

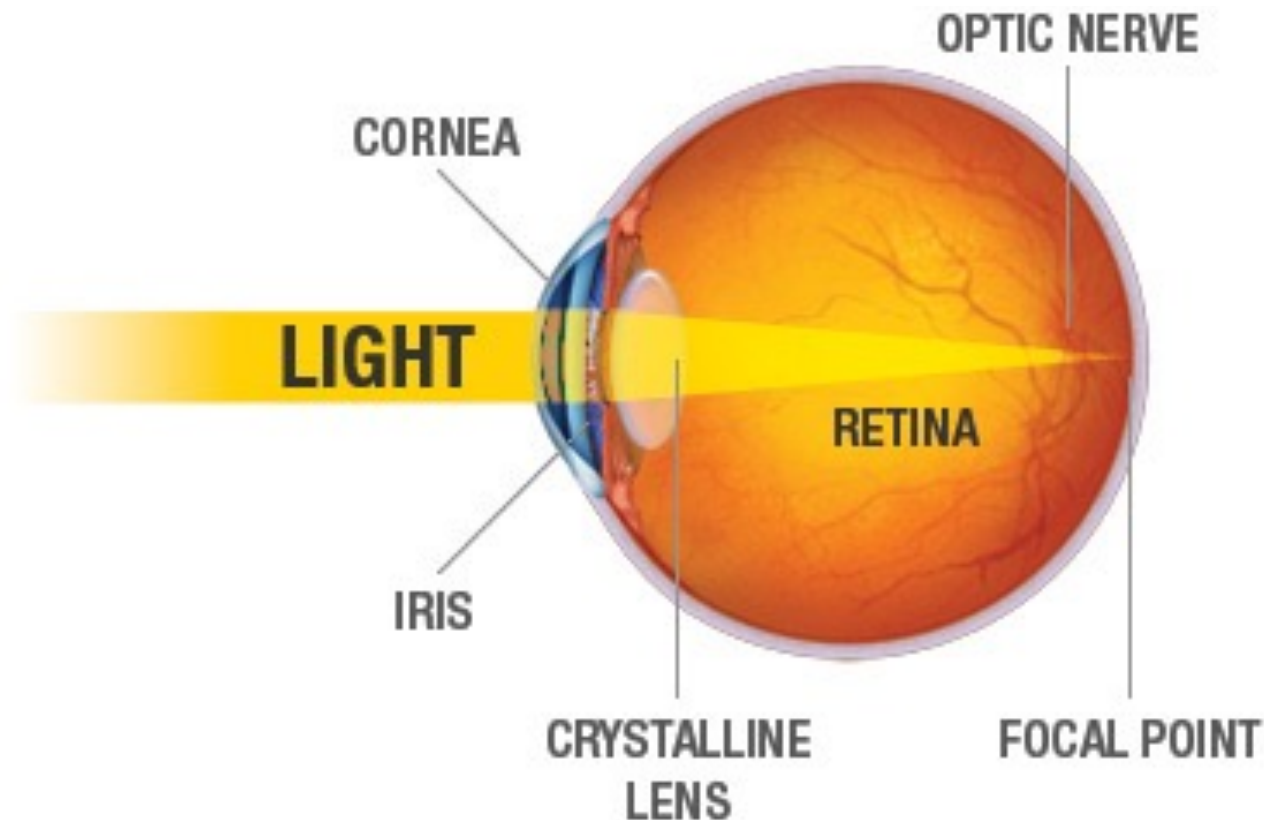


Recent Advances in Cataract Surgery: Light Adjustable Lens

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Vision Basics

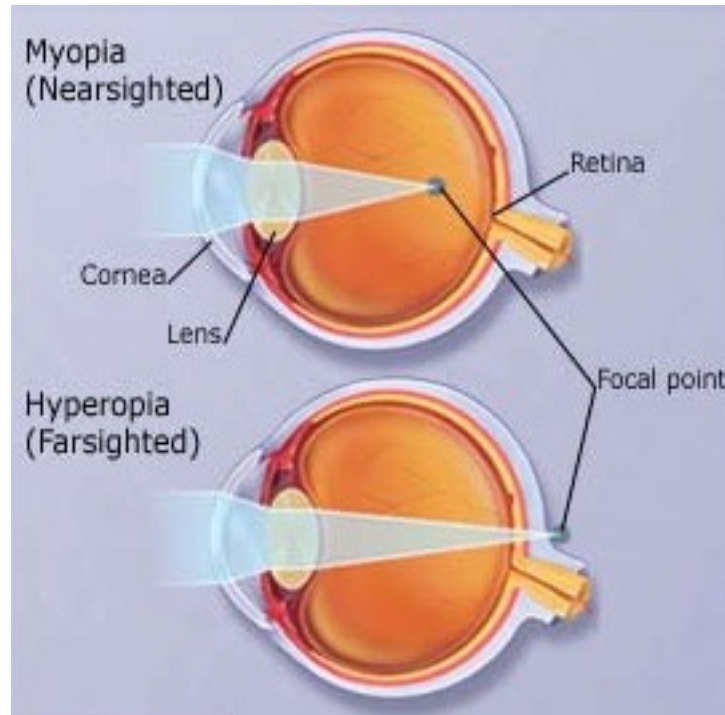
The cornea and the lens work together to focus images in the eye.



Near and Farsightedness

The Nearsighted Eye - the cornea and lens are too curved and/or the eye is too long.

The Farsighted Eye - the cornea and lens are too flat and/or the eye is too short.

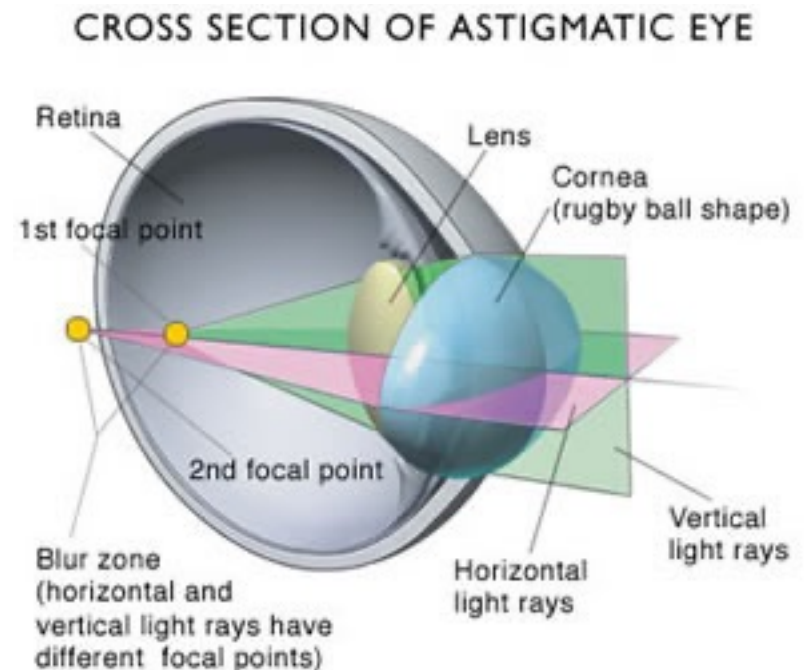
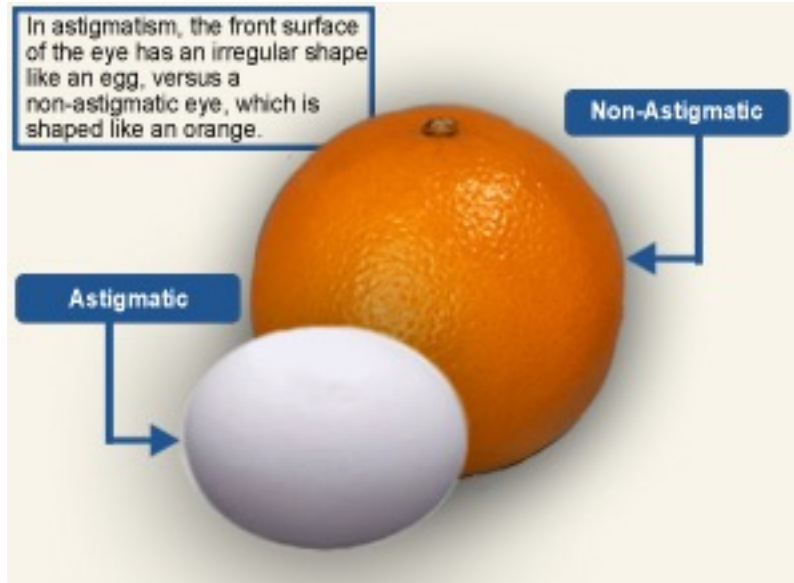


Astigmatism

- “out of roundness” of the eye

Usually from the cornea

Blurs vision at both far and near





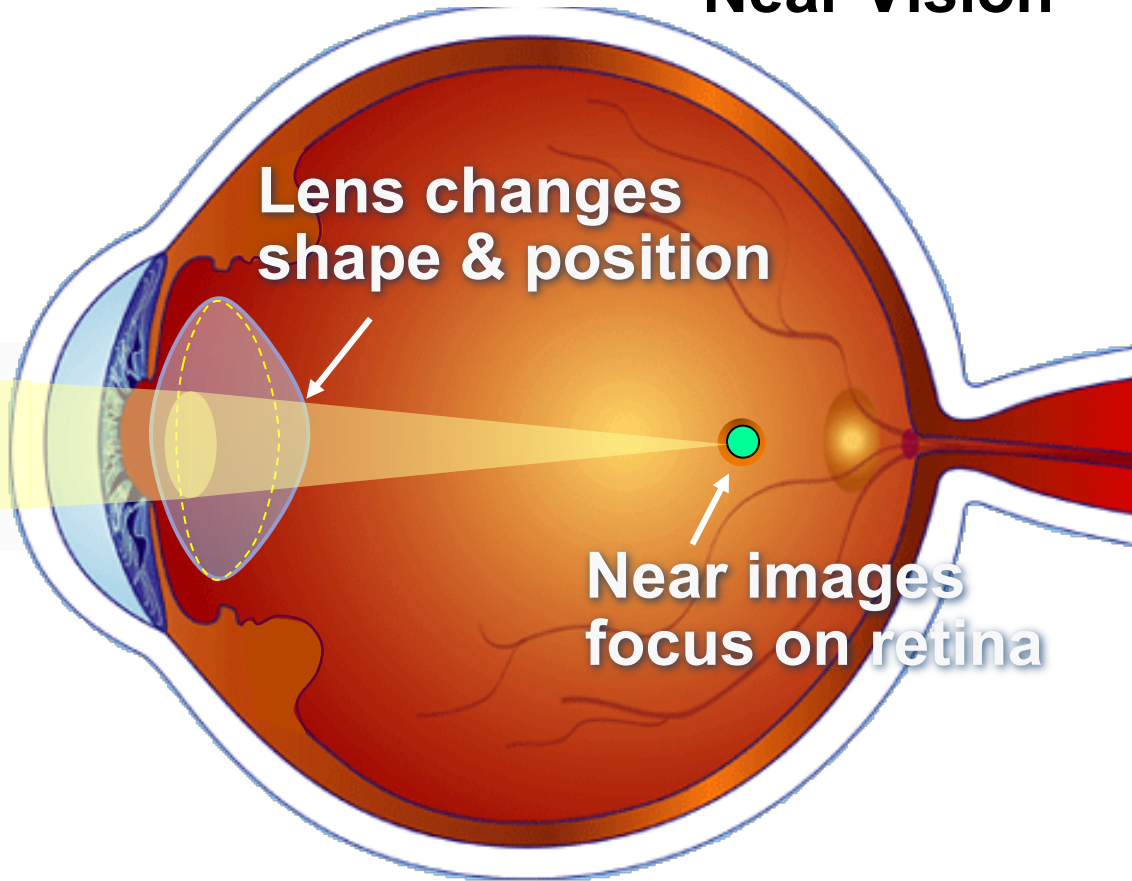
Accommodation

The automatic adjustment of the eye for seeing at different distances effected chiefly through changes in the position and convexity of the crystalline lens.

Normal Accommodation

Near Vision

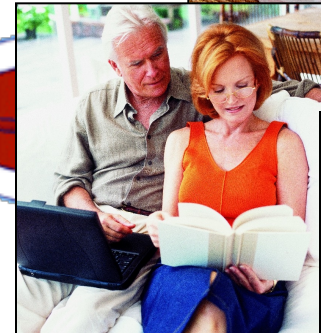
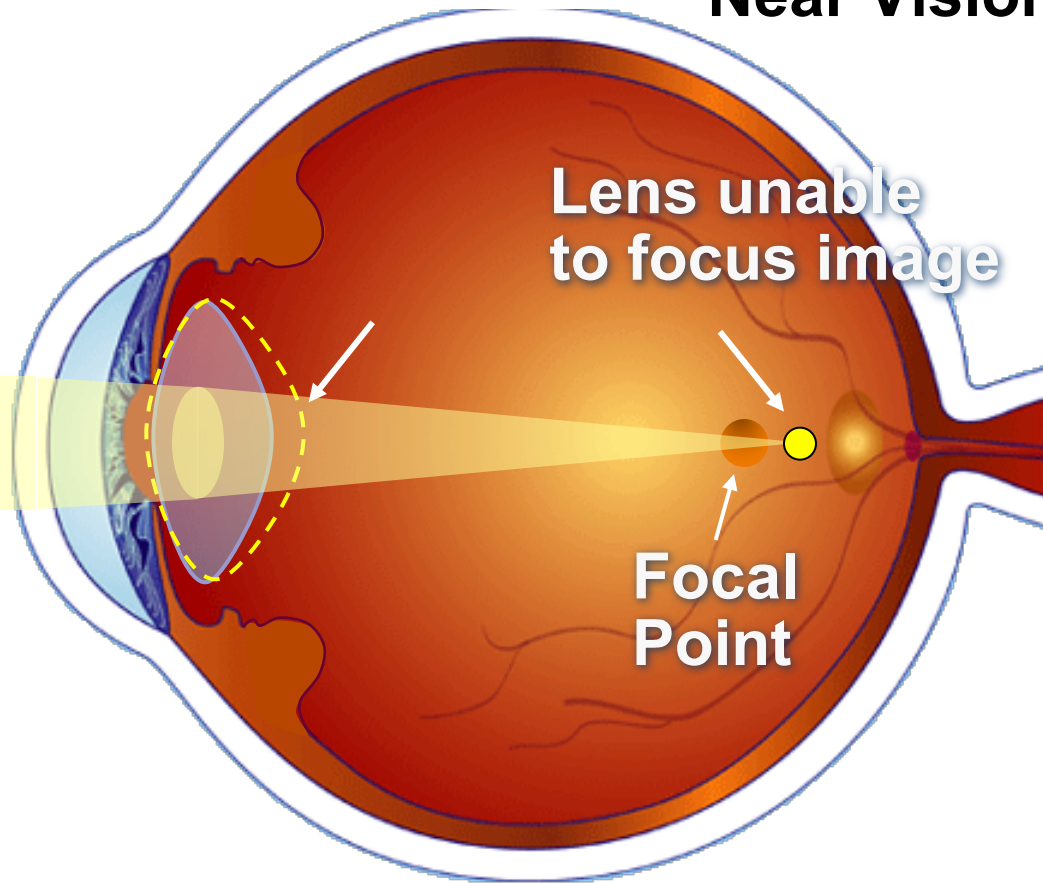
Near vision is clear
Distance vision
out of focus



When looking at near objects, the lens continues to change shape & move forward to focus image.

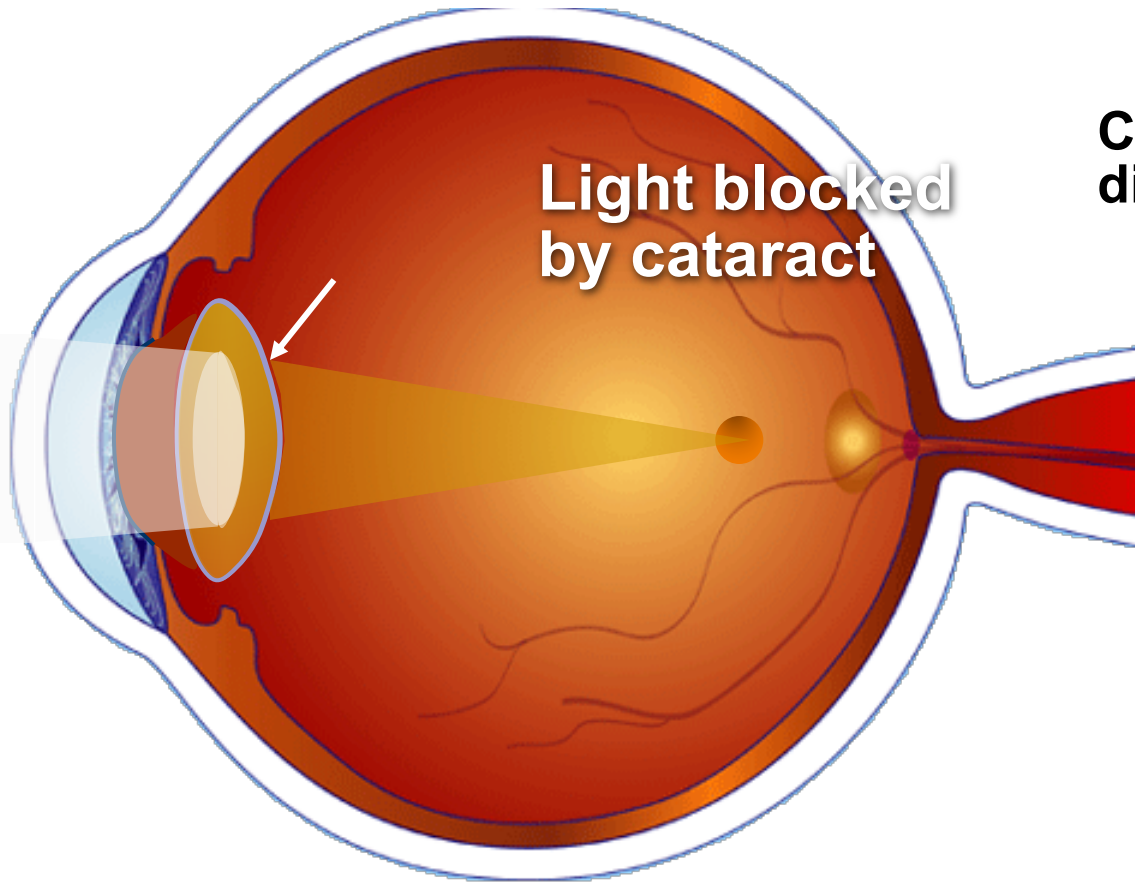
The Aging Eye

Near Vision



The aging lens loses its ability to change shape. Reading glasses or bifocals are required. Loss of Accommodation is called **PRESBYOPIA**.

Cataracts



Cataract blocking & distorting central vision



Cataract disrupts transmission of light through lens. Images may be blurred, dark & distorted.

Changes of a Healthy Human Crystalline Lens with Time



6 months



8 years



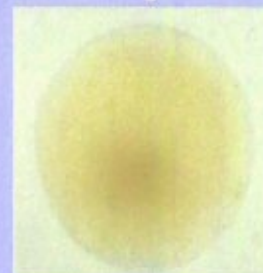
12 years



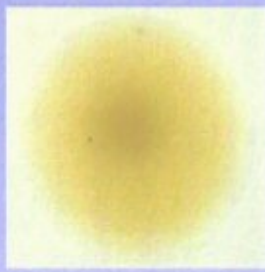
15 years



47 years



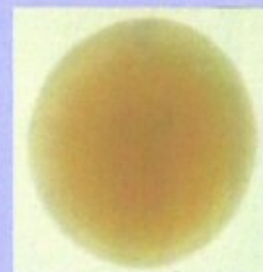
60 years



70 years



82 years



90 years

***photos
courtesy of
J. Marshall**



Cataract Surgery

- Most common surgery done in US
- Very successful with greater than 95% enjoying an improvement in vision
- The cataractous lens is removed leaving behind an empty “bag” of lens capsule
- The human lens is replaced with an artificial lens (intraocular lens)
- Advancements in incision size, irrigation fluid, time, lenses, safety, laser

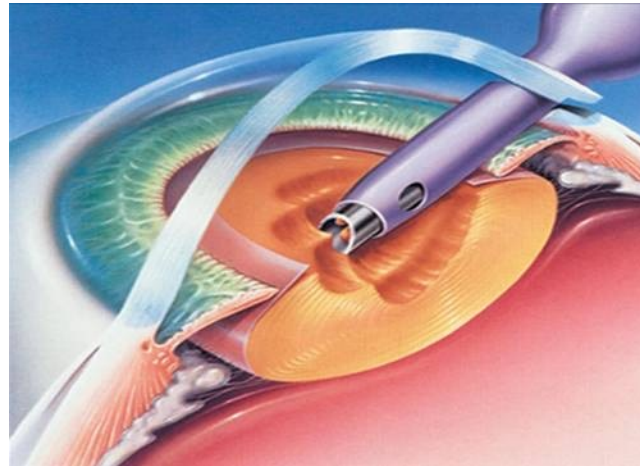
Cataract Surgery

■ Phacoemulsification

Surgical procedure to remove a cataract using sound waves to disintegrate the lens which is then removed by suction.

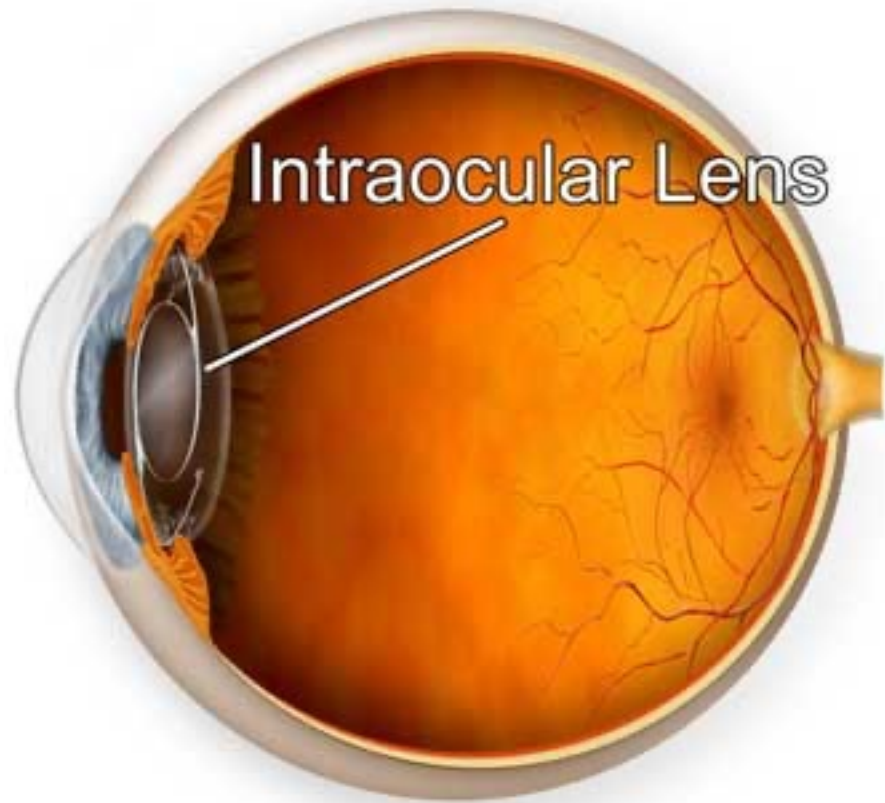
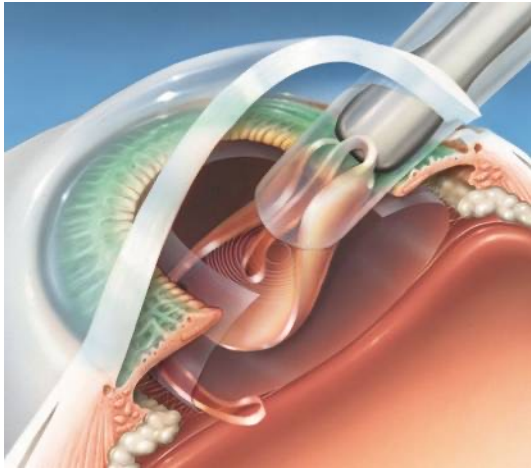
2-3 mm incision

80% less irrigation



Intraocular Lens Implantation

- Injectable through small incision





Recent Advancements

- **IMPROVED FRONT TO BACK PROCESS**
 - Pre-operative measurements, planning, surgery, and outcomes
- **HOW the surgery is performed**
 - Femtosecond Laser assisted cataract surgery
 - Droplens
- **LENS IMPLANT types**
 - Astigmatism correction, Multifocal, Accommodating Lens
 - Light Adjustable Lens



Pre-operative measurements

- Biometry

- Measurements of the length and front curvature of the eye

- Formulas to calculate PREDICTIVE lens implant power

Femtosecond Laser for Cataract

- History

 - Developed in 2005

 - First US case in 2010

 - Greater than 100,000
performed worldwide

 - LensX, Catalys,
Victus, Ziemer





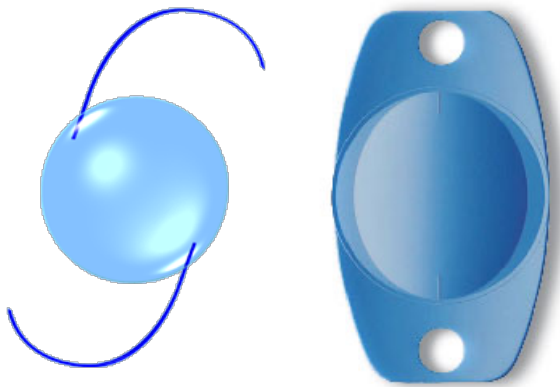
Intraocular Lenses

- Sir Harold Ridley
 - November 29, 1949
 - PMMA
- Widespread use in 1970s
- Small incision
 - Silicone and acrylic

Differentiating IOLs

**IOLs come in different sizes, shapes & materials.
Each has unique characteristics & capabilities**

Single Power Lenses (Monofocal and Toric)



- **Corrects only distance vision**
- **Toric lens corrects astigmatism**
- **Does not accommodate in eye**
- **Glasses required for near work**

Multifocal/Diffractive Lenses (+/- Toric)



- **Multiple, fixed focal points**
- **Does not accommodate**
- **Must find appropriate focal point**
- **Extensive neurological adaptation**

Accommodative Lens (+/- Toric)



- **Single focal point**
- **(Mostly) full range of distance, intermediate & near vision**
- **Uses eye's natural focusing mechanism**
- **Rapid visual recovery**



Outcomes data

- Modern cataract surgery has become complicated

Planning

Intraoperative issues

Post-operative outcomes



Outcomes with cataract surgery

- Until recently, ALL cataract surgery is a predictive model
 - Incredible variation between humans makes it impossible to predict every outcome with certainty
 - No option to “try it on” or adjust easily after surgery unless willing to have additional surgery (LASIK or lens exchange)



Light Adjustable Lens

- Developed in Europe for over a decade
- FDA approved in US in 2017
- 92% 20/25 or better without glasses
 - 92% within 0.5D of target (LASIK success)
 - Twice as likely to be 20/20 without glasses than control after 6 months
 - No other lens greater than 80% in an FDA study
- Silicone lens with UV sensitive macromers
- Long term studies show stability > 7 years

Light Adjustable Lens process

- Standard surgery performed with LAL
- UV protecting glasses all waking hours until 24 hours after final “lock-in” treatment



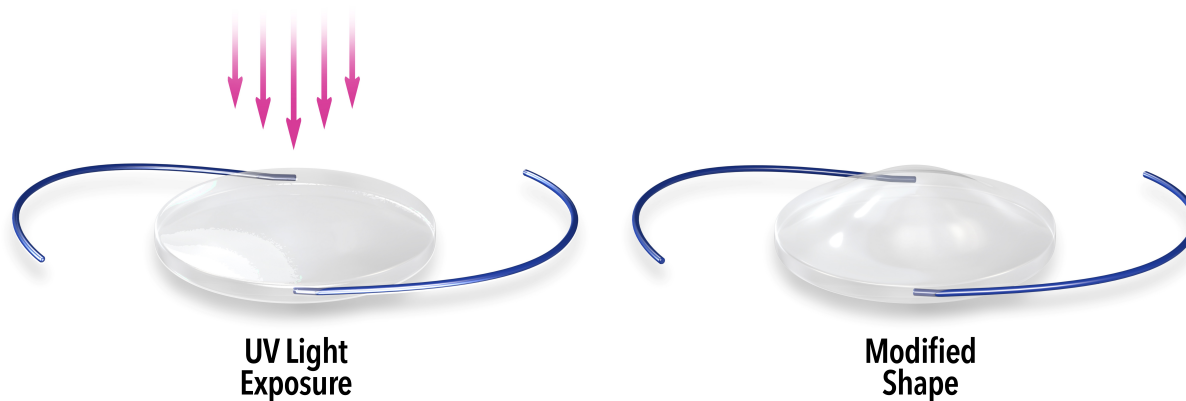
Light Adjustable Lens process

- First treatment 17 days after surgery

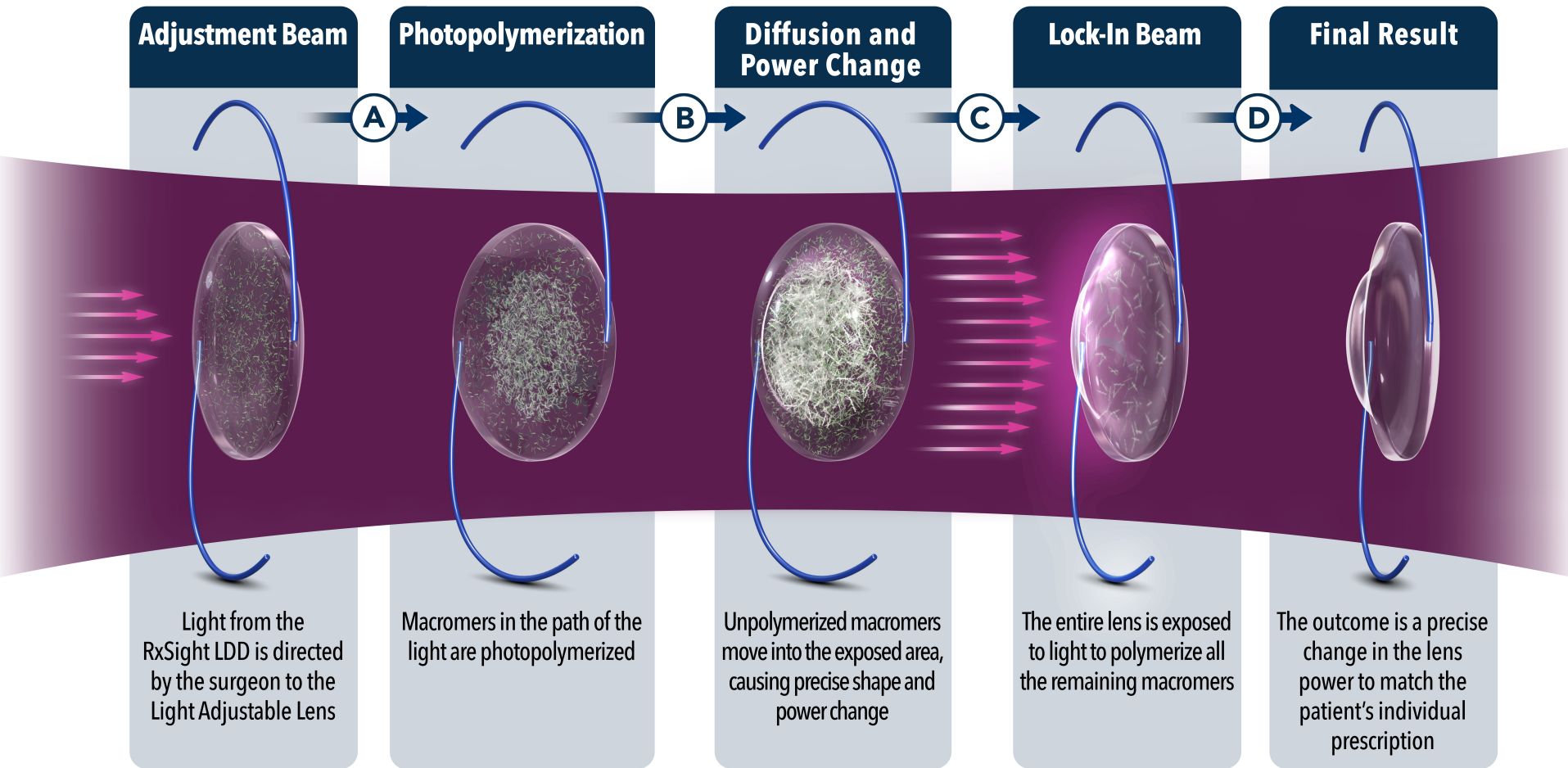


Light Adjustable Lens process

- Additional treatments every 3-4 days
Can adjust lens 3 times



Light Adjustable Lens process





Light Adjustable Lens limitations

- Must have good eye dilation ($> 7\text{mm}$) to treat entire lens
- UV absorbing medications
 - Hydrochlorothiazide, tetracyclines
- Must wear special UV protecting goggles for entire treatment period (4-5 weeks)



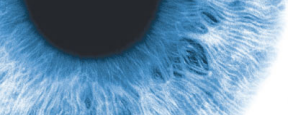
Case study 1-refractive surprise

- 76 year old patient wants to be glasses independent
Surgery performed using laser and implanting multifocal lens in both eyes
After surgery both eyes had slight far sightedness and astigmatism
“Weak” 20/25 vision and unable to read comfortably and consistently without glasses
Halos around lights at night
Options?



Case study 2-change your mind

- 67 year old patient wants to be glasses independent at distance
Surgery performed using Light Adjustable Lens in both eyes
After surgery both eyes had slight far sightedness and significant astigmatism
First treatment resulted in 20/20 distance vision in each eye
Patient returned and was unhappy with intermediate and near vision
 - Trial contact in non dominant eye successful
 - Treatment to make much better for intermediate and near vision before finalizing



Case study 3-treating result

- 74 year old patient wants to be glasses independent at distance and would like to have better near vision but is unsure about mono vision
 - Surgery performed using Light Adjustable Lens in both eyes
 - After surgery both eyes had significant unpredictable far sightedness and astigmatism - REFRACTIVE SURPRISE!
 - Would have been a poor outcome with all other approaches
 - First treatment resulted in 20/20 distance vision in each eye
 - Returned 3 days later with trial contact over non-dominant eye to improve intermediate and near vision
 - Liked! No way to know without trial after surgery
 - Second treatment improved near vision significantly in non-dominant eye (also incorporated negative spherical aberration (EDF))



Light Adjustable Lens

- Major advantage is the ability to correct ANY refractive error (hyperopia, myopia, astigmatism) AFTER surgery
- Major advantage is ability to adjust MORE THAN ONCE
- Major advantage is ability to EXPERIENCE outcome and then decide desired outcome
- Other technologies (i.e., multifocal lens) can result in great outcomes but predictions can NEVER be as consistently accurate as treating the outcome
 - Especially after previous refractive surgery (LASIK, PRK, RK)
- Takes the complexity OUT of the operating room and moves it into the clinic



Criticisms of Light Adjustable Lens

- “My surgical results are good enough”
- “It’s still just a monofocal lens”
 - Accuracy and superior optical performance
 - Negative spherical aberration incorporated
 - results in extended depth of focus
- “Just do LASIK after surgery”
 - Contrast sensitivity loss and dry eyes
- “It takes too much time”

Predicting vs Treating the Outcome

- “Off the rack” suit/dress
- Tailor fit



Comparing Lens Options

	Light Adjustable lens	Multifocal lens	Accommodative lens
Pros	Accuracy Very little dysphotopias	Good distance, near	Good distance, near
Cons	Intolerance to monovision	Halos, dysphotopias Refractive error	Unpredictable result, focusing Refractive error



What Matters Most in Outcomes?

- Computer/phone usage very high
- Don't underestimate the importance of intermediate vision!
- Light Adjustable Lens allows trial before finalizing result



Cataract Surgery Protocol 2021

- GOOD - standard surgery
 - Glasses for best vision (near and often distance)
- BETTER - Laser plus standard lens
 - Good distance vision - glasses for reading
 - Limited astigmatism treatment
 - Unavoidable risk of spherical error
- BEST 1 - Laser plus multifocal/accommodating lens
 - Unavoidable risk of spherical error
- BEST 2 - Light Adjustable Lens
 - Distance vision with readers or mono vision (1 near, 1 far)
 - Superior if previous refractive surgery (LASIK, PRK, RK)
 - “Try it on” before decision
 - Treat according to experience, NOT prediction

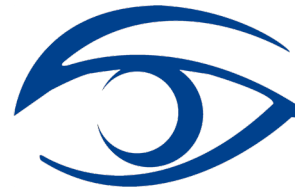


Conclusion

- Rapid evolution
 - Light Adjustable Lens
- Customized personal treatment
 - Make realistic goals and expectations to determine which approach is best
 - No single approach is best for everyone
- **Talk with your surgeon.**

Thank you!

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