TECNIS® Multifocal IOL and ReSTOR® 3.0: A Comparative Review

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Informal survey

- By a show of hands:
  - How many have co-managed a multifocal IOL patient with us at OMNI?
  - How many have NOT co-managed a multifocal IOL patient with us at OMNI?

Informal survey

- I have an overall favorable opinion of the multifocal IOLs and would encourage implantation of them to achieve a higher degree of spectacle independence.
- I would tend to encourage monofocal IOLs for the vast majority of patients but would entertain co-managing a multifocal for the highly motivated patient.
- I would discourage most every patient of mine from having a multifocal IOL.
Which IOL to use?

OMNI Eye Specialists

- June 05’ OMNI LRI program started
- Dec 05’ OMNI first ReSTOR implanted
- July 06’ OMNI first ReZoom implanted
- Sept 06’ OMNI Multifocal IOL Symposium
- July 07’ OMNI first Visian ICL implanted
- Jan 08’ OMNI first Toric IOL implanted
- July 08’ (My) first Crystalens implanted
- Oct 10’ OMNI first Tecnis MTF implanted

Wang IOL implantation proportions (2/15/10 – 2/15/13)

IOL type

- Monofocal (85.4%)
- Toric (6.1%)
- Multifocal (6.6%)
- Crystalens (1.9%)

N (total) = 4246 IOLs

2004-2011 Advanced Technology IOL Preference Share

More Surgeons are Implanting ATIOLs
Generation definitions

Lost generation (1883-1900)
- Describes generation of those who fought in WW1

Greatest Generation (1901-1924)
- Describes generation including veterans who fought in WW2

Silent Generation (1925-1945)
- Too young to join service in WW2, though many had fathers who served in WW1
- Experienced the great depression in their formative years

Baby Boomers (1946-1964)
- Marked increase in birth rates
- Rejection or redefinition of traditional values
- Associated with privilege as many grew up with affluence

Generation X (early 60s – early 80s)
Generation Y (early 80s – early 2000s)
Generation Z (early 2000’s onward)

Baby Boom Generation

Getting to Know Today’s Cataract Patient
- Large, rapidly growing demographic
- Educated, financially secure
- Increased life expectancy
- Longer working careers

Rate of Baby Boomers Turning 65 Yrs. Old in the US
- 2.7 million per year
- 7,584 per day

Getting to Know Today’s Cataract Patient
- Are unwilling to compromise active lifestyle
- Embrace demand-driven healthcare
- Demand high quality vision (e.g., reading, distance, night)
- Have new requirements for near and intermediate vision (e.g., computers, tablets, smart phones)
- Can NOT skip discussion on IOL options
Cataract Consultation
- Degree of bother / patient’s subjective visual disability
- Assess objective ocular findings
- Discuss risks of surgery / possibility of loss of vision
- Discussion of IOL options

What’s in a name?
- Array FDA approved in 1997
- ReSTOR 4.0 (non-aspheric), ReSTOR 4.0 (aspheric), ReSTOR 3.0 (aspheric)
- ReZoom (zonal refractive)
- Crystalens (4.5 mm optic), Crystalens 5.0, Crystalens HD, Crystalens AO
- Tecnis MTF Silicone, MTF Acrylic (3-piece), MTF Acrylic (1-piece)

Sorting through the hyperbole
- IOL reps
- Inherent Bias
- Lack of good, peer-reviewed direct comparative studies
- Bedazzled with technology

Tailor to the patient’s desires
- Monofocal
- Toric
- Monovision
- Crystalens
- Multifocal
- Tecnis multifocal
- ReSTOR

Tecnis MTF
- Optic posteriorly offset from haptics
- Optic and haptics are planar

ReSTOR 3.0
- Both 13 mm in length
- Both have diffraction gratings to split light between distance and near focus
- Both made of hydrophobic acrylic
- Optic and haptics are planar
TECNIS® Multifocal Design Benefits

**ProTEC™ 360° Edge Design**
- The 360° square edge is designed to limit LEC migration.
- Unlike traditional single-piece designs, it prevents cell migration along the haptic.

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**Tecnis MTF**

- +3.0 at spectacle plane
- +33 cm (13 inches) best reading
- +4.0 add power
- +30 cm (12 inches) best reading

**ReSTOR 3.0**

- +2.4 at spectacle plane
- +40 cm (16 inches) best reading
- +3.0 add power

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**Tecnis MTF**

- 32 rings from 1.0 mm to periphery

**ReSTOR 3.0**

- 9 rings from 0.86 mm to 3.6 mm

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**Tecnis MTF**

- All rings 0.25 microns height
- Apodization 1.3 to 0.2 microns

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**Theoretical Total Energy Balance for ReSTOR®**

- Crossed magnified schematic:
  - Larger steps at lens center divide light equally between two images.
  - Smaller steps further out direct less light to near.

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**Theoretical Total Energy Balance for ReSTOR 3.0 vs Tecnis Multifocal**

- Relative Energy vs Pupil Diameter (mm)
- Distance Focus vs Near Focus
Tecnis MTF

Diffraction rings on posterior surface

ReSTOR 3.0

Diffraction rings on anterior surface

Through focus sharpness of USAF resolution target (3 mm pupil)

AcrySof® IQ ReSTOR® IOL

SN6AD3
Add Power: +4.0 D
Spectacle Plane: +3.2 D

SN6AD1
Add Power: +3.0 D
Spectacle Plane: +2.5 D

Physical Comparison: ReSTOR 4.0 vs 3.0

- Both +4.0 D and +3.0 D have 3.6 mm Apodized Diffractive region
- +4.0 D central zone diameter = 0.74 mm
- +3.0 D central zone diameter = 0.86 mm

Mean Defocus Curve for AcrySof® IQ ReSTOR® +3.0 and +4.0 IOL (best case, 6 mos. post-op)

Range of Vision at Various Distances

Patients with SN6AD1 had 20/32 or better from distance to 30 cm.
(subgroup analysis Best case patients)
Average Near Best Distance

-6.7 cm difference

IQ ReSTOR® IOL +3.0 D [N=138]
IQ ReSTOR® IOL +4.0 D [N=131]

The Average Cornea Eye (ACE) Model

- The average cornea eye (ACE) model was developed by collecting topography measurements from a significant sampling of cataract patients.
- This study concluded that the average amount of corneal spherical aberration is +0.27 microns throughout life.
- Multiple studies with over 500 patients combined confirm this data.

Why Target Zero Spherical Aberration?

- Peak visual performance occurs around age 19-25.
- At this time, the average spherical aberration of the eye is zero.
- Spherical aberration increases with age.

The Problem – Spherical Optics

- Spherical aberration occurs when light rays are over-refracted at the periphery of a lens system, resulting in a region of defocused light which can decrease image quality.

Spherical Aberration Correction

- An IOL that fully corrects spherical aberration can provide a 13% increase in contrast over an IOL that leaves +0.1 residual spherical aberration.
- Tilted or decentered highly aspheric IOLs can induce coma and higher order aberrations.
What is chromatic aberration?
-Occurred when light is separated into its spectral components.
-These wavelengths refract differently, creating multiple focal points.

TECNIS Multifocal IOL material provides better chromatic aberration correction due to:
- Diffractive surface corrects chromatic aberration at near focus for all pupil sizes.
  1. +4.0 D add power corrects ocular chromatic aberration at near focus better than a +3.0 D add power.
  2. Material has a higher Abbe number and therefore less chromatic aberration at the distance focus.

AMO hydrophobic acrylic has a high Abbe number of 55. This can mean up to a 12% increase in contrast compared to the AcrySof material.

Glistenings can cause:
- A loss in contrast sensitivity.
- Eyes without glistenings were found to have a 40% increase in contrast sensitivity at high spatial frequencies.
- Decreased visual acuity.
- A study has shown that eyes with higher grades of glistenings had a small but significantly greater decrease in visual acuity than those with lesser grades.
**Lathing vs. Injection Molding**

- The advantage of cryolathing over injection molded IOLs:
  - Ensures refractive consistency of the material
  - Limits microvoid formation from high temperature fluctuations, which have been shown to cause glistenings*  


**Better Scotopic Vision with Blue Light Transmission**

AMO® hydrophobic acrylic lenses provide up to 21% more scotopic sensitivity compared to blue-blocking IOLs*

![Scotopic Sensitivity Reduction Chart](image)

0 15 0 10 0 5 0 0 0 0

<table>
<thead>
<tr>
<th>IOL Type</th>
<th>Scotopic Sensitivity Reduction</th>
</tr>
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<tbody>
<tr>
<td>AcrySof® Natural 20D</td>
<td>-21</td>
</tr>
<tr>
<td>Hoya 23D IOL</td>
<td>-15</td>
</tr>
<tr>
<td>AcrySof® Natural 20D</td>
<td>-14</td>
</tr>
<tr>
<td>AMO® UV-blocking IOL</td>
<td>0</td>
</tr>
</tbody>
</table>


**Tecnis MTF vs. ReSTOR 3.0**

- **Tecnis MTF**
  - Standard UV protection
  - Full-diffractive optic

- **ReSTOR 3.0**
  - Blue blocking chromophore
  - Mixed diffractive-refractive optic

**The 1951 USAF resolution test chart**

The 1951 USAF resolution test chart is a resolution test pattern conforming to MIL-STD-150A standard, set by US Air Force in 1951.

**Peer-reviewed**

- JCRS Hutz et al., 2006
Reading speed in low light conditions (Hutz et al., 2006)

ZM001 (Tecnis MTF silicone model)
SN60D3 (ReSTOR non-aspheric, +4.0 add)

**Bright light conditions (100 cd/m²)**
- 171 wpm vs 131 wpm

**Low Light conditions (6 cd/m²)**
- 140 wpm vs 79 wpm

Source: Journal of Cataract & Refractive Surgery 2006; 32:2015-2021

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Sorting through

- Diffractive Multifocal technology with both ReSTOR and Tecnis MTF, while preserving unaided distance clarity, provides functional unaided near vision.
- Multifocal lens implants aren’t perfect and are associated with halos around lights, glare, and decreased contrast sensitivity compared with a monofocal IOL, offsetting the benefit of lessened reliance on readers.

Sorting through

- ReSTOR 3.0 major strengths include:
  - More favorable reading distance add
  - Possibly better intermediate functioning
  - Acceptable distance clarity for most
  - Achieved by distance dominance IOL through apodization and having 60% of IOL devoted to near.
- Tecnis MTF major strengths include:
  - Better reading especially in dim illumination
  - Acceptable distance clarity for most
  - Achieved by lower spherical aberration.

Sorting through

- Minor advantages for Tecnis MTF
  - Possibly lower YAG cap rates
  - Lower rate/degree of glistenings
  - Absence of yellow chromophore
  - Reduced chromatic aberration
  - Surface not as easily scratched in implantation.