion of importance

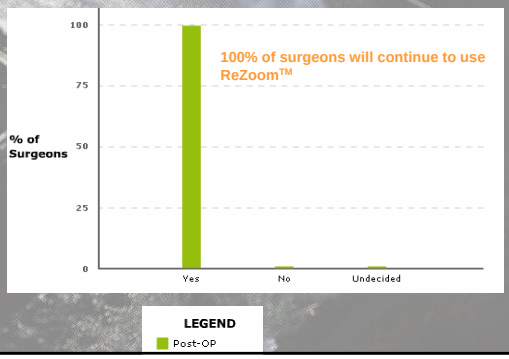
5th criterion of importance

3th criterion of importance

2nd criterion of importance

4th criterion of importance

## Surgeon satisfaction with ReZoom™



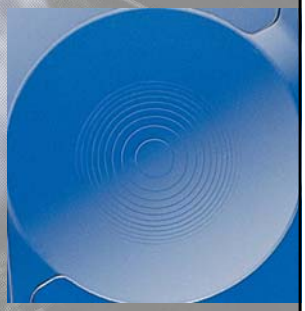

## Conclusions

- Ongoing study
- ReZoom provides excellent distance & intermediate vision and satisfactory near vision
- Significant improvement in distance, intermediate and near vision at 6 months post-op
- Dysphotopic phenomena were not significant and improved by 6 months
- 90% patients were spectacle independent; 90% were satisfied at 6 months
- Younger patients more likely to be spectacle independent

## Diffractive Bifocal Lenses

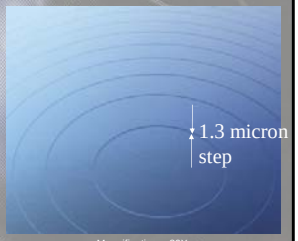
## AcrySof ® ReSTOR® IOL

- Diffractive Structure 3.6 mm center of optic; refractive peripheral area
- Incorporates +4.0 add at lens plane equaling +3.2 at spectacle plane
- Apodized diffractive optic to decrease halos
- Step heights peripherally decreasing 1.3 – 0.4 microns, peripherally decreasing widths

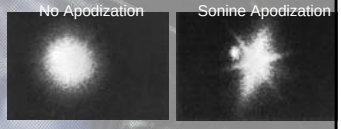


## Apodization Diffractive Optic

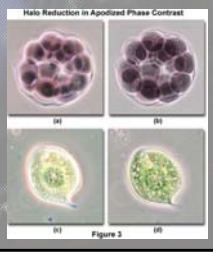
- Gradual decrease in step heights creating a smooth transition of light between focal points (1.3 to 0.4 microns)
- Responsible for reduction in photic phenomenon such as glare and halos.
- Unique to AcrySof® ReSTOR® IOL



## Apodization




Apodization is routinely used in microscopy and astronomy to reduce diffractive halos and improve resolution.




## AcrySof ® ReSTOR® IOL

Utilizes diffractive and refractive optics with apodization

- Allocating appropriate light energy according to an activity and light levels
- Minimizing photic issues through specialized optic design
- Separation of images

## AcrySof ® ReSTOR® IOL

Near VA of first 45 ReStor pts, (greater than 6 months) results for UCNVA

Monocular Results

20/16 or better: 9%
20/20 or better: 44%
20/25 or better: 84%
20/30 or better: 99%

Dick Mackool

## AcrySof ® ReSTOR® IOL

Near VA of first 45 ReStor pts, (greater than 6 months) results for UCNVA

Monocular Results

20/16 or better: 9%
20/20 or better: 44%
20/25 or better: 84%
20/30 or better: 99%

Binocular Results

20/16 or better: 20%
20/20 or better: 82%
20/25 or better: 96%
20/30 or better: 100%

Dick Mackool

## AcrySof ® ReSTOR® IOL

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Monocular Results

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20/30 or better: 99%

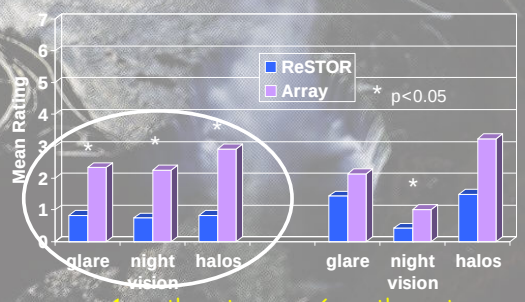
Binocular Results

20/16 or better: 20%
20/20 or better: 82%
20/25 or better: 96%
20/30 or better: 100%

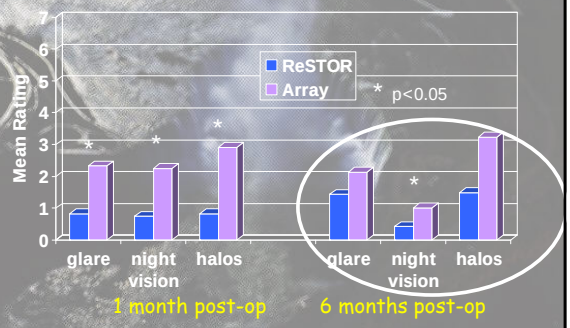
With best spectacle correction for distance, reading binocularly, 90% were 20/20 or better and 100% were 20/25 or better

Dick Mackool

## Visual Disturbances – Pilot Study Results



## Visual Disturbances – Pilot Study Results

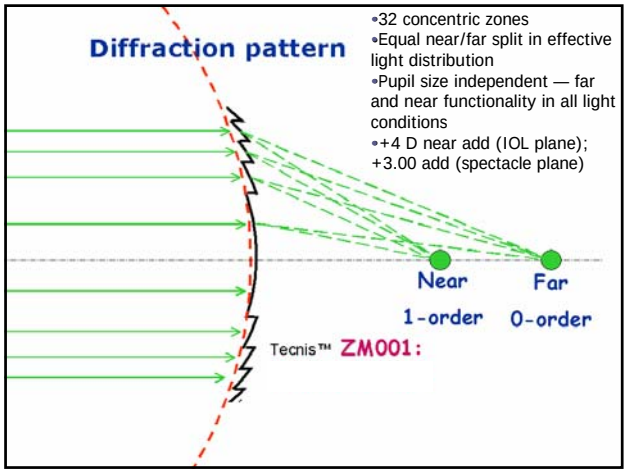



## AcrySof ® ReSTOR® IOL

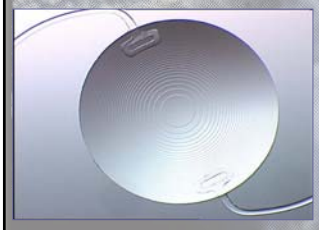
- intermediate VA improves significantly at one year time in ReStor patients (Robert Kaufer)

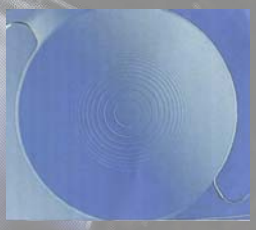
## AMO Tecnis Multifocal Lens

- Diffractive posterior surface
- Modified prolate anterior surface
- +4.0D near addition; Effective add of 3.0 D
- Light distribution 50/50
- 5D to 34D in 0.5D increments




## Comparison of 2 Diffractive IOLs





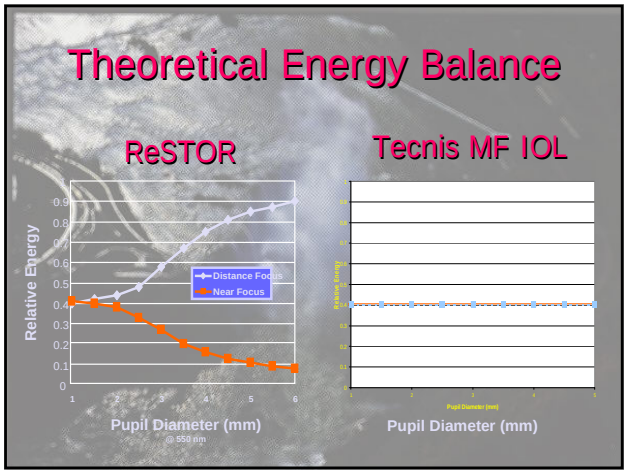
**Tecnis™ multifocal IOL**

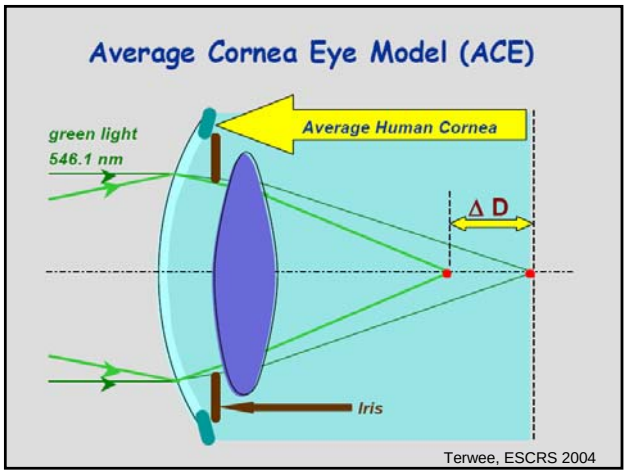
- Diffractive
- High refractive index silicon
- Aspheric
- Posterior surface

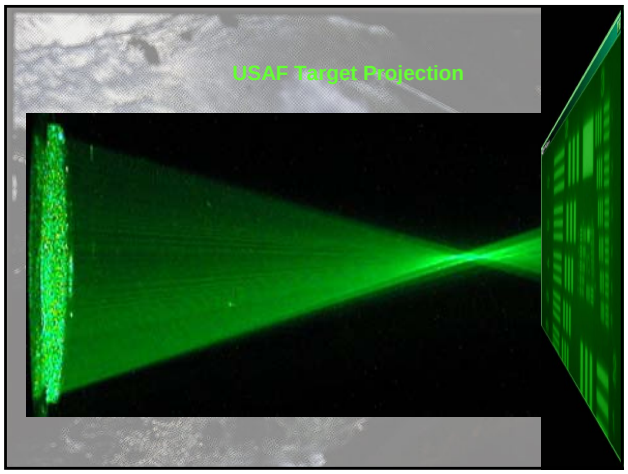
**Alcon ReSTOR® SA60D3 IOL**

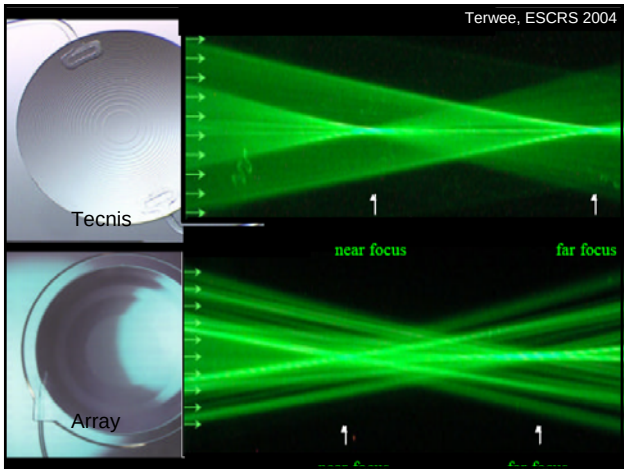
- Refractive/diffractive
- Acrylic
- Spheric
- Anterior surface

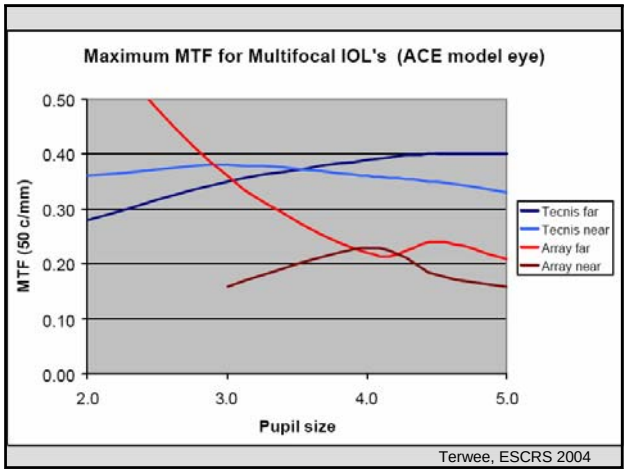
## Theoretical Energy Balance

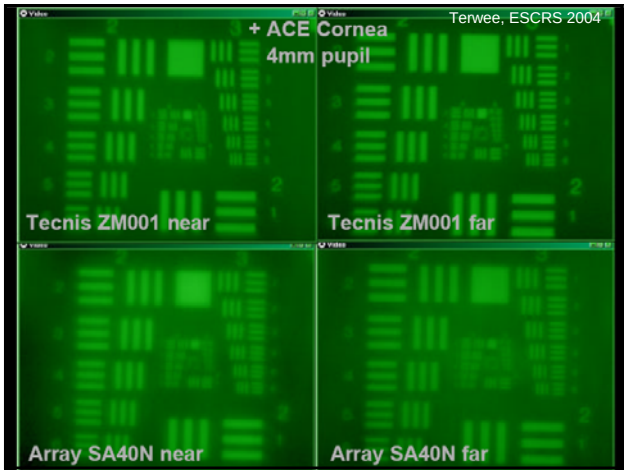


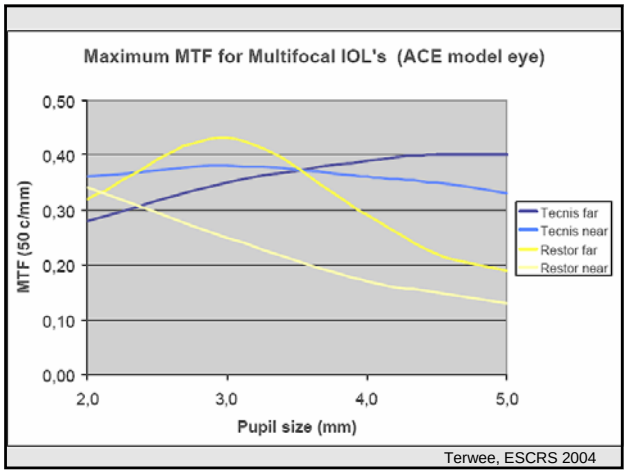

Average Cornea Eye Model (ACE)
green light
546.1 nm
Average Human Cornea
Δ D
Iris
Terwee, ESCRS 2004

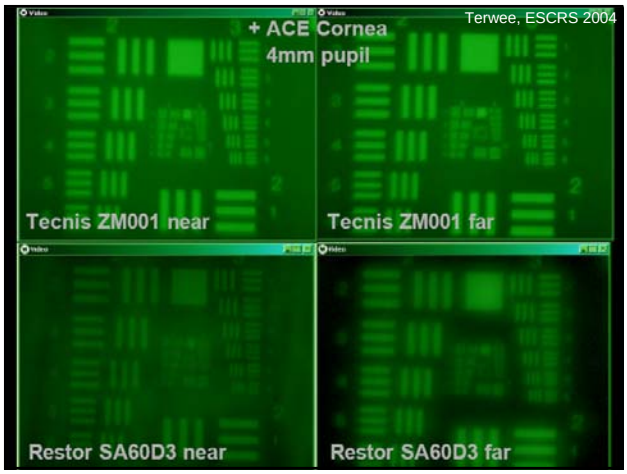

USAF Target Projection

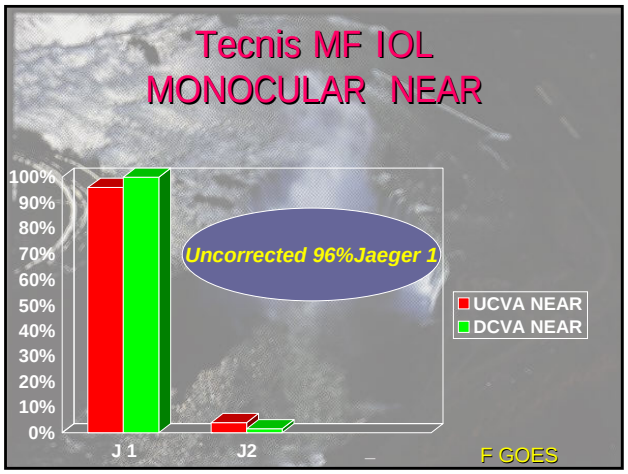

Terwee, ESCRS 2004
Tecnis
near focus
far focus
Array

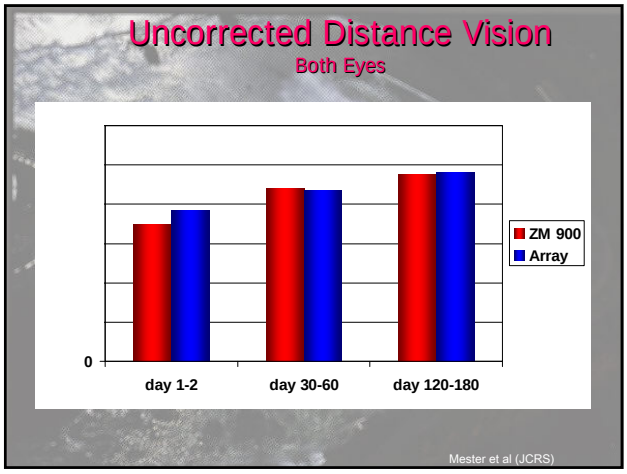

Maximum MTF for Multifocal IOL's (ACE model eye)
MTF (50 c/mm)
0.50
0.40
0.30
0.20
0.10
0.00
2.0
3.0
4.0
5.0
Pupil size
Tecnis far
Tecnis near
Array far
Array near
Terwee, ESCRS 2004

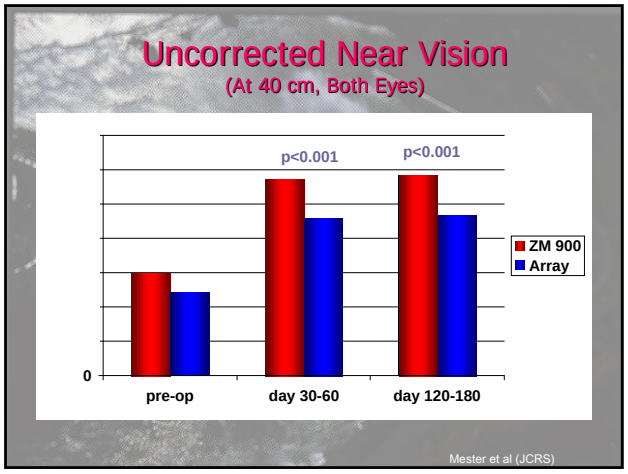

Terwee, ESCRS 2004
+ ACE Cornea
4mm pupil
Tecnis ZM001 near
Tecnis ZM001 far
Array SA40N near
Array SA40N far

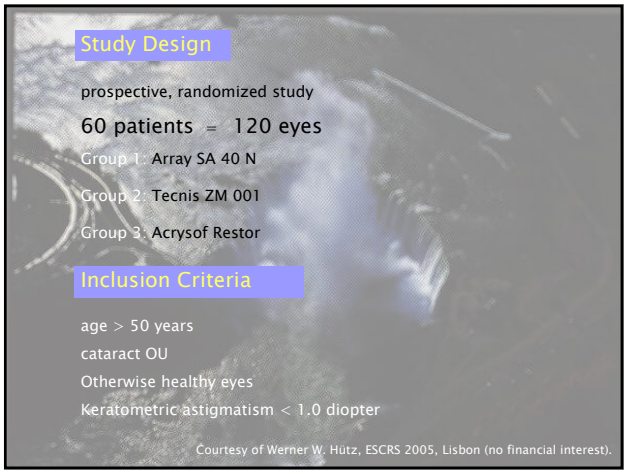

Maximum MTF for Multifocal IOL's (ACE model eye)
MTF (50 c/mm)
0,50
0,40
0,30
0,20
0,10
0,00
2,0
3,0
4,0
5,0
Pupil size (mm)
Tecnis far
Tecnis near
Restor far
Restor near
Terwee, ESCRS 2004

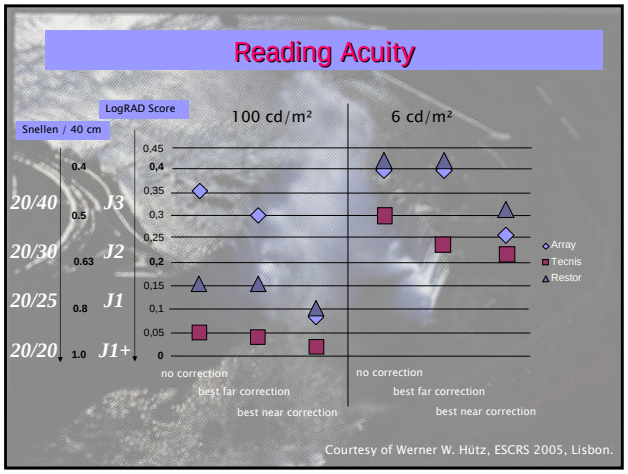

Terwee, ESCRS 2004
+ ACE Cornea
4mm pupil
Tecnis ZM001 near
Tecnis ZM001 far
Restor SA60D3 near
Restor SA60D3 far


Tecnis MF IOL
MONOCULAR NEAR
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Uncorrected 96%Jaeger 1
UCVA NEAR
DCVA NEAR
J 1
J2
F GOES


Uncorrected Distance Vision
Both Eyes
ZM 900
Array
0
day 1-2
day 30-60
day 120-180
Mester et al (JCRS)


Uncorrected Near Vision
(At 40 cm, Both Eyes)
p<0.001
p<0.001
ZM 900
Array
0
pre-op
day 30-60
day 120-180
Mester et al (JCRS)


Study Design
prospective, randomized study
60 patients = 120 eyes
Group 1: Array SA 40 N
Group 2: Tecnis ZM 001
Group 3: Acrysof Restor
Inclusion Criteria
age > 50 years
cataract OU
Otherwise healthy eyes
Keratometric astigmatism < 1.0 diopter
Courtesy of Werner W. Hütz, ESCRS 2005, Lisbon (no financial interest).


Reading Acuity
LogRAD Score
Snellen / 40 cm
100 cd/m²
6 cd/m²
20/40
20/30
20/25
20/20
J3
J2
J1
J1+
Array
Tecnis
Restor
no correction
best far correction
best near correction
Courtesy of Werner W. Hütz, ESCRS 2005, Lisbon.

## Multifocal Optics

- Spectacle independence can be achieved
  - Reasonable expectations
  - Halos
- Improvements continue for 12+ months
- Diffractive & refractive both work well
  - Differences reside in the details
  - Customize for the individual patient

## Mix & Match Technologies

**BILATERAL RESTOR**



100 patients (binocular implant)
Mean follow-up: 4 months
Average NVA: J 1.40 (30cm)
Average IVA: J 3.85
Average DVA: 20/25
Average reading speed (wpm*): 165 with 3.5 mm pupil
Average spectacle independence: 89%
Halos/Glare: (1+)
MTF at 100 c/mm: 0.12**

**BILATERAL REZOOM**

100 patients (binocular implant)
Mean follow-up: 4 months
Average NVA: J 2.30 (38 cm)
Average IVA: J 2.15
Average DVA: 20/20
Average reading speed (wpm*): 125 with 3.5 mm pupil
Average spectacle independence: 75%
Halos/Glare: (2+)
MTF at 100 c/mm: 0.20

Akaishi & Fabri, Feb 2006

## Mix & Match Technologies

Why Mix ?

Get the maximum strength from refractive and diffractive technologies

| | Refractive | Diffractive |
|---|---|---|
| Strengths | Excellent Intermediate Vision<br>100% Transmission of light<br>Excelent Distance Vision | |
| Weaknesses | Good Near Vision<br>Lower reading speed<br>Pupil dependent | |

Akaishi & Fabri, Feb 2006

## Mix & Match Technologies

Why Mix ?

Get the maximum strength from refractive and diffractive technologies

| | Refractive | Diffractive |
|---|---|---|
| Strengths | Excellent Intermediate Vision<br>100% Transmission of light<br>Excelent Distance Vision | Excellent Near Vision<br>Good reading speed<br>Pupil independent |
| Weaknesses | Good Near Vision<br>Lower reading speed<br>Pupil dependent | Lack of Intermediate Vision<br>Loss of transmitted light<br>Loss of contrast sensitivity |

Akaishi & Fabri, Feb 2006

## Mix & Match Technologies

Why Mix & Match ?

Get the maximum strength from refractive and diffractive technologies and get a binocular vision with:

Excellent Near Vision + reading speed
Excellent Intermediate Vision
Excellent Distance Vision
Greater spectacle independence…

… Fulfilling all Lifestyle expectations

Akaishi & Fabri, Feb 2006

## Mix & Match Technologies

**RESTOR N Dominant**



58 patients (M&M implant)
Mean age: 55 years old
Mean follow-up: 2 months

Average Binocular NVA: J 1.50 (39 cm)
Average Binocular IVA: J 2.30
Average Binocular DVA: 20/20
Average Binocular reading speed (wpm*): 155 with 3.5 mm pupil
Halos/Glare: (1+)
MTF at 100 c/mm: 0.18

**REZOOM Dominant**

Average spectacle independence: 100%

Akaishi & Fabri, Feb 2006

## Mix & Match Technologies

TECNIS MF | REZOOM

15 patients (M&M implant w/lifestyle dominance)
Mean age: 59 years old
Mean follow-up: 1 month

Average Binocular NVA: J 1.10 (42 cm)
Average IVA: J 2.10
Average DVA: 20/20
Average reading speed (wpm*): 185 with 3.5 mm pupil
Halos/Glare: (1-)
MTF at 100 c/mm: 0.38

Average spectacle independence: 100%

Akaishi & Fabri, Feb 2006

## Mix & Match Technologies

TECNIS MF | REZOOM

15 patients (M&M implant w/lifestyle dominance)
Mean age: 59 years old
Mean follow-up: 1 month

First Impressions:
- Less halos and glare than ReSTOR + ReZoom
- Less light needed to bilateral near vision
- More comfortable reading distance
- More bilateral contrast sensitivity
- Less spherical aberration (Tecnis MF eye)

Average spectacle independence: 100%

Akaishi & Fabri, Feb 2006

## Akaishi & Fabri (2006)

| | Bilateral ReSTOR n=100 | Bilateral ReZoom® n=100 | ReSTOR & ReZoom® n=88 | *Tecnis® MF + ReZoom® n=15* |
|---|---|---|---|---|
| Near vision | J 1.4 (30 cm) | | | |
| Intermed. v. | J 3.85 | | | |
| Far vision | 0.8 | | | |
| Reading speed | 165 | | | |
| No glasses | 89% | | | |
| Halos | 1+ | | | |

Akaishi & Fabri (ASCRS

## Akaishi & Fabri (2006)

| | Bilateral ReSTOR n=100 | Bilateral ReZoom® n=100 | ReSTOR & ReZoom® n=88 | *Tecnis® MF + ReZoom® n=15* |
|---|---|---|---|---|
| Near vision | J 1.4 (30 cm) | J 2.3 (38 cm) | | |
| Intermed. v. | J 3.85 | J 2.15 | | |
| Far vision | 0.8 | 1.0 | | |
| Reading speed | 165 | 125 | | |
| No glasses | 89% | 75% | | |
| Halos | 1+ | 2+ | | |

Akaishi & Fabri (ASCRS

## Akaishi & Fabri (2006)

| | Bilateral ReSTOR n=100 | Bilateral ReZoom® n=100 | ReSTOR & ReZoom® n=88 | *Tecnis® MF + ReZoom® n=15* |
|---|---|---|---|---|
| Near vision | J 1.4 (30 cm) | J 2.3 (38 cm) | J 1.5 (39 cm) | |
| Intermed. v. | J 3.85 | J 2.15 | J 2.3 | |
| Far vision | 0.8 | 1.0 | 1.0 | |
| Reading speed | 165 | 125 | 155 | |
| No glasses | 89% | 75% | 100% | |
| Halos | 1+ | 2+ | 1+ | |

Akaishi & Fabri (ASCRS

## Akaishi & Fabri (2006)

| | Bilateral ReSTOR n=100 | Bilateral ReZoom® n=100 | ReSTOR & ReZoom® n=88 | *Tecnis® MF + ReZoom® n=15* |
|---|---|---|---|---|
| Near vision | J 1.4 (30 cm) | J 2.3 (38 cm) | J 1.5 (39 cm) | J 1.1 (42 cm) |
| Intermed. v. | J 3.85 | J 2.15 | J 2.3 | J 2.1 |
| Far vision | 0.8 | 1.0 | 1.0 | 1.0 |
| Reading speed | 165 | 125 | 155 | 184 |
| No glasses | 89% | 75% | 100% | 100% |
| Halos | 1+ | 2+ | 1+ | 1- |

Akaishi & Fabri (ASCRS

## MILNE 2006

| | Bilateral ReSTOR | *ReZoom® + ReSTOR n=200* |
|---|---|---|
| **Far vision** | | |
| very satisfied/satisfied | 75% | *96%* |
| neutral | 0% | 4% |
| unsatisfied | 26% | 0% |
| **Near vision** | | |
| very satisfied/satisfied | 83% | *96%* |
| neutral | 0% | 4% |
| unsatisfied | 17% | 0% |
| **Independence of glasses** | 65% | *94%* |

Milne (ASCRS 2006)

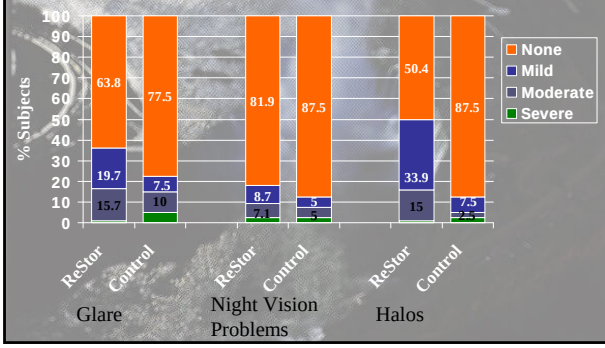
## Studies have shown that the MF IOL's provide distance, intermediate and near vision; but what is the quality of this vision?

## Presbyopia and Cataract Surgery

### Refracting/Diffracting Lenses

- glare and halos are common complaints
- loss of contrast sensitivity

## Photic Phenomena-ReSTOR




## ReSTOR vs Acrysof SA60AT

- 6 month comparison
- BCVA 0.9 or better in 94% ReSTOR and 96% monofocal
- 92% ReSTOR were spectacle independent
- Halos (22% vs 15%) and glare (28% vs 12%) higher in ReSTOR
- PCO rate higher (32% vs 18%) in ReSTOR

Grenga PL et al, 2007, unpublished

## AMO Array

- decreased contrast sensitivity, compared to monofocal, of 35-40%, which improves to 20-25% with neuroadaptation

Holladay

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- decreased contrast sensitivity, compared to monofocal, of 35-40%, which improves to 20-25% with neuroadaptation

Holladay

## ReSTOR- Decreased Contrast Sensitivity

Sign Identification Distances For ReSTOR MA60D3 Compared to the Control Monofocal IOL:

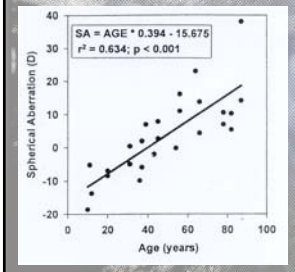
| Visibility Condition | Targets | RURAL SCENE SIGN FEET | RURAL SCENE SIGN % Loss over Control | CITY SCENE SIGN FEET | CITY SCENE SIGN % Loss over Control |
|---|---|---|---|---|---|
| Normal | Text | 19 | 7.5% | 17 | 10.8% |
| | Warning | 47 | 8.9% | 10 | 4.7% |
| Fog | Text | 33 | 13.4% | 21 | 13.2% |
| | Warning | 60 | 11.6% | 24 | 11.7% |
| Glare | Text | 33 | 14.1% | 40 | 28% |
| | Warning | 60 | 12.5% | 24 | 12.5% |

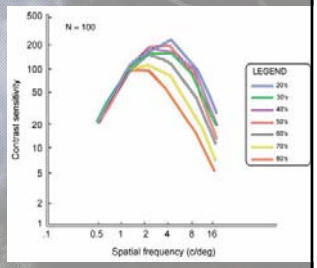
## ReSTOR vs Acrysof SA60AT

- 6 month comparison
- BCVA 0.9 or better in 94% ReSTOR and 96% monofocal
- 92% ReSTOR were spectacle independent
- Halos (22% vs 15%) and glare (28% vs 12%) higher in ReSTOR
- PCO rate higher (32% vs 18%) in ReSTOR
- Static photopic measurements same in both groups; dynamic photopic measurements sig. less ($p < 0.05$) in ReSTOR

Grenga PL et al, 2007, unpublished

## Contrast Sensitivity Declines with Age



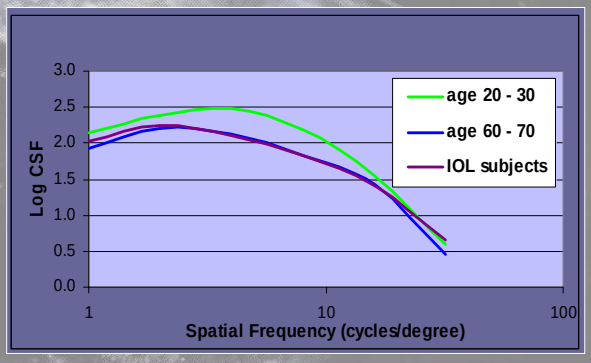

Glasser and Campbell. Vision Res 1998

DeValois, DeValois. Oxford Univ Press, 1988

## Spherical Aberration- Visual Effects

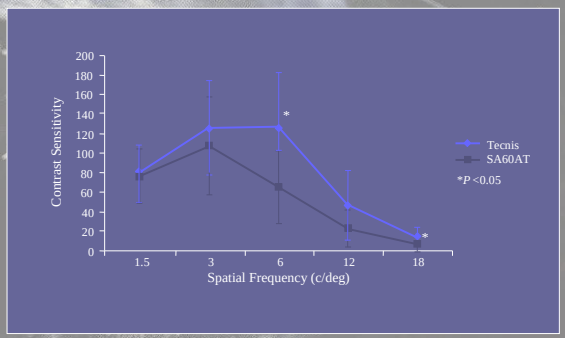
Figure 2. Spherical aberration is perceived as halos around lights that cause the symptoms of glare. Increasing amounts of spherical aberration create larger halos.

## Contrast Sensitivity Function with 4 mm Pupil



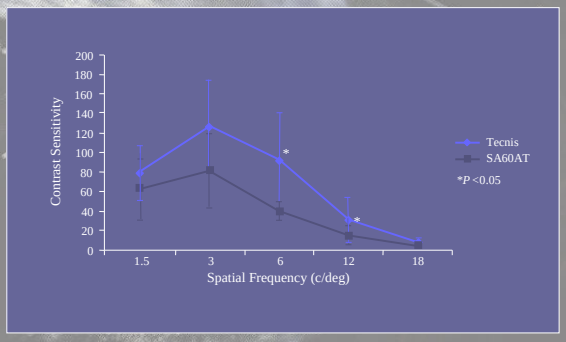

Nio, Jansonius, Fidler, Geraghty, Norrby, Kooijman

## Photopic Contrast Sensitivity




Bellucci et al., 2002

## Mesopic Contrast Sensitivity

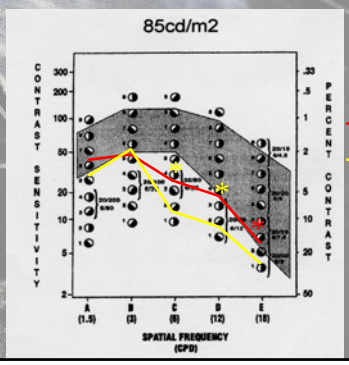



Bellucci et al., 2002

## Other Studies Comparing Tecnis and Acrysof

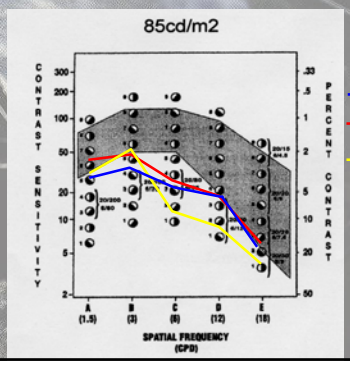
Packer, 2002
Meester, 2003; Packer, 2003; Kershner, 2003
Bellucci, 2004; Ricci, 2004; Kennis, 2004; Piers et al, 2004
Bellucci, 2005; Casprini, 2005; Martinez, Palmer 2005

## Photopic Contrast Sensitivity




SA 0.37/Tecnis
Tecnis nonsel
* P< 0.05
* P< 0.10

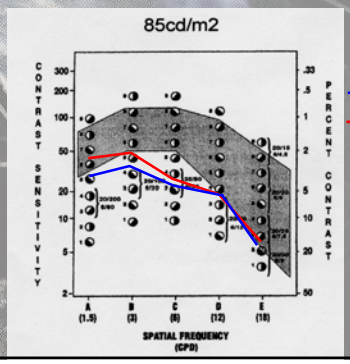
## Photopic Contrast Sensitivity




ReZoom
SA 0.37/Tecnis
Tecnis nonsel
* P< 0.05

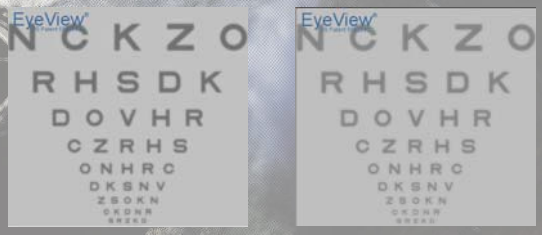
## Stereo Optical VT1600X

## Photopic Contrast Sensitivity




ReZoom
Tecnis
* P< 0.05

## Contrast Sensitivity

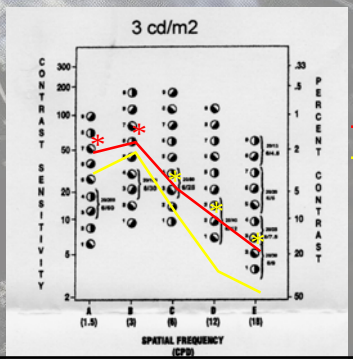



Tecnis Rezoom

## Contrast Sensitivity

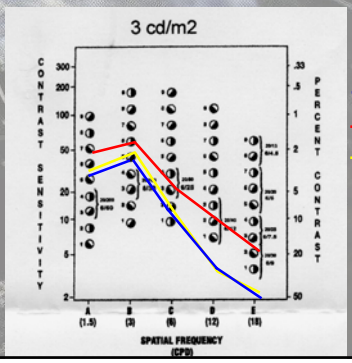

Tecnis Rezoom

## Mesopic Contrast Sensitivity



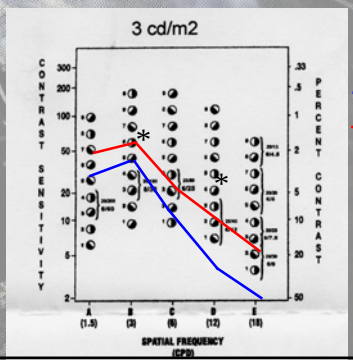

SA 0.37/Tecnis
Tecnis nonsel
* P< 0.05
* P< 0.10

## Mesopic Contrast Sensitivity




ReZoom
SA 0.37/Tecnis
Tecnis nonsel
* P< 0.05

## Mesopic Contrast Sensitivity

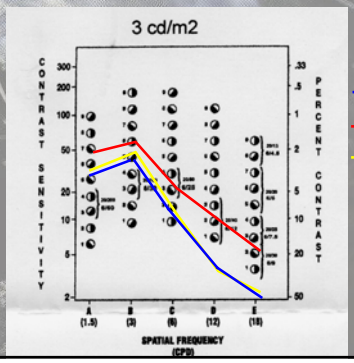



ReZoom
Tecnis
* P< 0.05

## Contrast Sensitivity

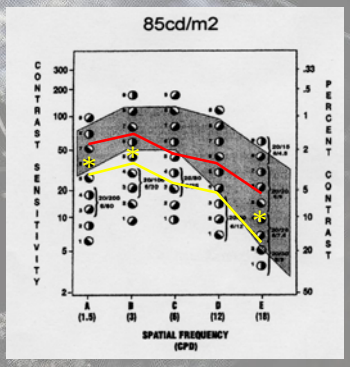

Tecnis Rezoom

## Mesopic Contrast Sensitivity



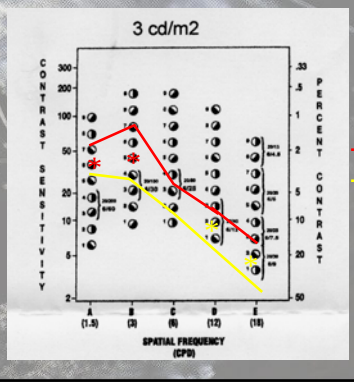

ReZoom
SA 0.37/Tecnis
Tecnis nonsel
* P< 0.05

## Photopic Contrast Sensitivity



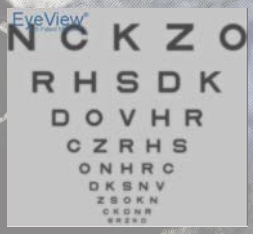

Young
Rezoom
* P< 0.05
* P< 0.10

## Mesopic Contrast Sensitivity




Young
Rezoom
* P< 0.05
* P< 0.10

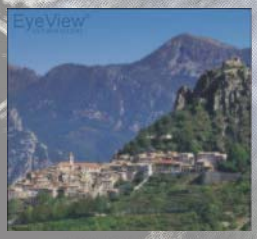
## Contrast Sensitivity




Young


Rezoom

## Contrast Sensitivity




Young

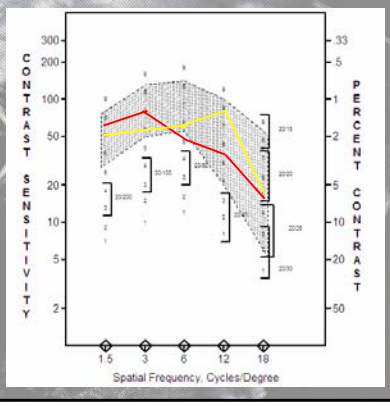

Rezoom

## Contrast Sensitivity


Young

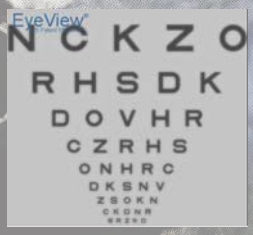

Rezoom

## Contrast Sensitivity




— 20-30 yr olds
— Rezoom-DY

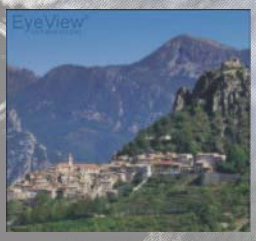
## Contrast Sensitivity




Young


Rezoom-DY

## Contrast Sensitivity




Young


Rezoom-DY

## Contrast Sensitivity


Young


Rezoom

## Conclusions

- Multifocal IOL's can provide excellent distance & intermediate vision and near vision
- Significant improvement in distance, intermediate and near vision with time post-op
- Dysphotopic phenomena are minimal with newer lenses and strategies, and improved by 6 months
- Selected patients are satisfied
- Younger patients more likely to be spectacle independent

## Contraindications to IOLs

**Warnings**

Physicians considering lens implantation under any of the following circumstances should weigh the potential risk/benefit ratio:

1. Recurrent severe anterior or posterior segment inflammation or uveitis.
2. Patients in whom the intraocular lens may affect the ability to observe, diagnose, or treat posterior segment diseases.
3. Surgical difficulties at the time of cataract extraction that might increase the potential for complications (e.g., persistent bleeding, significant iris damage, uncontrolled positive pressure, or significant vitreous prolapse or loss).
4. A distorted eye due to previous trauma or developmental defect in which appropriate support of the IOL is not possible.
5. Circumstances that would result in damage to the endothelium during implantation.
6. Suspected microbial infection.
7. Children under the age of 2 years are not suitable candidates for intraocular lenses.
8. Patients in whom neither the posterior capsule nor zonules are intact enough to provide support.


Thank you