New Technology in Cataract Surgery and Intraocular Lenses

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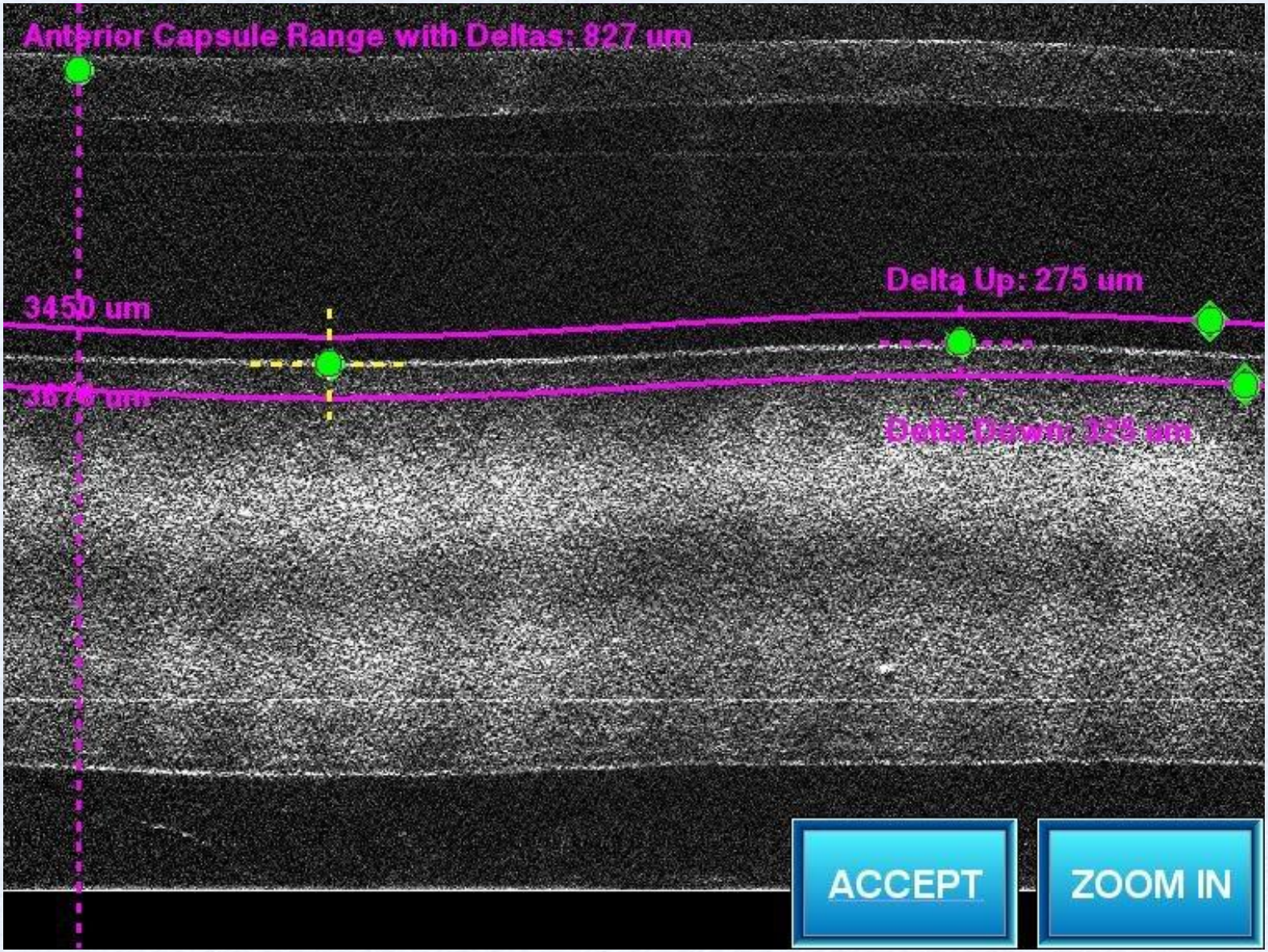
KC EYE CLINIC


VERION
Waiting for Pre-Dock Image...
Pre-Dock Image Registration

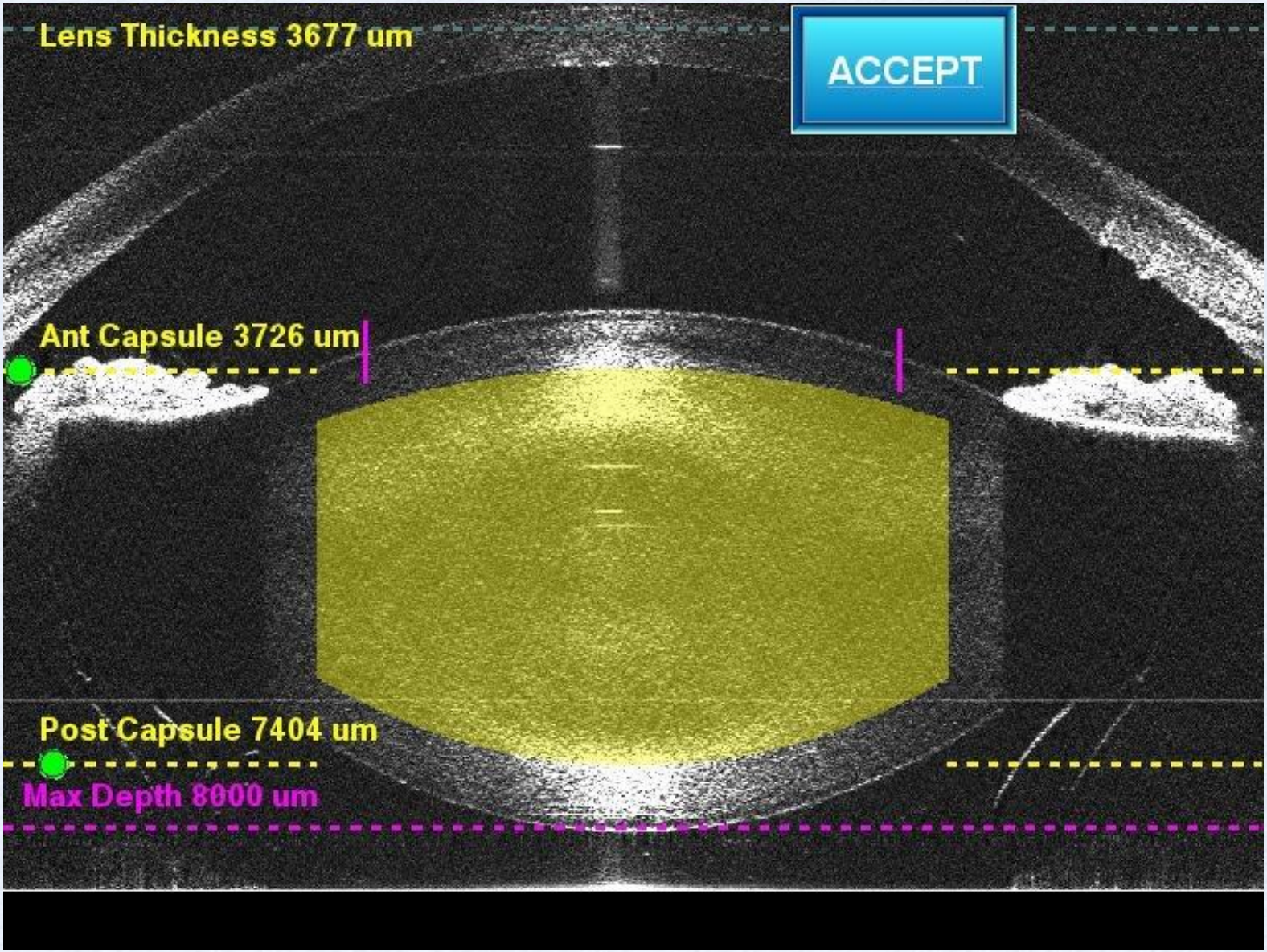
New Cataract Surgery Technology

- FLACS - Femtosecond laser assisted cataract surgery
  - Femto discovered by Dr. Kurtz at the University of Michigan in the early 1990s
  - Used in several types of corneal surgery - LASIK/PRK/IEK/PTK/etc
  - Emit light pulses at 1053 nm wavelength that cause photodisruption of the tissue
  - Minimal collateral damage - enables bladeless incisions to be made within the tissue at various patterns and depth with high precision.
  - Multiple platforms - Catalys, LENSX, Zeimer and LensAR are the most common in the US
  - Pros and Cons…
  - will continue to evolve…

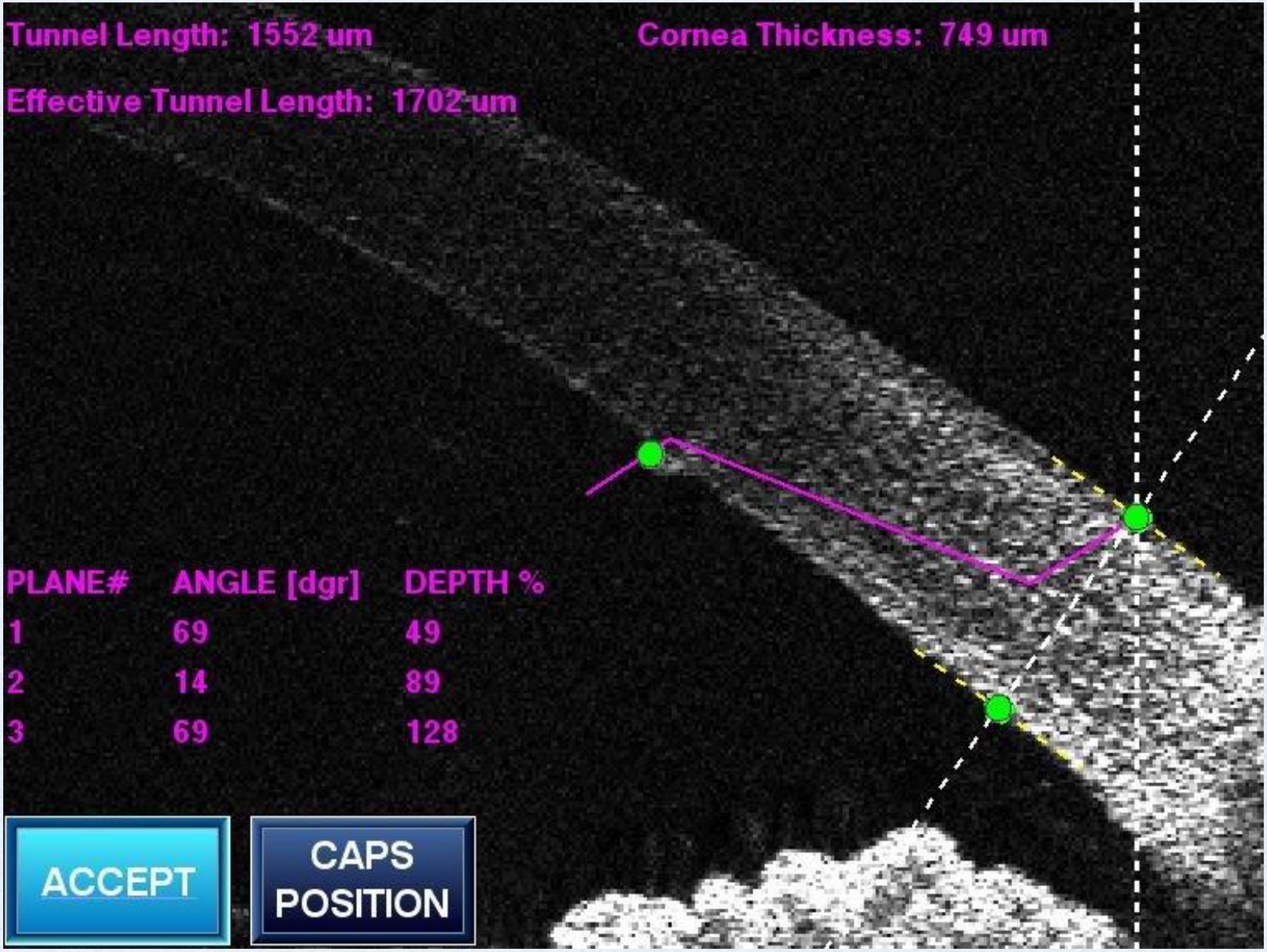
FLACS


Anterior Capsule Range with Deltas: 827 um
3450 um
Delta Up: 275 um
ACCEPT
ZOOM IN

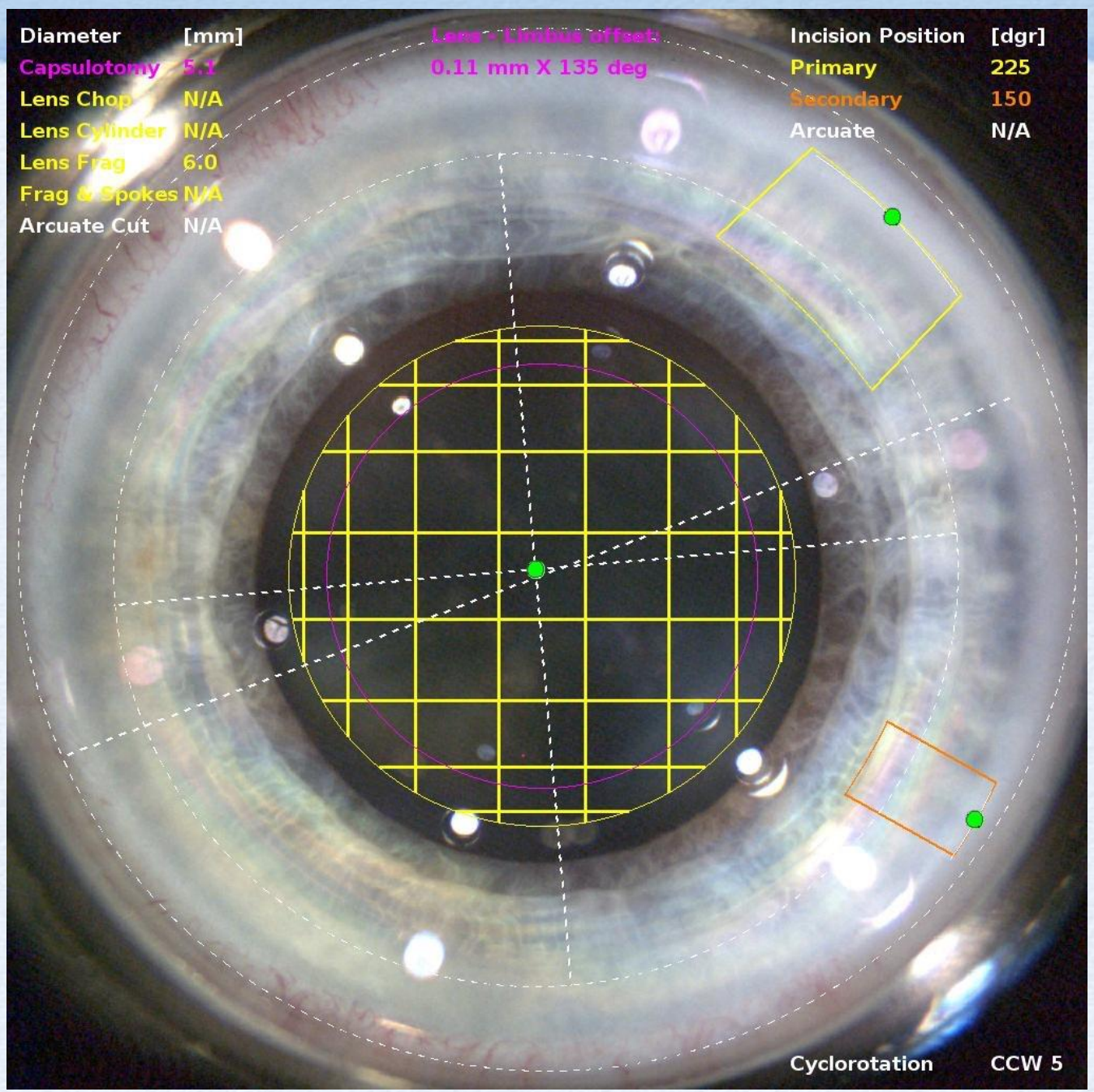
FLACS


Lens Thickness 3677 um
ACCEPT
Ant Capsule 3726 um
Post Capsule 7404 um
Max Depth 8000 um

FLACS


Tunnel Length: 1552 um
Cornea Thickness: 749 um
Effective Tunnel Length: 1702 um
PLANE# ANGLE [dgr] DEPTH %
1 69 49
2 14 89
3 69 128
ACCEPT
CAPS POSITION

FLACS


Diameter [mm]
Capsulotomy 5.1
Lens Chop N/A
Lens Cylinder N/A
Lens Frag 6.0
Frag & Spokes N/A
Arcuate Cut N/A
Lens - Limbus offset:
0.11 mm X 135 deg
Incision Position [dgr]
Primary 225
Secondary 150
Arcuate N/A
Cyclorotation CCW 5

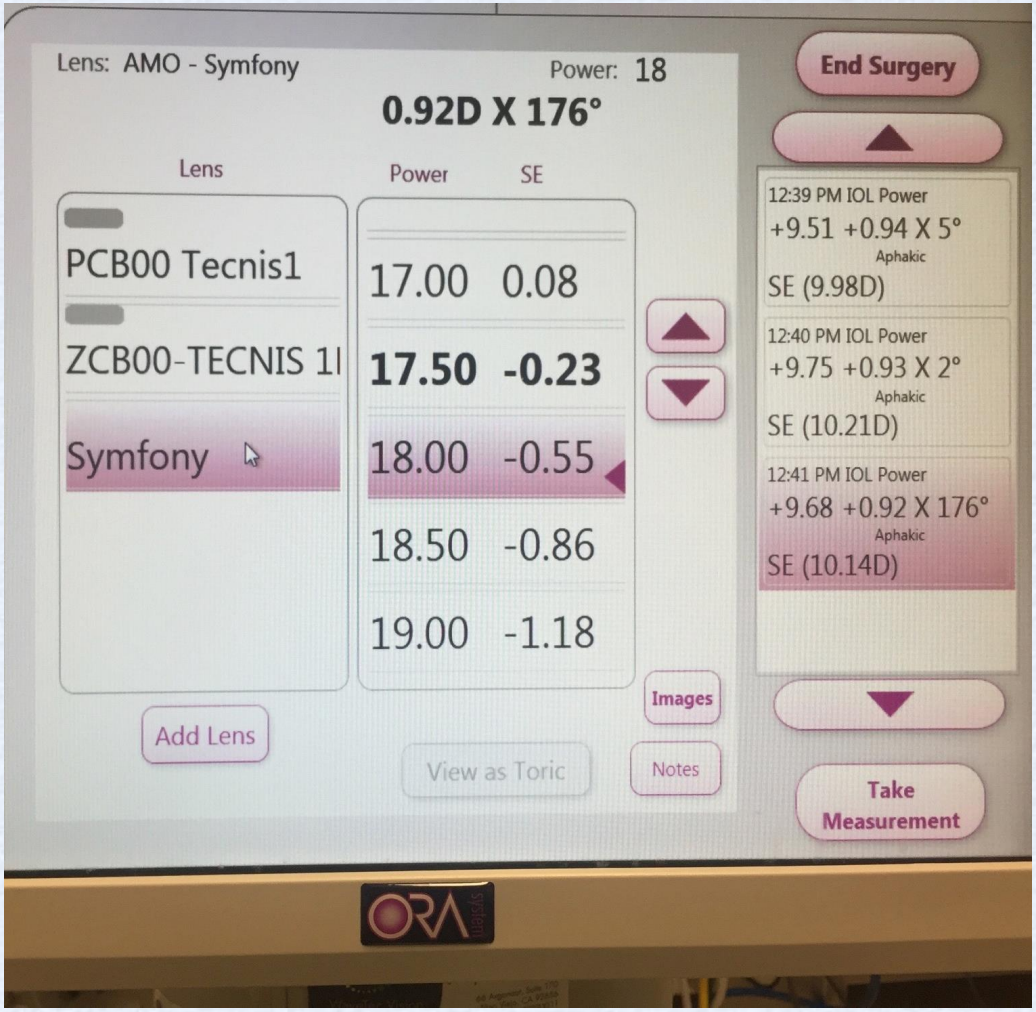
Verion

- **Verion image guided system -** advanced diagnostics, planning, intra-operative aid and postoperative tracking

ORA

- ORA - intra-operative aberrometry
- can predict lens power on the fly for sphere and cylinder
- can be especially helpful in post-LASIK eyes
- can sync with the Verion system for even more accuracy

ORA


Lens: AMO - Symfony
Power: 18
0.92D X 176°
Lens
Power
SE
PCB00 Tecnis1
ZCB00-TECNIS 1I
Symfony
17.00 0.08
17.50 -0.23
18.00 -0.55
18.50 -0.86
19.00 -1.18
Add Lens
View as Toric
Images
Notes
End Surgery
12:39 PM IOL Power
+9.51 +0.94 X 5°
Aphakic
SE (9.98D)
12:40 PM IOL Power
+9.75 +0.93 X 2°
Aphakic
SE (10.21D)
12:41 PM IOL Power
+9.68 +0.92 X 176°
Aphakic
SE (10.14D)
Take Measurement

IOL Technology

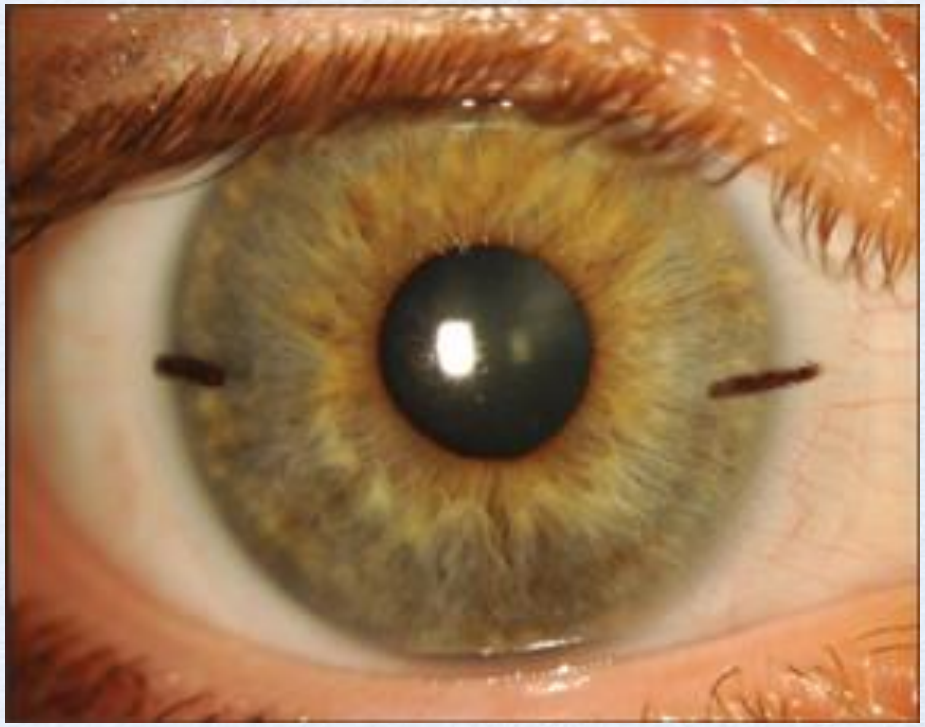
- **Current IOL technology**
  - Monofocal
  - Presbyopia correcting
    - (MF/EDF/Accom.)
  - Toric (+/- presbyopia correction)
  - Intraocular miniature telescope
- **Up and coming IOL technology**
  - NuLens
  - Tetraflex
  - ELENZA
  - Calhoun's light adjustable lens
  - Trifocal lens
  - Harmoni Modular
  - And many more…

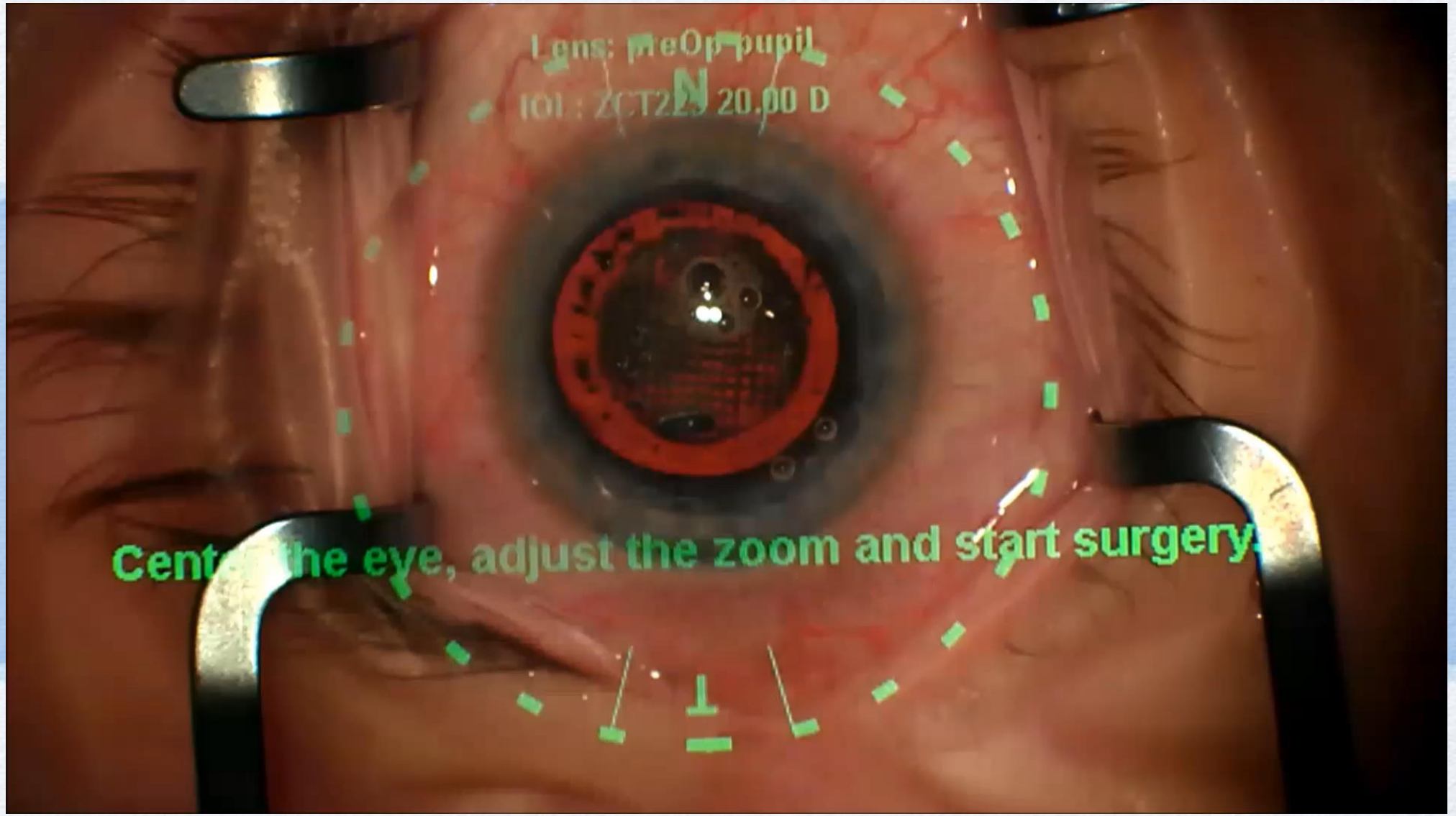
Current IOL

- **Presbyopia-correcting lenses**
  - Multifocal
    - Restor +3/2.5/Toric
    - Tecnis Multifocal +4.0/3.25/2.75
  - Accommodating - Crystalens/Trulign (toric)
  - EDF - SymFony/SymFony Toric

Current IOL

- **Toric**
  - Can be more accurate now!
  - Tecnis or Alcon most common monofocal used
  - monofocal, multifocal, EDF or accommodative
  - single piece acrylic

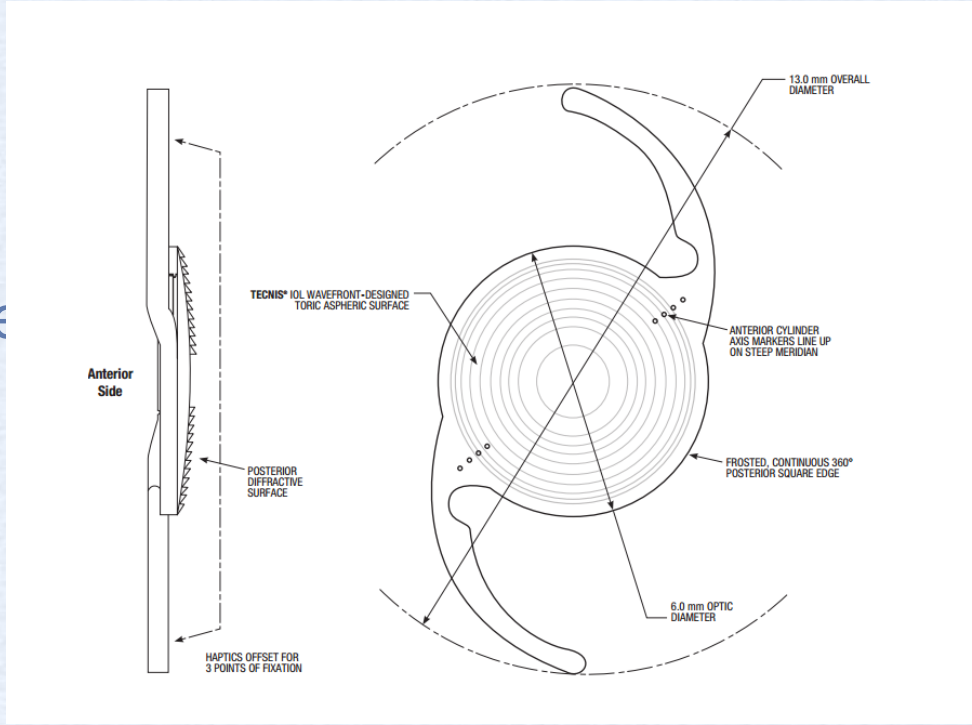



Lens: PreOp Pupil
N
IOL : ZCT225 20.00 D
Cent the eye, adjust the zoom and start surgery.

Multifocal - Tecnis

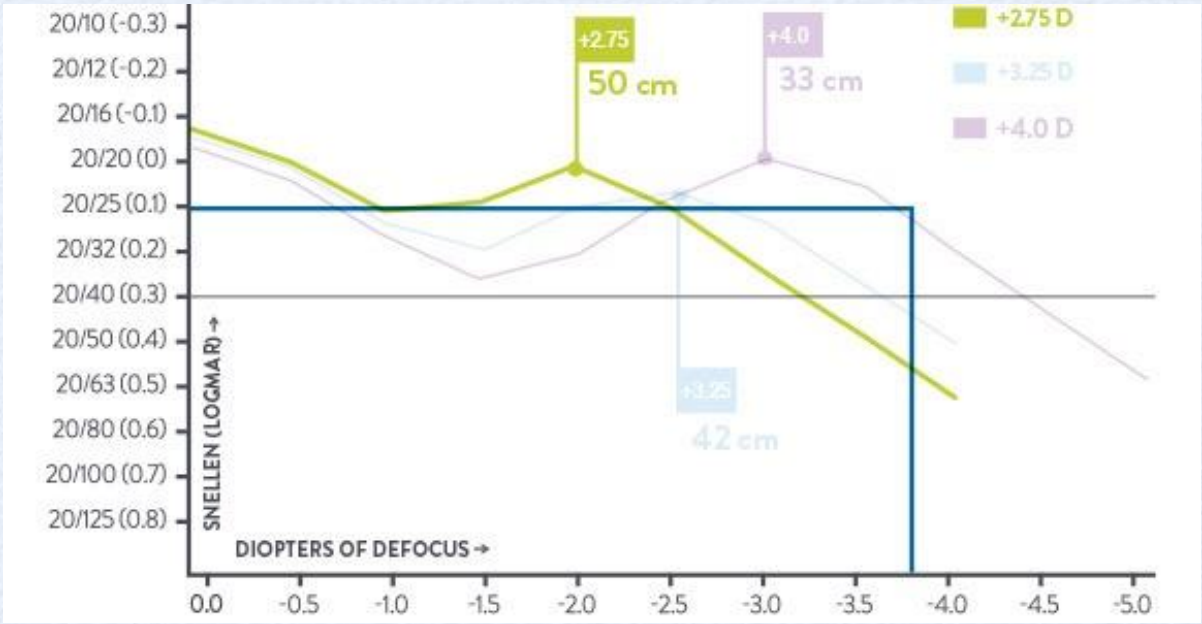
Tecnis MF

- Spherical aberration correction to essentially zero -
  corrects for the natural SA of +.27
- Better chromatic aberration reduction
- A pupil-independent, full-diffractive posterior surface
- High-quality vision in all light conditions
- Clear hydrophobic acrylic
- Not associated with “glistenings”
- Full transmission of blue light (a controversy still exists...)



Multifocal - Tecnis

- Tecnis +4.00
  - Great distance
  - Great Near at ~12 inches
  - OK intermediate
  - purple bar on graph

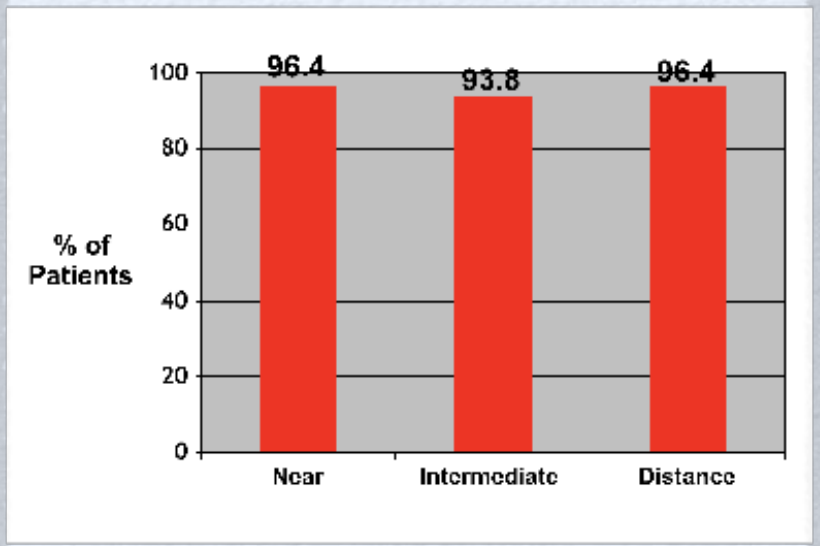


Multifocal - Tecnis

US Clinical Results - TMF +4

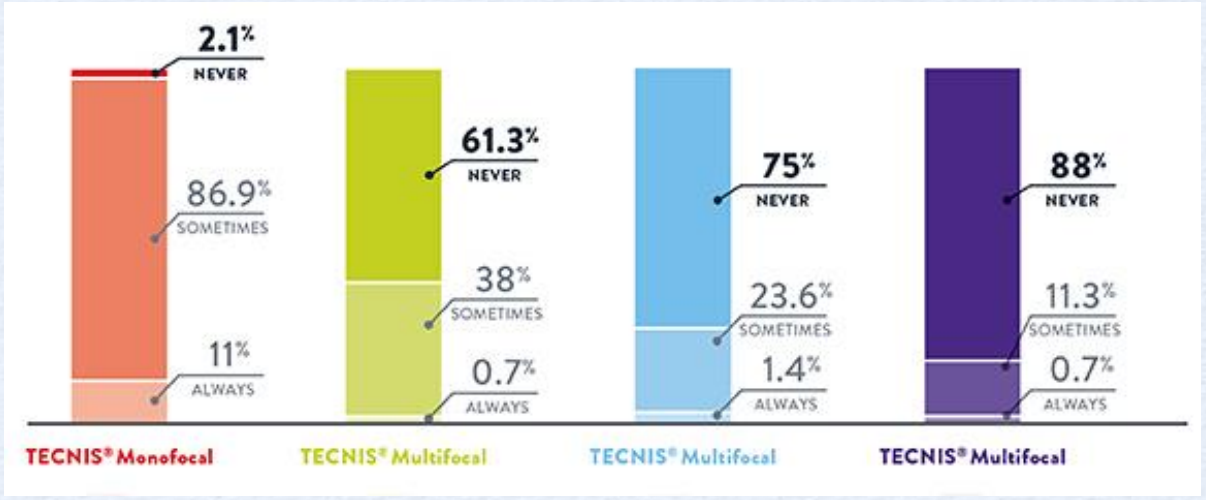
- Over 93% of patients are able to function comfortably without glasses at ALL distances
- Nearly 9 out of 10 patients NEVER wear glasses
- 94.6% patient satisfaction at 1 year
- 94.2% simultaneous 20/25 or better distance AND 20/32 or better near

Ability to function comfortably without glasses (1 year)



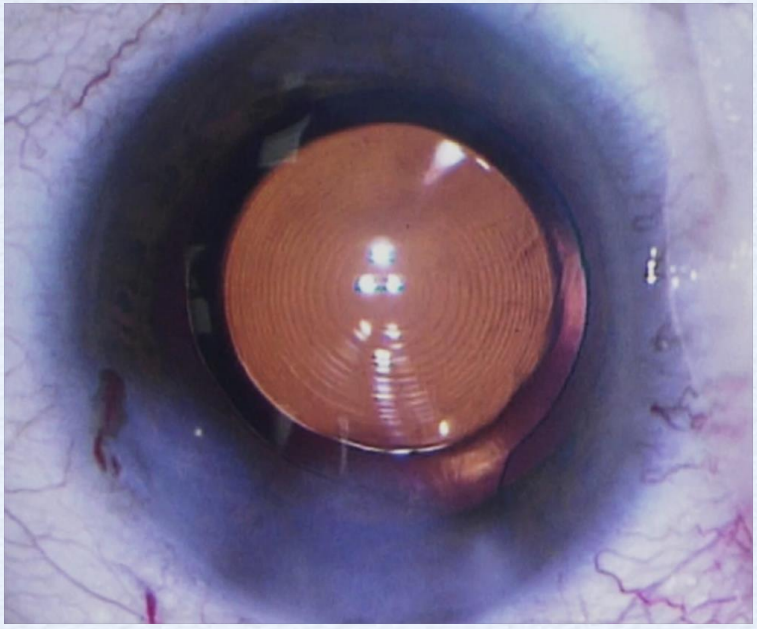
Multifocal - Tecnis

- Tecnis +3.25
  - Great distance
  - Great near at ~ 17 inches
  - Better intermediate, but still OK
  - blue bar on graph

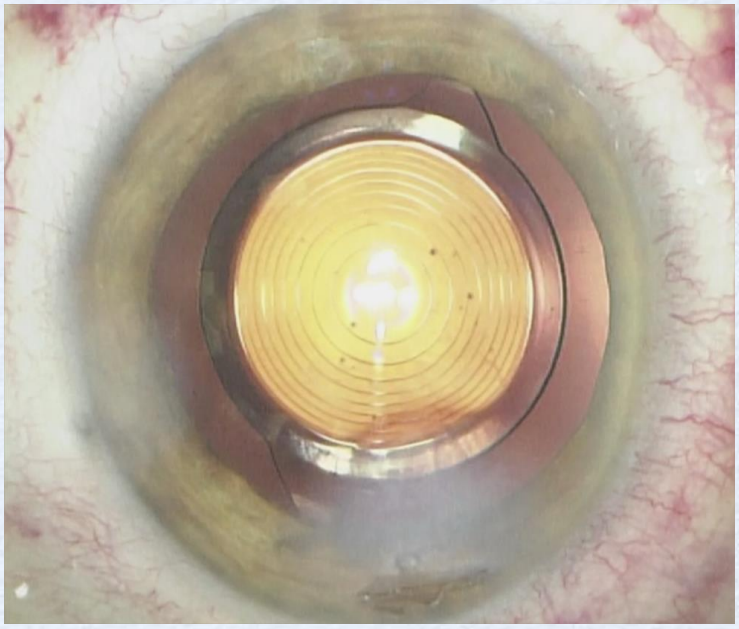


TMF vs SymFony

ZLBOO

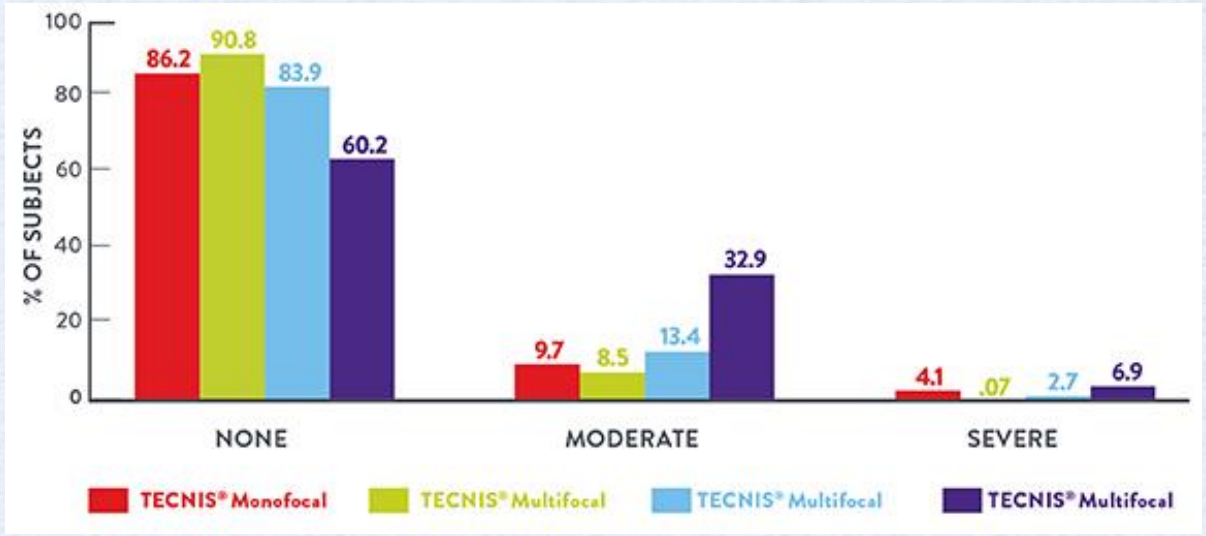


SymFony



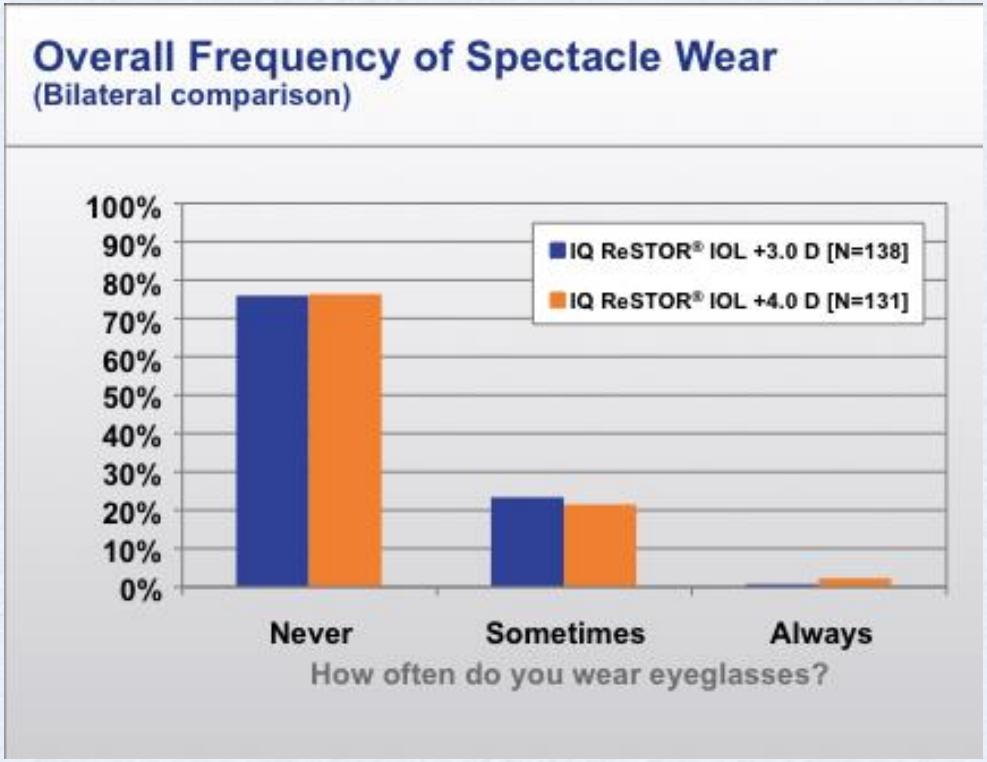
Multifocal - Tecnis

- Tecnis +2.75
  - Great Distance
  - Great Intermediate
  - OK near
- ***Multifocal Monovision***



Multifocal

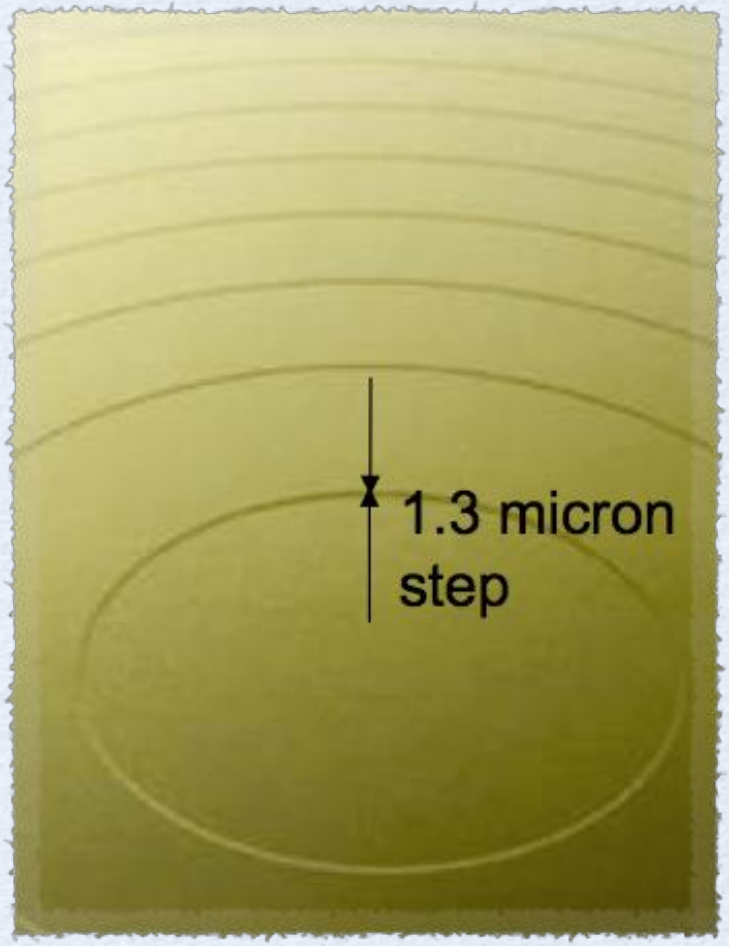
ReSTOR +3



Multifocal

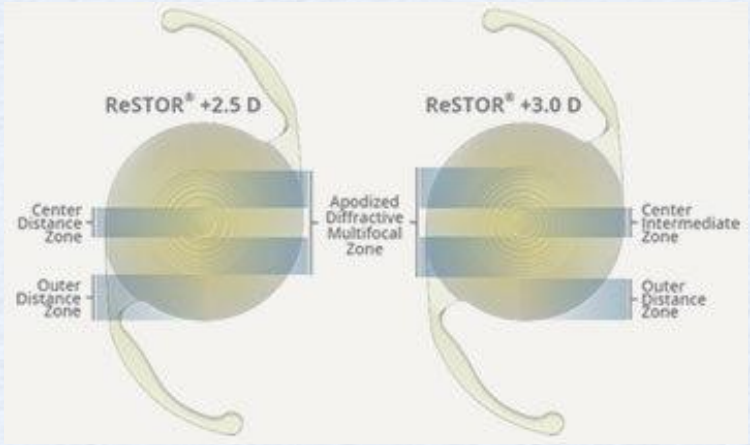
Apodization

- Gradual reduction or blending of the diffractive step heights.
- Optimally manages light energy delivered to the retina as it distributes the appropriate amount of light to near and distant focal points, regardless of the lighting situation.
- Designed to improve image quality



Multifocal - ReStor

- Restor +2.5
  - Similar to the Tecnis +2.75
  - better night driving
  - don’t get as much near
- ***Multifocal monovision with +3.0***

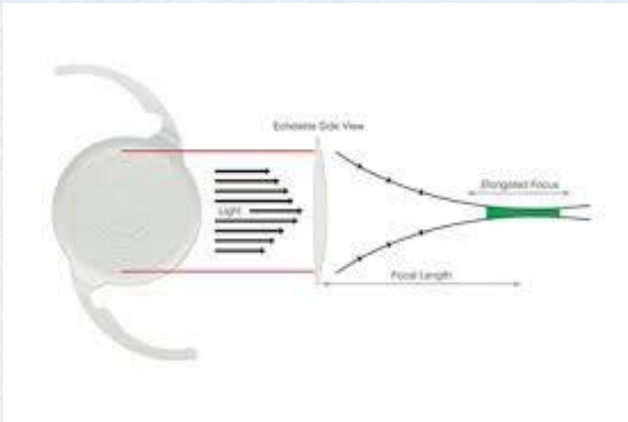


restor topic

- Acrysof IQ ReSTOR Multifocal Toric was released during 2010 ESCRS in Paris
- FDA approved early 2017
- Combines technology of ReSTOR +3 or +2.5 and Toric IOLs on Alcon's AcrySof platform
- Data shows that it gives similar quality of vision compared to the ReSTOR +3 and +2.5
- Can correct more cyl than SymFony Toric

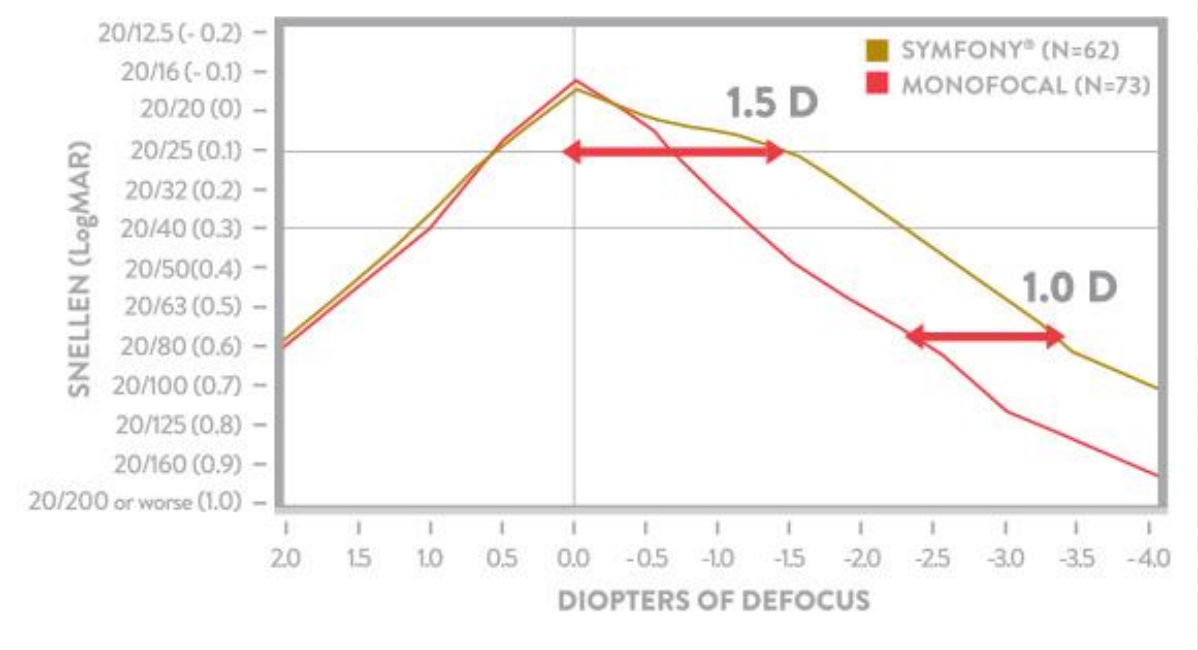
Extended Depth of Focus

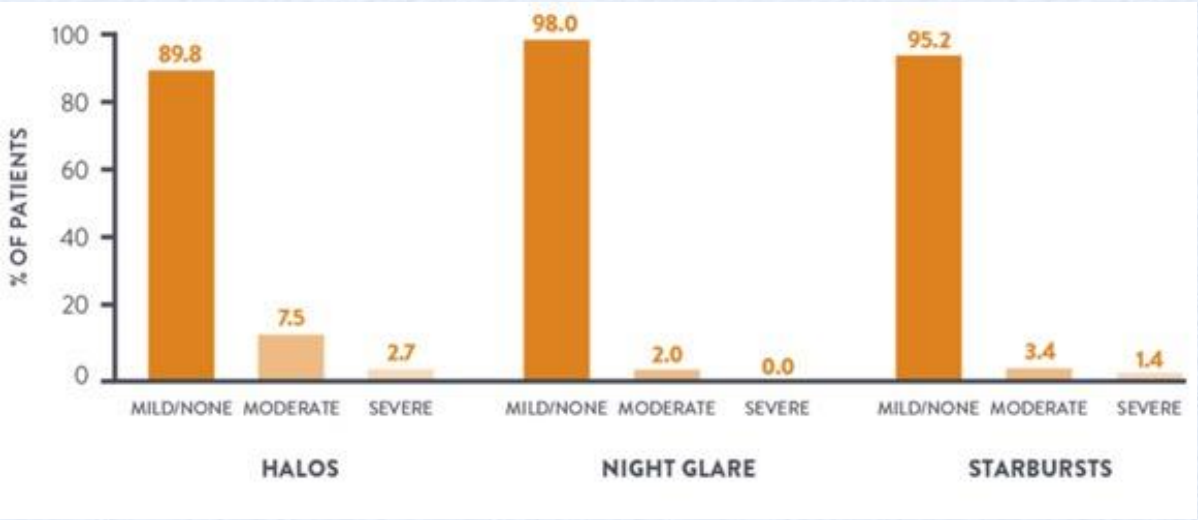
- **SymFony and SymFony Toric**
  - Single piece acrylic
  - EDOF-IOL - one elongated focal point as opposed to splitting light into two or three
  - uses significant decrease in chromatic aberration and spherical aberration to offset this
  - high image quality and contrast sensitivity - similar to a monofocal
  - similar range to a low power add MF



Extended Depth of Focus

- maintains clear vision to a defocus of 1.5 D and 1 D better throughout
- great distance and intermediate with “OK” near
- improved glare and halo over traditional MF
- high satisfaction rate with 95-97% stating they would choose same lens again
- 85% use spectacles “a little” or “none”
- more “forgiving” overall - good vision anywhere up to 1.5 D residual cyl



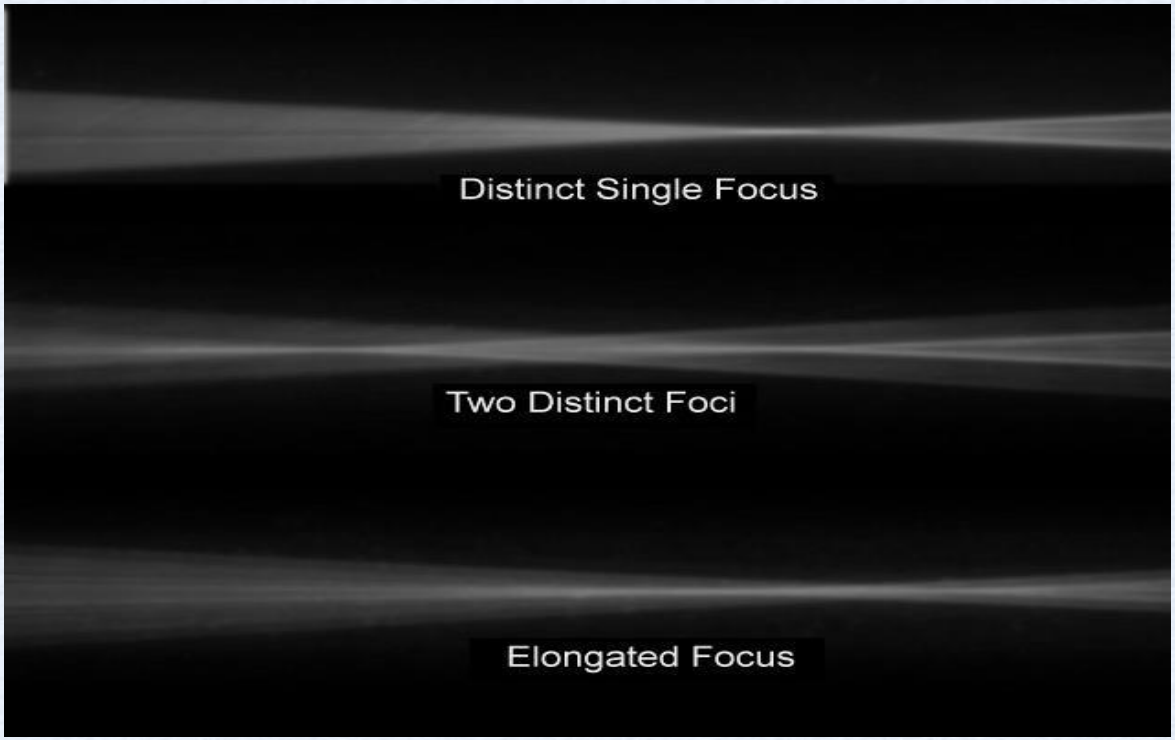


extended depth of focus

Monofocal lens

Multifocal lens

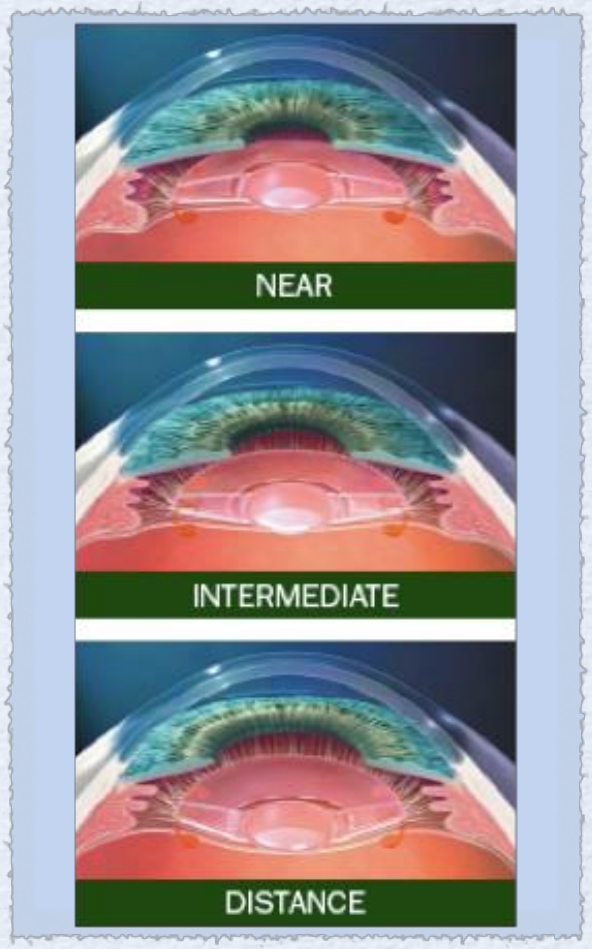
EDOF lens



I love Lamp!

Accommodating

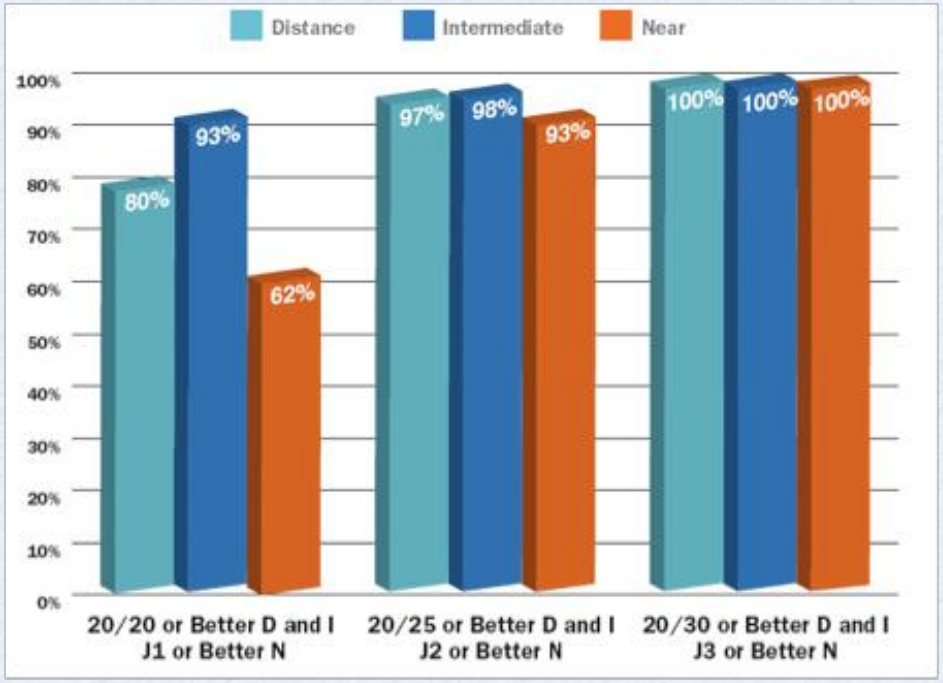
- Accommodating monofocal lens intends to deliver 100% of available light rays at all distances
- Patients should theoretically see near, intermediate and distance with equal clarity
- The IOL, like the natural crystalline lens, tries to provide accommodation from distance to near vision by moving along the visual axis
- Also arch, or change its radius of curvature, to increase accommodation
- Both move anteriorly and flex or arch to increase their focusing power in the intermediate and near ranges

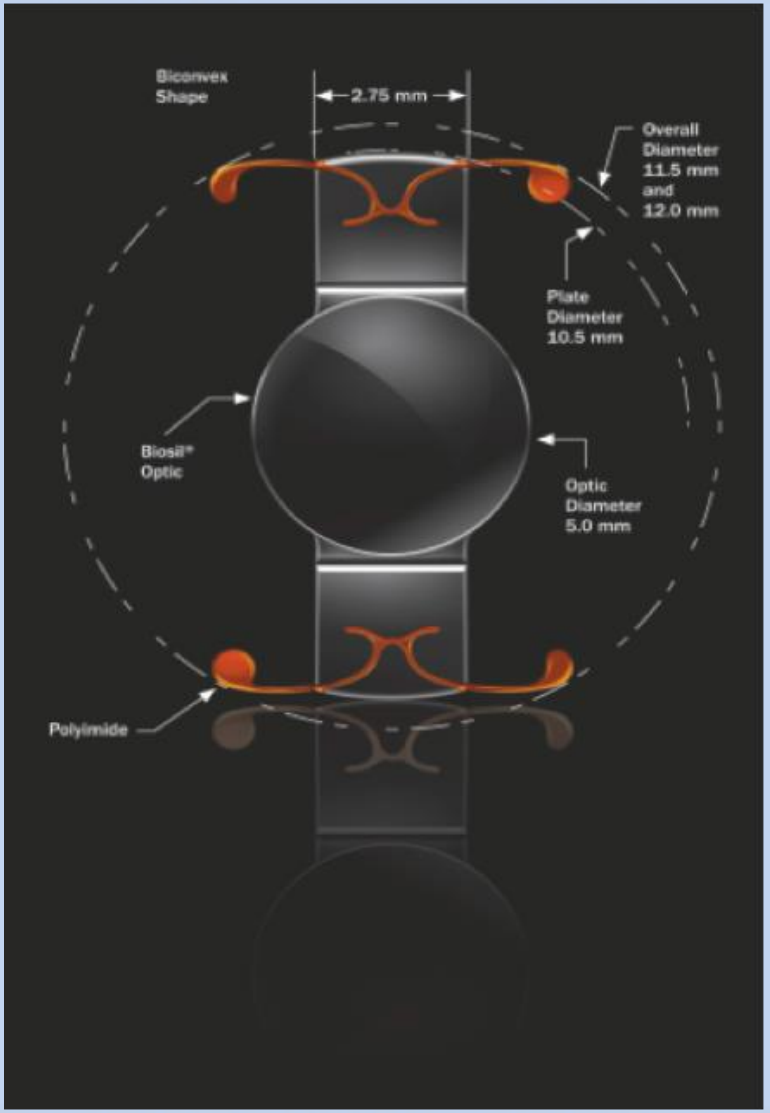


Accommodating

Crystalens HD

Binocular Acuities
3 Months Post-op n=45

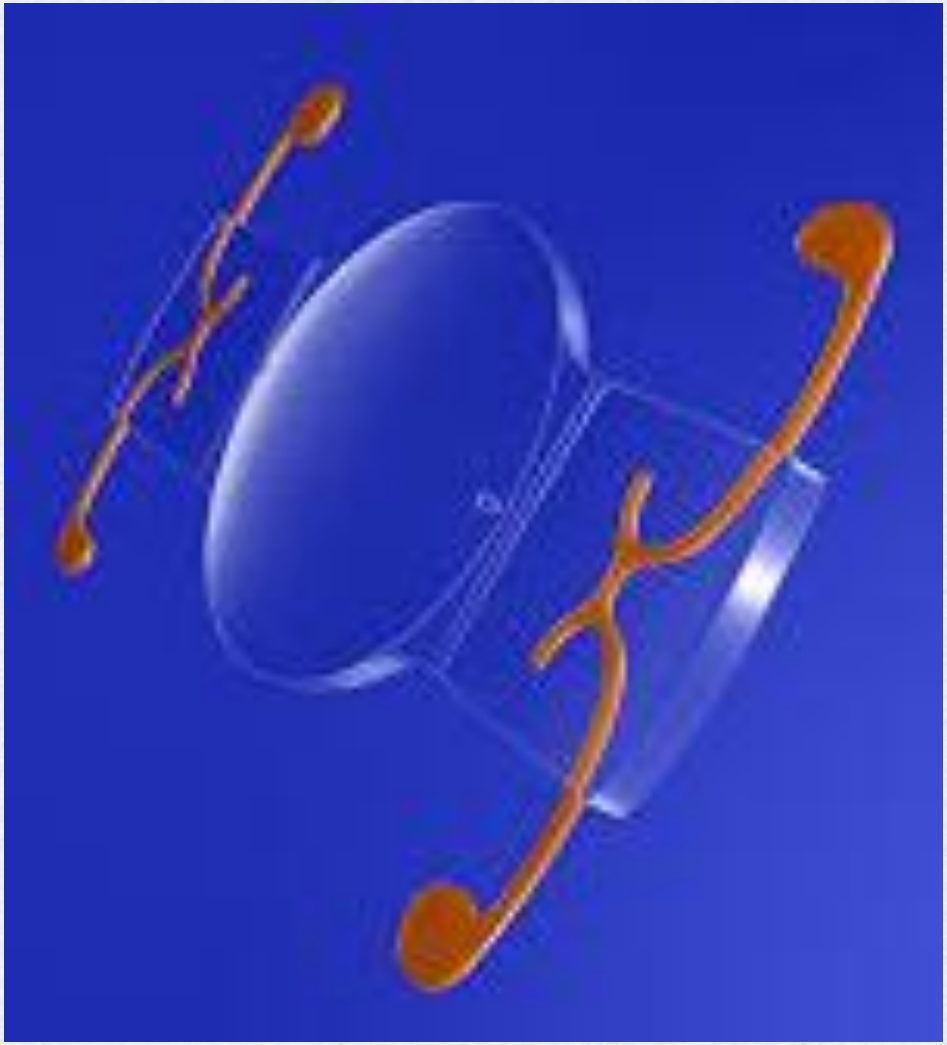




Accommodating/Toric

Trulign

- Approved in US for presbyopia and astigmatism
- Silicone with 5-mm optic and rectangular hinged haptics
- Approved for multiple powers of cylinder



Trulign

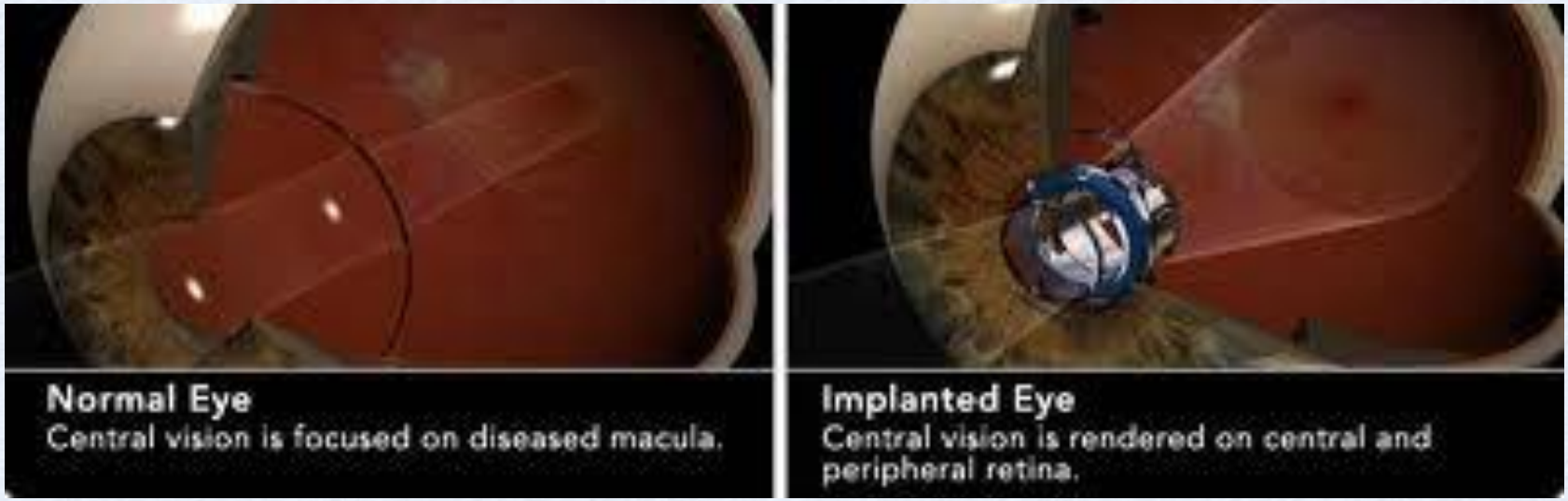
- FDA study of 210 patients
  - 85% reached the intended reduction of cyl
  - 97.8% had 20/40 or better at distance and intermediate
  - 70% had 20/40 near vision

IMT

- **Implantable Miniature Telescope**
- Visual prosthetic device developed by VisionCare Technologies
- No viable medical or surgical treatment is currently available for improving visual acuity and quality of life in those with end-stage AMD

IMT

- Includes the cornea to produce a telephoto effect that enlarges the objects in the patient's central visual field - a 20-24 degree field of view projects onto ~55 degrees of the retina
- Fixed focus telescopic system comprised of quartz glass wide-angle micro-optics



IMT

- Consists of glass cylinder (4.4 mm in length and 3.6 mm in diameter) held in a PMMA carrier with rigid haptics
- Height of the cylinder is ~ that of 13 IOLs stacked and it protrudes 0.1-0.5 mm through the pupillary plane

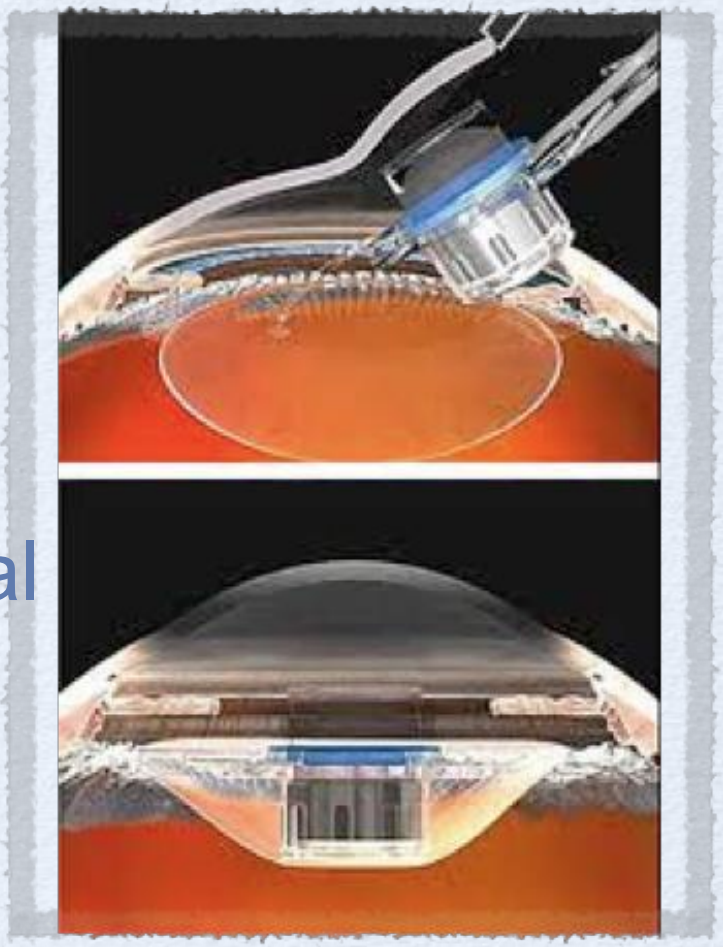
IMT

- 1 year study results of 206 patients showed 67% achieved 3-line or greater improvement in BCVA as well as significant improvement in quality of life measures.

- Challenging procedure and can have significant EC loss at time of surgery (best results were shown to be by those with cornea training)

IMT

- **2 models**
  - 2.2 X and 24 degrees of forward field of view
  - 3.0 X and 20 degrees of forward field of view
- Very specific indications for surgical candidates and intensive post-op rehabilitation
- Currently being used in the USA



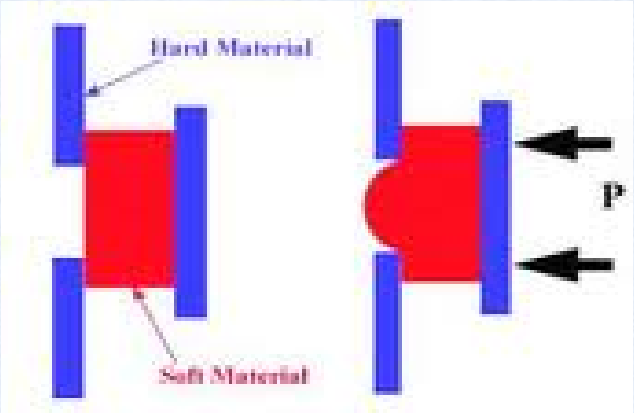
Up and Coming

- NuLens
- Tecnis MF Toric
- Trifocal lens
- Tetraflex
- Calhoun's light adjustable lens
- ELENZA
- Harmoni Modular

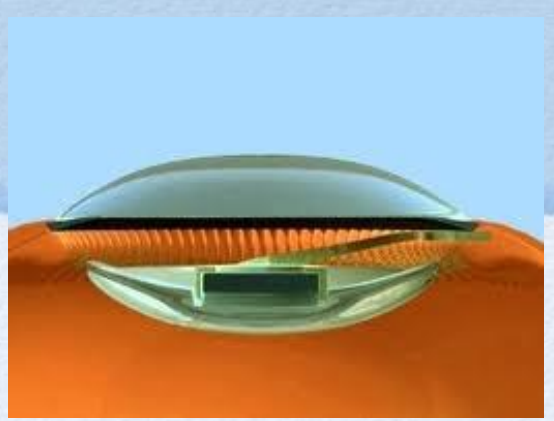
- A few further away from primetime

Nulens

- New concept in accommodating IOLs that uses basic physical principles of human eye
- Flexible gel contained in a small chamber
- “Piston” operated by capsular bag pushes contained gel through a round hole to form a bulge that acts as the lens



Nulens



- 1 year study with AMD (20/150 or worse) patients shows approximately a 3 line improvement in uncorrected near vision
- Showed approx 10-15 diopters of accommodation with this lens by UBM and near point
- Increased rate of PCO and approx 27% decrease in ECC initially

Nulens

- Good candidates are over 50 with no other serious eye disease (i.e.. low ECC)
- Likely available in the United States soon
- Probably around $3,000 per eye

Harmoni Modular

- **Harmoni Modular IOL**
  - 2-piece lens system
  - -Base component secures the lens in the capsular bag and captures the optic component
  - -Optic component provides flexibility to adjust or exchange the optic ***at any time***

Harmoni Modular

Harmoni Modular IOL on YouTube

Trifocal

- **FineVision (Micro F)**
  - first diffractive trifocal optic
  - combines two diffractive structures that give +3.5D add for near vision and +1.75D add for intermediate vision.
  - other similar lenses not in US are being compared (AT LISA)
  - said to have greater spectacle independence than bifocal lenses used in US

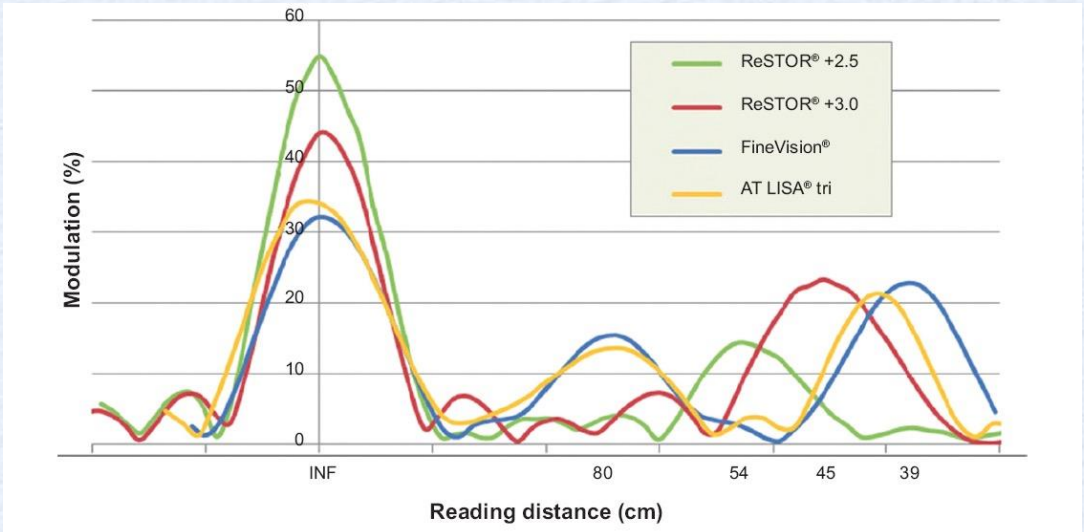
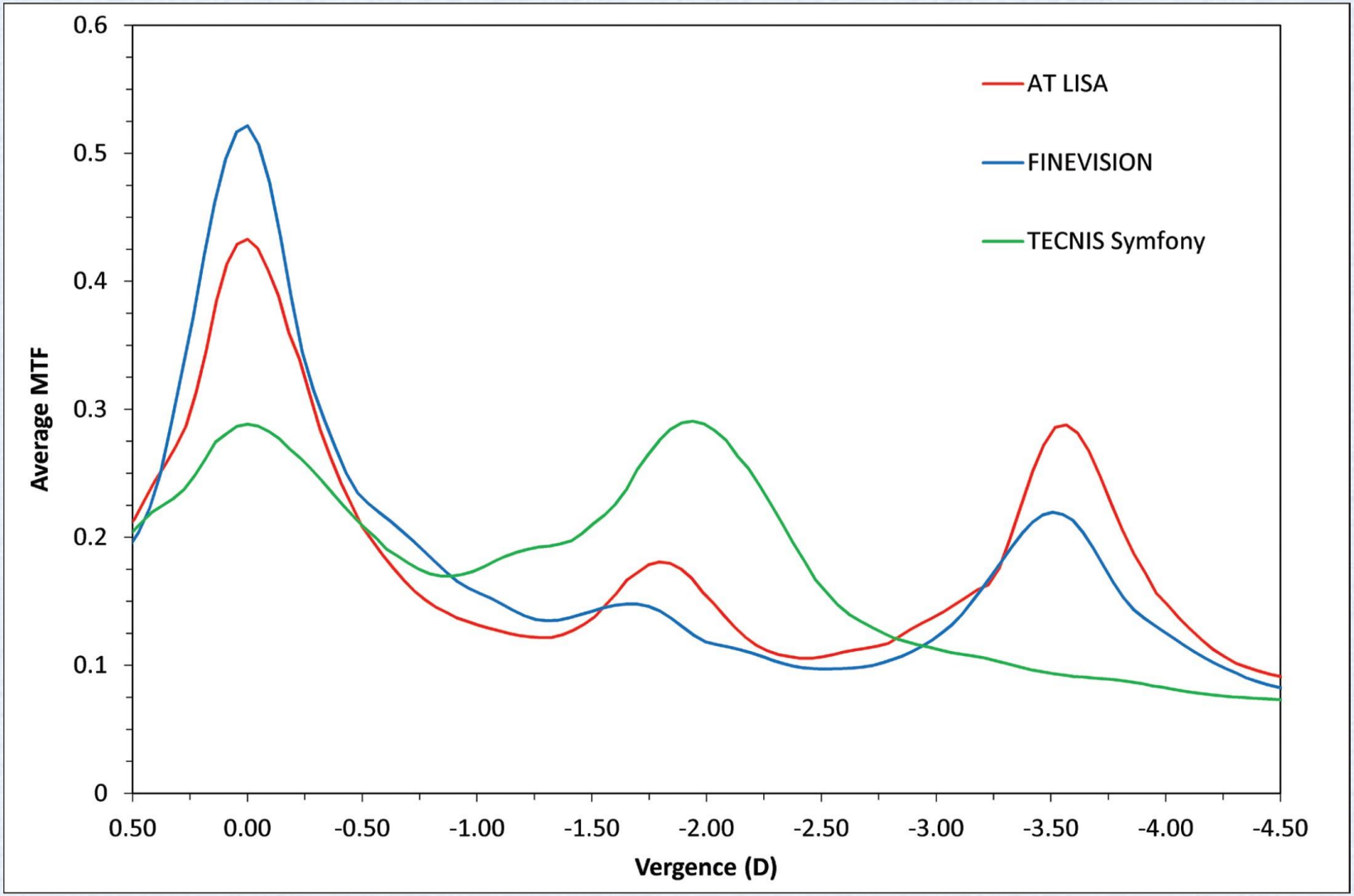


Figure 7 Through-focus MTF values of the AT LISA® tri, FineVision®, ReSTOR® +2.5 D, and ReSTOR® +3.0 D IOLs, at 20/40 Snellen visual acuity equivalent (50 line pairs per mm).
Notes: AcrySof® IQ ReSTOR® IOLs, Alcon Laboratories, Fort Worth, TX, USA; AT LISA® tri 839MP IOLs, Carl Zeiss Meditec AG, Jena, Germany; FineVision® Micro F12 IOLs, PhysIOL SA, Liège, Belgium.
Abbreviations: INF, infinity; IOL, intraocular lens; MTF, modulation transfer function.

Trifocal vs EDF



Tetraflex HD

- “Near-enhancing” IOL
- Significantly increased HOA’s - thought to help some with near vision
- Fits through 3-mm or smaller incision
- Has been studied in Europe and United States

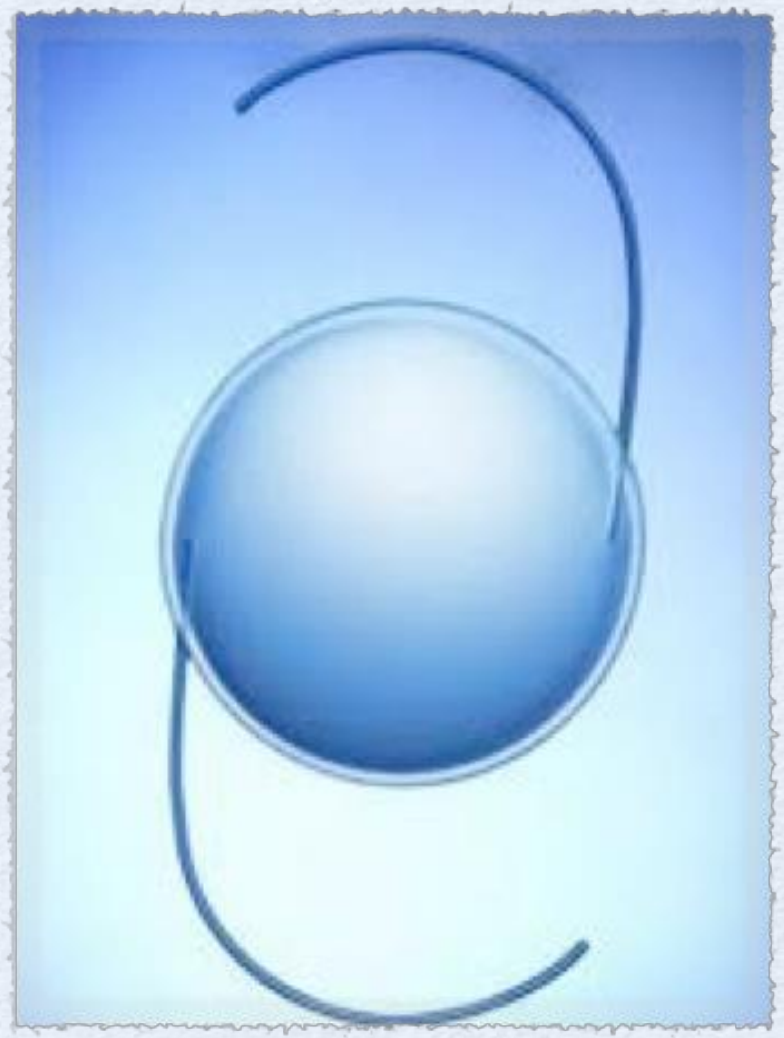
Tetraflex

- US FDA Clinical Trial compared 255 Tetraflex to monofocal patients
- 75% reported spectacle independence

- This is lower than the newer multifocal lenses such as ReSTOR +3 and Tecnis
- More recent study shows improved reading ability when compared with Crystalens

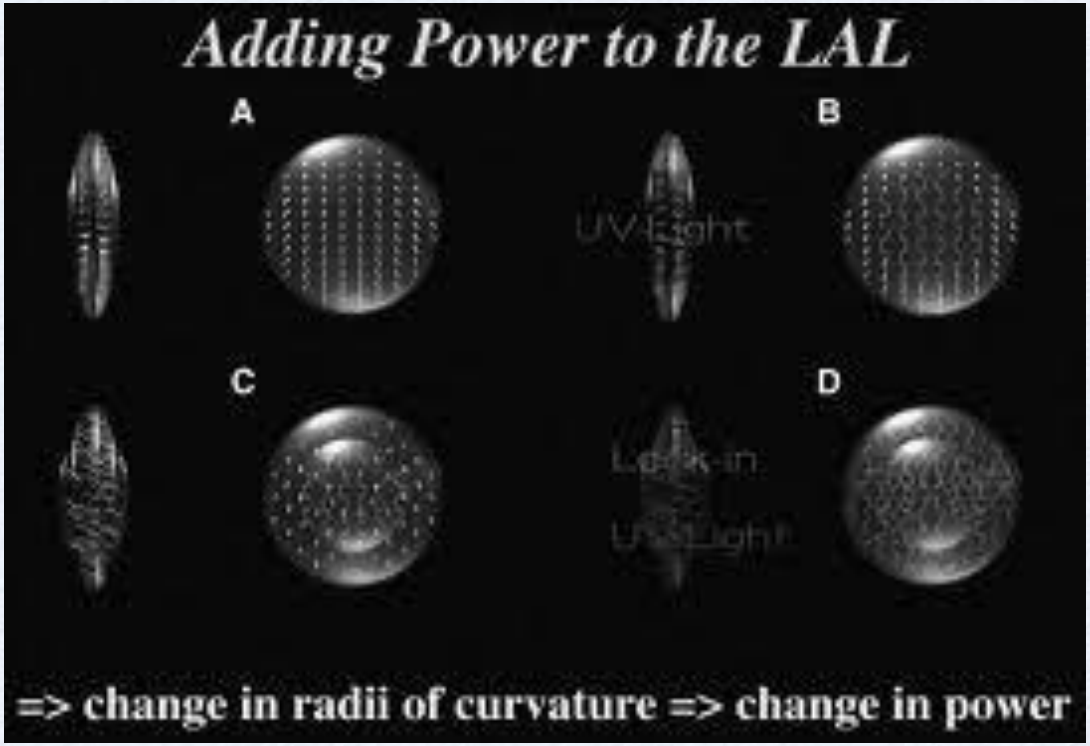
Calhoun LAL

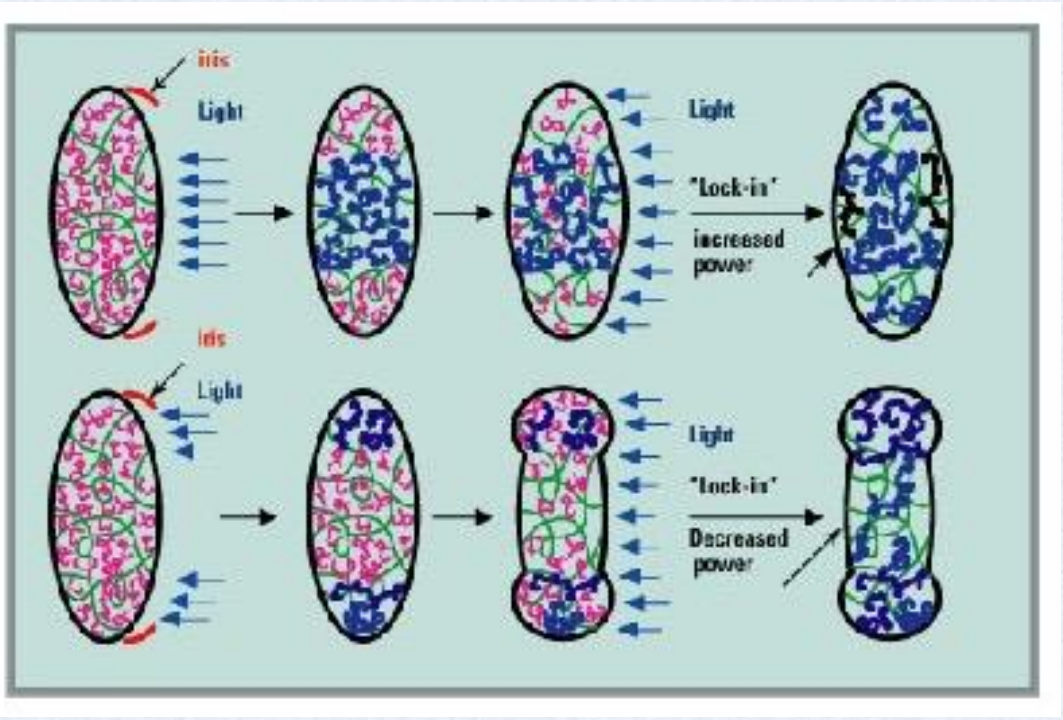
- Power can be adjusted post-op by UV light
- Now in clinical trials
- Looks and feels like a standard IOL and no difference in surgical technique
- Lens material is a flexible silicone polymer matrix that contains mobile, photosensitive silicone subunits called “macromers”



Calhoun LAL

- A new digital light delivery device (DLD) was developed to adjust the lens power
- Delivers a cool, low-intensity beam of near-UV light that is customized for each patient
- The portion of the lens that is irradiated causes polymerization of the macromers in that area
- This forms a diffusion gradient that moves the macromers toward the irradiated area


Adding Power to the LAL
A
B
UV Light
C
D
Lock-in
UV Light
=> change in radii of curvature => change in power


Iris
Light
Light
"Lock-in"
Increased power
Iris
Light
Light
"Lock-in"
Decreased power

Calhoun LAL

- So...the treated area will swell and correct hyperopia, myopia, or astigmatism. They are also looking at ways to treat presbyopia
- Do the adjustment at the time that you would normally give Rx for glasses
- Can adjust 2 D at a time, and can adjust more the next day if needed.
- Lock in the final treatment with a dose of light that treats the whole optic

Calhoun LAL

- Studies have shown post-op refractions within 0.5 D of emmetropia in over 85% and over 95% had less than 0.5 D of cyl
- The adjustment and lock-in procedures were well tolerated with all patients requiring at least an initial adjustment and 70% needing a second adjustment

ELenza

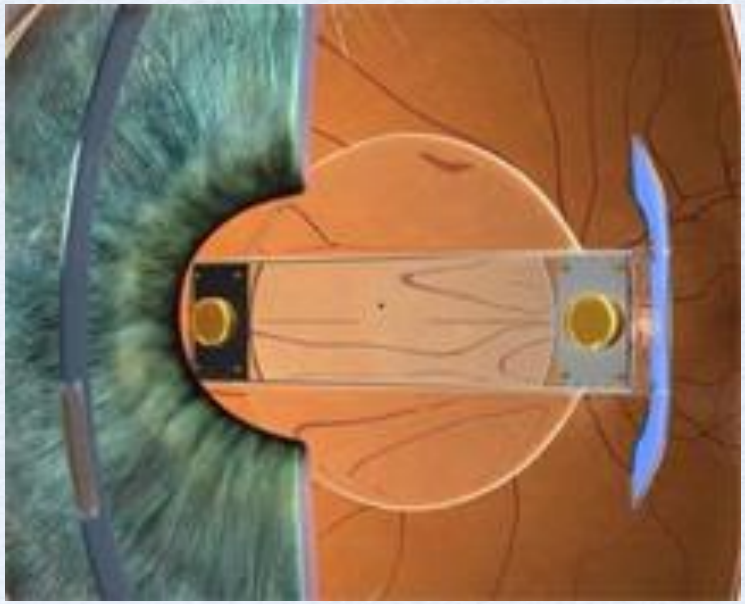
- Electronic IOL
  - “Autofocal” accommodating IOL

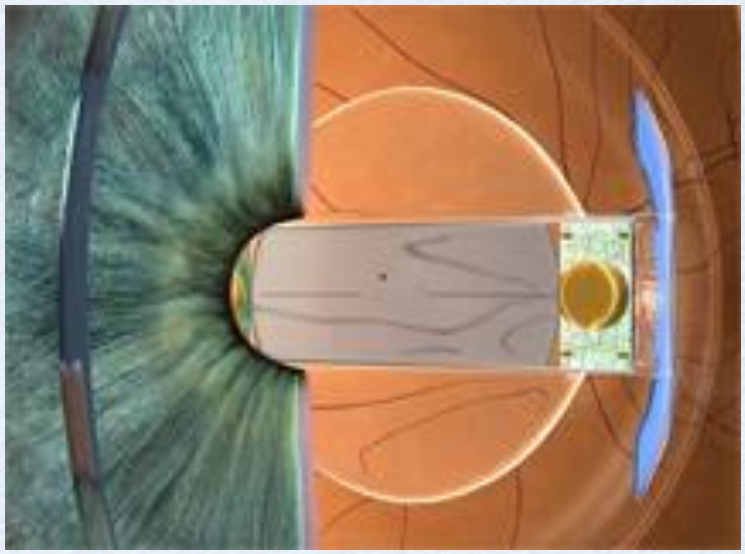
Elenza

- Liquid crystal lens allow lens to change shape
- Electric pulse changes the shape of the lens
- Microscopic rechargeable battery
  - Needs recharging every 3-4 days
  - Recharge with pillow or eyemask

Elenza

- Uses individual pupillary response to trigger accommodation
- Pupil gets smaller with accommodation
- Lens is programmable for each patient
- Within 300 seconds, lens learns specific pupil dynamics of that patient and customizes





Elenza

- Still a long time until safety issues addressed
- What happens with Yag laser?
- Are any of the substances toxic?
- Initially thought US release around 2018…but now stalled…

Some Lenses that are further away from primetime...

The End

Thank you!

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