Laser-Induced Refractive Index Change (LIRIC)
A REFRACTIVE PROCEDURE FOR THE FUTURE?

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What is LIRIC?

LIRIC is a minimally invasive method using a femtosecond laser at low energy levels to correct corneal aberrations including myopia, hyperopia, and mixed astigmatism to achieve a change in refractive error. With all previous refractive surgery techniques in which tissue is removed, a laser such as an excimer or femtosecond is used to cut and ablate tissues.

LIRIC is performed at a wavelength of 405 nm, which is at the blue end of the visible spectrum. At this wavelength, LIRIC is a 2-photon absorption process, resulting in highly localized refractive index changes. The laser focus volume is approximately $5-10 \mu m$ in diameter and length) and instead of removing or disrupting tissue collagen, fibril density is altered.

LIRIC is relatively noninvasive in that pulse energies are $1/100$th to $1/1,000$th those used to create a femtosecond laser flap. During LIRIC, the laser alters the refractive index in a highly localized fashion—akin to using a fine-point pen.

LIRIC Early stages of development

- Primary location of investigation is at University of Rochester under Scott MacRae MD.
- The first LIRIC patients were older pseudophakes who had received monofocal IOLs. They recovered quickly without complications. A diffractive multifocal pattern was imparted to their corneas with LIRIC, thereby increasing their depth of focus. All patients gained at least 2 lines of near vision without loss of distance acuity.
- Posttreatment corneas were clear, and they exhibited no light scatter or signs of inflammation. Histologic previous studies in rabbit have shown that LIRIC osteoarticular cells and death were significantly less cell death than cutting a flap with a femtosecond laser.
- Researchers have shown stability out to over 2 years. Because the LIRIC pattern occupies a very thin cross-section of the cornea; repeat treatments are possible at different depths.
- The LIRIC treatment consists of a modified layer of stroma that is approximately $10 \mu m$ thick, which corresponds to only a small percentage of the entire cornea. Researchers feel that the effect could even be reversible.

LIRIC and RxSight’s Light Adjustable IOL

- The RxLAL is an available FDA technology that increases cataract surgeons’ flexibility, but it requires having the patient avoid UV light exposure and can require repeat treatment.
- RxLAL uses an office-based UV light source called a Light Delivery Device or LDD. The Light Adjustable Lens itself has special particles (called macromers), which are distributed throughout the lens. When ultraviolet (UV) light from the LDD is directed to a specific area of the lens, the particles in the light path of the light connect with other particles (forming polymers). The remaining unconnected particles then move to the exposed area. This movement causes a highly predictable change in the curvature of the lens. As a result, the lens will match the prescription selected during the eye exam.
- RxLAL is limited to a specific IOL material, and the range of treatment is limited.

What is LIRIC?

Refractive Indexing

We understand that the refractive index is a change in the direction of light between materials of different densities. Now, we can alter a uniform material’s n value (a cornea or IOL) to alter the wavefront pathway and thus change the refractive error—instead of changing the material’s inherent total shape!!

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**LIRIC advantages over RxLAL**

- LIRIC offers ability to alter either an IOL or the human cornea's index of refraction. RxLAL can only alter an IOL.
- LIRIC at least in laboratory studies has been shown to create and even reverse multifocality. RxLAL cannot do either.

**Conclusion**

- Refractive Indexing may be a future promising technology.
- Continued monitoring patients over time for refractive changes with aging and remodeling along with continued monitoring for safety issues is imperative.

**LIRIC**

*Thank you for your attention!*

**It's been Forty Years!**

![Castle Rock, Colorado](image)

Thank you for allowing me to have a fulfilling career here in Lansing ... to have purpose in my life. It has been "a great ride". I hope to stay "in touch". As I would welcome all of you to do the same.

**Thank you ALL**

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- For allowing me to pursue my passion in my life.
- It has been "a great ride".
- I hope to stay "in touch" and would hope you all would do the same.